

平成31年度放射性物質測定調査委託費
(IAEAとの試験所間比較分析の実施)
事業成果報告書

2020年3月

公益財団法人 日本分析センター

本報告書は、原子力規制委員会 原子力規制庁の平成31年度放射性物質測定調査委託費（IAEAとの試験所間比較分析の実施）事業における委託業務として、公益財団法人日本分析センターが実施した成果を取りまとめたものです。

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1. 件名

平成31年度放射性物質測定調査委託費（IAEAとの試験所間比較分析の実施）事業

2. 目的

現在、福島県沖を中心とする海洋モニタリングデータの国際的な信頼性・透明性の向上のため、原子力規制委員会は、IAEAとの協力により試験所間比較分析（inter-laboratory comparison）を実施している。

この試験所間比較分析の一環として、IAEAが主導するALMERA Networkのメンバーである公益財団法人日本分析センター（以下「日本分析センター」という。）を中心とした体制を構築し、IAEAと共同で東京電力株式会社福島第一原子力発電所付近の海域で海水及び海底土を採取・分析し、分析結果等を試験所間比較分析のためにIAEAへ報告する。これらの結果を基に海洋環境試料の採取方法から放射能分析及び結果の評価に至る一連の工程を踏まえたモニタリングデータの国際的な比較・評価を中立公平な立場のIAEA側から得ることにより、信頼できるモニタリングデータの提供に資することを目的とする。

※ALMERA Network: IAEAの主導により1995年に設立され、IAEA加盟国の分析機関をメンバーとするネットワーク。分析技術の維持・向上のための取組みや事故等の際の信頼性ある適時の環境モニタリングデータを共有するための活動を実施している。

3. 実施期間

2019年4月1日～2020年3月31日

4. 業務実施内容

(1) IAEAとの試験所間比較分析に係る調整業務

IAEA専門家と共同で、試料の採取等を行うにあたり、以下の調整を行った。

- ・試料の採取等の日程について、原子力規制庁からの連絡を受け、株式会社環境総合テクノス（以下「環境総合テクノス」という。）を通じて、採取機材、船等の準備・手配に係る連絡及び調整を行った。試料採取のための船はIAEA等の担当者が採取状況を確認するため、2隻確保した。また、悪天候等で採取日程が変更することを考慮し、IAEA専門家の滞在期間中に確実に試料の採取が実施できるよう、備船期間を確保した。

- ・ IAEA 専門家と共同で試料の採取等を行うために必要な港、乗船場所、下船場所、サンプリングルート等に係る連絡及び調整を行った。
- ・ IAEA との試験所間比較分析に係る試料採取及び前処理作業に参加した IAEA 専門家を表 1 に示す。
- ・ IAEA 専門家の宿泊先及び移動の手配に係る連絡及び調整を行った。手配した宿泊先のリストを表 2 に示す。また、試料採取に伴う移動方法として、マイクrobバスを手配し、IAEA 専門家らを宿泊先から乗船及び下船場所の港までの送迎を行った。

表 1 IAEA 専門家リスト

所属	氏名
IAEA Environment Laboratories	Ms Iolanda Osvath
IAEA Environment Laboratories	Mr Paul Mc Ginnity
IAEA Office of Public Information and Communication	Ms Katherine Laffan
IAEA Office of Public Information and Communication	Mr Martin Klingenboek
Federal Office for Civil Protection Spiez Laboratory Nuclear Chemistry Division	Mr Mario Burger
Health Canada Radiation Protection Bureau	Mr Jean-Francois Mercier

表 2 宿泊先リスト

日程	宿泊先
2019 年 6 月 2 日(日)～ 2019 年 6 月 6 日(木)	ホテルルートインいわき駅前 〒970-8026 福島県いわき市平 4 丁目 22 番 3 号
2019 年 6 月 6 日(木)～ 2019 年 6 月 9 日(日)	ホテル京阪 天満橋 〒540-0012 大阪府大阪市中央区谷町 1 丁目 2-10

- ・ 試料の採取方法、均質化方法、分配方法、試料の送付方法、前処理方法、分析方法等に係る連絡及び調整を行った。
- ・ 日本分析センターで得られた分析結果については、IAEA 指定の報告様式にとりまとめ、2019 年 11 月に IAEA (Radiometrics Laboratory Environment

Laboratories Department of Nuclear Sciences and Applications IAEA) 宛て報告様式をメールにて報告した。

- ・業務実施にむけて必要な調整を、原子力規制庁担当官と適宜協議を行い実施した。原子力規制庁における打合せ内容について、以下に示す。

○原子力規制庁における打合せ（1回目）

日時：2019年4月24日（水） 13：00 から

内容：

- ・スケジュールについて
- ・海水及び海底土の採取について
- ・前処理、試料の分割及び送付について
- ・試料の分析について
- ・その他

○原子力規制庁における打合せ（2回目）

日時：2019年5月24日（金） 10：00 から

内容：

- ・スケジュールについて
- ・ホテル予約状況について
- ・海水、海底土の採取、分割、送付について
- ・その他

- ・試料採取及び試料前処理に係る一連の行程を別紙1に示す。
- ・IAEA 専門家との試料採取及び試料前処理期間中における業務の進捗状況について、適宜、原子力規制庁担当官、日本分析センター関係者、環境総合テクノス関係者にメールにて連絡し、情報共有を図った。

(2) 海水及び海底土の採取

IAEA 専門家と共同で試料の採取等を行った。海水、海底土を採取した場所を別紙2に、現地対応の状況を別紙3に示す。また、IAEA 専門家が試料の採取等の実施状況を確認するために必要となる諸準備を行った。

- ・海水の採取は5地点について、年1回実施した。

- ・海底土の採取は3地点について、年1回実施した。
- ・海水試料及び海底土試料の採取量を表3に示す。

表3 海水試料及び海底土試料の採取量

試料の種類	地点名	地点数	1地点における採取量
海水	T-D1	5地点	H-3用
	M-101		2 L/機関×8 機関= 16 L
	M-102		Sr-90, Cs-134, Cs-137用
	M-103		60 L/機関×6 機関=360 L
	M-104		T-D1のみ 60 L/機関×7 機関=420 L
海底土	F-P04	3地点	6 kgを目標に採取
	T-S3		
	T-S8		

- ・採取地点及び詳細な時期はIAEA及び原子力規制庁担当官と調整の上で決定した。
- ・採取方法については、放射能測定法シリーズ16「環境試料採取法」(1983年制定)に準じた。詳細はIAEA及び原子力規制庁担当官と調整の上で決定した。
- ・試料の採取のための船はIAEA専門家が採取状況を確認するため、及び作業の安全を確保するための監視船を含め2隻確保した。
- ・悪天候等で採取日程が変更することを考慮し、IAEA専門家の滞在期間中に確実に試料の採取が実施できるよう、傭船期間を確保した。
- ・海水試料については、ポンプで汲み上げた海水を大型プラスチック容器に溜めた後、同容器に取り付けた4つのバルブ口から試料容器(キュービテナー及びポリプロピレン製平角瓶2L容器)に移した。バルブ番号と試料容器に入れた順番が分かるように、試料容器に試料番号を付与した。試料番号の付与方法については、表4に示す。(例:1-3 「1」はバルブ番号、「3」は入れた順番を示す。)

表4 海水試料の採取方法及び送付方法

① Cs-134, Cs-137 用

地点名： M-101、M-102、M-103、M-104

バルブ No	1	2	3	4
海水試料コード	1-1-1	1-2-1	1-3-1	1-4-1
	1-1-2	1-2-2		

地点名： T-D1

バルブ No	1	2	3	4
海水試料コード	1-1-1	1-2-1	1-3-1	1-4-1
	1-1-2	1-2-2	1-3-2	

分析機関コード	A	B	C	D	E	F	G
送付パターン	1-1-1	1-2-1	1-3-1	1-4-1	1-1-2	1-2-2	1-3-2

② Sr-90 用

地点名： M-101、M-102、M-103、M-104

バルブ No	1	2	3	4
海水試料コード	2-1-1	2-2-1	2-3-1	2-4-1
	2-1-2	2-2-2		
	3-1-1	3-2-1	3-3-1	3-4-1
	3-1-2	3-2-2		

地点名： T-D1

バルブ No	1	2	3	4
海水試料コード	2-1-1	2-2-1	2-3-1	2-4-1
	2-1-2	2-2-2	2-3-2	
	3-1-1	3-2-1	3-3-1	3-4-1
	3-1-2	3-2-2	3-3-2	

分析機関コード	A	B	C	D	E	F	G
送付パターン	2-1-1	2-2-1	2-3-1	2-4-1	2-1-2	2-2-2	2-3-2
	3-1-1	3-2-1	3-3-1	3-4-1	3-1-2	3-2-2	3-3-2

③ H-3 用

バルブ No	1	2	3	4
海水試料コード	1-1-1	1-2-1	1-3-1	1-4-1
	1-1-2	1-2-2	1-3-2	1-4-2

分析機関コード	A	B	C	D	E	F	G	H
送付パターン	1-1-1	1-2-1	1-3-1	1-4-1	1-1-2	1-2-2	1-3-2	1-4-2

(3) 試料の前処理、分割、送付

IAEA 専門家と共同で試料の前処理、分割等を行った。また、IAEA 専門家が前処理等の実施状況を確認するために必要となる諸準備を行った。

① 海水

- ・ (2) で採取した試料は、IAEA との調整の上、決定された方法に従って必要な処理を行った。
- ・ トリチウム分析以外の海水試料は、陸揚げした後、海水 20 L 当たり塩酸 20 mL をそれぞれに添加した。
- ・ 海水試料の採取時における大型プラスチック容器内の均質性及び採取した海水を試料容器 (キュービテナー) に移す際にバルブが偏らないように考慮し、表 4 のように組み合わせた試料を分析機関に送付した。
- ・ トリチウム分析用海水については、塩酸を添加せずに、分析機関に送付した。
- ・ 海水試料については、環境総合テクノスにて、運送業者を通じて IAEA 側に引き渡した。

② 海底土

- ・ (2) で採取した試料は、IAEA との調整の上、決定された方法に従って必要な処理を行った。なお、海底土は乾燥後、細土として分析に用いた。
- ・ 海底土試料については、IAEA との調整の上、決定された方法に従って分割した。
- ・ 海底土試料については、環境総合テクノスにて、運送業者を通じて IAEA 側に引き渡した。

環境総合テクノスに依頼した試料採取、海底土の前処理作業については参考資料 1 に示した。

(4) 放射性核種の分析

海水及び海底土試料について、対象とする放射性核種及び試料数を表 5 に、日本分析センター及び分析実施機関の分析核種を表 6 に示す。また、日本分析センターと分析実施機関の分析結果を表 7 に、日本分析センターの分析結果詳細を別添資料 1 に、分析実施機関の分析結果詳細を参考資料 2 に示した。

分析方法は、放射能測定法シリーズに準じた。また、放射能分析を実施するにあたり、適用する分析方法及び確保すべき検出下限目標値については、表 8 の「分析方法及び検出目標レベル」を目安にした。

なお、分析方法等の詳細は IAEA と調整の上決定した。

表 5 分析試料、対象核種及び試料数

試料	放射性核種	試料数
海水	H-3	5 試料
	Cs-134, Cs-137	5 試料
	Sr-90	5 試料
海底土	Cs-134, Cs-137	3 試料
	Pu-238, Pu-239+240	3 試料

表 6 日本分析センター及び分析実施機関の分析核種

試料	分析実施機関	分析核種
海水	日本分析センター	H-3, Sr-90, Cs-134, Cs-137
	環境総合テクノス	H-3, Sr-90, Cs-134, Cs-137
	株式会社地球科学研究所	H-3
	公益財団法人海洋生物環境研究所	H-3
	東京パワーテクノロジー株式会社(地点:T-D1)	Sr-90, Cs-134, Cs-137
	福島県	Sr-90, Cs-134, Cs-137
海底土	日本分析センター	Cs-134, Cs-137, Pu-238, Pu-239+240
	東京パワーテクノロジー株式会社	Cs-134, Cs-137
	一般財団法人九州環境管理協会	Pu-238, Pu-239-240
	福島県	Cs-134, Cs-137, Pu-238, Pu-239+240

表7 日本分析センター及び分析実施機関の分析結果一覧

試料	核種	分析機関	M-101	M-102	M-103	M-104	T-D1
海水 (Bq/ kg)	H-3	日本分析センター	0.0610	0.0620	0.0740	0.0760	0.0770
		環境総合テクノス	0.0756	0.0741	0.0706	0.0677	0.0823
		株式会社地球科学研究所	0.0790	0.0870	0.0770	0.0800	0.0560
		公益財団法人海洋生物環境研究所	0.1121	0.1097	0.1303	0.1325	0.0941
	Sr-90	日本分析センター	0.0009	0.0012	0.0010	0.0010	0.0011
		環境総合テクノス	0.0012	0.0011	0.0010	0.0009	0.0007
		東京パワーテクノロジー株式会社	-	-	-	-	0.0017
		福島県	0.0008	0.0009	0.0007	0.0008	0.0006
	Cs-134	日本分析センター	0.0015	<0.00090	<0.00090	<0.00088	<0.00085
		環境総合テクノス	0.0010	0.0008	ND	ND	ND
		東京パワーテクノロジー株式会社	-	-	-	-	ND
		福島県	ND	ND	ND	ND	ND
	Cs-137	日本分析センター	0.0200	0.0119	0.0113	0.0062	0.0042
		環境総合テクノス	0.0152	0.0110	0.0098	0.0074	0.0035
		東京パワーテクノロジー株式会社	-	-	-	-	0.0037
		福島県	0.0163	0.0128	0.0115	0.0072	0.0030

試料	核種	分析機関	F-P04	T-S3	T-S8
海底土 (Bq/kg-dry)	Cs-134	日本分析センター	1.3000	0.8700	2.4000
		東京パワーテクノロジー株式会社	2.0300	ND	3.0200
		福島県	2.5844	ND	2.3038
	Cs-137	日本分析センター	29.0000	7.8000	30.0000
		東京パワーテクノロジー株式会社	27.6000	7.6000	31.8000
		福島県	28.0310	7.5002	32.9130
	Pu-238	日本分析センター	0.0059	0.0041	0.0081
		福島県	0.0072	0.0051	0.0103
		一般財団法人九州環境管理協会	<0.0082	<0.0071	<0.013
	Pu-239+240	日本分析センター	0.4120	0.3920	0.5500
		福島県	0.3994	0.3869	0.5587
		一般財団法人九州環境管理協会	0.3970	0.3590	0.5490

表8 分析方法及び検出目標レベル

試料	分析・測定方法	対象核種	検出下限目標値
海水	電解濃縮法・液体シンチレーション計測法	H-3	0.4 Bq/L
	AMP沈殿法 ゲルマニウム半導体検出器によるγ線スペクトロメトリー	Cs-134	1 mBq/L
		Cs-137	1 mBq/L
	放射化学分析、ガスフロー型β線計数装置又は液体シンチレーション測定	Sr-90	1 mBq/L
海底土	105℃乾燥後、2 mm孔径のふるい分け・ゲルマニウム半導体検出器によるγ線スペクトロメトリー	Cs-134	1 Bq/kg乾土
		Cs-137	1 Bq/kg乾土
	上記の乾燥、ふるい分けした試料を放射化学分析、α線スペクトロメトリー (Pu同位体の定量に際しては質量分析による方法も妨げない)	Pu-238	0.02 Bq/kg乾土
		Pu-239+240	0.02 Bq/kg乾土

(5) 関係団体等への作業説明・申請・結果報告

関係団体等（海上保安庁、関係漁業協同組合連合会及び漁業協同組合、必要に応じて自治体関係部局等）に対して、環境総合テクノスを通して、作業開始前に作業の説明を必要に応じて行うとともに、必要に応じて作業結果の説明を行った。また、海上保安庁等に対して作業に必要な申請を行った。

(6) 作業結果の取りまとめと報告

作業結果については、各作業・分析が完了後、分析結果内容を精査したのち、速報結果として原子力規制庁担当官へ報告した。

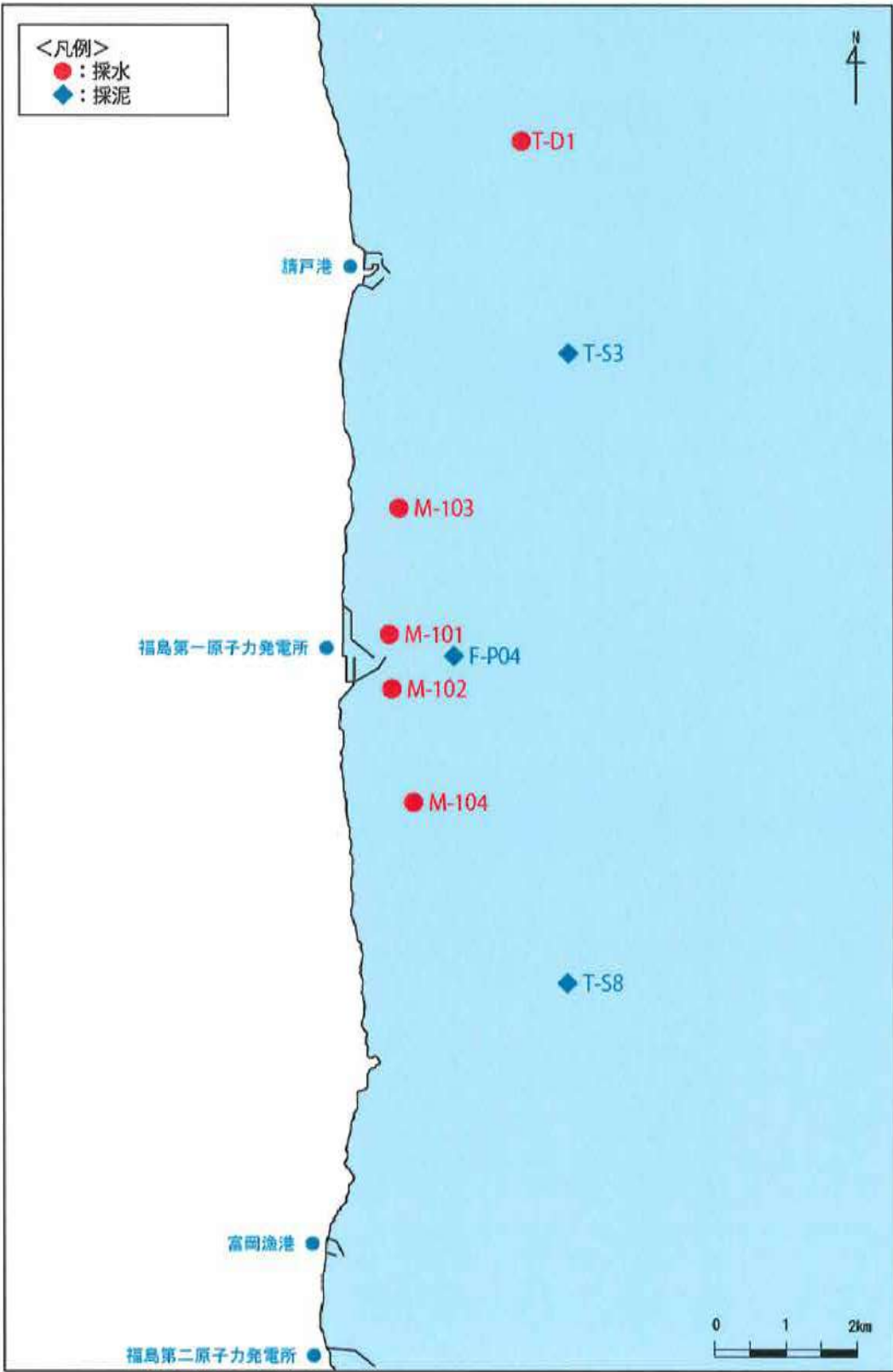
日本分析センターで得られた分析結果については、IAEA 指定の報告様式にとりまとめ、2019年11月に、IAEA (Radiometrics Laboratory Environment Laboratories Department of Nuclear Sciences and Applications IAEA) に報告様式をメールにて報告した。

試料採取及び試料前処理に係る行程表

日程	主な内容
2019年6月2日(日)	○IAEA 専門家2名、ALMERA 専門家2名がいわき市内ホテルに到着。
	○日本分析センター職員(サンプリング担当)3名、採取用具等を積み、車で千葉市から福島県いわき市へ移動。
	○いわき市内ホテルにて、IAEA 専門家、ALMERA 専門家、小此木氏、二宮氏、佐藤氏らとミーティング。
2019年6月3日(月)	○IAEA 専門家2名、ALMERA 専門家2名、小此木氏、二宮氏、佐藤氏らとマイクロバスにて双葉郡浪江町・請戸港へ移動。
	○請戸漁港に到着後、福島県環境創造センター草刈氏らと合流。
	○試料採取準備。
	○請戸港から出港。
	○海上サンプリング。T-S8 及び T-S3 の2地点で海底上、T-D1 で海水を採取。
	○請戸港に帰港。
	○請戸港にて、試料等荷下し作業、試料発送準備作業、試料の発送を行う。
	○福島県環境創造センター草刈氏、請戸港にて解散。
	○作業終了後、ホテルへ移動。佐藤氏解散。
	○ホテルにて、IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名、小此木氏、二宮氏らとミーティング。
2019年6月4日(火)	○IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名、小此木氏、二宮氏らとマイクロバスにて双葉郡浪江町・請戸港へ移動。
	○請戸港に到着、福島県環境創造センター古川氏らと合流。
	○試料採取準備。
	○請戸港から出港。
	○海上サンプリング。F-P04 で海底土、M-101 及び M-103 の2地点で海水を採取。

	<p>○請戸港に帰港。</p> <p>○請戸港にて、試料等荷下し作業、試料発送準備作業、試料の発送を行う。</p> <p>○福島県環境創造センター古川氏とは請戸港にて解散。</p> <p>○作業終了後、ホテルへ移動。</p> <p>○小此木氏解散。</p>
2019年6月5日(水)	<p>○IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名、二宮氏らとマイクロバスにていわき市・久之浜港へ移動。</p> <p>○請戸港に到着、福島県環境創造センター平塚氏らと合流。</p> <p>○試料採取準備。</p> <p>○久之浜港から出港。</p> <p>○海上サンプリング。M-102 及び M-104 の2地点で海水を採取。</p> <p>○久之浜港に帰港。</p> <p>○久之浜港にて、試料等荷下し作業、試料発送準備作業、試料の発送を行う。</p> <p>○福島県環境創造センター平塚氏とは久之浜港にて解散。</p> <p>○作業終了後、ホテルへ移動。</p> <p>○二宮氏解散。</p>
2019年6月6日(木)	<p>○IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名、坂田氏、水産庁担当者へ引き継ぎ。</p> <p>○日本分析センター職員レンタカーにて日本分析センターへ移動。</p> <p>○IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名の計6名と新大阪駅にて日本分析センター職員3名(前処理担当)と合流。大阪市内のホテルへ移動。</p>
2019年6月7日(金)	<p>○小此木氏、二宮氏(原子力規制庁)とホテルロビーにて合流。</p> <p>○ホテルにて、IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名、小此木氏、二宮氏らとミーティング。</p> <p>○IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名、小此木氏、二宮氏らと環境総合テクノス計測分析所(大阪府交野市)へ移動。</p> <p>○環境総合テクノス計測分析所へ到着。前処理作業準備、前処理作業実施。</p> <p>○作業終了後、大阪市内のホテルへ移動。小此木氏は解散。</p>

2019年6月8日(土)	○堀氏、古澤氏(原子力規制庁)と合流。
	○ホテルにて、IAEA 専門家2名、ALMERA 専門家2名、二宮氏、堀氏、古澤氏らとミーティング。
	○IAEA 専門家2名、ALMERA 専門家2名、二宮氏、堀氏、古澤氏らと環境総合テクノス計測分析所へ移動。
	○環境総合テクノス計測分析所へ到着。前処理作業準備、前処理作業実施。
	○作業終了後、大阪市内のホテルへ移動。二宮氏、堀氏、古澤氏は解散。
2019年6月9日(日)	○IAEA 専門家2名、ALMERA 専門家2名、IAEA 撮影担当2名、日本分析センター職員3名、東京駅へ移動。
	○東京駅にて水産庁担当者へ引き継ぎ。



別図 試料採取場所の地図

現地対応の状況



写真 1 関係者での集合写真
(IAEA、ALMERA、原子力規制庁)

海底土採取



写真 2-1 海底土の採取状況



写真 2-2 海底土の採取状況



写真 2-3 海底土の採取状況



写真 2-4 採取した海底土試料

海水試料採取



写真 3-1 海水の採取状況



写真 3-2 海水の採取状況



写真 3-3 海水の採取状況



写真 3-4 海水の採取状況

試料発送準備



写真 4-1 試料発送準備



写真 4-2 試料発送準備



写真 4-3 試料発送準備



写真 4-4 採取した海水試料に
酸を添加

別添資料 1 分析結果

公益財団法人 日本分析センターの測定結果
(海水)

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-101	Summary of data for submission		
Activity concentration	0.0610 ± 0.0110		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.3830 ± 0.0686		count/minute	
Chemical recovery	0.7400 ± 0.0204			
Detection efficiency	0.3070 ± 0.0088			
Radioactive decay	0.9780 ±	No uncertainty stated		
Mass of sample	50.0000 ± 0.0208		g	
Supporting information	No supporting information stated		No uncertainty stated	
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.33 ±	No uncertainty stated	year	No data source stated
Decay energy	No decay energy stated		No units stated	No data source stated
β emission probability	No β emission probability stated		No uncertainty stated	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sample water was distilled after addition of KMnO ₄ and Na ₂ O ₂ . Distilled water applied electrolytic enrichment of H-3. After H-3 enrichment, sample water was distilled again. Fifty mL of distilled water was mixed with 50mL of scintillator for measurement.				
Detection system (including method of calibration):				
Hitachi, Ltd. LSC-LB5(Quenching correction curve by H-3 STD with different ratio of water and scintillator)				
Detection limit (Bq/kg):	0.032			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3300 ±		year	
Decay energy				
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-101			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	0.0610 ± 0.0110			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.3830 ± 0.0686		count/minute	17.9%
Chemical recovery	0.7400 ± 0.0204			2.8%
Detection efficiency	0.3070 ± 0.0088			2.9%
Correction for radioactive decay	0.9780 ±			0.0%
Mass of sample	50.0000 ± 0.0208		g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
⁹⁰ Sr		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-101	Summary of data for submission			
Activity concentration	0.0009 ± 0.0001	Bq kg ⁻¹			
Uncertainties					
Net count rate	0.0206 ± 0.0027		count/sec		
Chemical recovery	0.9432 ± 0.0349				
Detection efficiency	0.6247 ± 0.0202				
Radioactive decay	1.0800 ±	No uncertainty stated			
Mass of sample	40.0000 ± 0.6600		L		
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	29.12 ±	No uncertainty stated	year	radiation data book(in Japanese)	
Decay energy	0.546 ±	No uncertainty stated	MeV	radiation data book(in Japanese)	
β emission probability	No β emission probability stated	No uncertainty stated			
		No data source stated			
Input data					
Method (including pre-concentration, if applicable):					
Seawater sample was concentrated to strontium preliminarily for ion-exchange resins. Precipitation of carbonate was produced from eluate. Precipitation of carbonate was dissolved with hydrochloric acid and removed calcium by ion-exchanged resins. The eluate was performed evaporation to dryness and residue was dissolved in water. Y-90 was removed in scavenging. Two weeks later, Y-90 co-precipitated with Fe(OH) ₃ was filtered using filter paper(milking). The precipitate on the filter paper was dried and used directly for measurement of β-ray activity.					
Detection system (including method of calibration):					
Hitachi : LBC-4211 Low background β-ray counter (by Y-90 of known activity co-precipitated with Fe(OH) ₃ . Detection Efficiency:62.467%					
Detection limit (Bq/kg):	0.00024				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	29.1200 ±		year	radiation data book(in Japanese)	
Decay energy	0.5460 ±		MeV	radiation data book(in Japanese)	
Particle emission energy 1	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-101	Uncertainty (R=1)			
	Bq/kg				
Activity concentration	0.0009 ± 0.0001				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0206 ± 0.0027		count/sec	13.1%	
Chemical recovery	0.9432 ± 0.0349			3.7%	
Detection efficiency	0.6247 ± 0.0202			3.2%	
Correction for radioactive decay	1.0800 ±			0.0%	
Mass of sample	40.0000 ± 0.6600		L	1.7%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML-INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-101	Summary of data for submission			
Activity concentration	0.0015 ± 0.0003		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.5622 ± 0.1128		count/1000s		
Principal γ-ray emission energy	795.8640 ± 0.0040		keV		
Principal γ-ray emission probability	0.8546 ± 0.0006				
Principal γ-ray detection efficiency	0.0239 ± 0.0007				
Radioactive decay	0.9032 ± 0.0000				
Mass of sample	20.4600 ± 0.2926		kg		
Supporting information	No supporting information stated		No uncertainty stated		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.0652 ± 0.0004	year		Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)	
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	0.00088				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0652 ± 0.0004		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	795.8640 ± 0.0040		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)					
γ-ray emission energy 3 (if used)					
γ-ray emission energy 4 (if used)					
γ-ray emission energy 5 (if used)					
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-101				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0015 ± 0.0003				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.5622 ± 0.1128		count/1000s	20.1%	
Principal γ-ray emission probability	0.8546 ± 0.0006			0.1%	
Emission probability 2 (if used)					
Emission probability 3 (if used)					
Emission probability 4 (if used)					
Emission probability 5 (if used)					
Principal γ-ray detection efficiency	0.0239 ± 0.0007			2.9%	
Detection efficiency 2 (if used)					
Detection efficiency 3 (if used)					
Detection efficiency 4 (if used)					
Detection efficiency 5 (if used)					
Correction for radioactive decay	0.9032 ± 0.0000			0.0%	
Mass of sample	20.4600 ± 0.2926		kg	1.4%	
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code		M-101	Summary of data for submission		
Activity concentration		0.0200 ± 0.0011	Bq kg ⁻¹		
Uncertainties					
Net count rate	11.7900 ± 0.2062		count/1000s		
Principal γ-ray emission energy	661.6570 ± 0.0030		keV		
Principal γ-ray emission probability	0.8510 ± 0.0020				
Principal γ-ray detection efficiency	0.0341 ± 0.0010				
Radioactive decay	0.9930 ± 0.0000				
Mass of sample	20.4600 ± 0.2926		kg		
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.08 ± 0.09 year				Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):		0.00051			
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	30.0800 ± 0.0900		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-101				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0200 ± 0.0011				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	11.7900 ± 0.2062		count/1000s	1.7%	
Principal γ-ray emission probability	0.8510 ± 0.0020			0.2%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0341 ± 0.0010			2.9%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9930 ± 0.0000			0.0%	
Mass of sample	20.4600 ± 0.2926		kg	1.4%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-102	Summary of data for submission		
Activity concentration	0.0620 ± 0.0110		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.3770 ± 0.0685		count/minute	
Chemical recovery	0.7400 ± 0.0204			
Detection efficiency	0.3070 ± 0.0088			
Radioactive decay	0.9780	No uncertainty stated		
Mass of sample	50.0000 ± 0.0208		g	
Supporting information	No supporting information stated. No uncertainty stated.			
Method	Analysis method stated.			
Detection system	Detection system stated.			
Half-life	12.33	No uncertainty stated	year	No data source stated
Decay energy	No decay energy stated			No data source stated
β emission probability	No β emission probability stated			No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sample water was distilled after addition of KMnO ₄ and Na ₂ O ₂ . Distilled water applied electrolytic enrichment of H-3. After H-3 enrichment, sample water was distilled again. Fifty mL of distilled water was mixed with 50mL of scintillator for measurement.				
Detection system (including method of calibration):				
Hitachi, Ltd. LSC-LB5(Quenching correction curve by H-3 STD with different ratio of water and scintillator)				
Detection limit (Bq/kg):	0.033			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3300 ±		year	
Decay energy				
Particle emission energy i				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102	Uncertainty (k=1)		
	Bq/kg			
Activity concentration	0.0620 ± 0.0110			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.3770 ± 0.0685		count/minute	18.2%
Chemical recovery	0.7400 ± 0.0204			2.8%
Detection efficiency	0.3070 ± 0.0088			2.9%
Correction for radioactive decay	0.9780 ±			0.0%
Mass of sample	50.0000 ± 0.0208		g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-102	Summary of data for submission		
Activity concentration	0.0012 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0267 ± 0.0030		count/sec	
Chemical recovery	0.9465 ± 0.0350			
Detection efficiency	0.6234 ± 0.0201			
Radioactive decay	1.0739 ±	No uncertainty stated		
Mass of sample	40.0000 ± 0.6600		L	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	29.12 ±	No uncertainty stated	year	radiation data book(in Japanese)
Decay energy	0.546 ±	No uncertainty stated	MeV	radiation data book(in Japanese)
β emission probability	No β emission probability stated	No uncertainty stated		
				No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Seawater sample was concentrated to strontium preliminarily for ion-exchange resins. Precipitation of carbonate was produced from eluate. Precipitation of carbonate was dissolved with hydrochloric acid and removed calcium by ion-exchanged resins. The eluate was performed evaporation to dryness and residue was dissolved in water. Y-90 was removed in scavenging. Two weeks later, Y-90 co-precipitated with Fe(OH) ₃ was filtered using filter paper (milkling). The precipitate on the filter paper was dried and used directly for measurement of β-ray activity.				
Detection system (including method of calibration):				
Hitachi: LBC-4211 Low background β-ray counter (by Y-90 of known activity co-precipitated with Fe(OH) ₃). Detection Efficiency: 62.341%				
Detection limit (Bq/kg):	0.00024			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	29.1200 ±		year	radiation data book(in Japanese)
Decay energy	0.5460 ±		MeV	radiation data book(in Japanese)
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	0.0012 ± 0.0002			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0267 ± 0.0030		count/sec	11.2%
Chemical recovery	0.9465 ± 0.0350			3.7%
Detection efficiency	0.6234 ± 0.0201			3.2%
Correction for radioactive decay	1.0739 ±			0.0%
Mass of sample	40.0000 ± 0.6600		L	1.7%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β -/ γ -EMITTING RADIONUCLIDES			
^{134}Cs		Fukushima related seawater containing low levels of β - and β -/ γ -emitting radionuclides			
Outcomes					
Laboratory code	M-102	Summary of data for submission			
Activity concentration	<0.00090	No uncertainty stated		Bq kg ⁻¹	#VALUE!
Uncertainties					
Net count rate	0.1913 ± 0.1097	count/1000s	Warning! Net count rate uncertainty is >50%		
Principal γ -ray emission energy	795.8640 ± 0.0040	keV			
Principal γ -ray emission probability	0.8546 ± 0.0006				
Principal γ -ray detection efficiency	0.0239 ± 0.0007				
Radioactive decay	0.8948 ± 0.0000				
Mass of sample	20.4600 ± 0.2926	kg			
Supporting information:	No Supporting information stated	No uncertainty stated			
Method:	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.0652 ±	0.0004 year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)		
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	0.0009				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	2.0652 ± 0.0004		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ -ray emission energy	795.8640 ± 0.0040		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ -ray emission energy 2 (if used)	±				
γ -ray emission energy 3 (if used)	±				
γ -ray emission energy 4 (if used)	±				
γ -ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-102				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	<0.00090 ±				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.1913 ± 0.1097		count/1000s	57.3%	
Principal γ -ray emission probability	0.8546 ± 0.0006			0.1%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ -ray detection efficiency	0.0239 ± 0.0007			2.9%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.8948 ± 0.0000			0.0%	
Mass of sample	20.4600 ± 0.2926		kg	1.4%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON		
	β-/γ-EMITTING RADIONUCLIDES		
¹³⁷ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides		
Outcomes			
Laboratory code	M-102	Summary of data for submission	
Activity concentration	0.0119 ± 0.0007		Bq kg ⁻¹
Uncertainties			
Net count rate	7.0300 ± 0.1690	count/1000s	
Principal γ-ray emission energy	661.6570 ± 0.0030	keV	
Principal γ-ray emission probability	0.8510 ± 0.0020		
Principal γ-ray detection efficiency	0.0341 ± 0.0010		
Radioactive decay	0.9924 ± 0.0000		
Mass of sample	20.4600 ± 0.2926	kg	
Supporting information	No Supporting information stated	No uncertainty stated	
Method	Analysis method stated		
Detection system	Detection system stated		
Half-life	30.08 ±	0.09 year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)

