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IAEA's underground laboratory in Monaco: upgrades and projects

Iolanda Osvath
IAEA Marine Environment Laboratories, Monaco

CELLAR Community Meeting, Dresden, 28-30.11.2022

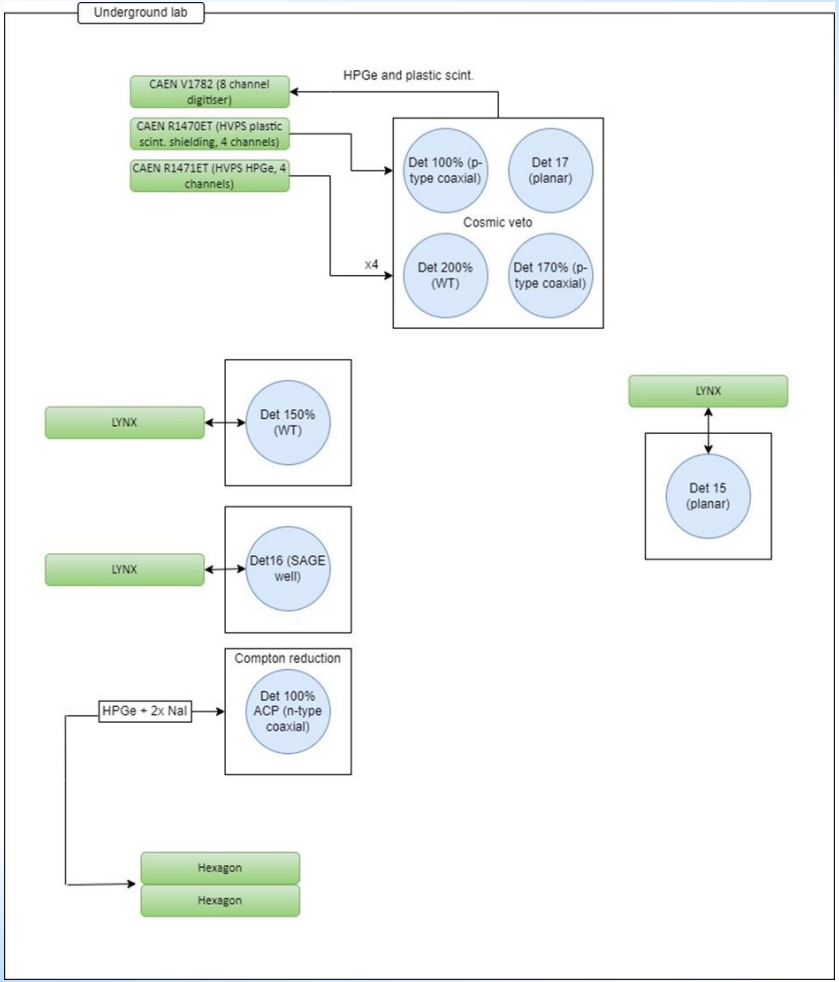
Acknowledgement

IAEA Marine Environment Laboratories, Radiometrics Laboratory, Monaco

Paul Mc Ginnity, Marian Fujak, Niall Murphy, Megan Cook, Oxana Blinova, Mai Pham…

IAEA Physics and Chemistry Division, Terrestrial Environmental Radiochemistry Laboratory, Seibersdorf

Monika Horsky, Sian Patersson, Barbara Nadalut, Bojan Seslak…



[IAEA MONACO underground Lab (matterport.com)]

IAEA's ISO 17034 accreditation

As of 2022, the IAEA is an **accredited producer** of **certified reference materials**, according to ISO 17034:2016 requirements.

INTERNATIONAL STANDARD **ISO 17034**

General requirements for the competence of reference material producers

Exigences générales pour la compétence des producteurs de matériaux de référence

Bundesministerium
Digitalisierung und
Wirtschaftsstandort

Die Nationale Akkreditierungsstelle / *The National Accreditation Body*:

AKKREDITIERUNG AUSTRIA

bestätigt die Akkreditierung der Rechtsperson / *confirms the accreditation of*

International Atomic Energy Agency

Wagramer Straße 5, 1400 Wien

Identifikationsnummer / *ID-number*: **0415**
als / *as* **Referenzmaterial-Hersteller / *Reference Material Producer***
gemäß / *according to* **EN ISO 17034:2016**
Datum der Erstakkreditierung / *Initial date of accreditation*: **18.05.2022**