Input data

Method (including pre-concentration, if applicable):

Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.

Detection system (including method of calibration):

detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source

Detection limit (Bq/kg): 0.0005

Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.0800 ± 0.0900		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			

RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0119 ± 0.0007			

Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	7.0300 ± 0.1690		count/1000s	2.4%
Principal γ-ray emission probability	0.8510 ± 0.0020			0.2%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	0.0341 ± 0.0010			2.9%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay	0.9924 ± 0.0000			0.0%
Mass of sample	20.4600 ± 0.2926		kg	1.4%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	0.0740 ± 0.0120		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.4640 ± 0.0698		count/minute	
Chemical recovery	0.7400 ± 0.0204			
Detection efficiency	0.3080 ± 0.0088			
Radioactive decay	0.9780 ±	No uncertainty stated		
Mass of sample	50.0000 ± 0.0208		g	
Supporting information	No supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.33 ±	No uncertainty stated	year	No data source stated
Decay energy	No decay energy stated	No uncertainty stated	No units stated	No data source stated
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sample water was distilled after addition of KMnO4 and Na2O2. Distilled water applied electrolytic enrichment of H-3. After H-3 enrichment, sample water was distilled again. Fifty ml. of distilled water was mixed with 50ml. of scintillator for measurement.				
Detection system (including method of calibration):				
Hitachi, Ltd. LSC-LB5(Quenching correction curve by H-3 STD with different ratio of water and scintillator)				
Detection limit (Bq/kg):	0.032			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3300 ±		year	
Decay energy				
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	0.0740 ±	0.0120		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.4640 ± 0.0698		count/minute	15.0%
Chemical recovery	0.7400 ± 0.0204			2.8%
Detection efficiency	0.3080 ± 0.0088			2.9%
Correction for radioactive decay	0.9780 ±			0.0%
Mass of sample	50.0000 ± 0.0208		g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	0.0010 ± 0.0001	Bq kg ⁻¹		
Uncertainties				
Net count rate	0.0211 ± 0.0027		count/sec	
Chemical recovery	0.8745 ± 0.0324			
Detection efficiency	0.6247 ± 0.0202			
Radioactive decay	1.0929 ±	No uncertainty stated		
Mass of sample	40.0000 ± 0.6600		L	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	29.12 ±	No uncertainty stated	year	radiation data book(in Japanese)
Decay energy	0.546 ±	No uncertainty stated	MeV	radiation data book(in Japanese)
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Seawater sample was concentrated to strontium preliminarily for ion-exchange resins.Precipitation of carbonate was produced from eluate.Precipitation of carbonate was dissolved with hydrochloric acid and removed calcium by ion-exchanged resins. The eluate was performed evaporation to dryness and residue was dissolved in water. Y-90 was removed in scavenging. Two weeks later,Y-90 co-precipitated with Fe(OH)3 was filtered using filter paper(milking). The precipitate on the filter paper was dried and used directly for measurement of β -ray activity.				
Detection system (including method of calibration):				
Hitachi :LBC-4211 Low background β -ray counter (by Y-90 of known activity co-precipitated with Fe(OH)3. Detection Efficiency:62.467%				
Detection limit (Bq/kg):	0.00026			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	29.1200 ±		year	radiation data book(in Japanese)
Decay energy	0.5460 ±		MeV	radiation data book(in Japanese)
Particle emission energy 1	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	0.0010 ± 0.0001			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0211 ± 0.0027		count/sec	12.9%
Chemical recovery	0.8745 ± 0.0324			3.7%
Detection efficiency	0.6247 ± 0.0202			3.2%
Correction for radioactive decay	1.0929 ±			0.0%
Mass of sample	40.0000 ± 0.6600		L	1.7%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-103	Summary of data for submission			
Activity concentration	<0.00090	No uncertainty stated	Bq kg ⁻¹	#VALUE!	
Uncertainties					
Net count rate	0.2209 ± 0.1101		count/1000s		
Principal γ-ray emission energy	795.8640 ± 0.0040		keV		
Principal γ-ray emission probability	0.8546 ± 0.0006				
Principal γ-ray detection efficiency	0.0239 ± 0.0007				
Radioactive decay	0.8982 ± 0.0000				
Mass of sample	20.4400 ± 0.2923		kg		
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.0652 ± 0.0004		year		Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	0.0009				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	2.0652 ± 0.0004		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	795.8640 ± 0.0040		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-103				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	<0.00090 ±				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.2209 ± 0.1101		count/1000s	49.8%	
Principal γ-ray emission probability	0.8546 ± 0.0006			0.1%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0239 ± 0.0007			2.9%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.8982 ± 0.0000			0.0%	
Mass of sample	20.4400 ± 0.2923		kg	1.4%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-103	Summary of data for submission			
Activity concentration	0.0113 ± 0.0006		Bq kg ⁻¹		
Uncertainties					
Net count rate	6.6740 ± 0.1669		count/1000s		
Principal γ-ray emission energy	661.6570 ± 0.0030		keV		
Principal γ-ray emission probability	0.8510 ± 0.0020				
Principal γ-ray detection efficiency	0.0341 ± 0.0010				
Radioactive decay	0.9927 ± 0.0000				
Mass of sample	20.4400 ± 0.2923		kg		
Supporting information:	No Supporting information stated	No uncertainty stated			
Method:	Analysis method stated				
Detection system:	Detection system stated				
Half-life:	30.08 ± 0.09	year		Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)	
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	0.00051				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	30.0800 ± 0.0900		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-103	Uncertainty (k=1)			
Activity concentration	0.0113 ± 0.0006				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	6.6740 ± 0.1669		count/1000s	2.5%	
Principal γ-ray emission probability	0.8510 ± 0.0020			0.2%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0341 ± 0.0010			2.9%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9927 ± 0.0000			0.0%	
Mass of sample	20.4400 ± 0.2923		kg	1.4%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-104	Summary of data for submission		
Activity concentration	0.0760 ± 0.0120	Bq kg ⁻¹		
Uncertainties				
Net count rate	0.4670 ± 0.0698		count/minute	
Chemical recovery	0.7400 ± 0.0204			
Detection efficiency	0.3070 ± 0.0088			
Radioactive decay	0.9780	No uncertainty stated		
Mass of sample	50.0000 ± 0.0208		g	
Supporting information	No supporting information stated		No uncertainty stated	
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.33	No uncertainty stated	year	No data source stated
Decay energy	No decay energy stated		No units stated	No data source stated
β emission probability	No β emission probability stated		No uncertainty stated	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sample water was distilled after addition of KMnO4 and Na2O2. Distilled water applied electrolytic enrichment of H-3. After H-3 enrichment, sample water was distilled again. Fifty mL of distilled water was mixed with 50mL of scintillator for measurement.				
Detection system (including method of calibration):				
Hitachi, Ltd. LSC-UB5(Quenching correction curve by H-3 STD with different ratio of water and scintillator)				
Detection limit (Bq/kg):	0.033			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3300 ±		year	
Decay energy				
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-104	Uncertainty (k=1)		
	Bq/kg			
Activity concentration	0.0760 ± 0.0120			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.4670 ±	0.0698	count/minute	14.9%
Chemical recovery	0.7400 ±	0.0204		2.8%
Detection efficiency	0.3070 ±	0.0088		2.9%
Correction for radioactive decay	0.9780 ±			0.0%
Mass of sample	50.0000 ±	0.0208	g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-104	Summary of data for submission		
Activity concentration	0.0010 ± 0.0001		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0219 ± 0.0028	count/sec		
Chemical recovery	0.9532 ± 0.0353			
Detection efficiency	0.6234 ± 0.0201			
Radioactive decay	1.0868 ± No uncertainty stated			
Mass of sample	40.0000 ± 0.6600	L		
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half life	29.12 ± No uncertainty stated	year		radiation data book(in Japanese)
Decay energy	0.546 ± No uncertainty stated	MeV		radiation data book(in Japanese)
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Seawater sample was concentrated to strontium preliminarily for ion-exchange resins.Precipitation of carbonate was produced from eluate.Precipitation of carbonate was dissolved with hydrochloric acid and removed calcium by ion-exchanged resins. The eluate was performed evaporation to dryness and residue was dissolved in water. Y-90 was removed in scavenging. Two weeks later, Y-90 co-precipitated with Fe(OH)3 was filtered using filter paper(milking). The precipitate on the filter paper was dried and used directly for measurement of β-ray activity.				
Detection system (including method of calibration):				
Hitachi: LBC-4211 Low background β-ray counter (by Y-90 of known activity co-precipitated with Fe(OH)3. Detection Efficiency:62.341%				
Detection limit (Bq/kg):	0.00024			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	29.1200 ±		year	radiation data book(in Japanese)
Decay energy	0.5460 ±		MeV	radiation data book(in Japanese)
Particle emission energy 1	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-104			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0010 ± 0.0001			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0219 ± 0.0028		count/sec	12.6%
Chemical recovery	0.9532 ± 0.0353			3.7%
Detection efficiency	0.6234 ± 0.0201			3.2%
Correction for radioactive decay	1.0868 ±			0.0%
Mass of sample	40.0000 ± 0.6600		L	1.7%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-104	Summary of data for submission			
Activity concentration	<0.00088	No uncertainty stated	Bq kg ⁻¹	#VALUE!	
Uncertainties					
Net count rate	0.1636 ± 0.1062		count/1000s		Warning! Net count rate uncertainty is >50%
Principal γ-ray emission energy	795.8640 ± 0.0040		keV		
Principal γ-ray emission probability	0.8546 ± 0.0006				
Principal γ-ray detection efficiency	0.0239 ± 0.0007				
Radioactive decay	0.8915 ± 0.0000				
Mass of sample	20.4200 ± 0.2920		kg		
Supporting information	No Supporting Information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.0652 *		0.0004 year		Evaluated Nuclear Structure Data File, NNDC, Brookhaven, [2016]
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	0.00088				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0652 ± 0.0004		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	795.8640 ± 0.0040		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-104				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	<0.00088 ±				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.1636 ± 0.1062		count/1000s	64.9%	
Principal γ-ray emission probability	0.8546 ± 0.0006			0.1%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0239 ± 0.0007			2.9%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.8915 ± 0.0000			0.0%	
Mass of sample	20.4200 ± 0.2920		kg	1.4%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-104	Summary of data for submission			
Activity concentration	0.0062 ± 0.0004		Bq kg ⁻¹		
Uncertainties					
Net count rate	3.6660 ± 0.1387		count/1000s		
Principal γ-ray emission energy	661.6570 ± 0.0030		keV		
Principal γ-ray emission probability	0.8510 ± 0.0020				
Principal γ-ray detection efficiency	0.0341 ± 0.0010				
Radioactive decay	0.9921 ± 0.0000				
Mass of sample	20.4200 ± 0.2920		kg		
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.38 ± 0.09	year			Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg): 0.00051					
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	30.0800 ± 0.0900		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-104				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0062 ± 0.0004				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	3.6660 ± 0.1387		count/1000s	3.8%	
Principal γ-ray emission probability	0.8510 ± 0.0020			0.2%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0341 ± 0.0010			2.9%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9921 ± 0.0000			0.0%	
Mass of sample	20.4200 ± 0.2920		kg	1.4%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	0.0770 ± 0.0120		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.4790 ± 0.0700		count/minute	
Chemical recovery	0.7410 ± 0.0204			
Detection efficiency	0.3070 ± 0.0088			
Radioactive decay	0.9780 ± No uncertainty stated			
Mass of sample	50.0000 ± 0.0208		g	
Supporting information	No Supporting information stated		No uncertainty stated	
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.33 ± No uncertainty stated		year	No data source stated
Decay energy	No decay energy stated		No units stated	No data source stated
β emission probability	No β emission probability stated		No uncertainty stated	No data source stated
Input data				
Method (Including pre concentration, if applicable):				
Sample water was distilled after addition of KMnO4 and Na2O2. Distilled water applied electrolytic enrichment of H-3. After H-3 enrichment, sample water was distilled again. Fifty mL of distilled water was mixed with 50mL of scintillator for measurement.				
Detection system (including method of calibration):				
Hitachi, Ltd. LSC-LB5(Quenching correction curve by H-3 STD with different ratio of water and scintillator)				
Detection limit (Bq/kg):	0.032			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3300 ±		year	
Decay energy	±			
Particle emission energy 1	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1	Uncertainty (k=1)		
	Bq/kg			
Activity concentration	0.0770 ± 0.0120			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.4790 ± 0.0700		count/minute	14.6%
Chemical recovery	0.7410 ± 0.0204			2.8%
Detection efficiency	0.3070 ± 0.0088			2.9%
Correction for radioactive decay	0.9780 ±			0.0%
Mass of sample	50.0000 ± 0.0208		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES				
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides				
Outcomes					
Laboratory code	T-D1	Summary of data for submission			
Activity concentration	0.0011 ± 0.0001		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.0233 ± 0.0028		count/sec		
Chemical recovery	0.8963 ± 0.0332				
Detection efficiency	0.6247 ± 0.0202				
Radioactive decay	1.0674 ±	No uncertainty stated			
Mass of sample	40.0000 ± 0.6600				
Supporting information	No supporting information stated		No uncertainty stated		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	29.12	No uncertainty stated	year	radiation data book (in Japanese)	
Decay energy	0.546	No uncertainty stated	MeV	radiation data book (in Japanese)	
β emission probability	No β emission probability stated		No data source stated		
Input data					
Method (including pre-concentration, if applicable):					
Seawater sample was concentrated to strontium preliminarily for ion-exchange resins. Precipitation of carbonate was produced from eluate. Precipitation of carbonate was dissolved with hydrochloric acid and removed calcium by ion-exchanged resins. The eluate was performed evaporation to dryness and residue was dissolved in water. Y-90 was removed in scavenging. Two weeks later, Y-90 co-precipitated with Fe(OH)3 was filtered using filter paper (milking). The precipitate on the filter paper was dried and used directly for measurement of β-ray activity.					
Detection system (including method of calibration):					
Hitachi: LBC-4211 Low background β-ray counter (by Y-90 of known activity co-precipitated with Fe(OH)3. Detection Efficiency: 62.467%					
Detection limit (Bq/kg):	0.00025				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	29.1200 ±		year	radiation data book (in Japanese)	
Decay energy	0.5460 ±		MeV	radiation data book (in Japanese)	
Particle emission energy 1	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	T-D1				
	Bq/kg		Uncertainty (k=1)		
Activity concentration	0.0011 ± 0.0001				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0233 ± 0.0028		count/sec	12.1%	
Chemical recovery	0.8963 ± 0.0332			3.7%	
Detection efficiency	0.6247 ± 0.0202			3.2%	
Correction for radioactive decay	1.0674 ±			0.0%	
Mass of sample	40.0000 ± 0.6600		L	1.7%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β -/ γ -EMITTING RADIONUCLIDES			
^{134}Cs		Fukushima related seawater containing low levels of β - and β -/ γ -emitting radionuclides			
Outcomes					
Laboratory code	T-D1	Summary of data for submission			
Activity concentration	<0.00085	No uncertainty stated	Bq kg ⁻¹	#VALUE!	
Uncertainties					
Net count rate	0.1351 ± 0.1041		count/1000s		Warning! Net count rate uncertainty is >80%
Principal γ -ray emission energy	795.8640 ± 0.0040		keV		
Principal γ -ray emission probability	0.8546 ± 0.0006				
Principal γ -ray detection efficiency	0.0239 ± 0.0007				
Radioactive decay	0.9067 ± 0.0000				
Mass of sample	20.4200 ± 0.2920		kg		
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.0652 ± 0.0004		year		Evaluated Nuclear Structure Data File, NNDC, Brookhaven, (2016)
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	0.00085				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0652 ± 0.0004		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ -ray emission energy	795.8640 ± 0.0040		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ -ray emission energy 2 (if used)	±				
γ -ray emission energy 3 (if used)	±				
γ -ray emission energy 4 (if used)	±				
γ -ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	T-D1				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	<0.00085 ±				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.1351 ± 0.1041		count/1000s	77.1%	
Principal γ -ray emission probability	0.8546 ± 0.0006			0.1%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ -ray detection efficiency	0.0239 ± 0.0007			2.9%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9067 ± 0.0000			0.0%	
Mass of sample	20.4200 ± 0.2920		kg	1.4%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β - γ -EMITTING RADIONUCLIDES		
^{137}Cs	Fukushima related seawater containing low levels of β - and β - γ -emitting radionuclides		
Outcomes			
Laboratory code	T-D1	Summary of data for submission	
Activity concentration	0.0042 \pm 0.0003		Bq kg ⁻¹
Uncertainties			
Net count rate	2.4780 \pm 0.1300	count/1000s	
Principal γ -ray emission energy	661.6570 \pm 0.0030	keV	
Principal γ -ray emission probability	0.8510 \pm 0.0020		
Principal γ -ray detection efficiency	0.0341 \pm 0.0010		
Radioactive decay	0.9933 \pm 0.0000		
Mass of sample	20.4200 \pm 0.2920	kg	
Supporting information	No Supporting information stated	No uncertainty stated	
Method	Analysis method stated		
Detection system	Detection system stated		
Half-life	30.08 \pm 0.09	year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)

Input data

Method (including pre-concentration, if applicable):

Detection system (including method of calibration): Chemical separation using AMP followed by gamma-ray spectrometry.

Detection system (including method of calibration):

detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source

Detection limit (Bq/kg): 0.00053

Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.0800	\pm 0.0900	year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
Principal γ -ray emission energy	661.6570	\pm 0.0030	keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
γ -ray emission energy 2 (if used)		\pm		
γ -ray emission energy 3 (if used)		\pm		
γ -ray emission energy 4 (if used)		\pm		
γ -ray emission energy 5 (if used)		\pm		

RESULTS

Reference time and date: 2019-06-03 12:00:00 UTC

Sample number: T-D1

Activity concentration: 0.0042 \pm 0.0003 Bq/kg

Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	2.4780	\pm 0.1300	count/1000s	5.2%
Principal γ -ray emission probability	0.8510	\pm 0.0020		0.2%
Emission probability 2 (if used)		\pm		
Emission probability 3 (if used)		\pm		
Emission probability 4 (if used)		\pm		
Emission probability 5 (if used)		\pm		
Principal γ -ray detection efficiency	0.0341	\pm 0.0010		2.9%
Detection efficiency 2 (if used)		\pm		
Detection efficiency 3 (if used)		\pm		
Detection efficiency 4 (if used)		\pm		
Detection efficiency 5 (if used)		\pm		
Correction for radioactive decay	0.9933	0.0000		0.0%
Mass of sample	20.4200	\pm 0.2920	kg	1.4%
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		

公益財団法人 日本分析センターの測定結果
(海底土)

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	F-P04	Summary of data for submission			
Activity concentration	1.3000 ± 0.3800		Bq kg ⁻¹		
Uncertainties					
Net count rate	1.3870 ± 0.3915		count/1000s		
Principal γ-ray emission energy	795.8640 ± 0.0040		keV		
Principal γ-ray emission probability	0.8546 ± 0.0006				
Principal γ-ray detection efficiency	0.0102 ± 0.0003				
Radioactive decay	0.9011 ± 0.0000				
Mass of sample	0.1345 ± 0.0000		kg		
Supporting information	No Supporting information stated		No uncertainty stated		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.0652 ± 0.0004	year			Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Direct gamma-counting of the sediment sample (Cylindrical)					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	1.2				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0652 ± 0.0004		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	795.8640 ± 0.0040		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	F-P04				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	1.3000 ± 0.3800				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	1.3870 ± 0.3915		count/1000s	28.2%	
Principal γ-ray emission probability	0.8546 ± 0.0006			0.1%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0102 ± 0.0003			3.0%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9011 ± 0.0000			0.0%	
Mass of sample	0.1345 ± 0.0000		kg	0.0%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON		
¹³⁷ Cs	β-/γ-EMITTING RADIONUCLIDES		
	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides		
	Outcomes		
Laboratory code	F-P04	Summary of data for submission	
Activity concentration	29.0000 ± 1.5000	Bq kg ⁻¹	
	Uncertainties		
Net count rate	40.8700 ± 0.7720	count/1000s	
Principal γ-ray emission energy	661.6570 ± 0.0030	keV	
Principal γ-ray emission probability	0.8510 ± 0.0020		
Principal γ-ray detection efficiency	0.0127 ± 0.0004		
Radioactive decay	0.9929 ± 0.0000		
Mass of sample	0.1345 ± 0.0000	kg	
Supporting information	No Supporting information stated	No uncertainty stated	
Method	Analysis method stated		
Detection system	Detection system stated		
Half life	30.08 ± 0.09	year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)

Input data

Method (including pre-concentration, if applicable):

Detection system (including method of calibration): Direct gamma-counting of the sediment sample (Cylindrical)

Detection system (including method of calibration):

detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source

Detection limit (Bq/kg):	0.66
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Parameter	Value	Nuclear data used		
		Uncertainty	Units	Data source
Half life	30.0800 ± 0.0900		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			

RESULTS			
Reference time and date	2019-06-03 12:00:00 UTC		
Sample number:	F-P04		
	Bq/kg	Uncertainty (k=1)	
Activity concentration (dry)	29.0000 ± 1.5000		

Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	40.8700 ± 0.7720		count/1000s	1.9%
Principal γ-ray emission probability	0.8510 ± 0.0020			0.2%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	0.0127 ± 0.0004			3.2%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	0.9929 ± 0.0000			0.0%
Mass of sample	0.1345 ± 0.0000		kg	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON α-EMITTING RADIONUCLIDES			
²³⁸ Pu		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	F-P04	Summary of data for submission			
Activity concentration	0.0059 ± 0.0015		Bq kg ⁻¹		
Uncertainties					
Net sample count rate	0.0750 ± 0.0190		counts/1000s		
Chemical recovery	0.9000 ± 0.0180				
Sample detection efficiency	0.2840	No uncertainty stated			
Sample radioactive decay	0.9970	No uncertainty stated			
Mass of sample	50.5800 ± 0.2500		g		
Supporting information:	No Supporting information stated		No uncertainty stated		
Activity concentration	0.0342	0.0002	Bq		
Net tracer count rate	8.7300 ± 0.1700		counts/1000s		
Tracer detection efficiency	0.2840	No uncertainty stated			
Tracer radioactive decay	1.0000 ± 0.0000	No uncertainty stated			
Mass of tracer added	2.0000 ± 0.0030		ml		
Supporting information:	0.2840		No uncertainty stated		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	87.7	No uncertainty stated	year		No data source stated
Decay energy	5.499	No uncertainty stated	MeV		No data source stated
α emission probability	No α emission probability stated		No data source stated		
Input data					
Method (including pre-concentration, if applicable):					
Sediment samples were leached with nitric acid. Plutonium were separated with anion exchange resin column. Purified plutonium was electrodeposited on a stainless steel disc for alpha spectrometry.					
Detection system (including method of calibration):					
Si semiconductor detector was used for plutonium measurement. (The calibration was carried out using NIST traceable Pu-242 tracer.)					
Detection limit (Bq/kg):	0.0042				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	87.7000 ±		year		
Decay energy	5.4990 ±		MeV		
Particle emission energy 1	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	F-P04				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	0.0059 ± 0.0015				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0750 ± 0.0190		counts/1000s	25.3%	
Chemical recovery	0.9000 ± 0.0180			2.0%	
Detection efficiency	0.2840 ±			0.0%	
Correction for radioactive decay	0.9970 ±			0.0%	
Mass of sample	50.5800 ± 0.2500		g	0.5%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
ISOTOPE DILUTION TRACER					
Activity concentration	0.0342 ± 0.0002		Bq	0.5%	
Net count rate	8.7300 ± 0.1700		counts/1000s		
Detection efficiency	0.2840 ±				
Correction for radioactive decay	1.0000 ±				
Mass of tracer added	2.0000 ± 0.0030		ml		
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
239/240 Pu		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	F-P04		Summary of data for submission		
Activity concentration	0.4120 ± 0.0130		Bq kg ⁻¹		
Uncertainties					
Net sample count rate	5.2700 ± 0.1300		counts/1000s		
Chemical recovery	0.9000 ± 0.0180				
Sample detection efficiency	0.2840	No uncertainty stated			
Sample radioactive decay	1.0000	No uncertainty stated			
Mass of sample	50.5800 ± 0.2500		g		
Supporting information	No Supporting information stated		No uncertainty stated		
Activity concentration	0.0342	0.0002	Bq		
Net tracer count rate	8.7300 ± 0.1700		counts/1000s		
Tracer detection efficiency	0.2840	No uncertainty stated			
Tracer radioactive decay	1.0000	No uncertainty stated			
Mass of tracer added	2.0000 ± 0.0030		ml		
Supporting information	0.2840		No uncertainty stated		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	24110	No uncertainty stated	year		No data source stated
Decay energy	5.157	No uncertainty stated	MeV		No data source stated
α emission probability	No α emission probability stated		No uncertainty stated		No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Sediment samples were leached with nitric acid. Plutonium were separated with anion exchange resin column. Purified plutonium was electrodeposited on a stainless steel disc for alpha spectrometry.					
Detection system (including method of calibration):					
Si semiconductor detector was used for plutonium measurement. (The calibration was carried out using NIST traceable Pu-242 tracer.)					
Detection limit (Bq/kg):	0.0025				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	24110.0000 ±		year		
Decay energy	5.1570 ±		MeV		
Particle emission energy 1					
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	F-P04				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	0.4120 ±	0.0130			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	5.2700 ±	0.1300	counts/1000s	2.5%	
Chemical recovery	0.9000 ±	0.0180		2.0%	
Detection efficiency	0.2840 ±			0.0%	
Correction for radioactive decay	1.0000 ±			0.0%	
Mass of sample	50.5800 ±	0.2500	g	0.5%	
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
ISOTOPE DILUTION TRACER					
Activity concentration	0.0342 ±	0.0002	Bq	Nuclide	Pu-242
Net count rate	8.7300 ±	0.1700	counts/1000s		0.5%
Detection efficiency	0.2840				
Correction for radioactive decay	1.0000				
Mass of tracer added	2.0000 ±	0.0030	ml		
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
134Cs		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-S3	Summary of data for submission			
Activity concentration	0.8700 ± 0.2900		Bq kg ⁻¹		
Uncertainties					
Net count rate	1.0030 ± 0.3312		count/1000s		
Principal γ-ray emission energy	795.8640 ± 0.0040		keV		
Principal γ-ray emission probability	0.8546 ± 0.0006				
Principal γ-ray detection efficiency	0.0100 ± 0.0003				
Radioactive decay	0.9003 ± 0.0000				
Mass of sample	0.1522 ± 0.0000		kg		
Supporting information	No Supporting Information stated		No uncertainty stated		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.0652 ±		0.0004 year		Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Direct gamma-counting of the sediment sample (Cylindrical)					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg):	0.86				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0652 ±	0.0004	year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	795.8640 ±	0.0040	keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	T-S3				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	0.8700 ± 0.2900				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	1.0030 ±	0.3312	count/1000s	33.0%	
Principal γ-ray emission probability	0.8546 ±	0.0006		0.1%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0100 ±	0.0003		3.0%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9003 ±	0.0000		0.0%	
Mass of sample	0.1522 ±	0.0000	kg	0.0%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-S3	Summary of data for submission			
Activity concentration	7.8000 ± 0.4900		Bq kg ⁻¹		
Uncertainties					
Net count rate	12.3800 ± 0.4765		count/1000s		
Principal γ-ray emission energy	661.6570 ± 0.0030		keV		
Principal γ-ray emission probability	0.8510 ± 0.0020				
Principal γ-ray detection efficiency	0.0124 ± 0.0004				
Radioactive decay	0.9928 ± 0.0000				
Mass of sample	0.1522 ± 0.0000		kg		
Supporting information	No supporting information stated		No uncertainty stated		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.08 ± 0.09	year			Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Direct gamma-counting of the sediment sample (Cylindrical)					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg): 0.55					
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	30.0800 ± 0.0900		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	T-S3				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	7.8000 ± 0.4900				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	12.3800 ± 0.4765		count/1000s	3.8%	
Principal γ-ray emission probability	0.8510 ± 0.0020			0.2%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0124 ± 0.0004			3.2%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9928 ± 0.0000			0.0%	
Mass of sample	0.1522 ± 0.0000		kg	0.0%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
²³⁸ Pu	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S3	Summary of data for submission		
Activity concentration	0.0041 ± 0.0016		Bq kg ⁻¹	
Uncertainties				
Net sample count rate	0.0047 ± 0.0018		counts/1000sec	
Chemical recovery	0.8620 ± 0.0180			
Sample detection efficiency	0.2660	No uncertainty stated		
Sample radioactive decay	0.9970	No uncertainty stated		
Mass of sample	50.6400 ± 0.2500		g	
Supporting information	No supporting information stated	No uncertainty stated		
Activity concentration	0.0042	0.0002	Bq	
Net tracer count rate	7.8300	0.1600	counts/1000s	
Tracer detection efficiency	0.2660	No uncertainty stated		
Tracer radioactive decay	1.0000	No uncertainty stated		
Mass of tracer added	2.0000 ± 0.0030		ml	
Supporting information	0.2560	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	87.7	No uncertainty stated	year	No data source stated
Decay energy	5.499	No uncertainty stated	MeV	No data source stated
α emission probability	No α emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sediment samples were leached with nitric acid. Plutonium were separated with anion exchange resin column. Purified plutonium was electrodeposited on a stainless steel disc for alpha spectrometry.				
Detection system (including method of calibration):				
Si semiconductor detector was used for plutonium measurement. (The calibration was carried out using NIST traceable Pu-242 tracer.)				
Detection limit (Bq/kg):	0.0052			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	87.7000 ±		year	
Decay energy	5.4990 ±		MeV	
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S3			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.0041 ± 0.0016			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0047 ± 0.0018		counts/1000sec	38.3%
Chemical recovery	0.8620 ± 0.0180			2.1%
Detection efficiency	0.2660 ±			0.0%
Correction for radioactive decay	0.9970 ±			0.0%
Mass of sample	50.6400 ± 0.2500		g	0.5%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
ISOTOPE DILUTION TRACER				
Activity concentration	0.0342 ± 0.0002		Bq	0.5%
Net count rate	7.8300	0.1600	counts/1000s	
Detection efficiency	0.2660			
Correction for radioactive decay	1.0000			
Mass of tracer added	2.0000	0.0030	ml	
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
239/240Pu		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code		T-S3		Summary of data for submission	
Activity concentration		0.3920 ± 0.0130		Bq kg ⁻¹	
Uncertainties					
Net sample count rate	4.5100 ± 0.1200			counts/1000sec	
Chemical recovery	0.8620 ± 0.0180				
Sample detection efficiency	0.2660	No uncertainty stated			
Sample radioactive decay	1.0000	No uncertainty stated			
Mass of sample	50.6400 ± 0.2500			g	
Supporting information	No Supporting information stated. No uncertainty stated				
Activity concentration	0.0342 ± 0.0002			Bq	
Net tracer count rate	7.8300 ± 0.1600			counts/1000s	
Tracer detection efficiency	0.2660	No uncertainty stated			
Tracer radioactive decay	1.0000	No uncertainty stated			
Mass of tracer added	2.0000 ± 0.0030			ml	
Supporting information	0.2660 No uncertainty stated				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	24110	No uncertainty stated		year	No data source stated
Decay energy	5.157	No uncertainty stated		MeV	No data source stated
Emission probability	No α emission probability stated. No uncertainty stated. No data source stated				
Input data					
Method (including pre-concentration, if applicable):					
Sediment samples were leached with nitric acid. Plutonium were separated with anion exchange resin column. Purified plutonium was electrodeposited on a stainless steel disc for alpha spectrometry.					
Detection system (including method of calibration):					
Si semiconductor detector was used for plutonium measurement. (The calibration was carried out using NIST traceable Pu-242 tracer)					
Detection limit (Bq/kg):	0.0028				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	24110.0000 ±		year		
Decay energy	5.1570 ±		MeV		
Particle emission energy 1					
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	T-S3				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	0.3920 ± 0.0130				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	4.5100 ± 0.1200		counts/1000sec	2.7%	
Chemical recovery	0.8620 ± 0.0180			2.1%	
Detection efficiency	0.2660 ±			0.0%	
Correction for radioactive decay	1.0000 ±			0.0%	
Mass of sample	50.6400 ± 0.2500		g	0.5%	
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
ISOTOPE DILUTION TRACER					
Activity concentration	0.0342 ± 0.0002		Nuclide	Pu-242	
Net count rate	7.8300 ± 0.1600		Bq	0.5%	
Detection efficiency	0.2660		counts/1000s		
Correction for radioactive decay	1.0000				
Mass of tracer added	2.0000 ± 0.0030		ml		
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-S8	Summary of data for submission			
Activity concentration	2.4000 ± 0.3800	Bq kg ⁻¹			
Uncertainties					
Net count rate	2.4910 ± 0.3689	count/1000s			
Principal γ-ray emission energy	795.8640 ± 0.0040	keV			
Principal γ-ray emission probability	0.8546 ± 0.0006				
Principal γ-ray detection efficiency	0.0102 ± 0.0003				
Radioactive decay	0.8891 ± 0.0000				
Mass of sample	0.1352 ± 0.0000	kg			
Supporting information:	No Supporting information stated	No uncertainty stated			
Method:	Analysis method stated				
Detection system:	Detection system stated				
Half-life	2.0652 ± 0.0004 year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)			
Input data					
Method (including pre-concentration, if applicable):					
Detection system (including method of calibration): Direct gamma-counting of the sediment sample (Cylindrical)					
Detection system (including method of calibration):					
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source					
Detection limit (Bq/kg): 1					
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0652 ± 0.0004		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
Principal γ-ray emission energy	795.8640 ± 0.0040		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	T-S8				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	2.4000 ± 0.3800				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	2.4910 ± 0.3689		count/1000s	14.8%	
Principal γ-ray emission probability	0.8546 ± 0.0006			0.1%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.0102 ± 0.0003			3.0%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.8891 ± 0.0000			0.0%	
Mass of sample	0.1352 ± 0.0000		kg	0.0%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	30.0000 ± 1.6000		Bq kg ⁻¹	
Uncertainties				
Net count rate	42.6600 ± 0.7832		count/1000s	
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	
Principal γ-ray emission probability	0.8510 ± 0.0020			
Principal γ-ray detection efficiency	0.0126 ± 0.0004			
Radioactive decay	0.9920 ± 0.0000			
Mass of sample	0.1352 ± 0.0000		kg	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life:	30.08 ±	0.09 year		Evaluated Nuclear Structure Data File, NNDC, Brookhaven (2016)
Input data				
Method (including pre-concentration, if applicable):				
Detection system (including method of calibration): Direct gamma-counting of the sediment sample (Cylindrical)				
Detection system (including method of calibration):				
detection system (including method of calibration): P-type coaxial (relative efficiency 31%) calibration with multi-gamma source				
Detection limit (Bq/kg):	0.64			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.0800 ± 0.0900		year	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
Principal γ-ray emission energy	661.6570 ± 0.0030		keV	Evaluated Nuclear Structure Data File, NNDC, Brookhaven
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	=			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	30.0000 ± 1.6000			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	42.6600 ± 0.7832		count/1000s	1.8%
Principal γ-ray emission probability	0.8510 ± 0.0020			0.2%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	0.0126 ± 0.0004			3.2%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	0.9920 ± 0.0000			0.0%
Mass of sample	0.1352 ± 0.0000		kg	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON α-EMITTING RADIONUCLIDES			
²³⁸ Pu	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	0.0081 ± 0.0018		Bq kg ⁻¹	
Uncertainties				
Net sample count rate	0.1000 ± 0.0220		counts/1000s	
Chemical recovery	0.9160 ± 0.0180			
Sample detection efficiency	0.2680	No uncertainty stated		
Sample radioactive decay	0.9970	No uncertainty stated		
Mass of sample	50.5800 ± 0.2500		g	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	0.0342	0.0002	Bq	
Net tracer count rate	8.3900	0.1600	counts/1000s	
Tracer detection efficiency	0.2680	No uncertainty stated		
Tracer radioactive decay	1.0000	No uncertainty stated		
Mass of tracer added	2.0000 ± 0.0030		ml	
Supporting information	0.2680	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	87.7	No uncertainty stated	year	No data source stated
Decay energy	5.499	No uncertainty stated	MeV	No data source stated
α emission probability	No α emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sediment samples were leached with nitric acid. Plutonium were separated with anion exchange resin column. Purified plutonium was electrodeposited on a stainless steel disc for alpha spectrometry.				
Detection system (including method of calibration):				
Si semiconductor detector was used for plutonium measurement. (The calibration was carried out using NIST traceable Pu-242 tracer.)				
Detection limit (Bq/kg):	0.0046			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	87.7000 ±		year	
Decay energy	5.4990 ±		MeV	
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8	Uncertainty (k=1)		
Activity concentration (dry)	0.0081 ± 0.0018			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.1000 ± 0.0220		counts/1000s	22.0%
Chemical recovery	0.9160 ± 0.0180			2.0%
Detection efficiency	0.2680 ±			0.0%
Correction for radioactive decay	0.9970 ±			0.0%
Mass of sample	50.5800 ± 0.2500		g	0.5%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
ISOTOPE DILUTION TRACER			Nuclide	Pu-242
Activity concentration	0.0342 ± 0.0002		Bq	0.5%
Net count rate	8.3900	0.1600	counts/1000s	
Detection efficiency	0.2680			
Correction for radioactive decay	1.0000			
Mass of tracer added	2.0000	0.0030	ml	
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
²³⁹ / ₂₄₀ Pu	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	0.5500 ± 0.0170	Bq kg ⁻¹		
Uncertainties				
Net sample count rate	6.7780 ± 0.1500		counts/1000s	
Chemical recovery	0.9160 ± 0.0180			
Sample detection efficiency	0.2680	No uncertainty stated		
Sample radioactive decay	1.0000	No uncertainty stated		
Mass of sample	50.5800 ± 0.2500		g	
Supporting information	No supporting information stated	No uncertainty stated		
Activity concentration	0.0342 ± 0.0002		Bq	
Net tracer count rate	8.3900 ± 0.1600		counts/1000s	
Tracer detection efficiency	0.2680	No uncertainty stated		
Tracer radioactive decay	1.0000	No uncertainty stated		
Mass of tracer added	2.0000 ± 0.0030		ml	
Supporting information	0.2680	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half life	24110	No uncertainty stated	year	No data source stated
Decay energy	5.157	No uncertainty stated	MeV	No data source stated
α emission probability	No α emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sediment samples were leached with nitric acid. Plutonium were separated with anion exchange resin column. Purified plutonium was electrodeposited on a stainless steel disc for alpha spectrometry.				
Detection system (including method of calibration):				
Si semiconductor detector was used for plutonium measurement. (The calibration was carried out using NIST traceable Pu-242 tracer.)				
Detection limit (Bq/kg):	0.0036			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	24110.0000 ±		year	
Decay energy	5.1570 ±		MeV	
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.5500 ± 0.0170			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	6.7700 ± 0.1500		counts/1000s	2.2%
Chemical recovery	0.9160 ± 0.0180			2.0%
Detection efficiency	0.2680 ±			0.0%
Correction for radioactive decay	1.0000 ±			0.0%
Mass of sample	50.5800 ± 0.2500		g	0.5%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
ISOTOPE DILUTION TRACER				
Activity concentration	0.0342 ± 0.0002		Nuclide Bq	Pu-242 0.5%
Net count rate	8.3900 ± 0.1600		counts/1000s	
Detection efficiency	0.2680			
Correction for radioactive decay	1.0000			
Mass of tracer added	2.0000 ± 0.0030		ml	
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

參考資料

参考資料 1

IAEA との試験所間比較分析に係る試料採取及び
試料調製等業務作業報告書

1. 概要

原子力規制委員会は、福島県沖を中心とする海洋モニタリングデータの国際的な信頼性・透明性の向上のため、IAEA（International Atomic Energy Agency：国際原子力機関）との協力により試験所間比較分析を実施している。

この試験所間比較分析の一環として、公益財団法人日本分析センターは、原子力規制庁及び IAEA と共同で、東京電力ホールディングス株式会社福島第一原子力発電所の周辺海域で海水及び海底土を採取し、試料の放射能分析を実施している。

本業務は、海水及び海底土の採取と、採取した海底土試料の調製作業全般を原子力規制庁が指定した方法に従って実施した。

2. 調査方法

2-1. 調査地点

調査地点は原子力規制委員会が指定した採水 5 地点、採泥 3 地点の計 8 地点とした。調査地点の位置情報を表 2-1 及び図 2-1 に示す。

表 2-1 調査地点の位置情報

地点	調査項目		北緯	東経
	採水	採泥		
M-101	●	—	37° 25' 36"	141° 02' 36"
M-102	●	—	37° 25' 06"	141° 02' 36"
M-103	●	—	37° 26' 42"	141° 02' 48"
M-104	●	—	37° 24' 06"	141° 02' 48"
T-D1	●	—	37° 30' 00"	141° 04' 20"
T-S3	—	●	37° 27' 30"	141° 04' 44"
T-S8	—	●	37° 23' 00"	141° 04' 44"
F-P04	—	●	37° 25' 27"	141° 03' 26"

※緯度・経度は世界測地系 WGS84 に準拠

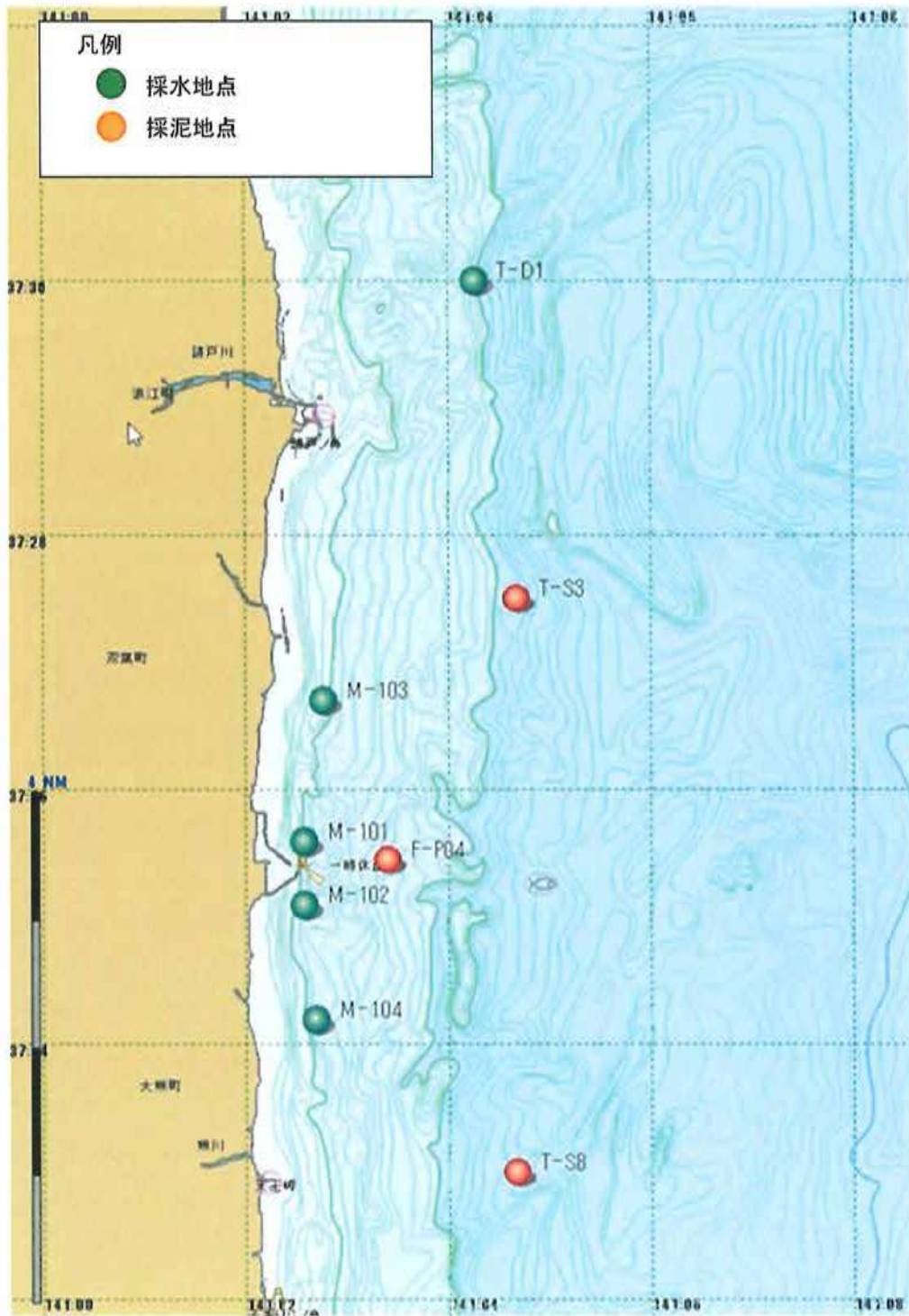


图 2-1 調査地点位置图

2-2. 調査時期

現地調査は 2019 年 6 月 3～5 日に、海底土前処理・分割は 2019 年 6 月 4～8 日に実施した。

現地調査の工程及び採取した海底土前処理・分割に係る工程を表 2-2 に示す。

表 2-2 調査工程

年月 日 曜日	2019年6月						
	2	3	4	5	6	7	8
	(日)	(月)	(火)	(水)	(木)	(金)	(土)
調査地点	現地入り 機材受取	T-S8 T-S3 T-D1	F-P04 M-101 M-103	M-102 M-104	機材発送 撤収	—	—
調査項目	水質	—	●●	●●	—	—	—
	底質	—	■	■	—	—	—
試料発送	海水試料	—	●	●●	●●	—	—
	海底土試料	—	■	■	—	—	—
海底土前処理・分割	T-S8	—	—	■			
	T-S3	—	—	■			
	F-P04	—	—	—	■		

※調査地点の青文字は採水地点(●)、赤文字は採泥地点(■)

2-3. 試料の採取量

海水試料及び海底土試料の地点毎の採取量を表2-3に示す。

表2-3 地点毎の海水試料及び海底土試料の採取量

海水試料 採取地点	^{90}Sr 、 ^{134}Cs 、 ^{137}Cs 分析用		^3H 分析用	
	分析機関数	採取量	分析機関数	採取量
M-101	6	20L × 18個	8	2L × 8個
M-102	6	20L × 18個	8	2L × 8個
M-103	6	20L × 18個	8	2L × 8個
M-104	6	20L × 18個	8	2L × 8個
T-D1	7	20L × 21個	8	2L × 8個

海底土試料 採取地点	Cs、Pu分析用	
	分析機関数	採取量
T-S3	6	6kg-wet
T-S8	6	6kg-wet
F-P04	6	6kg-wet

2-4. 調査方法

(1) 採水

D-GPS を用いて船位を確認後、水中ポンプを用いて採水を行った。

採水深度は 1.0m 程度とし、汲み上げた海水は船上の大型タンク内で十分に攪拌、均一化を図った後に、所定の容器に分取して海水試料とした。

図2-2に海水試料の採水・分取状況を、図2-3に海水試料の分取内訳を示す。



図2-2 海水試料の採水・分取状況

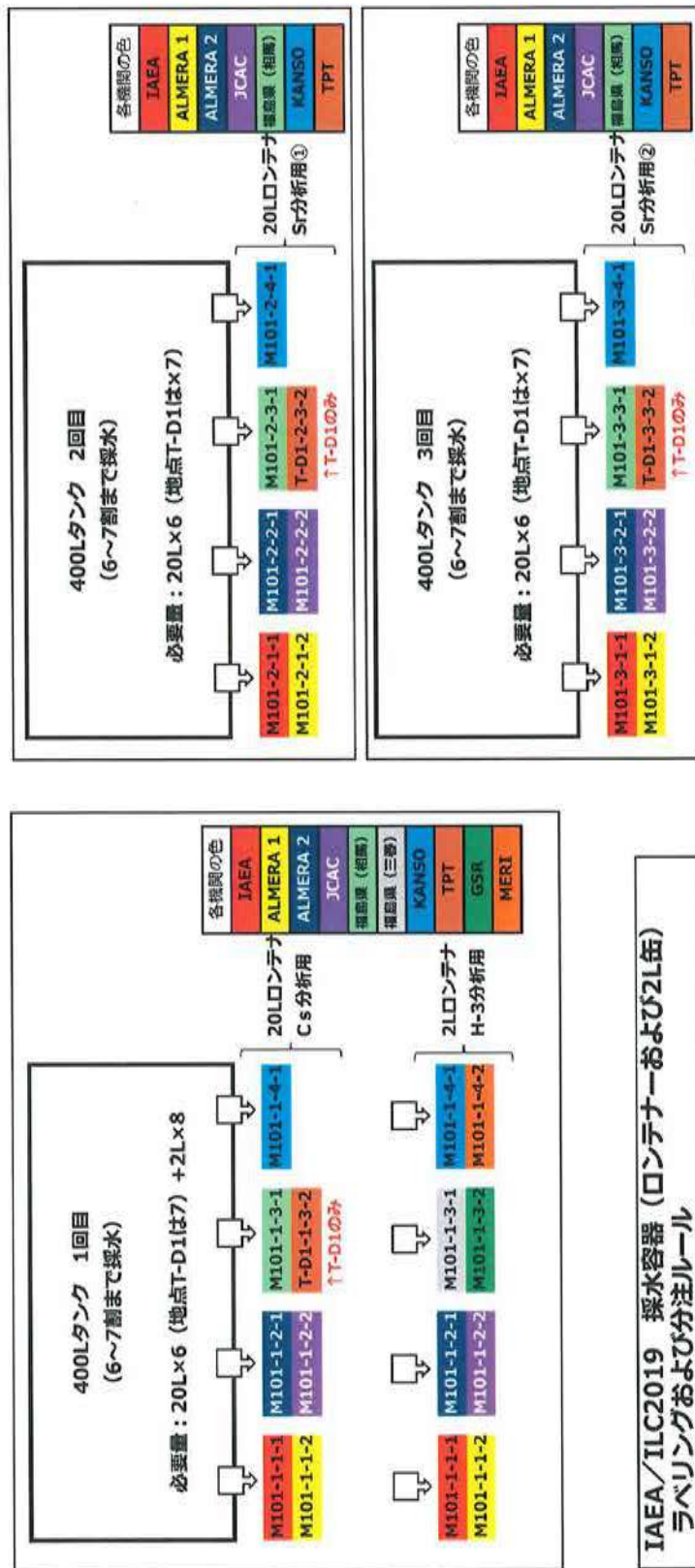


図 2 - 3 海水試料の分取内訳

(2) 採泥

D-GPS を用いて船位を確認後、グラブ式採泥器（スミス・マッキンタイヤ型採泥器）を用いて採泥を行った。採取した海底土はステンレス製のバットに移して攪拌・均一化を図った後に、湿重量で 6kg-wet 程度を分取して調製用の海底土試料とした。

図 2-4 に海底土試料の採泥状況を示す。



図 2-4 海底土試料の採泥状況

採取した海底土試料は、図 2-5 に示すフローに基づいて前処理、分割による均一化を図り、試験所間比較分析用試料とした。

試料の分割には筒井理化学器械社製の 2 分器 JIS6 号型を用いた。

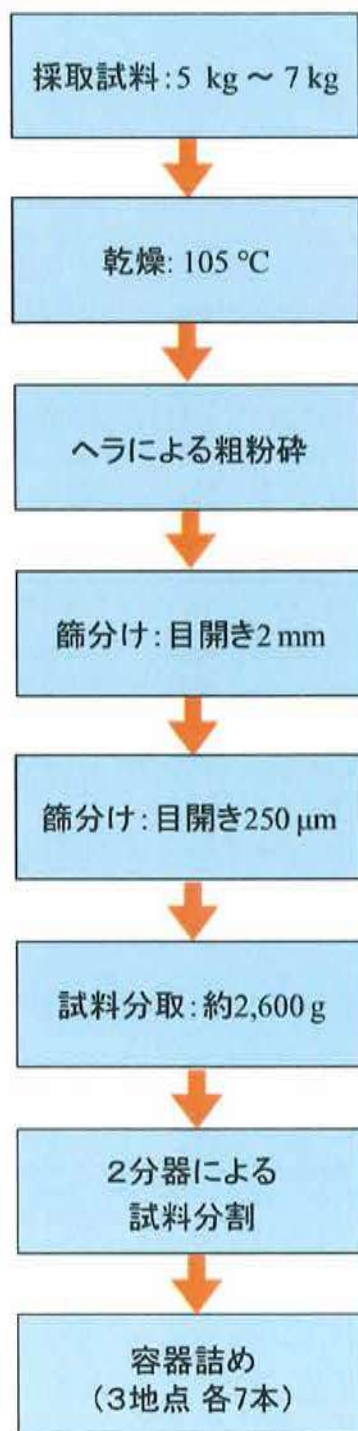


図 2-5 海底土試料の調製フロー

3. 結果

3-1. 現地調査記録

現地調査に係るインベントリデータを表 3-1 に、現地調査に係る記録写真を資料-1 に示す。

表 3-1-1 平成 31 年度 IAEA との試験所間比較試験に係る試料採取インベントリデータ

調査年月日	2019年6月3日	2019年6月3日	2019年6月3日	2019年6月4日	2019年6月4日	2019年6月4日	2019年6月5日	2019年6月5日
測点	T-S8	T-S3	T-D1	F-P04	M-101	M-103	M-102	M-104
緯度(予定) ^{*1}	37° 23' 00"	37° 27' 30"	37° 30' 00"	37° 25' 27"	37° 25' 36"	37° 26' 42"	37° 25' 06"	37° 24' 06"
経度(予定) ^{*1}	141° 04' 44"	141° 04' 44"	141° 04' 20"	141° 03' 26"	141° 02' 36"	141° 02' 48"	141° 02' 36"	141° 02' 48"
緯度(結果)	同上	同上	同上	同上	同上	同上	同上	同上
経度(結果)	同上	同上	同上	同上	同上	同上	同上	同上
天候	曇り	晴	晴	晴	晴	晴	曇り	曇り
風向 ^{*2}	-	-	-	SW	SW	SW	S	S
風速(m/s) ^{*2}	CALM	CALM	CALM	2.7	1.9	3.0	5.5	2.7
波高(m)	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0
透明度(m)	5.2	5.5	6.0	5.0	2.1	4.0	3.0	3.0
水色 ^{*2}	3G3.0/4.5	3G3.0/4.5	3G3.0/4.5	3G3.0/4.5	3GY3.5/5.0	3GY3.5/5.0	3G3.0/4.5	3G3.0/4.5
水深(m)	26.3	21.9	21.0	16.1	8.7	10.1	9.2	11.8
採水時刻	-	-	10:09 10:19 10:27	-	9:53 10:14 10:21	10:36 10:49 10:57	9:10 9:23 9:31	9:58 10:06 10:14
水温(°C) ^{*3}	-	-	13.86 14.12 14.36	-	10.54 10.80 10.71	10.76 10.88 10.80	10.78 10.92 10.96	10.47 10.51 10.59
塩分 ^{*4}	-	-	33.22 33.24 33.43	-	33.43 33.48 33.40	33.44 33.45 33.41	33.35 33.48 33.48	33.50 33.46 33.48
採泥時刻	8:50	9:25	-	8:45	-	-	-	-
泥温(°C)	11.4	10.5	-	9.8	-	-	-	-
色調 ^{*5}	7.5Y2/2	7.5Y2/2	-	7.5Y4/3	-	-	-	-
性状	砂	砂	-	砂	-	-	-	-
臭気	なし	なし	-	なし	-	-	-	-
混入物	なし	なし	-	なし	-	-	-	-
採泥回数	3	3	-	5	-	-	-	-
採泥量(kg-wet) ^{*6}	6.5	6.5	-	6.0	-	-	-	-
備考	気温:20.4°C 採泥量:6.5kg-wet	気温:21.4°C 採泥量:6.5kg-wet	気温:20.6°C	気温:22.6°C 採泥量:6.0kg-wet	気温:21.8°C	気温:20.6°C	気温:21.5°C	気温:17.6°C