Standorte/Organisationseinheiten / *sites/units*:
International Atomic Energy Agency - Marine Environment Laboratories, 4 Quai Antoine 1er, 98000 Monaco
International Atomic Energy Agency - Terrestrial Environmental Radiochemistry Laboratory, Friedensstraße 1, 2444 Seibersdorf

Multi-site accreditation: two locations

Radiometrics Laboratory (RML)

IAEA Marine Environment Laboratories (NAML), Monaco

Terrestrial Environmental Radiochemistry (TERC) **Laboratory**

Division of Physical and Chemical Sciences (NAPC), Seibersdorf, Austria

Production of matrix CRMs for measurement of activity concentration of specific gamma-emitting radionuclides in **marine** samples

Production of matrix CRMs for measurement of activity concentration of specific gamma-emitting radionuclides in **terrestrial** samples

Scope of accreditation

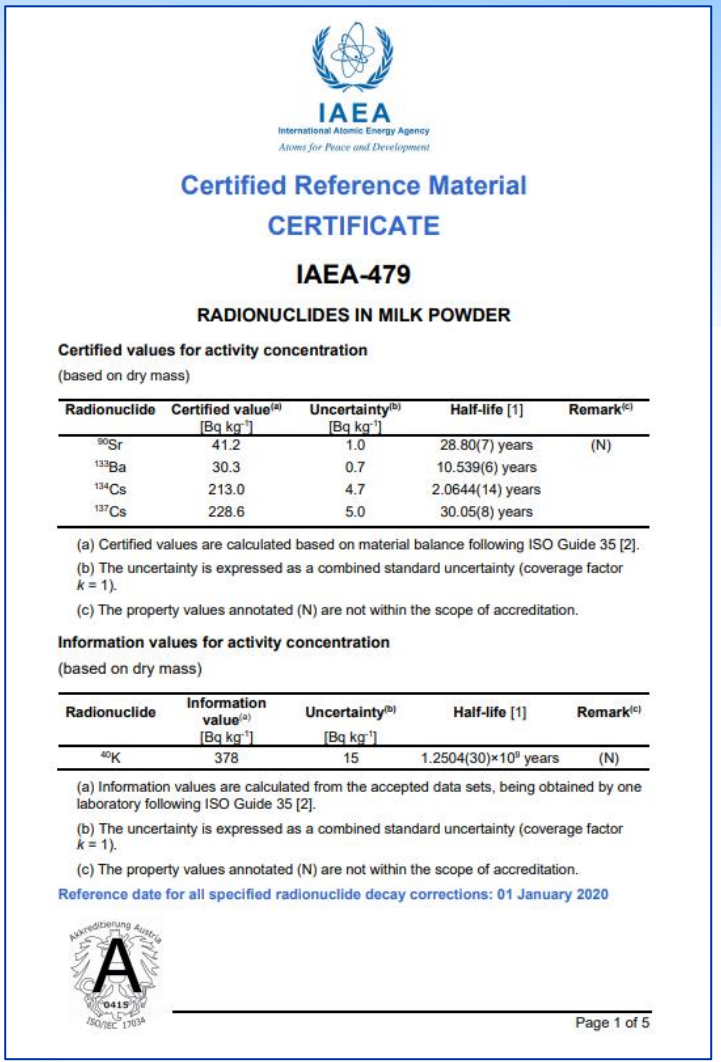
Type	Reference material matrix	Properties characterized	Approach used to assign property value
CRM	**marine sediment**	K-40, Cs-137, Pb-210, Ra-226, Ra-228, Th-228, Th-232, U-235, U-238, Am-241	statistical evaluation of data from competent expert laboratories
CRM	**rice**	K-40, Cs-134 and Cs-137	statistical evaluation of data from competent expert laboratories
CRM	**soil**	K-40, Co-60, Ba-133, Cs-134, Cs-137, Pb-210, Am-241	gravimetric spiking and statistical evaluation of data from competent expert laboratories
CRM	**shrimp**	K-40, Ra-228, Th-228, Cs-137, Ra-226	statistical evaluation of data from competent expert laboratories
CRM	**milk powder**	Ba-133, Cs-134 and Cs-137	gravimetric spiking
CRM	**fish**	K-40, Ra-226, Ra-228, Cs-134, Cs-137, Pb-210	gravimetric spiking and statistical evaluation of data from competent expert laboratories
CRM	**water**	Cs-137, K-40	gravimetric spiking and statistical evaluation of data from competent expert laboratories

Which specific CRMs…

…within the scope of accreditation?