^{*1}: 緯度・経度は世界測地系WGS84に準拠した。

^{*2}: 風速の“-”は方向なし、風速の“CALM”は静穏(風速0.2m/s以下)を示す。

^{*3}: 水色の色調判定は標準色カード202に従った。

^{*4}: 水温、塩分は船上の大型タンクに汲み上げた海水の性状を示す。

^{*5}: 底質の色調判定は新版標準土色帖に従った。

^{*6}: 採泥量は船上での簡易計測。

3-2. 海底土試料の分割

T-S3、T-S8 及び F-P04 の海底土試料の分割フローを図 3-1 に、分割状況を資料-2 に示す。試料調製に係る詳細データは資料-3 に示す。

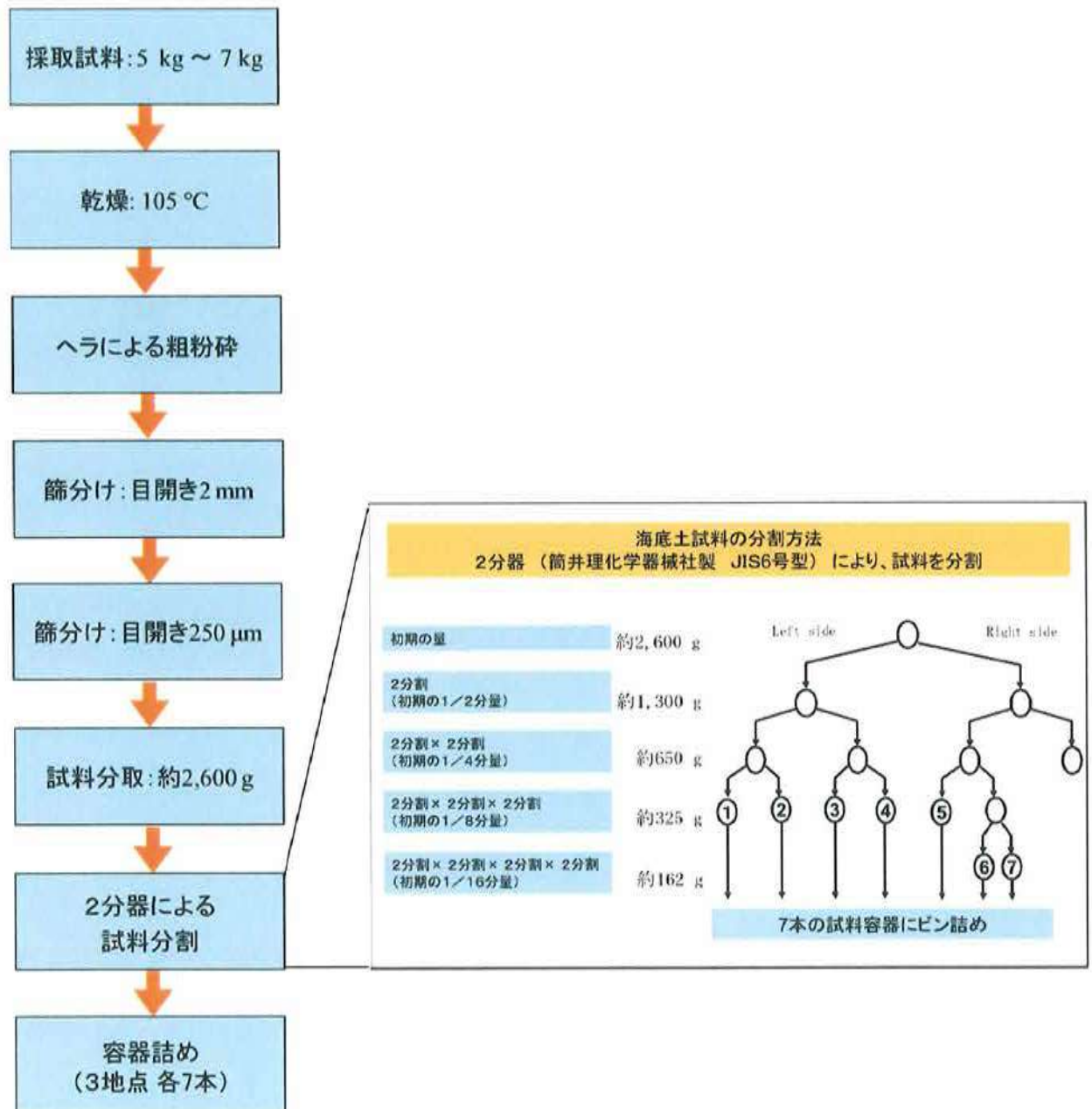


図 3-1 海底土試料の分割フロー

3-3. 試料の送付

試料の送付は（公財）日本分析センターの指示に従った。

海水試料は、採取当日に表3-2に示す分析実施機関に送付した。

海底土試料は、採取当日に現地から（株）環境総合テクノス計測分析所に送付し、前処理、分割の後、IAEA に送付した。

表3-2 海水試料の送付先（現地発送）

分析実施機関	^{90}Sr 、 ^{134}Cs 、 ^{137}Cs 分析用	^3H 分析用	送付先
IAEA(国際原子力機関)	20L×3個×5地点	2L×1個×5地点	環境総合テクノス計測分析所
Spiez Laboratory(ALMERA 1)	20L×3個×5地点	2L×1個×5地点	
Health Canada, Radiation Protection Bureau (ALMERA 2)	20L×3個×5地点	2L×1個×5地点	
株式会社環境総合テクノス	20L×3個×5地点	2L×1個×5地点	
公益財団法人日本分析センター	20L×3個×5地点	2L×1個×5地点	日本分析センター
福島県	20L×3個×5地点	—	福島県環境創造センター 環境放射線センター
	—	2L×1個×5地点	福島県環境創造センター 研究部
東京パワーテクノロジー株式会社	20L×3個×5地点	—	東京パワーテクノロジー 福島原子力事業所
公益財団法人海洋生物環境研究所	—	2L×1個×5地点	海洋生物環境研究所 中央研究所
株式会社地球科学研究所	—	2L×1個×5地点	地球科学研究所

※IAEA 及び ALMERA の海水試料については、現地から環境総合テクノス計測分析所に送付、保管し、その後 IAEA から委託を受けた DHL グローバルフォワーディングジャパン株式会社に調製済の海底土試料とともに引き渡した(引渡日:2019年7月8日)。


資料－1

平成 31 年度 IAEA との試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.1 調査地点 T-S8</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月3日</p>	
<p>No.2 調査地点 T-S8</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月3日</p>	
<p>No.3 調査地点 T-S8</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月3日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.4 調査地点 T-S8</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 風向・風速測定</p> <p>調査年月日 2019年6月3日</p>	
<p>No.5 調査地点 T-S8</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 水色測定</p> <p>調査年月日 2019年6月3日</p>	
<p>No.6 調査地点 T-S8</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 透明度測定</p> <p>調査年月日 2019年6月3日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

No.7
調査地点
T-S8

写真項目
調査実施状況

写真説明
採泥
採泥状況①

調査年月日
2019年6月3日



No.8
調査地点
T-S8

写真項目
調査実施状況

写真説明
採泥
採泥状況②

調査年月日
2019年6月3日



No.9
調査地点
T-S8

写真項目
調査実施状況

写真説明
採泥
泥温・泥色測定




調査年月日
2019年6月3日



平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.10 調査地点 T-S3</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月3日</p>	
<p>No.11 調査地点 T-S3</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月3日</p>	
<p>No.12 調査地点 T-S3</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月3日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.13 調査地点 T-S3</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 風向・風速測定</p> <p>調査年月日 2019年6月3日</p>	
<p>No.14 調査地点 T-S3</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 水色測定</p> <p>調査年月日 2019年6月3日</p>	
<p>No.15 調査地点 T-S3</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 透明度測定</p> <p>調査年月日 2019年6月3日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.16 調査地点 T-S3</p> <p>写真項目 調査実施状況</p> <p>写真説明 採泥 採泥状況①</p> <p>調査年月日 2019年6月3日</p>	
<p>No.17 調査地点 T-S3</p> <p>写真項目 調査実施状況</p> <p>写真説明 採泥 採泥状況②</p> <p>調査年月日 2019年6月3日</p>	
<p>No.18 調査地点 T-S3</p> <p>写真項目 調査実施状況</p> <p>写真説明 採泥 泥温・泥色測定</p> <p>調査年月日 2019年6月3日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.19 調査地点 T-D1</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月3日</p>	
<p>No.20 調査地点 T-D1</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月3日</p>	
<p>No.21 調査地点 T-D1</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月3日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

No.22
調査地点
T-D1

写真項目
調査実施状況

写真説明
気象・海象
風向・風速測定

調査年月日
2019年6月3日



No.23
調査地点
T-D1

写真項目
調査実施状況

写真説明
気象・海象
水色測定

調査年月日
2019年6月3日



No.24
調査地点
T-D1




写真項目
調査実施状況

写真説明
気象・海象
透明度測定




調査年月日
2019年6月3日



平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.25 調査地点 T-D1</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 水質測定</p> <p>調査年月日 2019年6月3日</p>	
<p>No.26 調査地点 T-D1</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 海水採取状況</p> <p>調査年月日 2019年6月3日</p>	
<p>No.27 調査地点 T-D1</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 分注状況</p> <p>調査年月日 2019年6月3日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.28 調査地点 F-P04</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月4日</p>	
<p>No.29 調査地点 F-P04</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月4日</p>	
<p>No.30 調査地点 F-P04</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月4日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.31 調査地点 F-P04</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 風向・風速測定</p> <p>調査年月日 2019年6月4日</p>	
<p>No.32 調査地点 F-P04</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 水色測定</p> <p>調査年月日 2019年6月4日</p>	
<p>No.33 調査地点 F-P04</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 透明度測定</p> <p>調査年月日 2019年6月4日</p>	


平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.34 調査地点 F-P04</p> <p>写真項目 調査実施状況</p> <p>写真説明 採泥 採泥状況①</p> <p>調査年月日 2019年6月4日</p>	
<p>No.35 調査地点 F-P04</p> <p>写真項目 調査実施状況</p> <p>写真説明 採泥 採泥状況②</p> <p>調査年月日 2019年6月4日</p>	
<p>No.36 調査地点 F-P04</p> <p>写真項目 調査実施状況</p> <p>写真説明 採泥 泥温・泥色測定</p> <p>調査年月日 2019年6月4日</p>	




平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.37 調査地点 M-101</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月4日</p>	
<p>No.38 調査地点 M-101</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月4日</p>	
<p>No.39 調査地点 M-101</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月4日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.40 調査地点 M-101</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 風向・風速測定</p> <p>調査年月日 2019年6月4日</p>	
<p>No.41 調査地点 M-101</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 水色測定</p> <p>調査年月日 2019年6月4日</p>	
<p>No.42 調査地点 M-101</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 透明度測定</p> <p>調査年月日 2019年6月4日</p>	


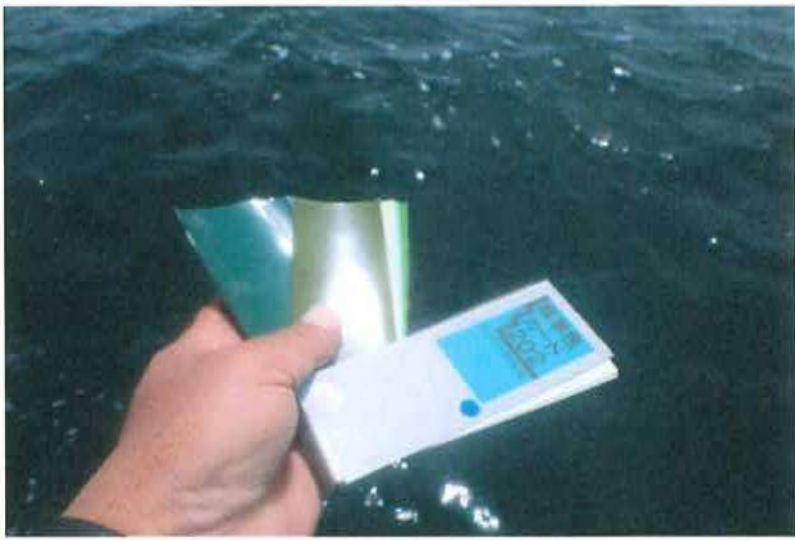

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.43 調査地点 M-101</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 水質測定</p> <p>調査年月日 2019年6月4日</p>	 A person wearing a blue jacket and a cap is standing on the deck of a boat. They are holding a vertical water sampling device that is partially submerged in a large blue plastic container. The background shows the open sea under a clear sky.
<p>No.44 調査地点 M-101</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 海水採取状況</p> <p>調査年月日 2019年6月4日</p>	 A close-up view of water splashing into a blue plastic container. The water is turbulent and white with foam. A person's hand is visible at the bottom right, possibly holding a container or a hose.
<p>No.45 調査地点 M-101</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 分注状況</p> <p>調査年月日 2019年6月4日</p>	 Several people in blue jackets are on the deck of a boat. They are using blue hoses to transfer water into clear plastic bags. The water is being poured from the hoses into the bags, which are held by the people. The deck is light blue.


平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.46 調査地点 M-103</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月4日</p>	
<p>No.47 調査地点 M-103</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月4日</p>	
<p>No.48 調査地点 M-103</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月4日</p>	


平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.49 調査地点 M-103</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 風向・風速測定</p> <p>調査年月日 2019年6月4日</p>	
<p>No.50 調査地点 M-103</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 水色測定</p> <p>調査年月日 2019年6月4日</p>	
<p>No.51 調査地点 M-103</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 透明度測定</p> <p>調査年月日 2019年6月4日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.52 調査地点 M-103</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 水質測定</p> <p>調査年月日 2019年6月4日</p>	
<p>No.53 調査地点 M-103</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 海水採取状況</p> <p>調査年月日 2019年6月4日</p>	
<p>No.54 調査地点 M-103</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 分注状況</p> <p>調査年月日 2019年6月4日</p>	




平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.55 調査地点 M-102</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月5日</p>	
<p>No.56 調査地点 M-102</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月5日</p>	
<p>No.57 調査地点 M-102</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月5日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.58 調査地点 M-102</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 風向・風速測定</p> <p>調査年月日 2019年6月5日</p>	 A person wearing a light blue long-sleeved shirt, a red life vest, and a green safety cap is on a boat. They are holding a handheld weather instrument (likely a wind speed and direction meter) and a smartphone. The background shows the sea and a cloudy sky.
<p>No.59 調査地点 M-102</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 水色測定</p> <p>調査年月日 2019年6月5日</p>	 A person wearing a light blue long-sleeved shirt is on a boat. They are holding a water sampling device (likely a water color meter) and a smartphone. The background shows the sea and a cloudy sky.
<p>No.60 調査地点 M-102</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 透明度測定</p> <p>調査年月日 2019年6月5日</p>	 A person wearing a light blue long-sleeved shirt, a red life vest, and a green safety cap is on a boat. They are holding a transparency measurement device (likely a Secchi disk) and a smartphone. The background shows the sea and a cloudy sky.

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.61 調査地点 M-102</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 水質測定</p> <p>調査年月日 2019年6月5日</p>	
<p>No.62 調査地点 M-102</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 海水採取状況</p> <p>調査年月日 2019年6月5日</p>	
<p>No.63 調査地点 M-102</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 分注状況</p> <p>調査年月日 2019年6月5日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.64 調査地点 M-104</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 遠景</p> <p>調査年月日 2019年6月5日</p>	
<p>No.65 調査地点 M-104</p> <p>写真項目 調査地点状況</p> <p>写真説明 調査地点 近景</p> <p>調査年月日 2019年6月5日</p>	
<p>No.66 調査地点 M-104</p> <p>写真項目 調査実施状況</p> <p>写真説明 気象・海象 気温測定</p> <p>調査年月日 2019年6月5日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

No.67
調査地点
M-104

写真項目
調査実施状況

写真説明
気象・海象
風向・風速測定

調査年月日
2019年6月5日



No.68
調査地点
M-104

写真項目
調査実施状況

写真説明
気象・海象
水色測定

調査年月日
2019年6月5日



No.69
調査地点
M-104

写真項目
調査実施状況

写真説明
気象・海象
透明度測定

調査年月日
2019年6月5日



平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.70 調査地点 M-104</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 水質測定</p> <p>調査年月日 2019年6月5日</p>	
<p>No.71 調査地点 M-104</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 海水採取状況</p> <p>調査年月日 2019年6月5日</p>	
<p>No.72 調査地点 M-104</p> <p>写真項目 調査実施状況</p> <p>写真説明 採水 分注状況</p> <p>調査年月日 2019年6月5日</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.73 調査地点 T-S3,T-S8</p> <p>写真項目 採取試料</p> <p>写真説明 採取試料 採泥試料</p> <p>調査年月日 2019年6月3日</p>	
<p>No.74 調査地点 T-D1</p> <p>写真項目 採取試料</p> <p>写真説明 採取試料 採水試料</p> <p>調査年月日 2019年6月3日</p>	
<p>No.75 調査地点 F-P04</p> <p>写真項目 採取試料</p> <p>写真説明 採取試料 採泥試料</p> <p>調査年月日 2019年6月4日</p>	



平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
現地調査状況写真集

<p>No.76 調査地点 M-101,103</p> <p>写真項目 採取試料</p> <p>写真説明 採取試料 採水試料</p> <p>調査年月日 2019年6月4日</p>	
<p>No.77 調査地点 M-102,104</p> <p>写真項目 採取試料</p> <p>写真説明 採取試料 採水試料</p> <p>調査年月日 2019年6月5日</p>	
<p>No.78 調査地点 M-102,104</p> <p>写真項目 採取試料</p> <p>写真説明 採取試料 採水試料</p> <p>調査年月日 2019年6月5日</p>	




資料－２

平成 31 年度 IAEA との試験所間比較分析に係る試料採取及び試料調製等業務
海底土試料の前処理、分割状況写真集




平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
海底土試料の前処理、分割状況写真集

<p>No.1</p> <p>写真項目 採取試料</p> <p>写真説明 採取試料</p>	
<p>No.2</p> <p>写真項目 乾燥処理</p> <p>写真説明 乾燥前試料</p>	
<p>No.3</p> <p>写真項目 乾燥処理</p> <p>写真説明 105℃乾燥</p>	




平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
海底土試料の前処理、分割状況写真集

<p>No.4</p> <p>写真項目 乾燥処理</p> <p>写真説明 乾燥後試料</p>	 A photograph showing four metal trays filled with a grey, granular sediment sample, arranged in a 2x2 grid on a stainless steel surface. A small label with 'F-P04' is visible at the bottom center.
<p>No.5</p> <p>写真項目 粗粉碎処理</p> <p>写真説明 ヘラによる粗粉碎</p>	 A photograph showing a person in a white lab coat and blue gloves using a metal spatula to crush sediment in a metal tray. The tray is placed on a stainless steel surface.
<p>No.6</p> <p>写真項目 篩分け処理</p> <p>写真説明 目開き2 mm篩分け</p>	 A photograph showing a person in a white lab coat and blue gloves using a sieve to separate sediment. The sieve is held over a metal tray, and the sediment is being poured through it.

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
海底土試料の前処理、分割状況写真集

<p>No.7</p> <p>写真項目 篩分け処理</p> <p>写真説明 目開き2 mm篩分け後</p>	
<p>No.8</p> <p>写真項目 篩分け処理</p> <p>写真説明 目開き250 μm篩分け</p>	
<p>No.9</p> <p>写真項目 篩分け処理</p> <p>写真説明 目開き250 μm篩分け後</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
海底土試料の前処理、分割状況写真集

<p>No.10</p> <p>写真項目 分割処理</p> <p>写真説明 2分器による試料分割</p>	
<p>No.11</p> <p>写真項目 分割処理</p> <p>写真説明 分割後の試料</p>	
<p>No.12</p> <p>写真項目 分割処理</p> <p>写真説明 調製した容器詰め試料</p>	

平成31年度 IAEAとの試験所間比較分析に係る試料採取及び試料調製等業務
海底土試料の前処理、分割状況写真集

No.13

写真項目
分析試料

写真説明
調製した容器詰め試料
(3地点分)



No.14

写真項目
分析試料の送付

写真説明
分析試料の梱包



No.15

写真項目
分析試料の送付

写真説明
分析試料の梱包



資料－3

平成 31 年度 IAEA との試験所間比較分析に係る試料採取及び試料調製等業務
海底土前処理、分割記録

参考資料 2

分析実施機関の分析結果

分析機関：株式会社 環境総合テクノス

Nuclide:	IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-101	Summary of data for submission		
Activity concentration	0.0756 ± 0.0124		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.5330	± 0.0837	cpm	
Chemical recovery	-	-		#VALUE!
Detection efficiency	0.2775	± 0.0077		
Radioactive decay	0.9749	± 0.0002		
Mass of sample	49.7900	± 0.0011	g	
Supporting information	8.7200	± 0.3527		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.33	±	0.02 year	Radioisotope Pocket Data Book 10th Edition
Decay energy	18.5940	±	0.008 keV	Radioisotope Pocket Data Book 10th Edition
β emission probability		±		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
The samples were purified by using distillation apparatus of glass made so as to keep the concentration of tritium in water unchanged before and after the distillation. Next, 1 liter of distilled water was electrolytically concentrated by using a solid polymer electrolytic film. For the liquid scintillation counting, 50mL of the sample was mixed with 50mL of scintillation cocktail (Ultima Gold LLT (PerkinElmer Japan Co., Ltd.)) in a teflon bottle. The scintillation due to low energy beta-ray of tritium was determined by the low background liquid scintillation counter for 1000 minutes.				
Detection system (including method of calibration):				
Liquid scintillation counter: AccoFLEX LSC-LB7 (Hitachi, Ltd.)				
Number of points in the efficiency curve: 10 points, Type of calibration: quadratic curve				
Detection limit (Bq/kg):	0.035			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3300	± 0.0200	year	Radioisotope Pocket Data Book 10th Edition
Decay energy	18.5940	± 0.0080	keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy 1	-	-		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-101			
Activity concentration	Bq/kg	0.0756 ± 0.0124	Uncertainty (k=1)	
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.5330	± 0.0837	cpm	15.7%
Chemical recovery	-	-		#VALUE!
Detection efficiency	0.2775	± 0.0077		2.8%
Correction for radioactive decay	0.9749	± 0.0002		0.0%
Mass of sample	49.7900	± 0.0011	g	0.0%
Concentration factor	8.7200	± 0.3527		4.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RME INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-101	Summary of data for submission		
Activity concentration	0.0012 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	1.0740	± 0.1421	cpm	
Chemical recovery	0.8794	± 0.0297		
Detection efficiency	0.5290	± 0.0137		
Radioactive decay	0.7695	± 0.0009		
Mass of sample	42.9400	± 0.0062	kg	
Supporting information	No supporting information stated			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	64.0416	± 0.0312	hour	Radioisotope Pocket Data Book 10th Edition
Decay energy	2279.8000	± 1.7000	keV	Radioisotope Pocket Data Book 10th Edition
β emission probability	No uncertainty stated			
No data source stated				
Input data				
Method (including pre-concentration, if applicable):				
Sr was concentrated using ion exchange resin (Dowex SOW-8X) from 40L of aqueous sample. Carbonate and barium chromate treatment was performed to separate and purify Sr. Solution was separated and purified Sr sat more than 2 weeks until Sr-Y became radioactively in equilibrium. After being in radioactive equilibrium, Y was separated using Fe co-precipitation method, and Y-90 radioactivity was measured from a Y-90 collected filter using 2π gas-flow counter for 100 minutes. Sr-90 concentration was determined from Y-90 radioactivity recovery rate, decay correction, and other necessary calculations.				
Detection system (including method of calibration):				
2π gas-flow counter: LBC-4202B (Hitachi Aloka Medical, Ltd.)				
Number of points in the efficiency: 1 points (Average value of 6 samples)				
Detection limit (Bq/kg):	0.000366			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	64.0416	± 0.0312	hour	Radioisotope Pocket Data Book 10th Edition
Decay energy	2279.8000	± 1.7000	keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy E _β	-	±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-101			
Activity concentration	Bq/kg	0.0012 ± 0.0002	Uncertainty (k=1)	
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	1.0740	± 0.1421	cpm	13.2%
Chemical recovery	0.8794	± 0.0297		3.4%
Detection efficiency	0.5290	± 0.0137		2.6%
Correction for radioactive decay	0.7695	± 0.0009		0.0%
Mass of sample	42.9400	± 0.0062	kg	0.0%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-101	Summary of data for submission		
Activity concentration	0.0010 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0011 ± 0.0003		cps	
Principal γ-ray emission energy	604.6600 ± 0.0200		keV	
Principal γ-ray emission probability	0.9756 ± 0.0032			
Principal γ-ray detection efficiency	0.0587 ± 0.0013			
Radioactive decay	0.9288 ± 0.0001			
Mass of sample	21.1900 ± 0.0245		kg	
Supporting information	0.9804 ± 0.0197			
Method:	Analysis method stated			
Detection system:	Detection system stated			
Half-life:	2.062 ± 0.005	y		Table of Isotopes (7th Edition)
Input data				
Method (including pre-concentration, if applicable):				
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-134 using well-type germanium semiconductor detector for 100000 seconds.				
Detection system (including method of calibration):				
Germanium semiconductor detector: GWL-90-15(ORTEC), Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve: 3 points, Type of calibration: quadratic curve				
Detection limit (Bq/kg):	0.00071			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0620 ± 0.0050		y	Table of Isotopes (7th Edition)
Principal γ-ray emission energy	604.6600 ± 0.0200		keV	Table of Isotopes (7th Edition)
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-101	Uncertainty (k=1)		
Activity concentration	0.0010 ± 0.0002			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0011 ± 0.0003		cps	23.4%
Principal γ-ray emission probability	0.9756 ± 0.0032			0.3%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	0.0587 ± 0.0013			2.3%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	0.9288 ± 0.0001			0.0%
Mass of sample	21.1900 ± 0.0245		kg	0.1%
Recovery rate of precipitation(AMP/Cs)	0.9804 ± 0.0197			2.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima-related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-101	Summary of data for submission			
Activity concentration	0.0152 ± 0.0006		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.0278	± 0.0006		cps	
Principal γ-ray emission energy	661.6880	± 0.0190		keV	
Principal γ-ray emission probability	0.8500	± 0.0050			
Principal γ-ray detection efficiency	0.1040	± 0.0024			
Radioactive decay	0.9950	± 0.0000			
Mass of sample	21.1900	± 0.0245		kg	
Supporting information	0.9804	± 0.0197			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.174	±	0.034	y	Table of Isotopes(7th Edition)
Input data					
Method (including pre-concentration, if applicable):					
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-137 using well-type germanium semiconductor detector for 100000 seconds.					
Detection system (including method of calibration):					
Germanium semiconductor detector : GWL-90-15(ORTEC) , Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve : 3 points, Type of calibration:quadratic curve					
Detection limit (Bq/kg):	0.00038				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	30.1740	± 0.0340	y	Table of Isotopes(7th Edition)	
Principal γ-ray emission energy	661.6880	± 0.0190	keV	Table of Isotopes(7th Edition)	
γ-ray emission energy 2 (if used)		±			
γ-ray emission energy 3 (if used)		±			
γ-ray emission energy 4 (if used)		±			
γ-ray emission energy 5 (if used)		±			
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-101				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0152 ± 0.0006				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0278	± 0.0006	cps	2.0%	
Principal γ-ray emission probability	0.8500	± 0.0050		0.6%	
Emission probability 2 (if used)		±			
Emission probability 3 (if used)		±			
Emission probability 4 (if used)		±			
Emission probability 5 (if used)		±			
Principal γ-ray detection efficiency	0.1040	± 0.0024		2.3%	
Detection efficiency 2 (if used)		±			
Detection efficiency 3 (if used)		±			
Detection efficiency 4 (if used)		±			
Detection efficiency 5 (if used)		±			
Correction for radioactive decay	0.9950	0.0000		0.0%	
Mass of sample	21.1900	± 0.0245	kg	0.1%	
Recovery rate of precipitation(AMP/Cs)	0.9804	± 0.0197		2.0%	
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			

Nuclide:		IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-102	Summary of data for submission			
Activity concentration	0.0741 ± 0.0128		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.5070 ± 0.0836	cpm	#VALUE!		
Chemical recovery	- ± -		#VALUE!		
Detection efficiency	0.2762 ± 0.0077		2.8%		
Radioactive decay	0.9748 ± 0.0002		0.0%		
Mass of sample	49.8700 ± 0.0012	g	0.0%		
Supporting information	8.4900 ± 0.3485		4.1%		
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	12.33 ± 0.02	year	H-3 NIST Standard Certificate		
Decay energy	18.594 ± 0.008	keV	H-3 NIST Standard Certificate		
β emission probability	- ± -		No data source stated		
Input data					
Method (including pre-concentration, if applicable):					
The samples were purified by using distillation apparatus of glass made so as to keep the concentration of tritium in water unchanged before and after the distillation. Next, 1 liter of distilled water was electrolytically concentrated by using a solid polymer electrolytic film. For the liquid scintillation counting, 50ml. of the sample was mixed with 50ml. of scint-cocktail (Ultima Gold L1T (PerkinElmer Japan Co., Ltd.)) in a teflon bottle. The scintillation due to low energy beta-ray of tritium was determined by the low background liquid scintillation counter for 1000 minutes.					
Detection system (including method of calibration):					
Liquid scintillation counter: AccuFLEX LSC-LB7 (Hitachi, Ltd.) Number of points in the efficiency curve: 10 points, Type of calibration: quadratic curve					
Detection limit (Bq/kg):	0.036				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	12.3300 ± 0.0200		year	H-3 NIST Standard Certificate	
Decay energy	18.5940 ± 0.0080		keV	H-3 NIST Standard Certificate	
Particle emission energy 1	- ± -				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-102				
Activity concentration	0.0741 ± 0.0128	Uncertainty (k=1)			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.5070 ± 0.0836		cpm	16.5%	
Chemical recovery	- ± -			#VALUE!	
Detection efficiency	0.2762 ± 0.0077			2.8%	
Correction for radioactive decay	0.9748 ± 0.0002			0.0%	
Mass of sample	49.8700 ± 0.0012		g	0.0%	
Concentration factor	8.4900 ± 0.3485			4.1%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML-INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code:	M-102	Summary of data for submission		
Activity concentration	0.0011 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.8800 ± 0.1350			cpm
Chemical recovery	0.8413 ± 0.0284			
Detection efficiency	0.5290 ± 0.0137			
Radioactive decay	0.7038 ± 0.0000			
Mass of sample	42.4000 ± 0.0061			kg
Supporting information	No supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection systems stated			
Half-life	64.0416 ± 0.0312	hour	90Y NIST Standard Certificate	
Decay energy	2279.8000 ± 1.7000	keV	90Y NIST Standard Certificate	
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Sr was concentrated using ion exchange resin (Dowex 50W-8X) from 40L of aqueous sample. Carbonate and barium chromate treatment was performed to separate and purify Sr. Solution with separated and purified Sr sat more than 2 weeks until Sr-Y became radioactively in equilibrium. After being in radioactive equilibrium, Y was separated using Fe co-precipitation method, and Y-90 radioactivity was measured from a Y-90 collected filter using 2π gas-flow counter for 100 minutes. Sr-90 concentration was determined from Y-90 radioactivity recovery rate, decay correction, and other necessary calculations.				
Detection system (including method of calibration):				
2π gas-flow counter: LBC-4202B (Hitachi Aloka Medical, Ltd.) Number of points in the efficiency: 1 points (Average value of 6 samples)				
Detection limit (Bq/kg):	0.000424			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	64.0416 ± 0.0312		hour	90Y NIST Standard Certificate
Decay energy	2279.8000 ± 1.7000		keV	90Y NIST Standard Certificate
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102			
Activity concentration	Bq/kg	0.0011 ± 0.0002	Uncertainty (k=1)	
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.8800 ± 0.1350		cpm	15.3%
Chemical recovery	0.8413 ± 0.0284			3.4%
Detection efficiency	0.5290 ± 0.0137			2.6%
Correction for radioactive decay	0.7038 ± 0.0000			0.0%
Mass of sample	42.4000 ± 0.0061		kg	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β -/ γ -EMITTING RADIONUCLIDES			
^{134}Cs	Fukushima related seawater containing low levels of β - and β -/ γ -emitting radionuclides			
Outcomes				
Laboratory code	M-102	Summary of data for submission		
Activity concentration	0.0008 \pm 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0009	\pm 0.0003		cps
Principal γ -ray emission energy	604.6600	\pm 0.0200		keV
Principal γ -ray emission probability	0.9756	\pm 0.0032		
Principal γ -ray detection efficiency	0.0591	\pm 0.0014		
Radioactive decay	0.9457	\pm 0.0001		
Mass of sample	21.4000	\pm 0.0247		kg
Supporting information	0.9805	\pm 0.0197		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.062	\pm 0.005		y Table of Isotopes (7th Edition)
Input data				
Method (including pre-concentration, if applicable):				
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-134 using well-type germanium semiconductor detector for 100000 seconds.				
Detection system (including method of calibration):				
Germanium semiconductor detector: GWL-90-15(ORTEC), Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve: 3 points, Type of calibration: quadratic curve				
Detection limit (Bq/kg):	0.0007			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	2.0620	\pm 0.0050	y	Table of Isotopes (7th Edition)
Principal γ -ray emission energy	604.6600	\pm 0.0200	keV	Table of Isotopes (7th Edition)
γ -ray emission energy 2 (if used)				
γ -ray emission energy 3 (if used)				
γ -ray emission energy 4 (if used)				
γ -ray emission energy 5 (if used)				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0008 \pm 0.0002			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0009	\pm 0.0003	cps	30.4%
Principal γ -ray emission probability	0.9756	\pm 0.0032		0.3%
Emission probability 2 (if used)				
Emission probability 3 (if used)				
Emission probability 4 (if used)				
Emission probability 5 (if used)				
Principal γ -ray detection efficiency	0.0591	\pm 0.0014		2.3%
Detection efficiency 2 (if used)				
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay	0.9457	\pm 0.0001		0.0%
Mass of sample	21.4000	\pm 0.0247	kg	0.1%
Recovery rate of precipitation (AMP/Cs)	0.9805	\pm 0.0197		2.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-102	Summary of data for submission		
Activity concentration	0.0110 ± 0.0004		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0205 ± 0.0005		cps	
Principal γ-ray emission energy	661.6380 ± 0.0190		keV	
Principal γ-ray emission probability	0.8500 ± 0.0050			
Principal γ-ray detection efficiency	0.1054 ± 0.0025			
Radioactive decay	0.9962 ± 0.0000			
Mass of sample	21.4000 ± 0.0247		kg	
Supporting information	0.9605 ± 0.0197			
Method	Analysis method stated:			
Detection system	Detection system stated:			
Half-life	30.174 ±	0.034		Table of Isotopes(7th Edition)
Input data				
Method (including pre-concentration, if applicable):				
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-137 using well-type germanium semiconductor detector for 100000 seconds.				
Detection system (including method of calibration):				
Germanium semiconductor detector : GWL-90-15(ORTEC) , Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve : 3 points,Type of calibration:quadratic curve				
Detection limit (Bq/kg):	0.00035			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	30.1740 ±	0.0340	y	Table of Isotopes(7th Edition)
Principal γ-ray emission energy	661.6380 ±	0.0190	keV	Table of Isotopes(7th Edition)
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102	Uncertainty (k=1)		
Activity concentration	0.0110 ± 0.0004			
Contributing parameters				
Net count rate	0.0205 ± 0.0005		cps	2.4%
Principal γ-ray emission probability	0.8500 ± 0.0050			0.6%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	0.1054 ± 0.0025			2.3%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	0.9962 ± 0.0000			0.0%
Mass of sample	21.4000 ± 0.0247		kg	0.1%
Recovery rate of precipitation(AMP/Cs)	0.9605 ± 0.0197			2.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	0.0706 ± 0.0124		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.4940 ± 0.0835		cpm	
Chemical recovery	±			#VALUE!
Detection efficiency	0.2753 ± 0.0076			
Radioactive decay	0.9747 ± 0.0002			
Mass of sample	49.8600 ± 0.0012		g	
Supporting information	8.7200 ± 0.3527			
Method:	Analysis method stated:			
Detection system:	Detection system stated:			
Half-life	12.33 ± 0.02	year		Radioisotope Pocket Data Book 10th Edition
Decay energy	18.594 ± 0.008	keV		Radioisotope Pocket Data Book 10th Edition
β emission probability:	±			No data source stated
Input data				
Method (including pre-concentration, if applicable):				
The samples were purified by using distillation apparatus of glass made so as to keep the concentration of tritium in water unchanged before and after the distillation. Next, 1 liter of distilled water was electrolytically concentrated by using a solid polymer electrolytic film for the liquid scintillation counting. 50mL of the sample was mixed with 50mL of scint-cocktail (Ultima Gold LLT (PerkinElmer Japan Co., Ltd.)) in a teflon bottle. The scintillation due to low energy beta-ray of tritium was determined by the low background liquid scintillation counter for 1000 minutes.				
Detection system (including method of calibration):				
Liquid scintillation counter: AccuFLX LSC-LB7 (Hitachi, Ltd.)				
Number of points in the efficiency curve: 10 points, Type of calibration: quadratic curve				
Detection limit (Bq/kg):	0.036			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3300 ± 0.0200		year	Radioisotope Pocket Data Book 10th Edition
Decay energy	18.5940 ± 0.0080		keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy 1	- ± -			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
Activity concentration	Bq/kg	Uncertainty (k = 1)		
	0.0706 ± 0.0124			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.4940 ± 0.0835		cpm	16.9%
Chemical recovery	±			#VALUE!
Detection efficiency	0.2753 ± 0.0076			2.8%
Correction for radioactive decay	0.9747 ± 0.0002			0.0%
Mass of sample	49.8600 ± 0.0012		g	0.0%
Concentration factor	8.7200 ± 0.3527			4.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	0.0010 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.8080 ± 0.1322		cpm	
Chemical recovery	0.7894 ± 0.0267			
Detection efficiency	0.5290 ± 0.0137			
Radioactive decay	0.7442 ± 0.0000			
Mass of sample	43.5000 ± 0.0063		kg	
Supporting information	No Supporting information stated. No uncertainty stated.			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	64.0416 ± 0.0312	hour		Radioisotope Pocket Data Book 10th Edition
Decay energy	2279.8000 ± 1.7000	keV		Radioisotope Pocket Data Book 10th Edition
β emission probability	No β emission probability stated. No uncertainty stated. No data source stated.			
Input data				
Method (including pre-concentration, if applicable):				
Sr was concentrated using ion exchange resin (Dowex 50W-8X) from 40L of aqueous sample. Carbonate and barium chromate treatment was performed to separate and purify Sr. Solution with separated and purified Sr sat more than 2 weeks until Sr-Y became radioactively in equilibrium. After being in radioactive equilibrium, Y was separated using Fe co-precipitation method, and Y-90 radioactivity was measured from a Y-90 collected filter using 2π gas-flow counter for 100 minutes. Sr-90 concentration was determined from Y-90 radioactivity recovery rate, decay correction, and other necessary calculations.				
Detection system (including method of calibration):				
2π gas-flow counter: LBC-4202B (Hitachi Aloca Medical, Ltd.) Number of points in the efficiency: 1 points (Average value of 6 samples)				
Detection limit (Bq/kg):	0.000417			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	64.0416 ± 0.0312		hour	Radioisotope Pocket Data Book 10th Edition
Decay energy	2279.8000 ± 1.7000		keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
Activity concentration	0.0010 ± 0.0002	Uncertainty (k=1)		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.8080 ± 0.1322		cpm	16.4%
Chemical recovery	0.7894 ± 0.0267			3.4%
Detection efficiency	0.5290 ± 0.0137			2.6%
Correction for radioactive decay	0.7442 ± 0.0000			0.0%
Mass of sample	43.5000 ± 0.0063		kg	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES		
134Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides		
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net count rate		±	cps	#VALUE!
Principal γ-ray emission energy	604.6600	± 0.0200	keV	#VALUE!
Principal γ-ray emission probability		±		#VALUE!
Principal γ-ray detector efficiency		±		#VALUE!
Radioactive decay		±		#VALUE!
Mass of sample		±	kg	#VALUE!
Supporting information		±		#VALUE!
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.0620	± 0.0050	y	Table of Isotopes(7th Edition)
Input data				
Method (including pre-concentration, if applicable):				
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-134 using well-type germanium semiconductor detector for 100000 seconds.				
Detection system (including method of calibration):				
Germanium semiconductor detector : GWL-90-15(ORTEC) , Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve : 3 points, Type of calibration:quadratic curve				
Detection limit (Bq/kg):	0.0007			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0620	± 0.0050	y	Table of Isotopes(7th Edition)
Principal γ-ray emission energy	604.6600	± 0.0200	keV	Table of Isotopes(7th Edition)
γ-ray emission energy 2 (if used)		±		
γ-ray emission energy 3 (if used)		±		
γ-ray emission energy 4 (if used)		±		
γ-ray emission energy 5 (if used)		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	ND	±		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	-	-	cps	#VALUE!
Principal γ-ray emission probability	-	-		#VALUE!
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detector efficiency	-	-		#VALUE!
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	-	-		#VALUE!
Mass of sample	-	-	kg	#VALUE!
Recovery rate of precipitation(AMP/Cs)	-	-		#VALUE!
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β -/ γ -EMITTING RADIONUCLIDES			
^{137}Cs		Fukushima related seawater containing low levels of β - and β -/ γ -emitting radionuclides			
Outcomes					
Laboratory code	M-103	Summary of data for submission			
Activity concentration	0.0098 ± 0.0004		Bq kg⁻¹		
Uncertainties					
Net count rate	0.0184 ± 0.0005		cps		
Principal γ -ray emission energy	661.6380 ± 0.0190		keV		
Principal γ -ray emission probability	0.8500 ± 0.0050				
Principal γ -ray detection efficiency	0.1058 ± 0.0025				
Radioactive decay	0.9960 ± 0.0000				
Mass of sample	21.3300 ± 0.0246		kg		
Supporting information	0.9781 ± 0.0197				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.174 ± 0.034		y		Table of Isotopes(7th Edition)
Input data					
Method (including pre-concentration, if applicable):					
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-137 using well-type germanium semiconductor detector for 100000 seconds.					
Detection system (including method of calibration):					
Germanium semiconductor detector : GWL-90-15(ORTEC) , Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve : 3 points, Type of calibration:quadratic curve					
Detection limit (Bq/kg):	0.00034				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	30.1740	± 0.0340	y	Table of Isotopes(7th Edition)	
Principal γ -ray emission energy	661.6380	± 0.0190	keV	Table of Isotopes(7th Edition)	
γ -ray emission energy 2 (if used)	±				
γ -ray emission energy 3 (if used)	±				
γ -ray emission energy 4 (if used)	±				
γ -ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-103				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0098	± 0.0004			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0184 ± 0.0005		cps	2.6%	
Principal γ -ray emission probability	0.8500 ± 0.0050			0.6%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ -ray detection efficiency	0.1058 ± 0.0025			2.3%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)					
Detection efficiency 4 (if used)					
Detection efficiency 5 (if used)					
Correction for radioactive decay	0.9960 ± 0.0000			0.0%	
Mass of sample	21.3300 ± 0.0246		kg	0.1%	
Recovery rate of precipitation(AMP/Cs)	0.9781 ± 0.0197			2.0%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-IIC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-104	Summary of data for submission		
Activity concentration	0.0677 ± 0.0126		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.4640 ± 0.0834	cpm		
Chemical recovery	- ± -			#VALUE!
Detection efficiency	0.2770 ± 0.0077			
Correction for radioactive decay	0.9745 ± 0.0002			
Mass of sample	49.8600 ± 0.0012	g		
Supporting information	8.4900 ± 0.3485			
Method:	Analysis method stated			
Detection system:	Detection system stated			
Half-life	12.33 ± 0.02	year		Radioisotope Pocket Data Book 10th Edition
Decay energy	18.594 ± 0.008	keV		Radioisotope Pocket Data Book 10th Edition
β emission probability	- ± -			No data source stated
Input data				
Method (including pre-concentration, if applicable):				
The samples were purified by using distillation apparatus of glass made so as to keep the concentration of tritium in water unchanged before and after the distillation. Next, 1 liter of distilled water was electrolytically concentrated by using a solid polymer electrolytic film. For the liquid scintillation counting, 50 mL of the sample was mixed with 50 mL of scint-cocktail (Ultima Gold LLT (PerkinElmer Japan Co., Ltd.)) in a teflon bottle. The scintillation due to low energy beta-ray of tritium was determined by the low background liquid scintillation counter for 1000 minutes.				
Detection system (including method of calibration):				
Liquid scintillation counter: AccuFLEX LSC-LB7 (Hitachi, Ltd.) Number of points in the efficiency curve: 10 points, Type of calibration: quadratic curve				
Detection limit (Bq/kg):	0.036			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3300 ± 0.0200		year	Radioisotope Pocket Data Book 10th Edition
Decay energy	18.5940 ± 0.0080		keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy 1	- ± -			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-104			
Activity concentration	Bq/kg	0.0677 ± 0.0126		Uncertainty (k=1)
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.4640 ± 0.0834		cpm	18.0%
Chemical recovery	- ± -			#VALUE!
Detection efficiency	0.2770 ± 0.0077			2.8%
Correction for radioactive decay	0.9745 ± 0.0002			0.0%
Mass of sample	49.8600 ± 0.0012		g	0.0%
Concentration factor	8.4900 ± 0.3485			4.1%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-104	Summary of data for submission		
Activity concentration	0.0009 ± 0.0001		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.8180 ± 0.1349		cpm	
Chemical recovery	0.8327 ± 0.0282			
Detection efficiency	0.5290 ± 0.0137			
Radioactive decay	0.8393 ± 0.0000			
Mass of sample	42.1900 ± 0.0061		kg	
Supporting information	No supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	64.0416 ± 0.0312	hour	Radioisotope Pocket Data Book 10th Edition	
Decay energy	2279.8000 ± 1.7000	keV	Radioisotope Pocket Data Book 10th Edition	
β emission probability	No β emission probability stated. No uncertainty stated. No data source stated			
Input data				
Method (including pre-concentration, if applicable):				
Sr was concentrated using ion exchange resin (Dowex 50W-8X) from 40L of aqueous sample. Carbonate and barium chromate treatment was performed to separate and purify Sr. Solution with separated and purified Sr sat more than 2 weeks until Sr-Y became radioactively in equilibrium. After being in radioactive equilibrium, Y was separated using Fe co-precipitation method, and Y-90 radioactivity was measured from a Y-90 collected filter using 2π gas-flow counter for 100 minutes. Sr-90 concentration was determined from Y-90 radioactivity recovery rate, decay correction, and other necessary calculations.				
Detection system (including method of calibration):				
2π gas-flow counter: LDC-4202B (Hitachi Aloka Medical, Ltd.) Number of points in the efficiency: 1 points (Average value of 6 samples)				
Detection limit (Bq/kg):	0.000371			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	64.0416 ± 0.0312		hour	Radioisotope Pocket Data Book 10th Edition
Decay energy	2279.8000 ± 1.7000		keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-104			
Activity concentration	Bq/kg	0.0009 ± 0.0001	Uncertainty (k=1)	
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.8180 ± 0.1349		cpm	16.5%
Chemical recovery	0.8327 ± 0.0282			3.4%
Detection efficiency	0.5290 ± 0.0137			2.6%
Correction for radioactive decay	0.8393 ± 0.0000			0.0%
Mass of sample	42.1900 ± 0.0061		kg	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-104	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net count rate			cps	#VALUE!
Principal γ-ray emission energy	604.6600 ± 0.0200		keV	#VALUE!
Principal γ-ray emission probability				#VALUE!
Principal γ-ray detection efficiency				#VALUE!
Radioactive decay				#VALUE!
Mass of sample			kg	#VALUE!
Supporting information				#VALUE!
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.062 ± 0.005		y	Table of Isotopes(7th Edition)
Input data				
Method (including pre-concentration, if applicable):				
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container; then measured Cs-134 using well-type germanium semiconductor detector for 100000 seconds.				
Detection system (including method of calibration):				
Germanium semiconductor detector : GWL-90-15(ORTEC) , Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve : 3 points, Type of calibration:quadratic curve				
Detection limit (Bq/kg):	0.00073			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0620 ± 0.0050		y	Table of Isotopes(7th Edition)
Principal γ-ray emission energy	604.6600 ± 0.0200		keV	Table of Isotopes(7th Edition)
γ-ray emission energy 2 (if used)				
γ-ray emission energy 3 (if used)				
γ-ray emission energy 4 (if used)				
γ-ray emission energy 5 (if used)				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-104			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	ND ±			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate			cps	#VALUE!
Principal γ-ray emission probability				#VALUE!
Emission probability 2 (if used)				
Emission probability 3 (if used)				
Emission probability 4 (if used)				
Emission probability 5 (if used)				
Principal γ-ray detection efficiency				#VALUE!
Detection efficiency 2 (if used)				
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay				#VALUE!
Mass of sample			kg	#VALUE!
Recovery rate of precipitation(AMP/Cs)			%	#VALUE!
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML-INTERLABORATORY COMPARISON: β -/ γ -EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related seawater containing low levels of β - and β -/ γ -emitting radionuclides			
Outcomes				
Laboratory code	M-104	Summary of data for submission		
Activity concentration	0.0074 ± 0.0003		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0137 ± 0.0004		cps	
Principal γ -ray emission energy	661.6380 ± 0.0190		keV	
Principal γ -ray emission probability	0.8500 ± 0.0050			
Principal γ -ray detection efficiency	0.1058 ± 0.0025			
Radioactive decay	0.9958 ± 0.0000			
Mass of sample	21.1100 ± 0.0244		kg	
Supporting information	0.9752 ± 0.0196			
Method:	Analysis method stated:			
Detection system:	Detection system stated:			
Half-life:	30.174 ± 0.034		y	Table of Isotopes(7th Edition)
Input data				
Method (including pre-concentration, if applicable):				
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-137 using well-type germanium semi-conductor detector for 100000 seconds.				
Detection system (including method of calibration):				
Germanium semiconductor detector: GWL-90-15(ORTEC), Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve: 3 points, Type of calibration: quadratic curve				
Detection limit (Bq/kg):	0.00037			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	30.1740 ± 0.0340		y	Table of Isotopes(7th Edition)
Principal γ -ray emission energy	661.6380 ± 0.0190		keV	Table of Isotopes(7th Edition)
γ -ray emission energy 2 (if used)	±			
γ -ray emission energy 3 (if used)	±			
γ -ray emission energy 4 (if used)	±			
γ -ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-104			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0074 ± 0.0003			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0137 ± 0.0004		cps	3.1%
Principal γ -ray emission probability	0.8500 ± 0.0050			0.6%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ -ray detection efficiency	0.1058 ± 0.0025			2.3%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	0.9958 ± 0.0000			0.0%
Mass of sample	21.1100 ± 0.0244		kg	0.1%
Recovery rate of precipitation(AMP/Cs)	0.9752 ± 0.0196			2.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	0.0823 ± 0.0126		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.5810 ± 0.0840		cpm	
Chemical recovery	±			#VALUE!
Detection efficiency	0.2774 ± 0.0077			
Radioactive decay	0.9744 ± 0.0002			
Mass of sample	49.9100 ± 0.0012		g	
Supporting information	8.7200 ± 0.3527			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.33 ± 0.02	year		Radioisotope Pocket Data Book 10th Edition
Decay energy	18.594 ± 0.008	keV		Radioisotope Pocket Data Book 10th Edition
β emission probability				No data source stated
Input data				
Method (including pre-concentration, if applicable):				
The samples were purified by using distillation apparatus of glass made so as to keep the concentration of tritium in water unchanged before and after the distillation. Next, 1 liter of distilled water was electrolytically concentrated by using a solid polymer electrolytic film. For the liquid scintillation counting, 50ml of the sample was mixed with 50ml of scinti-cocktail (Ultima Gold LLI (PerkinElmer Japan Co., Ltd.)) in a teflon bottle. The scintillation due to low energy beta-ray of tritium was determined by the low background liquid scintillation counter for 1000 minutes.				
Detection system (including method of calibration):				
Liquid scintillation counter: AccuFLEX LSC-LB7 (Hitachi, Ltd.) Number of points in the efficiency curve: 10 points. Type of calibration: quadratic curve				
Detection limit (Bq/kg):	0.035			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3300 ± 0.0200		year	Radioisotope Pocket Data Book 10th Edition
Decay energy	18.5940 ± 0.0080		keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy 1	- ± -			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	0.0823 ± 0.0126			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.5810 ± 0.0840		cpm	14.5%
Chemical recovery	±			#VALUE!
Detection efficiency	0.2774 ± 0.0077			2.8%
Correction for radioactive decay	0.9744 ± 0.0002			0.0%
Mass of sample	49.9100 ± 0.0012		g	0.0%
Concentration factor	8.7200 ± 0.3527			4.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	0.0007 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.6240	± 0.1274	cpm	
Chemical recovery	0.8319	± 0.0282		
Detection efficiency	0.5290	± 0.0137		
Radioactive decay	0.7675	± 0.0000		
Mass of sample	42.8800	± 0.0062	kg	
Supporting information	No supporting information stated			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	64.0416	± 0.0312	hour	Radioisotope Pocket Data Book 10th Edition
Decay energy	2279.8000	± 1.7000	keV	Radioisotope Pocket Data Book 10th Edition
β emission probability	No β emission probability stated			
	No data source stated			
Input data				
Method (including pre-concentration, if applicable):				
Sr was concentrated using ion exchange resin (Dowex 50W-8X) from 40L of aqueous sample. Carbonate and barium chromate treatment was performed to separate and purify Sr. Solution was separated and purified Sr sat more than 2 weeks until Sr-Y became radioactively in equilibrium. After being in radioactive equilibrium, Y was separated using Fe co-precipitation method, and Y-90 radioactivity was measured from a Y-90 collected filter using 2π gas-flow counter for 100 minutes. Sr-90 concentration was determined from Y-90 radioactivity recovery rate, decay correction, and other necessary calculations.				
Detection system (including method of calibration):				
2π gas-flow counter LBC-4202B (Hitachi Aloka Medical, Ltd.) Number of points in the efficiency: 1 points (Average value of 6 samples)				
Detection limit (Bq/kg):	0.0004			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	64.0416	± 0.0312	hour	Radioisotope Pocket Data Book 10th Edition
Decay energy	2279.8000	± 1.7000	keV	Radioisotope Pocket Data Book 10th Edition
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1			
Activity concentration	Bq/kg	0.0007	± 0.0002	Uncertainty (k=1)
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.6240	± 0.1274	cpm	20.4%
Chemical recovery	0.8319	± 0.0282		3.4%
Detection efficiency	0.5290	± 0.0137		2.6%
Correction for radioactive decay	0.7675	± 0.0000		0.0%
Mass of sample	42.8800	± 0.0062	kg	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β -/ γ -EMITTING RADIONUCLIDES			
^{134}Cs	Fukushima related seawater containing low levels of β - and β -/ γ -emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net count rate			cps	#VALUE!
Principal γ -ray emission energy	604.6609	± 0.0200	keV	#VALUE!
Principal γ -ray emission probability				#VALUE!
Principal γ -ray detection efficiency				#VALUE!
Radioactive decay				#VALUE!
Mass of sample			kg	#VALUE!
Supporting information				#VALUE!
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.062	± 0.005	y	Table of Isotopes(7th Edition)
Input data				
Method (including pre-concentration, if applicable):				
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-134 using well-type germanium semiconductor detector for 100000 seconds.				
Detection system (including method of calibration):				
Germanium semiconductor detector: GWL-90-15(ORTEC), Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve: 3 points, Type of calibration:quadratic curve				
Detection limit (Bq/kg):	0.0007			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0620	± 0.0050	y	Table of Isotopes(7th Edition)
Principal γ -ray emission energy	604.6600	± 0.0200	keV	Table of Isotopes(7th Edition)
γ -ray emission energy 2 (if used)				
γ -ray emission energy 3 (if used)				
γ -ray emission energy 4 (if used)				
γ -ray emission energy 5 (if used)				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	ND ±			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate			cps	#VALUE!
Principal γ -ray emission probability				#VALUE!
Emission probability 2 (if used)				
Emission probability 3 (if used)				
Emission probability 4 (if used)				
Emission probability 5 (if used)				
Principal γ -ray detection efficiency				#VALUE!
Detection efficiency 2 (if used)				
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay				#VALUE!
Mass of sample			kg	#VALUE!
Recovery rate of precipitation(AMP/Cs)			%	#VALUE!
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
137Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-D1	Summary of data for submission			
Activity concentration	0.0035 ± 0.0002		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.0058 ± 0.0003		cps		
Principal γ-ray emission energy	661.6380 ± 0.0190		keV		
Principal γ-ray emission probability	0.8500 ± 0.0050				
Principal γ-ray detection efficiency	0.1060 ± 0.0025				
Radioactive decay	0.9953 ± 0.0000				
Mass of sample	19.5200 ± 0.0225		kg		
Supporting information	0.9672 ± 0.0195				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.174 ± 0.034		y		Table of Isotopes(7th Edition)
Input data					
Method (including pre-concentration, if applicable):					
Added nitrate to 20L of aqueous sample and adjust pH to about 1.6. Added 0.39 g of CsCl and mixed well; then added 6 g of AMP and mixed well again. Solution was settled overnight and collected AMP/Cs by filtering. Dried AMP/Cs at room temperature and calculated recovery rate by weighing. Insert AMP/Cs to teflon tube container, then measured Cs-137 using well-type germanium semiconductor detector for 100000 seconds.					
Detection system (including method of calibration):					
Germanium semiconductor detector: GWL-90-15(ORTEC) , Software:Gamma Station(SEIKO EG&G CO., LTD.) Number of points in the efficiency curve : 3 points,Type of calibration:quadratic curve					
Detection limit (Bq/kg):	0.00042				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	30.1740 ± 0.0340		y	Table of Isotopes(7th Edition)	
Principal γ-ray emission energy	661.6380 ± 0.0190		keV	Table of Isotopes(7th Edition)	
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	T-D1				
	Bq/kg				
Activity concentration	0.0035 ± 0.0002		Uncertainty (k=1)		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0058 ± 0.0003		cps	5.6%	
Principal γ-ray emission probability	0.8500 ± 0.0050			0.6%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	0.1060 ± 0.0025			2.3%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	0.9953 ± 0.0000			0.0%	
Mass of sample	19.5200 ± 0.0225		kg	0.1%	
Recovery rate of precipitation(AMP/Cs)	0.9672 ± 0.0195			2.0%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

分析機関：株式会社 地球科学研究所

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-101	Summary of data for submission		
Activity concentration	0.0790 ± 0.0140	Bq kg ⁻¹		
Uncertainties				
Net count rate	0.2648 ± 0.0420		cpm	
Chemical recovery	0.8700 ± 0.0070			
Detection efficiency	25.1460 ± 0.0700			
Radioactive decay	1.0044 ± 0.0020			
Mass of sample	10.0000 ± 0.0050		g	
Supporting information	No Supporting information stated		No uncertainty stated	
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.312 ± 0.025	year		DDEP
Decay energy	No decay energy stated		No uncertainty stated	No units stated
β emission probability	No β emission probability stated		No uncertainty stated	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Distillation, electrolytic enrichment and liquid scintillation counting.				
Detection system (including method of calibration):				
Low-background liquid scintillation counting system (Hitachi Aloka Medical Ltd. LSC-LB5) Quenching correction : sample channel ratio method				
Detection limit (Bq/kg):	0.036			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3120 ± 0.0250		year	DDEP
Decay energy				
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-101			
Activity concentration	0.0790 ± 0.0140	Uncertainty (k=1)		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.2648 ± 0.0420		cpm	15.9%
Chemical recovery	0.8700 ± 0.0070			0.8%
Detection efficiency	25.1460 ± 0.0700			0.3%
Correction for radioactive decay	1.0044 ± 0.0020			0.2%
Mass of sample	10.0000 ± 0.0050		g	0.1%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-102	Summary of data for submission		
Activity concentration	0.0870 ± 0.0140	Bq kg ⁻¹		
Uncertainties				
Net count rate	0.2915 ± 0.0424	cpm		
Chemical recovery	0.8670 ± 0.0069			
Detection efficiency	25.0630 ± 0.0390			
Radioactive decay	1.0045 ± 0.0020			
Mass of sample	10.0000 ± 0.0050	g		
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.3120 ± 0.0250	year	BBEP	
Decay energy	No decay energy stated	No uncertainty stated	No units stated	No data source stated
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Distillation, electrolytic enrichment and liquid scintillation counting.				
Detection system (including method of calibration):				
Low-background liquid scintillation counting system (Hitachi Aloka Medical, Ltd. LSC-LB5) Quenching correction: sample channel ratio method				
Detection limit (Bq/kg):	0.036			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3120 ± 0.0250		year	DDEP
Decay energy				
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0870 ± 0.0140			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.2915 ± 0.0424		cpm	14.5%
Chemical recovery	0.8670 ± 0.0069			0.8%
Detection efficiency	25.0630 ± 0.0390			0.2%
Correction for radioactive decay	1.0045 ± 0.0020			0.2%
Mass of sample	10.0000 ± 0.0050		g	0.1%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	0.0770 ± 0.0140		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.2562 ± 0.0419		cpm	
Chemical recovery	0.8650 ± 0.0069			
Detection efficiency	25.0140 ± 0.0630			
Correction for radioactive decay	1.0045 ± 0.0020			
Mass of sample	10.0000 ± 0.0050		g	
Supporting information	No Supporting information stated		No uncertainty stated	
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.312 ± 0.025	year	DDEP	
Decay energy	No decay energy stated		No units stated	No data source stated
β emission probability	No β emission probability stated		No uncertainty stated	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Distillation, electrolytic enrichment and liquid scintillation counting				
Detection system (including method of calibration):				
Low-background liquid scintillation counting system (Hitachi Aloka Medical, Ltd. LSC-LB5) Quenching correction : sample channel ratio method				
Detection limit (Bq/kg):	0.036			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3120 ± 0.0250		year	DDEP
Decay energy				
Particle emission energy 1				
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
Activity concentration	Bq/kg	Uncertainty (k=1)		
	0.0770 ± 0.0140			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.2562 ± 0.0419		cpm	16.4%
Chemical recovery	0.8650 ± 0.0069			0.8%
Detection efficiency	25.0140 ± 0.0630			0.3%
Correction for radioactive decay	1.0045 ± 0.0020			0.2%
Mass of sample	10.0000 ± 0.0050		g	0.1%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-104	Summary of data for submission			
Activity concentration	0.0800 ± 0.0140	Bq kg ⁻¹			
Uncertainties					
Net count rate	0.2672 ± 0.0421	cpm			
Chemical recovery	0.8700 ± 0.0070				
Detection efficiency	24.9560 ± 0.0720				
Radioactive decay	1.0045 ± 0.0020				
Mass of sample	10.0000 ± 0.0050	g			
Supporting information	No supporting information stated	No uncertainty stated			
Method	Analysts method stated				
Detection system	Detection system stated				
Half-life	12.312 ± 0.025	year		DDEP	
Decay energy	No decay energy stated	No uncertainty stated	No units stated	No data source stated	
β emission probability	No β emission probability stated	No uncertainty stated	No data source stated		
Input data					
Method (including pre-concentration, if applicable):					
Distillation, electrolytic enrichment and liquid scintillation counting.					
Detection system (including method of calibration):					
Low-background liquid scintillation counting system (Hitachi Aloka Medical Ltd. LSC-LB5) Quenching correction: sample channel ratio method					
Detection limit (Bq/kg):	0.036				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	12.3120 ± 0.0250		year	DDEP	
Decay energy					
Particle emission energy 1					
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-104				
	Bq/kg				
Activity concentration	0.0800 ± 0.0140	Uncertainty (k=1)			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.2672 ± 0.0421		cpm	15.8%	
Chemical recovery	0.8700 ± 0.0070			0.8%	
Detection efficiency	24.9560 ± 0.0720			0.3%	
Correction for radioactive decay	1.0045 ± 0.0020			0.2%	
Mass of sample	10.0000 ± 0.0050		g	0.1%	
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					