- IAEA-412 Pacific Ocean Sediment
- IAEA-464 Brown Rice
- IAEA-479 Milk Powder
- IAEA-465 Baltic Sea Sediment

- additional CRMs in production
  e.g. soil, seawater, shrimp (w CELLAR)



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Atoms for Peace and Development

Certified Reference Material

CERTIFICATE

IAEA-479

RADIONUCLIDES IN MILK POWDER

Certified values for activity concentration

(based on dry mass)

Radionuclide	Certified value[a] [Bq kg^{-1}]	Uncertainty[b] [Bq kg^{-1}]	Half-life [1]	Remark[c]
^{90}Sr	41.2	1.0	28.80(7) years	(N)
^{133}Ba	30.3	0.7	10.539(6) years	
^{134}Cs	213.0	4.7	2.0644(14) years	
^{137}Cs	228.6	5.0	30.05(8) years	

(a) Certified values are calculated based on material balance following ISO Guide 35 [2].

(b) The uncertainty is expressed as a combined standard uncertainty (coverage factor $k = 1$).

(c) The property values annotated (N) are not within the scope of accreditation.

Information values for activity concentration

(based on dry mass)

Radionuclide	Information value[a] [Bq kg^{-1}]	Uncertainty[b] [Bq kg^{-1}]	Half-life [1]	Remark[c]
^{40}K	378	15	1.2504(30)×10^{9} years	(N)

(a) Information values are calculated from the accepted data sets, being obtained by one laboratory following ISO Guide 35 [2].

(b) The uncertainty is expressed as a combined standard uncertainty (coverage factor $k = 1$).

(c) The property values annotated (N) are not within the scope of accreditation.

Reference date for all specified radionuclide decay corrections: 01 January 2020

Akkreditierung Austria
A
0415
ISO/IEC 17043

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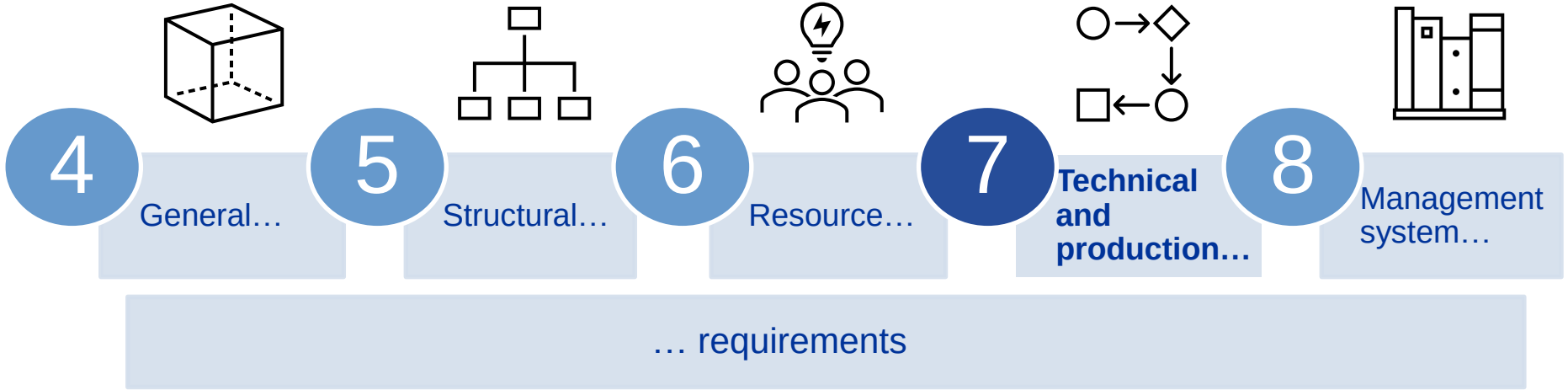
Reference material production according to ISO 17034 requirements

ISO 17034:2016 General requirements for the competence of reference material producers



ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories is a Normative Reference in ISO 17034.