Nuclide:		IAEA-HC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
³ H		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-D1	Summary of data for submission			
Activity concentration	0.0560 ± 0.0130		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.1873 ± 0.0411		cpm		
Chemical recovery	0.8680 ± 0.0069				
Detection efficiency	25.3030 ± 0.0550				
Radioactive decay	1.0045 ± 0.0020				
Mass of sample	10.0000 ± 0.0050		g		
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	12.312 ± 0.025	year		DDEP	
Decay energy	No decay energy stated	No uncertainty stated		No units stated	No data source stated
β emission probability	No β emission probability stated	No uncertainty stated			No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Distillation, electrolytic enrichment and liquid scintillation counting.					
Detection system (including method of calibration):					
Low-background liquid scintillation counting system (Hitachi Aloka Medical, Ltd, LSC-LB5) Quenching correction : sample channel ratio method					
Detection limit (Bq/kg):	0.036				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	12.3120 ± 0.0250		year	DDEP	
Decay energy					
Particle emission energy 1					
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	T-D1				
Activity concentration	Bq/kg	0.0560 ± 0.0130	Uncertainty (k=1)		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.1873 ± 0.0411		cpm	21.9%	
Chemical recovery	0.8680 ± 0.0069			0.8%	
Detection efficiency	25.3030 ± 0.0550			0.2%	
Correction for radioactive decay	1.0045 ± 0.0020			0.2%	
Mass of sample	10.0000 ± 0.0050		g	0.1%	
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					

分析機関：東京パワーテクノロジー株式会社

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	0.0017 ± 0.0001		Bq kg ⁻¹	
Net count rate	0.9940 ± 0.0260			cpm
Chemical recovery	0.8310 ± 0.0288			
Detection efficiency	No Detection efficiency stated	No uncertainty stated		
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	40000.0000 ± 200.0500			ml
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	28.74	No uncertainty stated		year Radioisotope Pocket Data Book 10th Ed.
Decay energy	0.546	No uncertainty stated		MeV Radioisotope Pocket Data Book 10th Ed.
β emission probability	2.28	No uncertainty stated		Radioisotope Pocket Data Book 10th Ed.
Input data				
Method (including pre-concentration, if applicable):				
Strontium was separated from seawater by alkaline precipitation with sodium carbonate (Na ₂ CO ₃), and strontium was separated using cation exchange chromatography and reprecipitated as strontium carbonate (SrCO ₃). After yttrium 90 reached long-term equilibrium, 90Y was separated using an iron hydroxide coprecipitation method and measured with a gas flow counter.				
Detection system (including method of calibration):				
Calibration of the proportional counter (low-background gas flow proportional counter) was performed by using the yttrium oxalate precipitates produced by standard Si-90 solution.				
Detection limit (Bq/kg):	0.0006324			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	28.7400 ±		year	Radioisotope Pocket Data Book 10th Ed.
Decay energy	0.5460 ±		MeV	Radioisotope Pocket Data Book 10th Ed.
Particle emission energy 1	2.2800 ±			Radioisotope Pocket Data Book 10th Ed.
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1			
Activity concentration	Bq/kg	0.0017 ± 0.0001	Uncertainty (k=1)	
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.9940 ±	0.0260	cpm	2.6%
Chemical recovery	0.8310 ±	0.0288		3.5%
Detection efficiency	±			
Correction for radioactive decay	±			
Mass of sample	40000.0000 ±	200.0000	ml	0.5%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net count rate	No Net count rate stated	No uncertainty stated	counts	
Principal γ-ray emission energy	604.6600	0.0200	keV	
Principal γ-ray emission probability	No principal γ-ray emission probability stated	No uncertainty stated		
Principal γ-ray detection efficiency	No principal γ-ray detection efficiency stated	No uncertainty stated		
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	No Mass of sample stated	No uncertainty stated	No units stated	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.0623		0.003 year	Table of Isotopes 7th Ed.
Input data				
Method (including pre-concentration, if applicable):				
Adsorption on AMP (ammonium phosphomolybdate) and subsequent gamma spectrometry. The AMP suspension was allowed to settle and the supernatant solution is decanted away. Measurement was carried out by using gamma-spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio (SEIKO EG&G).				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in U8 type polypropylene container (Cd-109,Co-57,Ce-139,Cr-51,Sr-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.000927			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0620	± 0.0050	year	Table of Isotopes 7th Ed.
Principal γ-ray emission energy	604.6600	+ 0.0200	keV	Table of Isotopes 7th Ed.
γ-ray emission energy 2 (if used)		±		
γ-ray emission energy 3 (if used)		±		
γ-ray emission energy 4 (if used)		±		
γ-ray emission energy 5 (if used)		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	ND			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate		±	counts	
Principal γ-ray emission probability		±		
Emission probability 2 (if used)		±		
Emission probability 3 (if used)		±		
Emission probability 4 (if used)		±		
Emission probability 5 (if used)		±		
Principal γ-ray detection efficiency		±		
Detection efficiency 2 (if used)		±		
Detection efficiency 3 (if used)		±		
Detection efficiency 4 (if used)		±		
Detection efficiency 5 (if used)		±		
Correction for radioactive decay		±		
Mass of sample		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	0.0037 ± 0.0004		Bq kg ⁻¹	
Uncertainties				
Net count rate	448.7000 ± 42.7000		counts	
Principal γ-ray emission energy	661.6380 ± 0.0190		keV	
Principal γ-ray emission probability	0.5000 ± 0.0000			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	20000.0000 ± 100.0000		ml	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	30.17 ± 0.034	year	Table of Isotopes 7th Ed.	
Input data				
Method (including pre-concentration, if applicable):				
Adsorption on AMP (ammonium phosphomolybdate) and subsequent gamma spectrometry. The AMP suspension was allowed to settle and the supernatant solution is decanted away. Measurement was carried out by using gamma-spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio (SEIKO EG&G).				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in UB type polypropylene container (Cd-109,Co-57,Ce-139,Cr-51,Sr-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.000955			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.1740 ± 0.0340		year	Table of Isotopes 7th Ed.
Principal γ-ray emission energy	661.6380 ± 0.0190		keV	Table of Isotopes 7th Ed.
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1	Uncertainty (k=1)		
Activity concentration	0.0037 ± 0.0004			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	448.7000 ± 42.7000		counts	9.5%
Principal γ-ray emission probability	0.5000 ± 0.0000			0.6%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			2.7%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay				
Mass of sample	20000.0000 ± 100.0000		ml	0.5%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IARA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related sediment containing low levels of α- and β-γ-emitting radionuclides			
Outcomes				
Laboratory code	F-PO4	Summary of data for submission		
Activity concentration	2.0300 ± 0.2420		Bq kg ⁻¹	
Uncertainties				
Net count rate	269.4000 ± 31.1000	counts		
Principal γ-ray emission energy	604.6600 ± 0.0200	keV		
Principal γ-ray emission probability	97.5600 ± 0.3200			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			
Radioactive decay	No radioactive decay stated	No uncertainty stated		
Mass of sample	100.0000 ± 0.0001	g		
Supporting information	No supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.062 ± 0.005 year			Table of Isotopes 7th Ed.
Input data				
Method (including pre-concentration, if applicable):				
For gamma-spectrometric measurements, the sample was transferred to 118 type polypropylene container and weighed. Measurement was carried out by using gamma-spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio (SEIKO EG&G).				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in 118 type polypropylene container (Cd-109,Co-57,Co-139,Cr-51,Sr-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.633			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0620 ± 0.0050		year	Table of Isotopes 7th Ed.
Principal γ-ray emission energy	604.6600 ± 0.0200		keV	Table of Isotopes 7th Ed.
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	F-PO4			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	2.0300 ± 0.2420			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	269.4000 ± 31.1000		counts	11.5%
Principal γ-ray emission probability	97.5600 ± 0.3200			0.3%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			2.7%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay				
Mass of sample	100.0000 ± 0.0001		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code:	F-PO4	Summary of data for submission		
Activity concentration	27.6000 ± 0.9280		Bq kg ⁻¹	
Uncertainties				
Net count rate	3550.5000 ± 65.1000		counts	
Principal γ-ray emission energy	661.6380 ± 0.0190		keV	
Principal γ-ray emission probability	85.0000 ± 0.5000			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	100.0000 ± 0.0001		g	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	30.174 ± 0.034	year		Table of Isotopes 7th Ed.
Input data				
Method (including pre-concentration, if applicable):				
For gamma-spectrometric measurements, the sample was transferred to U8 type polypropylene container and weighed. Measurement was carried out by using gamma-spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio (SEIKO EG&G).				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in U8 type polypropylene container (Cd-109,Cs-57,Ce-139,Cr-51,Sr-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.645			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	30.1740 ± 0.0340		year	Table of Isotopes 7th Ed.
Principal γ-ray emission energy	661.6380 ± 0.0190		keV	Table of Isotopes 7th Ed.
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	F-PO4	Uncertainty (k=1)		
	Bq/kg			
Activity concentration (dry)	27.6000 ± 0.9280			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	3550.5000 ± 65.1000		counts	1.8%
Principal γ-ray emission probability	85.0000 ± 0.5000			0.6%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			2.7%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay				
Mass of sample	100.0000 ± 0.0001		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β -/ γ -EMITTING RADIONUCLIDES			
^{134}Cs	Fukushima related sediment containing low levels of α - and β -/ γ -emitting radionuclides			
Outcomes				
Laboratory code	T-S3	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg^{-1}	#VALUE!
Uncertainties				
Net count rate	No Net count rate stated	No uncertainty stated	counts	
Principal γ -ray emission energy	604.6600	0.0200	keV	
Principal γ -ray emission probability	No principal γ -ray emission probability stated	No uncertainty stated		
Principal γ -ray detection efficiency	No principal γ -ray detection efficiency stated	No uncertainty stated		
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	No Mass of sample stated	No uncertainty stated	No units stated	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.062		0.005 year	Table of Isotopes 7th Ed.
Input data				
Method (including pre-concentration, if applicable):				
For gamma-spectrometric measurements, the sample was transferred to U8 type polypropylene container and weighed. Measurement was carried out by using gamma-spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio (SEIKO EG&G).				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in U8 type polypropylene container (Cd-109,Co-57,Ce-139,Cr-51,Sr-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.629			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	2.0620	± 0.0050	year	Table of Isotopes 7th Ed.
Principal γ -ray emission energy	604.6600	± 0.0200	keV	Table of Isotopes 7th Ed.
γ -ray emission energy 2 (if used)		\pm		
γ -ray emission energy 3 (if used)		\pm		
γ -ray emission energy 4 (if used)		\pm		
γ -ray emission energy 5 (if used)		\pm		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S3			
	Bq/kg		Uncertainty (k=1)	
Activity concentration (dry)	ND			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate		\pm	COUNTS	
Principal γ -ray emission probability		\pm		
Emission probability 2 (if used)		\pm		
Emission probability 3 (if used)		\pm		
Emission probability 4 (if used)		\pm		
Emission probability 5 (if used)		\pm		
Principal γ -ray detection efficiency		\pm		
Detection efficiency 2 (if used)		\pm		
Detection efficiency 3 (if used)		\pm		
Detection efficiency 4 (if used)		\pm		
Detection efficiency 5 (if used)		\pm		
Correction for radioactive decay		\pm		
Mass of sample		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code:	T-S3	Summary of data for submission		
Activity concentration	7.6000 ± 0.3710	Bq kg ⁻¹		
Uncertainty				
Net count rate	1071.3000 ± 42.6000	counts		
Principal γ-ray emission energy	661.6380 ± 0.0190	keV		
Principal γ-ray emission probability	85.0000 ± 0.5000			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	100.0000 ± 0.0001	g		
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	30.174 ± 0.034	year	Table of Isotopes 7th Ed.	
Input data				
Method (including pre-concentration, if applicable):				
For gamma-spectrometric measurements, the sample was transferred to 1l8 type polypropylene container and weighed. Measurement was carried out by using gamma-spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio (SEIKO EG&G).				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in UB type polypropylene container (Cd-109,Co-57,Ce-139,Cr-51,Sr-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.613			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.1740 ± 0.0340		Year	Table of Isotopes 7th Ed.
Principal γ-ray emission energy	661.6380 ± 0.0190		keV	Table of Isotopes 7th Ed.
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S3			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	7.6000 ± 0.3710			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	1071.3000 ± 42.6000		counts	4.0%
Principal γ-ray emission probability	85.0000 ± 0.5000			0.6%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			2.7%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay				
Mass of sample	100.0000 ± 0.0001		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	3.0200 ± 0.2560		Bq kg ⁻¹	
Uncertainties				
Net count rate	417.5000 ± 33.4000		counts	
Principal γ-ray emission energy	604.6600 ± 0.0200		keV	
Principal γ-ray emission probability	97.5600 ± 0.3200			
Principal γ-ray detection efficiency	352.8000 ± 9.3492			
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	100.0000 ± 0.0001		g	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.062 ± 0.005 year			Table of Isotopes 7th Ed.
Input data				
Method (including pre-concentration, if applicable):				
For gamma-spectrometric measurements, the sample was transferred to UB type polypropylene container and weighed. Measurement was carried out by using gamma spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio (SEIKO EG&G).				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in UB type polypropylene container (Cd-109,Cu-57,Ce-139,Cr-51,Sr-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.606			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0620	± 0.0050	year	Table of Isotopes 7th Ed.
Principal γ-ray emission energy	604.6600	± 0.0200	keV	Table of Isotopes 7th Ed.
γ-ray emission energy 2 (if used)		±		
γ-ray emission energy 3 (if used)		±		
γ-ray emission energy 4 (if used)		±		
γ-ray emission energy 5 (if used)		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	3.0200	± 0.2560		
Contributing parameters				
Parameter	Value	Uncertainty	Units	Relative uncertainty
Net count rate	417.5000 ± 33.4000		counts	8.0%
Principal γ-ray emission probability	97.5600 ± 0.3200			0.3%
Emission probability 2 (if used)		±		
Emission probability 3 (if used)		±		
Emission probability 4 (if used)		±		
Emission probability 5 (if used)		±		
Principal γ-ray detection efficiency	352.8000 ± 9.3492			2.7%
Detection efficiency 2 (if used)		±		
Detection efficiency 3 (if used)		±		
Detection efficiency 4 (if used)		±		
Detection efficiency 5 (if used)		±		
Correction for radioactive decay				
Mass of sample	100.0000 ± 0.0001		g	0.0%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β - γ -EMITTING RADIONUCLIDES			
^{137}Cs	Fukushima related sediment containing low levels of α - and β - γ -emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	31.8000 \pm 1.0400	Bq kg ⁻¹		
Uncertainties				
Net count rate	4205.2000 \pm 69.9000	counts		
Principal γ -ray emission energy	661.6380 \pm 0.0190	keV		
Principal γ -ray emission probability	85.0000 \pm 0.5000			
Principal γ -ray detection efficiency	352.8000 \pm 9.3492			
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	100.0000 \pm 0.0001	g		
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	30.174 \pm 0.034	year		Table of Isotopes 7th Ed.
Input data				
Method (including pre-concentration, if applicable):				
For gamma-spectrometric measurements, the sample was transferred to UB type polypropylene container and weighed. Measurement was carried out by using gamma-spectrometry by means of a p-type coaxial HPGe. The spectrum analysis was performed by using a software named Gamma Studio [SEIKO EC&C].				
Detection system (including method of calibration):				
Efficiency calibration by means of standards in UB type polypropylene container (Cd-109,Co-57,Ce-139,Cr-51,Sc-85,Cs-137,Mn-54,Y-88 and Co-60) coincidence summing corrections, self-absorption corrections.				
Detection limit (Bq/kg):	0.623			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.1740	\pm 0.0340	year	Table of Isotopes 7th Ed.
Principal γ -ray emission energy	661.6380	\pm 0.0190	keV	Table of Isotopes 7th Ed.
γ -ray emission energy 2 (if used)		\pm		
γ -ray emission energy 3 (if used)		\pm		
γ -ray emission energy 4 (if used)		\pm		
γ -ray emission energy 5 (if used)		\pm		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	31.8000	\pm 1.0400		
Contributing parameters				
	Value	Uncertainty	Units	Relative uncertainty
Net count rate	4205.2000	\pm 69.9000	counts	1.7%
Principal γ -ray emission probability	85.0000	\pm 0.5000		0.6%
Emission probability 2 (if used)		\pm		
Emission probability 3 (if used)		\pm		
Emission probability 4 (if used)		\pm		
Emission probability 5 (if used)		\pm		
Principal γ -ray detection efficiency	352.8000	\pm 9.3492		2.7%
Detection efficiency 2 (if used)		\pm		
Detection efficiency 3 (if used)		\pm		
Detection efficiency 4 (if used)		\pm		
Detection efficiency 5 (if used)		\pm		
Correction for radioactive decay				
Mass of sample	100.0000	\pm 0.0001	g	0.0%
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		
Other parameter (only if included in calculation)		\pm		

分析機關：公益財団法人 海洋生物環境研究所

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M101-1-4-2	Summary of data for submission		
Activity concentration	0.1121 ± 0.0198		Bq kg ⁻¹	
Uncertainties				
Net count rate	288.0000 ± 49.6470			
Chemical recovery	6.2350 ± 0.1750			
Detection efficiency	28.1145 ± 0.7828			
Radioactive decay	0.9767 ± 0.0001			
Mass of sample	50.0000 ± 0.0207			
Supporting information	No Supporting Information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.32 ± 0.0200	0.02 year	Evaluated Nuclear Structure Data File	
Decay energy	18.5906 ± 0.0032	0.0032 keV	Evaluated Nuclear Structure Data File	
β emission probability	100	No uncertainty stated	Evaluated Nuclear Structure Data File	
Input data				
Method (including pre-concentration, if applicable):				
The seawater samples were purified by distillation, and then tritium in the sample was concentrated by an electrolytic enrichment method (500 mL to 50 mL). Enriched sample was further purified by distillation. 50ml of the distilled water was mixed with 50 mL of Ultima Gold ULLT scintillation cocktail.				
Detection system (including method of calibration):				
β ray of the sample were measured using a Hitachi AccuPLEX LSC-LM7 low background liquid scintillation counter. By using 8 standard samples with known concentrations of tritium and variable quenching levels, relationship between counting efficiencies and external standard channel ratios was derived. The relationship was used to estimate counting efficiencies for each sample.				
Detection limit (Bq/kg):	0.0483			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	12.3200 ± 0.0200	0.0200	year	Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032	0.0032	keV	Evaluated Nuclear Structure Data File
Particle emission energy 1	100.0000 ±			Evaluated Nuclear Structure Data File
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M101-1-4-2			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.1121 ± 0.0198			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	288.0000 ± 49.6470		cps	17.2%
Chemical recovery	6.2350 ± 0.1750			2.8%
Detection efficiency	28.1145 ± 0.7828			2.8%
Correction for radioactive decay	0.9767 ± 0.0001			0.0%
Mass of sample	50.0000 ± 0.0207		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M102-1-4-2	Summary of data for submission		
Activity concentration	0.1097 ± 0.0220		Bq kg ⁻¹	
Uncertainties				
Net count rate	251.0000 ± 49.2724		cps	
Chemical recovery	5.5560 ± 0.1559			
Detection efficiency	28.1235 ± 0.7826			
Radioactive decay	0.9767 ± 0.0001			
Mass of sample	50.0000 ± 0.0207		g	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.32 ± 0.02	year	Evaluated Nuclear Structure Data File	
Decay energy	18.5906 ± 0.0032	keV	Evaluated Nuclear Structure Data File	
β emission probability	100 ± 0	No uncertainty stated		
			Evaluated Nuclear Structure Data File	
Input data				
Method (including pre-concentration, if applicable):				
The seawater samples were purified by distillation, and then tritium in the sample was concentrated by an electrolytic enrichment method (500 mL to 50 mL). Enriched sample was further purified by distillation. 50ml of the distilled water was mixed with 50 mL of Ultima Gold uLLT scintillation cocktail.				
Detection system (including method of calibration):				
β ray of the sample were measured using a Hitachi AccuFLEX LSC-LB7 low background liquid scintillation counter. By using 8 standard samples with known concentrations of tritium and variable quenching levels, relationship between counting efficiencies and external standard channel ratios was derived. The relationship was used to estimate counting efficiencies for each sample.				
Detection limit (Bq/kg):	0.0542			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3200 ± 0.0200		year	Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032		keV	Evaluated Nuclear Structure Data File
Particle emission energy 1	100.0000 ± 0			Evaluated Nuclear Structure Data File
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M102-1-4-2			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.1097 ± 0.0220			
Contributing parameters				
Parameter	Value	Uncertainty	Units	Relative uncertainty
Net count rate	251.0000 ± 49.2724		cps	19.6%
Chemical recovery	5.5560 ± 0.1559			2.8%
Detection efficiency	28.1235 ± 0.7826			2.8%
Correction for radioactive decay	0.9767 ± 0.0001			0.0%
Mass of sample	50.0000 ± 0.0207		g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M103-1-4-2	Summary of data for submission		
Activity concentration	0.1303 ± 0.0236		Bq kg ⁻¹	
Uncertainties				
Net count rate	281.0000 ± 49.5764		cps	
Chemical recovery	5.2396 ± 0.1470			
Detection efficiency	28.0694 ± 0.7817			
Radioactive decay	0.9766 ± 0.0001			
Mass of sample	50.0000 ± 0.0207		g	
Supporting information	No Supporting Information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	12.32 ± 0.0200	year		Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032	keV		Evaluated Nuclear Structure Data File
β emission probability	100 ± 0			Evaluated Nuclear Structure Data File
Input data				
Method (including pre-concentration, if applicable):				
The seawater samples were purified by distillation, and then tritium in the sample was concentrated by an electrolytic enrichment method (500 ml. to 50 ml). Enriched sample was further purified by distillation. 50ml of the distilled water was mixed with 50 ml of Ultima Gold uLTL scintillation cocktail.				
Detection system (including method of calibration):				
β ray of the sample were measured using a Hitachi AccuFLEX LSC-LB7 low background liquid scintillation counter. By using β standard samples with known concentrations of tritium and variable quenching levels, relationship between counting efficiencies and external standard channel ratios was derived. The relationship was used to estimate counting efficiencies for each sample.				
Detection limit (Bq/kg):	0.0576			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3200 ± 0.0200		year	Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032		keV	Evaluated Nuclear Structure Data File
Particle emission energy 1	100.0000 ± 0			Evaluated Nuclear Structure Data File
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M103-1-4-2			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.1303 ± 0.0236			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	281.0000 ± 49.5764		cps	17.6%
Chemical recovery	5.2396 ± 0.1470			2.8%
Detection efficiency	28.0694 ± 0.7817			2.8%
Correction for radioactive decay	0.9766 ± 0.0001			0.0%
Mass of sample	50.0000 ± 0.0207		g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RME INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M104-1-4-2	Summary of data for submission		
Activity concentration	0.1325 ± 0.0200	Bq kg ⁻¹		
Uncertainties				
Net count rate	344.0000 ± 50.2089		cps	
Chemical recovery	6.2756 ± 0.1761			
Detection efficiency	28.2360 ± 0.7858			
Radioactive decay	0.9764 ± 0.0001			
Mass of sample	50.0000 ± 0.0207		g	
Supporting information	No Supporting Information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half life	12.320 ± 0.0200	year	0.02	Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032	keV	0.0032	Evaluated Nuclear Structure Data File
β emission probability	100	No uncertainty stated		
				Evaluated Nuclear Structure Data File
Input data				
Method (including pre-concentration, if applicable):				
The seawater samples were purified by distillation, and then tritium in the sample was concentrated by an electrolytic enrichment method (500 ml. to 50 ml). Enriched sample was further purified by distillation. 50ml of the distilled water was mixed with 50 mL of Ultima Gold uLLT scintillation cocktail.				
Detection system (including method of calibration):				
β ray of the sample were measured using a Hitachi AccuFLEX LSC-LB7 low background liquid scintillation counter. By using 8 standard samples with known concentrations of tritium and variable quenching levels, relationship between counting efficiencies and external standard channel ratios was derived. The relationship was used to estimate counting efficiencies for each sample.				
Detection limit (Bq/kg):	0.0478			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3200 ± 0.0200		year	Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032		keV	Evaluated Nuclear Structure Data File
Particle emission energy 1	100.0000 ±			Evaluated Nuclear Structure Data File
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M104-1-4-2			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.1325 ± 0.0200			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	344.0000 ± 50.2089		cps	14.6%
Chemical recovery	6.2756 ± 0.1761			2.8%
Detection efficiency	28.2360 ± 0.7858			2.8%
Correction for radioactive decay	0.9764 ± 0.0001			0.0%
Mass of sample	50.0000 ± 0.0207		g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-IEC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
³ H	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1-1-4-2	Summary of data for submission		
Activity concentration	0.0941 ± 0.0203		Bq kg ⁻¹	
Uncertainties:				
Net count rate	232.0000 ± 49.0790			
Chemical recovery	5.9772 ± 0.1677			
Detection efficiency	28.1522 ± 0.7838			
Radioactive decay	0.9767 ± 0.0001			
Mass of sample	50.0000 ± 0.0207			
Supporting information	No Supporting information stated. No uncertainty stated.			
Method	Analysis method stated.			
Detection system	Detection system stated.			
Half-life	12.32 ± 0.02	year		Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032	keV		Evaluated Nuclear Structure Data File
β emission probability	100		No uncertainty stated.	Evaluated Nuclear Structure Data File
Input data				
Method (including pre-concentration, if applicable):				
The seawater samples were purified by distillation, and then tritium in the sample was concentrated by an electrolytic enrichment method (500 mL to 50 mL). Enriched sample was further purified by distillation. 50ml of the distilled water was mixed with 50 mL of Ultima Gold ULL scintillation cocktail.				
Detection system (including method of calibration):				
β ray of the sample were measured using a Hitachi ARIUMPLEX LSC-LB7 low background liquid scintillation counter. By using 8 standard samples with known concentrations of tritium and variable quenching levels, relationship between counting efficiencies and external standard channel ratios was derived. The relationship was used to estimate counting efficiencies for each sample.				
Detection limit (Bq/kg):	0.0504			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	12.3200 ± 0.0200		year	Evaluated Nuclear Structure Data File
Decay energy	18.5906 ± 0.0032		keV	Evaluated Nuclear Structure Data File
Particle emission energy 1	100.0000 ±			Evaluated Nuclear Structure Data File
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1-1-4-2			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0941 ± 0.0203			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	232.0000 ± 49.0790		cps	21.2%
Chemical recovery	5.9772 ± 0.1677			2.8%
Detection efficiency	28.1522 ± 0.7838			2.8%
Correction for radioactive decay	0.9767 ± 0.0001			0.0%
Mass of sample	50.0000 ± 0.0207		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

分析機関：一般財団法人 九州環境管理協会

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α -EMITTING RADIONUCLIDES			
²³⁸ Pu	Fukushima related sediment containing low levels of α - and β - γ -emitting radionuclides			
Outcomes				
Laboratory code	F-P04	Summary of data for submission		
Activity concentration	<0.0082	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net sample count rate	0.0000 ± 0.0000	0.0000	cps	Warning! Net sample count rate uncertainty is >50%
Chemical recovery	No Chemical recovery stated	No uncertainty stated		
Sample detection efficiency	No Sample detection efficiency stated	No uncertainty stated		
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	50.0000 ± 0.0403	0.0403	g-dry	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	17.2598 ± 0.4373	0.4373	mBq/mL	
Net tracer count rate	0.0103 ± 0.0004	0.0004	cps	
Tracer detection efficiency	No Tracer detection efficiency stated	No uncertainty stated		
Tracer radioactive decay	No Tracer radioactive decay stated	No uncertainty stated		
Mass of tracer added	2.0000 ± 0.0058	0.0058	mL	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated:			
Detection system	Detection system stated:			
Half-life	87.74 ± 0.03	0.03	year	BIPM-5 Table of Radionuclides Vol.5
Decay energy	5593.2000 ± 0.1900	0.19	keV	BIPM-5 Table of Radionuclides Vol.5
α emission probability	0.7184 ± 0.0006	0.0006		BIPM-9 Table of Radionuclides Vol.5
Input data				
Method (including pre-concentration, if applicable):				
50 g dried sediment samples was heated at 450 °C overnight. Pu-242 tracer was added, and Pu in the sediment sample was extracted with 8M nitric acid. The extracted solution was heated and concentrated and adjusted to 8M nitric acid. Sodium nitrite was added to adjust Pu oxidation state. Pu separation and purification was carried out using anion exchange resin (Dowex 1x8 100 - 200 mesh). The purified Pu was electrodeposited on the stainless steel plate and measured by Si semiconductor detector.				
Detection system (including method of calibration):				
CANBERRA Alpha Analyst, energy calibrated with Am-243 source.				
Detection limit (Bq/kg):	0.0082			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	87.7400	± 0.0300	year	BIPM-5 Table of Radionuclides Vol.5
Decay energy	5593.2000	± 0.1900	keV	BIPM-5 Table of Radionuclides Vol.5
Particle emission energy 1	0.7104	± 0.0006		BIPM-5 Table of Radionuclides Vol.5
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	F-P04			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	<0.0082 ±			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0000	± 0.0000	cps	100.0%
Chemical recovery		±		
Detection efficiency		±		
Correction for radioactive decay		±		
Mass of sample	50.0000	± 0.0403	g-dry	0.1%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
ISOTOPE DILUTION TRACER			Nuclide	Pu-242
Activity concentration	17.2598	± 0.4373	mBq/mL	2.5%
Net count rate	0.0103	± 0.0004	cps	
Detection efficiency				
Correction for radioactive decay				
Mass of tracer added	2.0000	± 0.0058	mL	
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON α-EMITTING RADIONUCLIDES			
239/240 Pu	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code:	F-P04	Summary of data for submission		
Activity concentration	0.3970 ± 0.0290		Bq kg ⁻¹	
Uncertainties				
Net sample count rate	0.0059 ± 0.0003	cps		
Chemical recovery	No Chemical recovery stated	No uncertainty stated		
Sample detection efficiency	No Sample detection efficiency stated	No uncertainty stated		
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	50.0000 ± 0.0403	g-dry		
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	17.2598 ± 0.4373	mBq/mL		
Net tracer count rate	0.0303 ± 0.0004	cps		
Tracer detection efficiency	No Tracer detection efficiency stated	No uncertainty stated		
Tracer radioactive decay	No Tracer radioactive decay stated	No uncertainty stated		
Mass of tracer added	2.0000 ± 0.0058	mg		
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	24100 ± 11	year		Pu-239 half-life: 24100 ± 11 year (BIPM-5 Table of Radionuclides)
Decay energy	5244.43 ± 0.14	keV		Pu-239 alpha energy: 5244.43 ± 0.14 keV (BIPM-5 Table of Radionuclides)
α emission probability	0.7079 ± 0.0010			Pu-239 probability: 0.7079 ± 0.0010 (BIPM-5 Table of Radionuclides)
Input data				
Method (including pre-concentration, if applicable):				
50 g dried sediment samples was heated at 450 °C overnight. Pu-242 tracer was added, and Pu in the sediment sample was extracted with 8M nitric acid. The extracted solution was heated and concentrated and adjusted to 8M nitric acid. Sodium nitrite was added to adjust Pu oxidation state. Pu separation and purification was carried out using anion exchange resin (Dowex 1x8 100 - 200 mesh). The purified Pu was electrodeposited on the stainless steel plate and measured by Si semiconductor detector.				
Detection system (including method of calibration):				
CANBERRA Alpha Analyst, energy calibrated with Am-243 source.				
Detection limit (Bq/kg):	0.006			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	24100.0000	± 11.0000	year	Pu-239 half-life: 24100 ± 11 year (BIPM-5 Table of Radionuclides)
Decay energy	5244.4300	± 0.1400	keV	Pu-239 alpha energy: 5244.43 ± 0.14 keV (BIPM-5 Table of Radionuclides)
Particle emission energy 1	0.7079	± 0.0010		Pu-239 probability: 0.7079 ± 0.0010 (BIPM-5 Table of Radionuclides)
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	F-P04			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.3970	± 0.0290		
Contributing parameters				
Net count rate	0.0059 ± 0.0003	cps		4.6%
Chemical recovery	±			
Detection efficiency	±			
Correction for radioactive decay	±			
Mass of sample	50.0000 ± 0.0403	g-dry		0.1%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
ISOTOPE DILUTION TRACER			Nuclide	Pu-242
Activity concentration	17.2598 ± 0.4373	mBq/mL		2.5%
Net count rate	0.0303 ± 0.0004	cps		
Detection efficiency	±			
Correction for radioactive decay	±			
Mass of tracer added	2.0000 ± 0.0058	mg		
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RMI-INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
²³⁸ Pu	Fukushima-related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S3	Summary of data for submission		
Activity concentration	<0.0071	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net sample count rate	0.0001 ± 0.0000		cps	
Chemical recovery	No Chemical recovery stated	No uncertainty stated		
Sample detection efficiency	No Sample detection efficiency stated	No uncertainty stated		
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	50.0000 ± 0.0403		g-dry	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	17.2598 ± 0.4373		mBq/ml	
Net tracer count rate	0.0110 ± 0.0004		cps	
Tracer detection efficiency	No Tracer detection efficiency stated	No uncertainty stated		
Tracer radioactive decay	No Tracer radioactive decay stated	No uncertainty stated		
Mass of tracer added	2.0000 ± 0.0058		ml	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	87.74 ± 0.03	year		BIPM-5 Table of Radionuclides Vol.5
Decay energy	5593.2 ± 0.19	keV		BIPM-5 Table of Radionuclides Vol.5
α emission probability	0.7104 ± 0.0006			BIPM-5 Table of Radionuclides Vol.5
Input data				
Method (including pre-concentration, if applicable):				
50 g dried sediment samples was heated at 450 °C overnight. Pu-242 tracer was added, and Pu in the sediment sample was extracted with 8M nitric acid. The extracted solution was heated and concentrated and adjusted to 8M nitric acid. Sodium nitrite was added to adjust Pu oxidation state. Pu separation and purification was carried out using anion exchange resin (Dowex 1x8 100 - 200 mesh). The purified Pu was electrodeposited on the stainless steel plate and measured by Si semiconductor detector.				
Detection system (including method of calibration):				
CANBERRA Alpha Analyst, energy calibrated with Am-243 source.				
Detection limit (Bq/kg):	0.0071			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	87.7400	± 0.0300	year	BIPM-5 Table of Radionuclides Vol.5
Decay energy	5593.2000	± 0.1900	keV	BIPM-5 Table of Radionuclides Vol.5
Particle emission energy 1	0.7104	± 0.0006		BIPM-5 Table of Radionuclides Vol.5
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S3			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	<0.0071 ±			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0001	± 0.0000	cps	37.8%
Chemical recovery		±		
Detection efficiency		±		
Correction for radioactive decay		±		
Mass of sample	50.0000	± 0.0403	g-dry	0.1%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
ISOTOPE DILUTION TRACER			Nuclide	
Activity concentration	17.2598	± 0.4373	mBq/ml	2.5%
Net count rate	0.0110	± 0.0004	cps	
Detection efficiency				
Correction for radioactive decay				
Mass of tracer added	2.0000	± 0.0058	ml	
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON α-EMITTING RADIONUCLIDES			
^{239/240} Pu	Fukushima related sediment containing low levels of α- and β-γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S3	Summary of data for submission		
Activity concentration	0.3590 ± 0.0260		Bq kg ⁻¹	
Uncertainties				
Net sample count rate	0.0057 ± 0.0003		cps	
Chemical recovery	No Chemical recovery stated	No uncertainty stated		
Sample detection efficiency	No Sample detection efficiency stated	No uncertainty stated		
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	50.0000 ± 0.0403		g-dry	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	17.2598 ± 0.4373		mBq/mL	
Net tracer count rate	0.0110 ± 0.0004		cps	
Tracer detection efficiency	No Tracer detection efficiency stated	No uncertainty stated		
Tracer radioactive decay	No Tracer radioactive decay stated	No uncertainty stated		
Mass of tracer added	2.0000 ± 0.0058		mL	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	24100 ± 11	year		Pu-239 half-life: 24100 ± 11 year (BIPM-5 Table of Radionuclides)
Decay energy	5244.43 ± 0.14	keV		Pu-239 alpha energy: 5244.43 ± 0.14 keV (BIPM-5 Table of Radionuclides)
α emission probability	0.7079 ± 0.0010			Pu-239 probability: 0.7079 ± 0.0010 (BIPM-5 Table of Radionuclides)
Input data				
Method (including pre-concentration, if applicable):				
50 g dried sediment samples was heated at 450 °C overnight. Pu-242 tracer was added, and Pu in the sediment sample was extracted with 8M nitric acid. The extracted solution was heated and concentrated and adjusted to 8M nitric acid. Sodium nitrite was added to adjust Pu oxidation state. Pu separation and purification was carried out using anion exchange resin (Dowex 1x8 100 - 200 mesh). The purified Pu was electrodeposited on the stainless steel plate and measured by SI semiconductor detector.				
Detection system (including method of calibration):				
CANBERRA Alpha Analyst, energy calibrated with Am-243 source.				
Detection limit (Bq/kg):	0.007			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	24100.0000 ± 11.0000		year	Pu-239 half-life: 24100 ± 11 year (BIPM-5 Table of Radionuclides)
Decay energy	5244.4300 ± 0.1400		keV	Pu-239 alpha energy: 5244.43 ± 0.14 keV (BIPM-5 Table of Radionuclides)
Particle emission energy 1	0.7079 ± 0.0010			Pu-239 probability: 0.7079 ± 0.0010 (BIPM-5 Table of Radionuclides)
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S3			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.3590 ± 0.0260			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0057 ± 0.0003		cps	4.7%
Chemical recovery				
Detection efficiency				
Correction for radioactive decay				
Mass of sample	50.0000 ± 0.0403		g-dry	0.1%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
ISOTOPE DILUTION TRACER			Nuclide	Pu-242
Activity concentration	17.2598 ± 0.4373		mBq/mL	2.5%
Net count rate	0.0110 ± 0.0004		cps	
Detection efficiency				
Correction for radioactive decay				
Mass of tracer added	2.0000 ± 0.0058		mL	
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON α -EMITTING RADIONUCLIDES			
²³⁸ Pu	Fukushima related sediment containing low levels of α - and β - γ -emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	<0.013	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net sample count rate	0.0001	0.0000	cps	
Chemical recovery	No Chemical recovery stated	No uncertainty stated		
Sample detection efficiency	No Sample detection efficiency stated	No uncertainty stated		
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	50.0000	0.0403	g-dry	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	17.2598	0.4373	mBq/mL	
Net tracer count rate	0.0058	0.0003	cps	
Tracer detection efficiency	No Tracer detection efficiency stated	No uncertainty stated		
Tracer radioactive decay	No Tracer radioactive decay stated	No uncertainty stated		
Mass of tracer added	2.0000	0.0058	mL	
Supporting information	No Supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	87.74	± 0.03	year	BIPM-5 Table of Radionuclides Vol.5
Decay energy	5593.2000	± 0.190	keV	BIPM-5 Table of Radionuclides Vol.5
α emission probability	0.7104	± 0.0006		BIPM-5 Table of Radionuclides Vol.5
Input data				
Method (including pre-concentration, if applicable):				
50 g dried sediment samples was heated at 450 °C overnight. Pu-242 tracer was added, and Pu in the sediment sample was extracted with 8M nitric acid. The extracted solution was heated and concentrated and adjusted to 8M nitric acid. Sodium nitrite was added to adjust Pu oxidation state. Pu separation and purification was carried out using anion exchange resin (Dowex 1x8 100 - 200 mesh). The purified Pu was electrodeposited on the stainless steel plate and measured by Si semiconductor detector.				
Detection system (including method of calibration):				
CANBERRA Alpha Analyst, energy calibrated with Am-243 source.				
Detection limit (Bq/kg):	0.013			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	87.7400	± 0.0300	year	BIPM-5 Table of Radionuclides Vol.5
Decay energy	5593.2000	± 0.1900	keV	BIPM-5 Table of Radionuclides Vol.5
Particle emission energy 1	0.7104	± 0.0006		BIPM-5 Table of Radionuclides Vol.5
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	<0.013	±		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0001	± 0.0000	cps	50.0%
Chemical recovery		±		
Detection efficiency		±		
Correction for radioactive decay		±		
Mass of sample	50.0000	± 0.0403	g-dry	0.1%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
ISOTOPE DILUTION TRACER			Nuclide	Pu-242
Activity concentration	17.2598	± 0.4373	mBq/mL	2.5%
Net count rate	0.0058	0.0003	cps	
Detection efficiency				
Correction for radioactive decay				
Mass of tracer added	2.0000	0.0058	mL	
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
239/240 Pu		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-S8	Summary of data for submission			
Activity concentration	0.5490 ± 0.0480		Bq kg ⁻¹		
Uncertainties					
Net sample count rate	0.0046 ± 0.0002			cps	
Chemical recovery	No Chemical recovery stated	No uncertainty stated			
Sample detection efficiency	No Sample detection efficiency stated	No uncertainty stated			
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated			
Mass of sample	50.0000 ± 0.0403			g-dry	
Supporting information	No Supporting information stated	No uncertainty stated			
Activity concentration	17.2598 ± 0.4373			mBq/ml	
Net tracer count rate	0.0058 ± 0.0003			cps	
Tracer detection efficiency	No Tracer detection efficiency stated	No uncertainty stated			
Tracer radioactive decay	No Tracer radioactive decay stated	No uncertainty stated			
Mass of tracer added	2.0000 ± 0.0058			ml	
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	24100 ± 11	year	Pu-239 half-life: 24100 ± 11 year (BIPM-5 Table of Radionuclides)		
Decay energy	5244.43 ± 0.14	keV	Pu-239 alpha energy: 5244.43 ± 0.14 keV (BIPM-5 Table of Radionuclides)		
α emission probability	0.7079 ± 0.0010		Pu-239 probability: 0.7079 ± 0.0010 (BIPM-5 Table of Radionuclides)		
Input data					
Method (including pre-concentration, if applicable):					
50 g dried sediment samples was heated at 450 °C overnight. Pu-242 tracer was added, and Pu in the sediment sample was extracted with 8M nitric acid. The extracted solution was heated and concentrated and adjusted to 8M nitric acid. Sodium nitrite was added to adjust Pu oxidation state. Pu separation and purification was carried out using anion exchange resin (Dowex 1x8 100 - 200 mesh). The purified Pu was electrodeposited on the stainless steel plate and measured by Si semiconductor detector.					
Detection system (including method of calibration):					
CANBERRA Alpha Analyst, energy calibrated with Am-243 source.					
Detection limit (Bq/kg):	0.013				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	24100.0000 ± 11.0000		year	Pu-239 half-life: 24100 ± 11 year (BIPM-5 Table of Radionuclides)	
Decay energy	5244.4300 ± 0.1400		keV	Pu-239 alpha energy: 5244.43 ± 0.14 keV (BIPM-5 Table of Radionuclides)	
Particle emission energy 1	0.7079 ± 0.0010			Pu-239 probability: 0.7079 ± 0.0010 (BIPM-5 Table of Radionuclides)	
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	T-S8				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	0.5490	± 0.0480			
Contributing parameters					
Parameter	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0046 ± 0.0002		cps	5.2%	
Chemical recovery	±				
Detection efficiency	±				
Correction for radioactive decay	±				
Mass of sample	50.0000 ± 0.0403		g-dry	0.1%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
ISOTOPE DILUTION TRACER					
Activity concentration	17.2598 ± 0.4373		mBq/ml	2.5%	
Net count rate	0.0058 ± 0.0003		cps		
Detection efficiency	±				
Correction for radioactive decay	±				
Mass of tracer added	2.0000 ± 0.0058		ml		
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

分析機関：福島県

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-101	Summary of data for submission		
Activity concentration	0.0008 ± 0.0002	Bq kg ⁻¹		
Uncertainties				
Net count rate	27.0000 ± 6.1237			cpb
Chemical recovery	0.9956 ± 0.0310			
Detection efficiency	0.2649 ± 0.0055			
Correction for radioactive decay	No radioactive decay stated	No uncertainty stated		
Mass of sample	40.9200 ± 0.7518			kg
Supporting information	No supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	No half-life stated	No uncertainty stated	No units stated	No data source stated
Decay energy	No decay energy stated	No uncertainty stated	No units stated	No data source stated
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Measurement of Y-90 chemical separated from Sr-90 and another elements with Fe-precipitation and ion-exchange method				
Detection system (including method of calibration):				
low-background beta counter calibrated with standard Y-90 source				
Detection limit (Bq/kg):	0.00052932			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life		±		
Decay energy		±		
Particle emission energy 1		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-101	Uncertainty (k=1)		
	Bq/kg			
Activity concentration	0.0008 ± 0.0002			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	27.0000 ± 6.1237		cpb	22.7%
Chemical recovery	0.9956 ± 0.0310			3.1%
Detection efficiency	0.2649 ± 0.0055			2.1%
Correction for radioactive decay	±			
Mass of sample	40.9200 ± 0.7518		kg	1.8%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-101	Summary of data for submission			
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!	
Uncertainties					
Net count rate	0.0006 ± 0.0002		s		
Principal γ-ray emission energy	795.7600	No uncertainty stated	keV		
Principal γ-ray emission probability	85.4400 ± 0.3800				
Principal γ-ray detection efficiency	2.1690 ± 0.0896				
Radioactive decay	1.1684	No uncertainty stated			
Mass of sample	20.4548 ± 0.2925		kg		
Supporting information	100.0000 ± 1.2600				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.06	No uncertainty stated	year		No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Chemical separation of caesium by using ammonium molybdophosphate (AMP) and manganese dioxide (MnO ₂) followed by gamma-ray spectrometry with a HPGe detector					
Detection system (including method of calibration):					
CANBERRA Genie 2000 (Calibration with multi-γ-gamma source)					
Detection limit (Bq/kg):	0.002				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0600 ±		year		
Principal γ-ray emission energy	795.7600 ±		keV		
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-101				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	ND ±				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0006 ± 0.0002		s	36.3%	
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	2.1690 ± 0.0896			4.1%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)					
Detection efficiency 4 (if used)					
Detection efficiency 5 (if used)					
Correction for radioactive decay	1.1684			0.0%	
Mass of sample	20.4548 ± 0.2925		kg	1.4%	
Chemical separation	100.0000 ± 1.2600			1.3%	
Weight measurement	46.3700 ± 0.0199		g	0.0%	
Height measurement	1.3030 ± 0.0027		cm	0.2%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-101	Summary of data for submission			
Activity concentration	0.0163 ± 0.0011		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.0083 ± 0.0004				
Principal γ-ray emission energy	661.6400	No uncertainty stated	keV		
Principal γ-ray emission probability	85.1000 ± 0.2000				
Principal γ-ray detection efficiency	2.9620 ± 0.1223				
Radioactive decay	1.0107	No uncertainty stated			
Mass of sample	20.4548 ± 0.2925		kg		
Supporting information	100.0000 ± 1.2600				
Method	Analysis method stated:				
Detection system	Detection system stated:				
Half-life	30.2	No uncertainty stated	year		No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Chemical separation of caesium by using ammonium molybdophosphate(AMP) and manganese dioxide(MnO2) followed by gamma-ray spectrometry with a HPGe detector					
Detection system (including method of calibration):					
CANBERRA Genie 2000 (Calibration with multi-γ-source)					
Detection limit (Bq/kg):	0.0013				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	30.2000 ±		year		
Principal γ-ray emission energy	661.6400 ±		keV		
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	M-101				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0163 ± 0.0011				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0083 ± 0.0004		s	3.6%	
Principal γ-ray emission probability	85.1000 ± 0.2000			0.2%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	2.9620 ± 0.1223			4.1%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	1.0107			0.0%	
Mass of sample	20.4548 ± 0.2925		kg	1.4%	
Chemical separation	100.0000 ± 1.2600			1.3%	
Weight measurement	46.3700 ± 0.0199		g	0.0%	
Height measurement	1.3030 ± 0.0027		cm	0.2%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-102	Summary of data for submission		
Activity concentration	0.0009 ± 0.0002	Bq kg ⁻¹		
Uncertainties				
Net count rate	31.0000 ± 6.4420		cph	
Chemical recovery	0.9965 ± 0.0320			
Detection efficiency	0.2648 ± 0.0055			
Radioactive decay	No radioactive decay stated	No uncertainty stated		
Mass of sample	40.9200 ± 0.7510		kg	
Supporting information	No supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	No half-life stated	No uncertainty stated	No units stated	No data source stated
Decay energy	No decay energy stated	No uncertainty stated	No units stated	No data source stated
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Measurement of Y-90 chemical-separated from Sr-90 and another elements with Fe-precipitation and ion-exchange method				
Detection system (including method of calibration):				
Low-background beta counter calibrated with standard Y-90 source				
Detection limit (Bq/kg):	0.000562381			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life		±		
Decay energy		±		
Particle emission energy 1		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102			
	Bq/kg			
Activity concentration	0.0009	± 0.0002		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	31.0000	± 6.4420	cph	20.8%
Chemical recovery	0.9965	± 0.0320		3.2%
Detection efficiency	0.2648	± 0.0055		2.1%
Correction for radioactive decay		±		
Mass of sample	40.9200	± 0.7510	kg	1.8%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	M-102	Summary of data for submission			
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!	
Uncertainties					
Net count rate	0.0004 ± 0.0002		s	Warning! Net count rate uncertainty is >50%	
Principal γ-ray emission energy	795.7600 ± 0.3800	No uncertainty stated	keV		
Principal γ-ray emission probability	85.4400 ± 0.3800				
Principal γ-ray detection efficiency	2.1860 ± 0.0903				
Radioactive decay	1.1695 ± 0.2926	No uncertainty stated			
Mass of sample	20.4591 ± 1.2560		kg		
Supporting information	100.0000 ± 1.2600				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	2.66 ± 0.0000	No uncertainty stated	year	No data source stated	
Input data					
Method (including pre-concentration, if applicable):					
Chemical separation of caesium by using ammonium molybdophosphate(AMP) and manganese dioxide(MnO2) followed by gamma-ray spectrometry with a HPGe detector					
Detection system (including method of calibration):					
CANBERRA Genie 2000 (Calibration with multi-γ source)					
Detection limit (Bq/kg)	0.0019				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	2.6600 ± 0.0000		year		
Principal γ-ray emission energy	795.7600 ± 0.3800		keV		
γ-ray emission energy 2 (if used)					
γ-ray emission energy 3 (if used)					
γ-ray emission energy 4 (if used)					
γ-ray emission energy 5 (if used)					
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-102				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	ND ± 0.0000				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0004 ± 0.0002		s	52.0%	
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%	
Emission probability 2 (if used)					
Emission probability 3 (if used)					
Emission probability 4 (if used)					
Emission probability 5 (if used)					
Principal γ-ray detection efficiency	2.1860 ± 0.0903			4.1%	
Detection efficiency 2 (if used)					
Detection efficiency 3 (if used)					
Detection efficiency 4 (if used)					
Detection efficiency 5 (if used)					
Correction for radioactive decay	1.1695 ± 0.2926			0.0%	
Mass of sample	20.4591 ± 1.2560		kg	1.4%	
Chemical separation	100.0000 ± 1.2600			1.3%	
Weight measurement	46.2800 ± 0.0204		g	0.0%	
Height measurement	1.2560 ± 0.0025		cm	0.2%	
Other parameter (only if included in calculation)					
Other parameter (only if included in calculation)					

IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON:				
β-/γ-EMITTING RADIONUCLIDES				
Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides				
Outcomes				
Laboratory code	M-102			
Summary of data for submission				
Activity concentration	0.0128 ± 0.0009 Bq kg ⁻¹			
Uncertainties				
Net count rate	0.0066 ± 0.0004 s			
Principal γ-ray emission energy	661.6400 ± No uncertainty stated keV			
Principal γ-ray emission probability	85.1000 ± 0.2000			
Principal γ-ray detection efficiency	2.9900 ± 0.1235			
Radioactive decay	1.0108 ± No uncertainty stated			
Mass of sample	20.4591 ± 0.2926 kg			
Supporting information	100.0000 ± 1.2600			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	30.2 ± No uncertainty stated year			
	No data source stated			
Input data				
Method (including pre-concentration, if applicable):				
Chemical separation of caesium by using ammonium molybdophosphate (AMP) and manganese dioxide (MnO ₂) followed by gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-gamma source)				
Detection limit (Bq/kg):	0.0013			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.2000 ±		year	
Principal γ-ray emission energy	661.6400 ±		keV	
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-102			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0128 ± 0.0009			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0066 ± 0.0004		s	5.3%
Principal γ-ray emission probability	85.1000 ± 0.2000			0.2%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	2.9900 ± 0.1235			4.1%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay	1.0108			0.0%
Mass of sample	20.4591 ± 0.2926		kg	1.4%
Chemical separation	100.0000 ± 1.2600			1.3%
Weight measurement	46.2800 ± 0.0204		g	0.0%
Height measurement	1.2560 ± 0.0025		cm	0.2%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	0.0007 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	25.0000	± 5.9582	cpb	
Chemical recovery	0.9829	± 0.0274		
Detection efficiency	0.2648	± 0.0055		
Radioactive decay	No Radioactive decay stated	No uncertainty stated		
Mass of sample	40.8800	± 0.7511	kg	
Supporting information	No Supporting information stated			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	No half-life stated	No uncertainty stated	No units stated	No data source stated
Decay energy	No decay energy stated	No uncertainty stated	No units stated	No data source stated
β emission probability	No β emission probability stated	No uncertainty stated		No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Measurement of Y-90 chemical-separated from Sr-90 and another elements with Fe-precipitation and ion-exchange method				
Detection system (including method of calibration):				
Low-background beta counter calibrated with standard Y-90 source				
Detection limit (Bq/kg):	0.000533603			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life		±		
Decay energy		±		
Particle emission energy 1		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	0.0007	± 0.0002		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	25.0000	± 5.9582	cpb	23.8%
Chemical recovery	0.9829	± 0.0274		2.8%
Detection efficiency	0.2648	± 0.0055		2.1%
Correction for radioactive decay		±		
Mass of sample	40.8800	± 0.7511	kg	1.8%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related seawater containing low levels of β- and β-γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net count rate	0.0007 ± 0.0002		s	
Principal γ-ray emission energy	795.7600 ± 0.3800	No uncertainty stated	keV	
Principal γ-ray emission probability	85.4400 ± 0.3800			
Principal γ-ray detection efficiency	2.1760 ± 0.0899			
Radioactive decay	1.1724 ± 0.2923	No uncertainty stated		
Mass of sample	20.4371 ± 1.2600		kg	
Supporting information	100.0000 ± 1.2600			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.05	No uncertainty stated	year	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Chemical separation of caesium by using ammonium molybdophosphate (AMP) and manganese dioxide (MnO ₂) followed by gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-γ gamma source)				
Detection limit (Bq/kg):	0.0018			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	2.0600	±	year	
Principal γ-ray emission energy	795.7600	±	keV	
γ-ray emission energy 2 (if used)		±		
γ-ray emission energy 3 (if used)		±		
γ-ray emission energy 4 (if used)		±		
γ-ray emission energy 5 (if used)		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103			
	Bq/kg		Uncertainty (k=1)	
Activity concentration	ND	±		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0007 ± 0.0002		s	30.5%
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%
Emission probability 2 (if used)		±		
Emission probability 3 (if used)		±		
Emission probability 4 (if used)		±		
Emission probability 5 (if used)		±		
Principal γ-ray detection efficiency	2.1760 ± 0.0899			4.1%
Detection efficiency 2 (if used)		±		
Detection efficiency 3 (if used)		±		
Detection efficiency 4 (if used)		±		
Detection efficiency 5 (if used)		±		
Correction for radioactive decay	1.1724			0.0%
Mass of sample	20.4371 ± 0.2923		kg	1.4%
Chemical separation	100.0000 ± 1.2600			1.3%
Weight measurement	46.2400 ± 0.0203		g	0.0%
Height measurement	1.2830 ± 0.0027		cm	0.2%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON: β-γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-103	Summary of data for submission		
Activity concentration	0.0115 ± 0.0008		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0059 ± 0.0003		s	
Principal γ-ray emission energy	661.6400	No uncertainty stated	keV	
Principal γ-ray emission probability	85.1000 ± 0.2000			
Principal γ-ray detection efficiency	2.9740 ± 0.1228			
Radioactive decay	1.0109	No uncertainty stated		
Mass of sample	20.4371 ± 0.2923		kg	
Supporting information	100.0000 ± 1.2600			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	56.2	No uncertainty stated	year	No data source stated

Input data				
Method (including pre-concentration, if applicable):				
Chemical separation of caesium by using ammonium molybdophosphate(AMP) and manganese dioxide(MnO2) followed by gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-γ source)				
Detection limit (Bq/kg):	0.0012			

Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.2000 ±		year	
Principal γ-ray emission energy	661.6400 ±		keV	
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			

RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-103	Uncertainty (k=1)		
Activity concentration	Bq/kg	0.0115 ± 0.0008		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0059 ± 0.0003		s	5.1%
Principal γ-ray emission probability	85.1000 ± 0.2000			0.2%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	2.9740 ± 0.1228			4.1%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	1.0109			0.0%
Mass of sample	20.4371 ± 0.2923		kg	1.4%
Chemical separation	100.0000 ± 1.2600			1.3%
Weight measurement	46.2400 ± 0.0203		g	0.0%
Height measurement	1.2830 ± 0.0027		cm	0.2%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON: β-EMITTING RADIONUCLIDES			
⁹⁰ Sr	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	M-104	Summary of data for submission		
Activity concentration	0.0008 ± 0.0002		Bq kg ⁻¹	
Uncertainties				
Net count rate	25.0000 ± 5.9582			cpb
Chemical recovery	0.9255 ± 0.0277			
Detection efficiency	0.2648 ± 0.0055			
Radioactive decay	No radioactive decay stated	No uncertainty stated		
Mass of sample	40.8400 ± 0.7504			kg
Supporting information	No supporting information stated	No uncertainty stated		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	No half-life stated	No uncertainty stated		No units stated No data source stated
Decay energy	No decay energy stated	No uncertainty stated		No units stated No data source stated
β emission probability	No β emission probability stated	No uncertainty stated		No units stated No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Measurement of Y-90 chemical-separated from Sr-90 and another elements with Fe-precipitation and ion-exchange method				
Detection system (including method of calibration):				
low-background beta counter calibrated with standard Y-90 source				
Detection limit (Bq/kg):	0.000573544			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life		±		
Decay energy		±		
Particle emission energy I		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	M-104	Uncertainty (k=1)		
	Bq/kg			
Activity concentration	0.0008 ± 0.0002			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	25.0000 ± 5.9582		cpb	23.8%
Chemical recovery	0.9255 ± 0.0277			3.0%
Detection efficiency	0.2648 ± 0.0055			2.1%
Correction for radioactive decay	±			
Mass of sample	40.8400 ± 0.7504		kg	1.8%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-IIC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
134Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
		Outcomes			
Laboratory code	M-104	Summary of data for submission			
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!	
Uncertainties					
Net count rate	-0.0002 ± 0.0002		s		
Principal γ-ray emission energy	795.7600 ± No uncertainty stated		keV		
Principal γ-ray emission probability	85.4400 ± 0.3800				
Principal γ-ray detection efficiency	2.1940 ± 0.0906				
Radioactive decay	1.1737 ± No uncertainty stated				
Mass of sample	20.4240 ± 0.2921		kg		
Supporting information	100.0000 ± 1.2600				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	7.06 ± No uncertainty stated		year		No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Chemical separation of caesium by using ammonium molybdophosphate (AMP) and manganese dioxide (MnO ₂) followed by gamma-ray spectrometry with a HPGe detector					
Detection system (including method of calibration):					
CANBERRA Genie 2000 (Calibration with multi-γ source)					
Detection limit (Bq/kg):	0.0022				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	2.0600 ±		year		
Principal γ-ray emission energy	795.7600 ±		keV		
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-104				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	ND ±				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	-0.0002 ± 0.0002		s	137.7%	
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	2.1940 ± 0.0906			4.1%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	1.1737 ±			0.0%	
Mass of sample	20.4240 ± 0.2921		kg	1.4%	
Chemical separation	100.0000 ± 1.2600			1.3%	
Weight measurement	46.0660 ± 0.0203		g	0.0%	
Height measurement	1.2350 ± 0.0025		cm	0.2%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-/γ-EMITTING RADIONUCLIDES			
137Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Laboratory code		Outcomes			
M-104		Summary of data for submission			
Activity concentration		0.0072 ± 0.0007		Bq kg ⁻¹	
Uncertainties					
Net count rate	0.0037 ± 0.0003			s	
Principal γ-ray emission energy	661.6400	No uncertainty stated		keV	
Principal γ-ray emission probability	85.1000 ± 0.2000				
Principal γ-ray detection efficiency	3.0030 ± 0.1240				
Radioactive decay	1.0110	No uncertainty stated			
Mass of sample	20.4240 ± 0.2921			kg	
Supporting information		100.0000 ± 1.2600			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.2	No uncertainty stated		year	No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Chemical separation of caesium by using ammonium molybdophosphate (AMF) and manganese dioxide (MnO ₂) followed by gamma-ray spectrometry with a HPGe detector					
Detection system (including method of calibration):					
CANBERRA Genie 2000 (Calibration with multi-gamma source)					
Detection limit (Bq/kg):		0.0013			
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	30.2000	±	year		
Principal γ-ray emission energy	661.6400	±	keV		
γ-ray emission energy 2 (if used)		±			
γ-ray emission energy 3 (if used)		±			
γ-ray emission energy 4 (if used)		±			
γ-ray emission energy 5 (if used)		±			
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	M-104				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0072 ± 0.0007				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0037 ± 0.0003		s	8.1%	
Principal γ-ray emission probability	85.1000 ± 0.2000			0.2%	
Emission probability 2 (if used)		±			
Emission probability 3 (if used)		±			
Emission probability 4 (if used)		±			
Emission probability 5 (if used)		±			
Principal γ-ray detection efficiency	3.0030 ± 0.1240			4.1%	
Detection efficiency 2 (if used)		±			
Detection efficiency 3 (if used)					
Detection efficiency 4 (if used)					
Detection efficiency 5 (if used)					
Correction for radioactive decay	1.0110			0.0%	
Mass of sample	20.4240 ± 0.2921		kg	1.4%	
Chemical separation	100.0000 ± 1.2600			1.3%	
Weight measurement	46.0600 ± 0.0203		g	0.0%	
Height measurement	1.2350 ± 0.0025		cm	0.2%	
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON β-EMITTING RADIONUCLIDES			
⁹⁰ Sr		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-D1	Summary of data for submission			
Activity concentration	0.0006 ± 0.0002		Bq kg ⁻¹		
Uncertainties					
Net count rate	19.0000 ± 5.4314			cph	
Chemical recovery	0.9633 ± 0.0310				
Detection efficiency	0.2648 ± 0.0055				
Radioactive decay	No Radioactive decay stated	No uncertainty stated			
Mass of sample	40.8400 ± 0.7504			kg	
Supporting information	No Supporting information stated	No uncertainty stated			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	No half-life stated	No uncertainty stated		No units stated	No data source stated
Decay energy	No decay energy stated	No uncertainty stated		No units stated	No data source stated
β emission probability	No β emission probability stated	No uncertainty stated			No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Measurement of Y-90 chemical- separated from Sr-90 and another elements with Fe-precipitation and ion-exchange method					
Detection system (including method of calibration):					
low-background beta counter calibrated with standard Y-90 source					
Detection limit (Bq/kg):	0.00050782				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life		±			
Decay energy		±			
Particle emission energy 1		±			
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	T-D1				
	Bq/kg	Uncertainty (k=1)			
Activity concentration	0.0006 ± 0.0002				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	19.0000 ± 5.4314		cph	28.6%	
Chemical recovery	0.9633 ± 0.0310			3.2%	
Detection efficiency	0.2648 ± 0.0055			2.1%	
Correction for radioactive decay					
Mass of sample	40.8400 ± 0.7504		kg	1.8%	
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			