Production collaborators

ISO 17034 requirements for ‘subcontractors’ (Clause 6.2)

= any collaborator supporting the RM producer in sampling / processing / handling / homogeneity and stability testing / characterization / …

- selected based on ability to meet stipulated requirements
- assess that tasks comply with set requirements and ISO 17034 clauses
- establish and maintain evidence of competence → examples

- Assessment of tasks performed in the past
- Participation in relevant proficiency testing
- Conformity assessment certificates relevant for the task
- Acceptable results on well-characterized materials (similar to the candidate RM)

Production collaborators

ISO 17034 requirements for ‘subcontractors’ (Clause 6.2)

= any collaborator supporting the RM producer in sampling / processing / handling / homogeneity and stability testing / characterization / …

- selected based on ability to meet stipulated requirements

→ Approved list of subcontractors

- selection policy

When the characterization strategy involves external laboratories, the reference material specialist/project officer selects one or more competent laboratory/ies according to their demonstrated analytical performance in proficiency tests and/or an operational Quality Management System demonstrated e.g. by their accreditation status.

Production collaborators

ISO 17034 requirements for measurement results used in RM production

7.6 Measurement procedures

- Compliance to relevant requirements of ISO/IEC 17025

→ Process requirements

7.9 Metrological traceability

For CRMs:

- establish metrological traceability
- provide evidence

→ Collect information on procedures used by collaborators, including on calibrants (traceability), validation, uncertainty…

→ Technical evaluation of results

Monitoring/analytical data quality project examples

1. Marine Monitoring: Confidence Building & Data Quality Assurance (NA3/38)
   - IAEA verification of marine monitoring following the accidental releases of radioactivity from Fukushima Daiichi Nuclear Power Station (FDNPS) into the Pacific Ocean

2. Plans & first steps for IAEA corroboration of source & environmental monitoring related to discharges of ALPS treated water from FDNPS (2023)

Interlaboratory comparisons (ILCs) & proficiency tests (PTs)

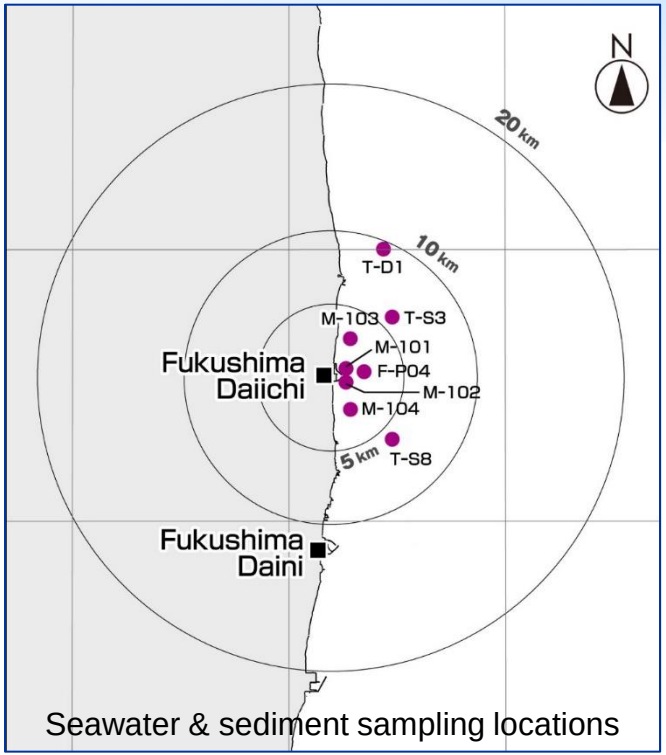
Marine Monitoring: Confidence Building & Data Quality Assurance (NA3/38)

- Assist Government of Japan to ensure the marine monitoring component of its Comprehensive Radiation Monitoring Plan (CRMP) is credible & transparent
- Test sampling & analytical performance of the Japanese labs for radionuclides in seawater, sediment & fish samples
- 1-2 ILCs & 1 PT each year since 2014
- PTs open to all interested labs

ILC process

- Samples collected near FDNPS
  - Seawater (^{3}H, ^{90}Sr, ^{134}Cs,^{137}Cs)
  - Sediment (^{134}Cs, ^{137}Cs, ^{238}Pu, $^{239,240}Pu$)
  - Fish (^{134}Cs, ^{137}Cs)
- Sampling, pre-treatment & splitting in Japan
  - Sediment homogeneity check in Monaco
- Analyses by participating labs
  - Japanese labs
  - IAEA Marine Environment Laboratories
  - IAEA ALMERA member labs
- Statistical evaluation & reporting by IAEA
  - Reference value as power-moderated mean of the combined results
  - Check if relative degree of equivalence (*DoE*) for each lab's result significantly different from zero using *u(DoE)* (≤ 2.58, 99% confidence level)

ILC process

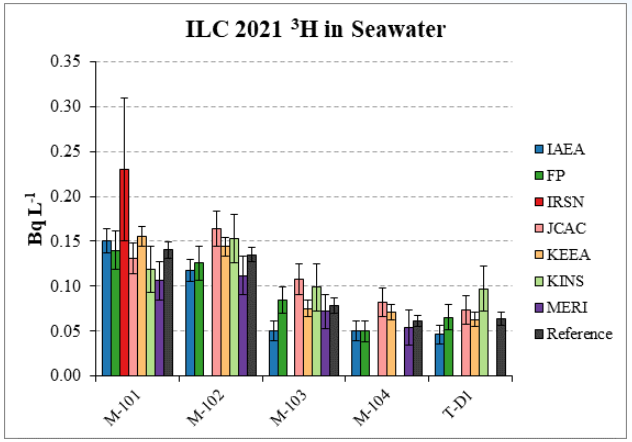


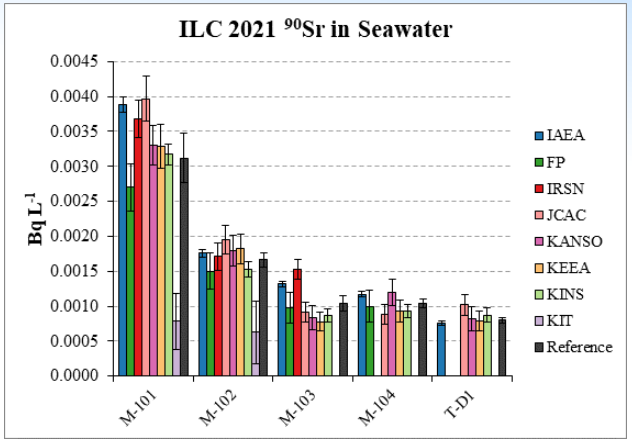
Seawater & sediment sampling locations

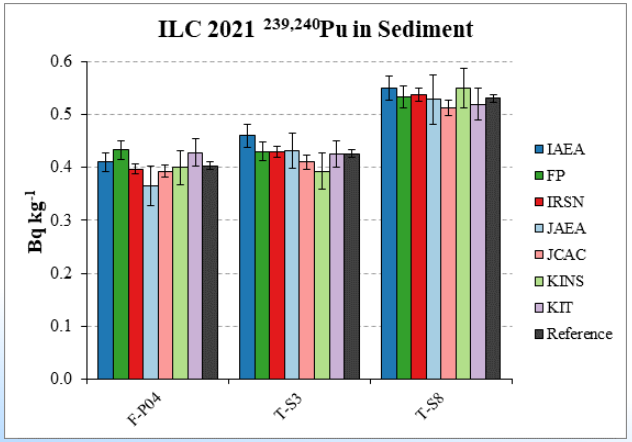
Target DLs (approximate)

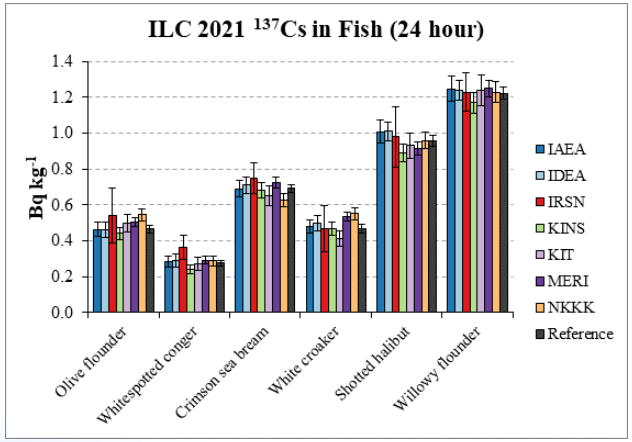
Sample type	Nuclide	Detection Limit	Unit
Seawater	^{3}H	50	mBq/L
	^{90}Sr	0.5	
	^{134}Cs	0.5	
	^{137}Cs	2	
Sediment	^{134}Cs	1	Bq/kg d.w.
	^{137}Cs	20	
	^{238}Pu	0.005	
	$^{239,240}Pu$	0.2	
Fish (24h in 1 L Marinelli)	^{134}Cs	0.05	Bq/kg f.w.
	^{137}Cs	0.2	