Nuclide:	IAEA-ILC-2019-01/RMI INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-D1	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties				
Net count rate	0.0000 ± 0.0002		s	Warning! Net count rate uncertainty is >50%
Principal γ-ray emission energy	795.7600 ± No uncertainty stated		keV	
Principal γ-ray emission probability	85.4400 ± 0.3800			
Principal γ-ray detection efficiency	2.1360 ± 0.0861			
Radioactive decay	1.1739 ± No uncertainty stated			
Mass of sample	20.4285 ± 0.2921		kg	
Supporting information	100.0000 ± 1.2600			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.06 ± No uncertainty stated		year	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
Chemical separation of caesium by using ammonium molybdophosphate(AMP) and manganese dioxide(MnO2) followed by gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-gamma source)				
Detection limit (Bq/kg):	0.0022			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	2.0600 ±		year	
Principal γ-ray emission energy	795.7600 ±		keV	
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number	T-D1			
	Bq/kg	Uncertainty (k=1)		
Activity concentration	ND ±			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0000 ± 0.0002		s	640.9%
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	2.1360 ± 0.0861			4.0%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay	1.1739 ±			0.0%
Mass of sample	20.4285 ± 0.2921		kg	1.4%
Chemical separation	100.0000 ± 1.2600			1.3%
Weight measurement	46.1200 ± 0.0203		g	0.0%
Height measurement	1.3500 ± 0.0030		cm	0.2%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima related seawater containing low levels of β- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-D1	Summary of data for submission			
Activity concentration	0.0030 ± 0.0005		Bq kg ⁻¹		
Uncertainties					
Net count rate	0.0015	± 0.0003		s	
Principal γ-ray emission energy	661.6400	No uncertainty stated		keV	
Principal γ-ray emission probability	85.1000	± 0.2000			
Principal γ-ray detection efficiency	2.9160	± 0.1175			
Radioactive decay	1.0110	No uncertainty stated			
Mass of sample	20.4285	± 0.2921		kg	
Supporting information	100.0000	± 1.2600			
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.2	No uncertainty stated		year	No data source stated
Input data					
Method (including pre-concentration, if applicable):					
Chemical separation of caesium by using ammonium molybdophosphate (AMP) and manganese dioxide (MnO ₂) followed by gamma-ray spectrometry with a HPGe detector					
Detection system (including method of calibration):					
CANBERRA Genie 2000 (Calibration with multi-γ source)					
Detection limit (Bq/kg):	0.0014				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	30.2000	±	year		
Principal γ-ray emission energy	661.6400	±	keV		
γ-ray emission energy 2 (if used)		±			
γ-ray emission energy 3 (if used)		±			
γ-ray emission energy 4 (if used)		±			
γ-ray emission energy 5 (if used)		±			
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number	T-D1				
Activity concentration	Bq/kg	0.0030 ± 0.0005	Uncertainty (k=1)		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0015	± 0.0003	s	17.1%	
Principal γ-ray emission probability	85.1000	± 0.2000		0.2%	
Emission probability 2 (if used)		±			
Emission probability 3 (if used)		±			
Emission probability 4 (if used)		±			
Emission probability 5 (if used)		±			
Principal γ-ray detection efficiency	2.9160	± 0.1175		4.0%	
Detection efficiency 2 (if used)		±			
Detection efficiency 3 (if used)					
Detection efficiency 4 (if used)					
Detection efficiency 5 (if used)					
Correction for radioactive decay	1.0110			0.0%	
Mass of sample	20.4285	± 0.2921	kg	1.4%	
Chemical separation	100.0000	± 1.2600		1.3%	
Weight measurement	46.1200	± 0.0203	g	0.0%	
Height measurement	1.3500	± 0.0030	cm	0.2%	
Other parameter (only if included in calculation)		±			
Other parameter (only if included in calculation)		±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	F-P04	Summary of data for submission		
Activity concentration	2.5844 ± 0.3799	Bq kg ⁻¹		
Uncertainties				
Net count rate	0.0027 ± 0.0004	s		
Principal γ-ray emission energy	795.7600	No uncertainty stated		
Principal γ-ray emission probability	85.4400 ± 0.3800	keV		
Principal γ-ray detection efficiency	1.4220 ± 0.0586			
Radioactive decay	1.1279	No uncertainty stated		
Mass of sample	0.0956 ± 0.0000	kg		
Supporting information	3.8480 ± 0.0062			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.06	No uncertainty stated		year
		No data source stated		
Input data				
Method (including pre-concentration, if applicable):				
gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-gamma source)				
Detection limit (Bq/kg):	1.0074			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	2.0600 ±		year	
Principal γ-ray emission energy	795.7600 ±		keV	
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	F-P04			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	2.5844 ± 0.3799			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0027 ± 0.0004		s	14.1%
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	1.4220 ± 0.0586			4.1%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	1.1279			0.0%
Mass of sample	0.0956 ± 0.0000		kg	0.0%
Height measurement	3.8480 ± 0.0062		cm	0.2%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	F-P04	Summary of data for submission		
Activity concentration	28.0310 ± 1.2730	Bq kg ⁻¹		
Uncertainties				
Net count rate	0.0412 ± 0.0008		s	
Principal γ-ray emission energy	661.6400	No uncertainty stated	keV	
Principal γ-ray emission probability	85.1000 ± 0.2000			
Principal γ-ray detection efficiency	1.8220 ± 0.0751			
Radioactive decay	1.0083	No uncertainty stated		
Mass of sample	0.0956 ± 0.0000		kg	
Supporting information	3.8480 ± 0.0062			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	30.2	No uncertainty stated	year	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-gamma source)				
Detection limit (Bq/kg):	0.67329			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	30.2000 ±		year	
Principal γ-ray emission energy	661.6400 ±		keV	
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	F-P04			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	28.0310 ± 1.2730			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0412 ± 0.0008		s	1.9%
Principal γ-ray emission probability	85.1000 ± 0.2000			0.2%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	1.8220 ± 0.0751			4.1%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	1.0083			0.0%
Mass of sample	0.0956 ± 0.0000		kg	0.0%
Height measurement	3.8480 ± 0.0062		cm	0.2%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α -EMITTING RADIONUCLIDES			
^{238}Pu	Fukushima related sediment containing low levels of α - and β - γ -emitting radionuclides			
Outcomes				
Laboratory code	F-P04	Summary of data for submission		
Activity concentration	0.0072 ± 0.0014	Bq kg ⁻¹		
Uncertainties				
Net sample count rate	0.0109 ± 0.0021		cpm	
Chemical recovery	79.9010 ± 2.2370			
Sample detection efficiency	0.3146 ± 0.0000			
Sample radioactive decay	No Sample radioactive decay stated			No uncertainty stated
Mass of sample	100.1000 ± 0.0200		g	
Supporting information	No Supporting information stated			No uncertainty stated
Activity concentration	0.9533 ± 0.0062		dpm/mL	
Net tracer count rate	0.4793 ± 0.0134		cpm	
Tracer detection efficiency	0.3146 ± 0.0000			
Tracer radioactive decay	0.9533 ± 0.0001			
Mass of tracer added	2.0000 ± 0.0100		mL	
Supporting information	0.3146 ± 0.0000			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	87.7 ±	0	year	Radioisotope pocket data book 11th edition
Decay energy	5.499 ±	0	MeV	Radioisotope pocket data book 11th edition
α emission probability	99.9 ±	0		Radioisotope pocket data book 11th edition
Input data				
Method (including pre-concentration, if applicable):				
After conditioning plutonium valence using reducing agent, purified plutonium by anion exchange column was adhered to stainless steel plate electrically.				
Detection system (including method of calibration):				
Silicon semiconductor detector calibrated by alpha reference source certified by LRQA.				
Detection limit (Bq/kg):	0.00419			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	87.7000	± 0.0000	year	Radioisotope pocket data book 11th edition
Decay energy	5.4990	± 0.0000	MeV	Radioisotope pocket data book 11th edition
Particle emission energy 1	99.9000	± 0.0000		Radioisotope pocket data book 11th edition
RESULTS				
Reference time and date	2019/6/1	12:00		
Sample number:	F-P04			
	Bq/kg		Uncertainty (k=1)	
Activity concentration (dry)	0.0072	± 0.0014		
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0109 ± 0.0021		cpm	19.2%
Chemical recovery	79.9010 ± 2.2370			2.8%
Detection efficiency	0.3146 ± 0.0000			0.0%
Correction for radioactive decay	±			
Mass of sample	100.1000 ± 0.0200		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
ISOTOPE DILUTION TRACER				
Activity concentration	0.9533 ± 0.0062		dpm/mL	0.7%
Net count rate	0.4793 ± 0.0134		cpm	
Detection efficiency	0.3146 ± 0.0000			
Correction for radioactive decay	0.9533 ± 0.0001			
Mass of tracer added	2.0000 ± 0.0100		mL	
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
239/240 Pu		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	F-P04	Summary of data for submission			
Activity concentration	0.3994 ± 0.0192	Bq kg ⁻¹			
Uncertainties					
Net sample count rate	0.6030 ± 0.0151		cpm		
Chemical recovery	79.9010 ± 2.2370				
Sample detection efficiency	31.4610 ± 0.0000				
Sample radioactive decay	No sample radioactive decay stated		No uncertainty stated		
Mass of sample	100.1000 ± 0.0200		g		
Supporting information	No Supporting information stated		No uncertainty stated		
Activity concentration	0.9533 ± 0.0062		dpm/ml		
Net tracer count rate	0.4793 ± 0.0134		cpm		
Tracer detection efficiency	0.3146 ± 0.0000				
Tracer radioactive decay	0.9533 ± 0.0001				
Mass of tracer added	2.0000 ± 0.0100		ml		
Supporting information	0.3146 ± 0.0000				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	6564 ±	0	year		Radioisotope pocket data book 11th edition
Decay energy	5.15 ±	0	MeV		Radioisotope pocket data book 11th edition
α emission probability	99.9 ±	0			Radioisotope pocket data book 11th edition
Input data					
Method (including pre-concentration, if applicable):					
After conditioning plutonium valence using reducing agent, purified plutonium by anion exchange column was adhered to stainless steel plate electrically.					
Detection system (including method of calibration):					
Silicon semiconductor detector calibrated by alpha reference source certified by LRQA.					
Detection limit (Bq/kg):	0.04495				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half-life	6564.0000 ± 0.0000		year	Radioisotope pocket data book 11th edition	
Decay energy	5.1500 ± 0.0000		MeV	Radioisotope pocket data book 11th edition	
Particle emission energy	99.9000 ± 0.0000			Radioisotope pocket data book 11th edition	
RESULTS					
Reference time and date	2019/6/1 12:00				
Sample number:	F-P04				
	Bq/kg		Uncertainty (k=1)		
Activity concentration (dry)	0.3994 ± 0.0192				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.6030 ± 0.0151		cpm	2.5%	
Chemical recovery	79.9010 ± 2.2370			2.8%	
Detection efficiency	31.4610 ± 0.0000			0.0%	
Correction for radioactive decay					
Mass of sample	100.1000 ± 0.0200		g	0.0%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
ISOTOPE DILUTION TRACER					
Activity concentration	0.9533 ± 0.0062		dpm/ml		0.7%
Net count rate	0.4793 ± 0.0134		cpm		
Detection efficiency	0.3146 ± 0.0000				
Correction for radioactive decay	0.9533 ± 0.0001				
Mass of tracer added	2.0000 ± 0.0100		ml		
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-JLC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S3	Summary of data for submission		
Activity concentration	ND	No uncertainty stated	Bq kg ⁻¹	#VALUE!
Uncertainties:				
Net count rate	0.0005 ± 0.0003		s	Warning! Net count rate uncertainty is >50%
Principal γ-ray emission energy	795.7600 ± 0.3800	No uncertainty stated	keV	
Principal γ-ray emission probability	85.4400 ± 0.3800			
Principal γ-ray detection efficiency	1.3020 ± 0.0536			
Radioactive decay	1.1290 ± 0.0000	No uncertainty stated		
Mass of sample	0.1192 ± 0.0000		kg	
Supporting information	4.4270 ± 0.0053			
Method:	Analysis method stated			
Detection system:	Detection system stated			
Half-life	2.06 ± 0.0000	No uncertainty stated	year	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-gamma source)				
Detection limit (Bq/kg):	0.03965			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half life	2.0600 ±		year	
Principal γ-ray emission energy	795.7600 ±		keV	
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S3			
	Bq/kg		Uncertainty (k=1)	
Activity concentration (dry)	ND ±			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0005 ± 0.0003		s	64.7%
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	1.3020 ± 0.0536			4.1%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay	1.1290 ± 0.0000			0.0%
Mass of sample	0.1192 ± 0.0000		kg	0.0%
Height measurement	4.4270 ± 0.0053		cm	0.1%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:		IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs		Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes					
Laboratory code	T-S3	Summary of data for submission			
Activity concentration	7.5002 ± 0.4206	Bq kg ⁻¹			
Uncertainties					
Net count rate	0.0124 ± 0.0005	s			
Principal γ-ray emission energy	661.6400 ± 0.2000	keV			
Principal γ-ray emission probability	85.1000 ± 0.2000				
Principal γ-ray detection efficiency	1.6510 ± 0.0680				
Radioactive decay	1.0083 ± 0.0000	No uncertainty stated			
Mass of sample	0.1192 ± 0.0000	kg			
Supporting information	4.4270 ± 0.0053				
Method	Analysis method stated				
Detection system	Detection system stated				
Half-life	30.2	No uncertainty stated		year	No data source stated
Input data					
Method (including pre-concentration, if applicable):					
gamma-ray spectrometry with a HPGe detector					
Detection system (including method of calibration):					
CANBERRA Genie 2000 (Calibration with multi-gamma source)					
Detection limit (Bq/kg):	0.51059				
Nuclear data used					
Parameter	Value	Uncertainty	Units	Data source	
Half life	30.2000 ±		year		
Principal γ-ray emission energy	661.6400 ±		keV		
γ-ray emission energy 2 (if used)	±				
γ-ray emission energy 3 (if used)	±				
γ-ray emission energy 4 (if used)	±				
γ-ray emission energy 5 (if used)	±				
RESULTS					
Reference time and date	2019-06-03 12:00:00 UTC				
Sample number:	T-S3				
	Bq/kg	Uncertainty (k=1)			
Activity concentration (dry)	7.5002 ± 0.4206				
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty	
Net count rate	0.0124 ± 0.0005		s	3.8%	
Principal γ-ray emission probability	85.1000 ± 0.2000			0.2%	
Emission probability 2 (if used)	±				
Emission probability 3 (if used)	±				
Emission probability 4 (if used)	±				
Emission probability 5 (if used)	±				
Principal γ-ray detection efficiency	1.6510 ± 0.0680			4.1%	
Detection efficiency 2 (if used)	±				
Detection efficiency 3 (if used)	±				
Detection efficiency 4 (if used)	±				
Detection efficiency 5 (if used)	±				
Correction for radioactive decay	1.0083 ± 0.0000			0.0%	
Mass of sample	0.1192 ± 0.0000		kg	0.0%	
Height measurement	4.4270 ± 0.0053		cm	0.1%	
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				
Other parameter (only if included in calculation)	±				

Nuclide:	IAEA-ILC-2019-01/RMI, INTERLABORATORY COMPARISON: α -EMITTING RADIONUCLIDES			
²³⁸ Pu	Fukushima related sediment containing low levels of α - and β - γ -emitting radionuclides			
Outcomes				
Laboratory code	T-S3	Summary of data for submission		
Activity concentration	0.0051 \pm 0.0012		Bq kg ⁻¹	
Uncertainties				
Net sample count rate	0.0075 \pm 0.0018		cpm	
Chemical recovery	77.4110 \pm 2.1890			
Sample detection efficiency	31.7870 \pm 0.0000			
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	100.0500 \pm 0.0200		g	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	0.9533 \pm 0.0062		dpm/mL	
Net tracer count rate	0.4691 \pm 0.0133		cpm	
Tracer detection efficiency	0.3179 \pm 0.0000			
Tracer radioactive decay	0.9533 \pm 0.0001			
Mass of tracer added	2.0000 \pm 0.0100		mL	
Supporting information	0.2179 \pm 0.0000			
Method:	Analysis method stated			
Detection system	Detection system stated			
Half-life	87.7 \pm 0	year		Radioisotope pocket data book 11th edition
Decay energy	5.4990 \pm 0	MeV		Radioisotope pocket data book 11th edition
α emission probability	99.9 \pm 0			Radioisotope pocket data book 11th edition
Input data				
Method (including pre-concentration, if applicable):				
After conditioning plutonium valence using reducing agent, purified plutonium by anion exchange column was adhered to stainless steel plate electrically.				
Detection system (including method of calibration):				
Silicon semiconductor detector calibrated by alpha reference source certified by LRQA.				
Detection limit (Bq/kg):	0.0036			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	87.7000 \pm 0.0000		year	Radioisotope pocket data book 11th edition
Decay energy	5.4990 \pm 0.0000		MeV	Radioisotope pocket data book 11th edition
Particle emission energy 1	99.9000 \pm 0.0000			Radioisotope pocket data book 11th edition
RESULTS				
Reference time and date	2019/6/1 12:00			
Sample number:	T-S3			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.0051 \pm 0.0012			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0075 \pm 0.0018		cpm	23.5%
Chemical recovery	77.4110 \pm 2.1890			2.8%
Detection efficiency	31.7870 \pm 0.0000			0.0%
Correction for radioactive decay	\pm			
Mass of sample	100.0500 \pm 0.0200		g	0.0%
Other parameter (only if included in calculation)	\pm			
Other parameter (only if included in calculation)	\pm			
Other parameter (only if included in calculation)	\pm			
ISOTOPE DILUTION TRACER			Nuclide	Pu-242
Activity concentration	0.9533 \pm 0.0062		dpm/mL	0.7%
Net count rate	0.4691 \pm 0.0133		cpm	
Detection efficiency	0.3179 \pm 0.0000			
Correction for radioactive decay	0.9533 \pm 0.0001			
Mass of tracer added	2.0000 \pm 0.0100		mL	
Other parameter (only if included in calculation)	\pm			
Other parameter (only if included in calculation)	\pm			
Other parameter (only if included in calculation)	\pm			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
^{239/240} Pu	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S3	Summary of data for submission		
Activity concentration	0.3869 ± 0.0186	Bq kg ⁻¹		
Uncertainties				
Net sample count rate	0.5715 ± 0.0146		cpm	
Chemical recovery	77.4110 ± 2.1890			
Sample detection efficiency	31.7870 ± 0.0000			
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	100.0500 ± 0.0200		g	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	0.9533 ± 0.0062		dpm/mL	
Net tracer count rate	0.4691 ± 0.0133		cpm	
Tracer detection efficiency	0.3179 ± 0.0000			
Tracer radioactive decay	0.9533 ± 0.0001			
Mass of tracer added	2.0000 ± 0.0100		mL	
Supporting information	0.3179 ± 0.0000			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	6564 ±	0 year	Radioisotope pocket data book 11th edition	
Decay energy	5.15 ±	0 MeV	Radioisotope pocket data book 11th edition	
α emission probability	99.9 ±	0	Radioisotope pocket data book 11th edition	
Input data				
Method (including pre-concentration, if applicable):				
After conditioning plutonium valence using reducing agent, purified plutonium by anion exchange column was adhered to stainless steel plate electrically.				
Detection system (including method of calibration):				
Silicon semiconductor detector calibrated by alpha reference source certified by LRQA.				
Detection limit (Bq/kg):	0.04428			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	6564.0000 ± 0.0000		year	Radioisotope pocket data book 11th edition
Decay energy	5.1500 ± 0.0000		MeV	Radioisotope pocket data book 11th edition
Particle emission energy 1	99.9000 ± 0.0000			Radioisotope pocket data book 11th edition
RESULTS				
Reference time and date	2019/6/1 12:00			
Sample number:	T-S3			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.3869 ± 0.0186			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.5715 ± 0.0146		cpm	2.6%
Chemical recovery	77.4110 ± 2.1890			2.8%
Detection efficiency	31.7870 ± 0.0000			0.0%
Correction for radioactive decay	±			
Mass of sample	100.0500 ± 0.0200		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
ISOTOPE DILUTION TRACER				
Activity concentration	0.9533 ± 0.0062		Nuclide	Pu-242
Net count rate	0.4691 ± 0.0133		dpm/mL	0.7%
Detection efficiency	0.3179 ± 0.0000		cpm	
Correction for radioactive decay	0.9533 ± 0.0001			
Mass of tracer added	2.0000 ± 0.0100		mL	
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁴ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	2.3038 ± 0.3145	Bq kg ⁻¹		
Uncertainties				
Net count rate	0.0026 ± 0.0003			
Principal γ-ray emission energy	795.7600	No uncertainty stated	keV	
Principal γ-ray emission probability	85.4400 ± 0.3800			
Principal γ-ray detection efficiency	1.3230 ± 0.0545			
Radioactive decay	1.1301	No uncertainty stated		
Mass of sample	0.1114 ± 0.0000		kg	
Supporting information	4.3540 ± 0.0057			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	2.06	No uncertainty stated	year	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-gamma source)				
Detection limit (Bq/kg):	0.81249			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	2.0600 ±		year	
Principal γ-ray emission energy	795.7600 ±		keV	
γ-ray emission energy 2 (if used)	±			
γ-ray emission energy 3 (if used)	±			
γ-ray emission energy 4 (if used)	±			
γ-ray emission energy 5 (if used)	±			
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	2.3038 ± 0.3145			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0026 ± 0.0003		s	13.0%
Principal γ-ray emission probability	85.4400 ± 0.3800			0.4%
Emission probability 2 (if used)	±			
Emission probability 3 (if used)	±			
Emission probability 4 (if used)	±			
Emission probability 5 (if used)	±			
Principal γ-ray detection efficiency	1.3230 ± 0.0545			4.1%
Detection efficiency 2 (if used)	±			
Detection efficiency 3 (if used)	±			
Detection efficiency 4 (if used)	±			
Detection efficiency 5 (if used)	±			
Correction for radioactive decay	1.1301			0.0%
Mass of sample	0.1114 ± 0.0000		kg	0.0%
Uncertainty (height measurement)	4.3540 ± 0.0057		cm	0.1%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: β-/γ-EMITTING RADIONUCLIDES			
¹³⁷ Cs	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	32.9130 ± 1.4562		Bq kg ⁻¹	
Uncertainties				
Net count rate	0.0520	± 0.0009	s	
Principal γ-ray emission energy	661.6400	(No uncertainty stated)	keV	
Principal γ-ray emission probability	85.1000	± 0.2000		
Principal γ-ray detection efficiency	1.6820	± 0.0693		
Radioactive decay	1.0084	(No uncertainty stated)		
Mass of sample	0.1114	± 0.0000	kg	
Supporting information	4.3540	± 0.0057		
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	30.2	No uncertainty stated	year	No data source stated
Input data				
Method (including pre-concentration, if applicable):				
gamma-ray spectrometry with a HPGe detector				
Detection system (including method of calibration):				
CANBERRA Genie 2000 (Calibration with multi-gamma source)				
Detection limit (Bq/kg):	0.56221			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	30.2000	±	year	
Principal γ-ray emission energy	661.6400	±	keV	
γ-ray emission energy 2 (if used)		±		
γ-ray emission energy 3 (if used)		±		
γ-ray emission energy 4 (if used)		±		
γ-ray emission energy 5 (if used)		±		
RESULTS				
Reference time and date	2019-06-03 12:00:00 UTC			
Sample number:	T-S8	Uncertainty (k=1)		
	Bq/kg			
Activity concentration (dry)	32.9130	± 1.4562		
Contributing parameters				
Parameter	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0520	± 0.0009	s	1.6%
Principal γ-ray emission probability	85.1000	± 0.2000		0.2%
Emission probability 2 (if used)		±		
Emission probability 3 (if used)		±		
Emission probability 4 (if used)		±		
Emission probability 5 (if used)		±		
Principal γ-ray detection efficiency	1.6820	± 0.0693		4.1%
Detection efficiency 2 (if used)		±		
Detection efficiency 3 (if used)				
Detection efficiency 4 (if used)				
Detection efficiency 5 (if used)				
Correction for radioactive decay	1.0084			0.0%
Mass of sample	0.1114	± 0.0000	kg	0.0%
Height measurement	4.3540	± 0.0057	cm	0.1%
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		
Other parameter (only if included in calculation)		±		

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON: α-EMITTING RADIONUCLIDES			
²³⁸ Pu	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	0.0103 ± 0.0018		Bq kg ⁻¹	
Uncertainties				
Net sample count rate	0.0139	± 0.0023	cpm	
Chemical recovery	70.3480	± 2.0880		
Sample detection efficiency	31.7910	± 0.0000		
Sample radioactive decay	No Sample radioactive decay stated	(No uncertainty stated)		
Mass of sample	100.3000	± 0.0200	g	
Supporting information	No Supporting information stated	(No uncertainty stated)		
Activity concentration	0.9533	± 0.0062	dpm/mL	
Net tracer count rate	0.4264	± 0.0127	cpm	
Tracer detection efficiency	31.7910	± 0.0000		
Tracer radioactive decay	0.9533	± 0.0001		
Mass of tracer added	2.0000	± 0.0100	mL	
Supporting information	31.7910	± 0.0000		
Method	Analysis method stated:			
Detection system	Detection system stated:			
Half-life	87.7	±	0 year	Radioisotope pocket data book 11th edition
Decay energy	5.499	±	0 MeV	Radioisotope pocket data book 11th edition
α-emission probability	99.9	±	0	Radioisotope pocket data book 11th edition
Input data				
Method (including pre-concentration, if applicable):				
After conditioning plutonium valence using reducing agent, purified plutonium by anion exchange column was adhered to stainless steel plate electrically.				
Detection system (including method of calibration):				
Silicon semiconductor detector calibrated by alpha reference source certified by LRQA.				
Detection limit (Bq/kg):	0.0053			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	87.7000	± 0.0000	year	Radioisotope pocket data book 11th edition
Decay energy	5.4990	± 0.0000	MeV	Radioisotope pocket data book 11th edition
Particle emission energy 1	99.9000	± 0.0000		Radioisotope pocket data book 11th edition
RESULTS				
Reference time and date	2019/6/1 12.00			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.0103 ± 0.0018			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.0139	± 0.0023	cpm	16.9%
Chemical recovery	70.3480	± 2.0880		3.0%
Detection efficiency	31.7910	± 0.0000		0.0%
Correction for radioactive decay				
Mass of sample	100.3000	± 0.0200	g	0.0%
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
ISOTOPE DILUTION TRACER				
Activity concentration	0.9533	± 0.0062	Nuclide	Pu-242
Net count rate	0.4264	± 0.0127	dpm/mL	0.7%
Detection efficiency	31.7910	± 0.0000	cpm	
Correction for radioactive decay	0.9533	± 0.0001		
Mass of tracer added	2.0000	± 0.0100	mL	
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				
Other parameter (only if included in calculation)				

Nuclide:	IAEA-ILC-2019-01/RML INTERLABORATORY COMPARISON α-EMITTING RADIONUCLIDES			
^{239/240} Pu	Fukushima related sediment containing low levels of α- and β-/γ-emitting radionuclides			
Outcomes				
Laboratory code	T-S8	Summary of data for submission		
Activity concentration	0.5587 ± 0.0274	Bq kg ⁻¹		
Uncertainties				
Net sample count rate	0.7519 ± 0.0168		cpm	
Chemical recovery	70.3480 ± 2.0880			
Sample detection efficiency	31.7910 ± 0.0000			
Sample radioactive decay	No Sample radioactive decay stated	No uncertainty stated		
Mass of sample	100.3000 ± 0.0200		g	
Supporting information	No Supporting information stated	No uncertainty stated		
Activity concentration	0.9533 ± 0.0062		dpm/mL	
Net tracer count rate	0.4264 ± 0.0127		cpm	
Tracer detection efficiency	31.7910 ± 0.0000			
Tracer radioactive decay	0.9533 ± 0.0001			
Mass of tracer added	2.0000 ± 0.0100		mL	
Supporting information	31.7910 ± 0.0000			
Method	Analysis method stated			
Detection system	Detection system stated			
Half-life	6564 ± 0	year		Radioisotope pocket data book 11th edition
Decay energy	5.15 ± 0	MeV		Radioisotope pocket data book 11th edition
α emission probability	99.9 ± 0			Radioisotope pocket data book 11th edition
Input data				
Method (including pre-concentration, if applicable):				
After conditioning plutonium valence using reducing agent, purified plutonium by anion exchange column was adhered to stainless steel plate electrically.				
Detection system (including method of calibration):				
Silicon semiconductor detector calibrated by alpha reference source certified by LRQA.				
Detection limit (Bq/kg):	0.06226			
Nuclear data used				
Parameter	Value	Uncertainty	Units	Data source
Half-life	6564.0000 ± 0.0000		year	Radioisotope pocket data book 11th edition
Decay energy	5.1500 ± 0.0000		MeV	Radioisotope pocket data book 11th edition
Particle emission energy 1	99.9000 ± 0.0000			Radioisotope pocket data book 11th edition
RESULTS				
Reference time and date	2019/6/1 12:00			
Sample number:	T-S8			
	Bq/kg	Uncertainty (k=1)		
Activity concentration (dry)	0.5587 ± 0.0274			
Contributing parameters	Value	Uncertainty	Units	Relative uncertainty
Net count rate	0.7519 ± 0.0168		cpm	2.2%
Chemical recovery	70.3480 ± 2.0880			3.0%
Detection efficiency	31.7910 ± 0.0000			0.0%
Correction for radioactive decay	±			
Mass of sample	100.3000 ± 0.0200		g	0.0%
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
ISOTOPE DILUTION TRACER				
Activity concentration	0.9533 ± 0.0062		dpm/mL	0.7%
Net count rate	0.4264 ± 0.0127		cpm	
Detection efficiency	31.7910 ± 0.0000			
Correction for radioactive decay	0.9533 ± 0.0001			
Mass of tracer added	2.0000 ± 0.0100		mL	
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			
Other parameter (only if included in calculation)	±			

リサイクル適性 (A)

この印刷物は、印刷用の紙へ
リサイクルできます。