Example ILC results



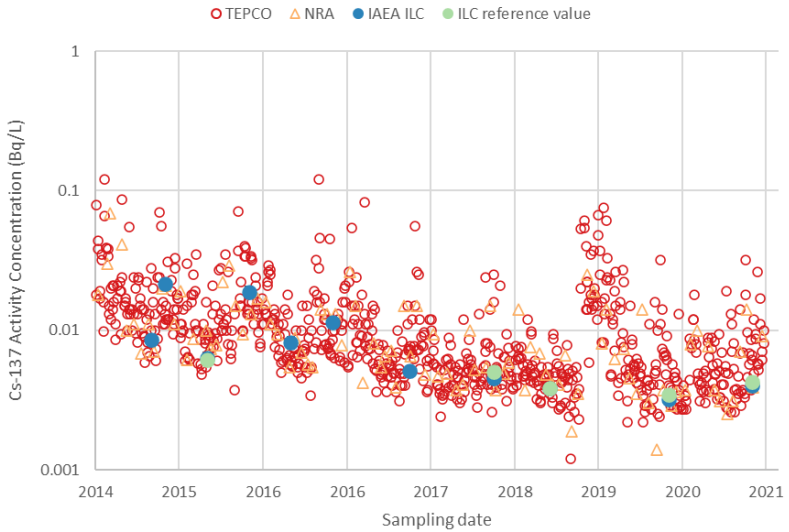


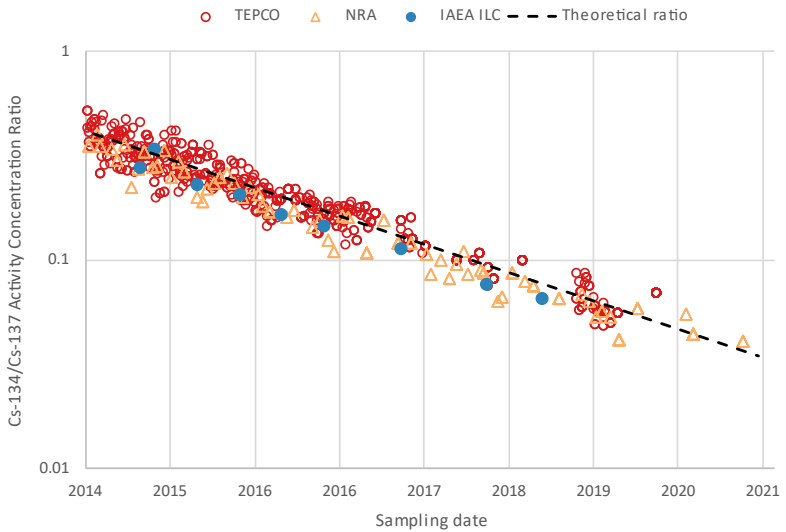




Comparison of ILC results with routine monitoring data

Seawater sampling location T-D1

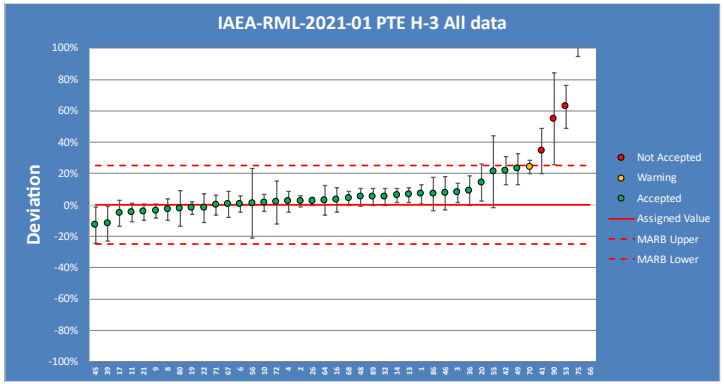


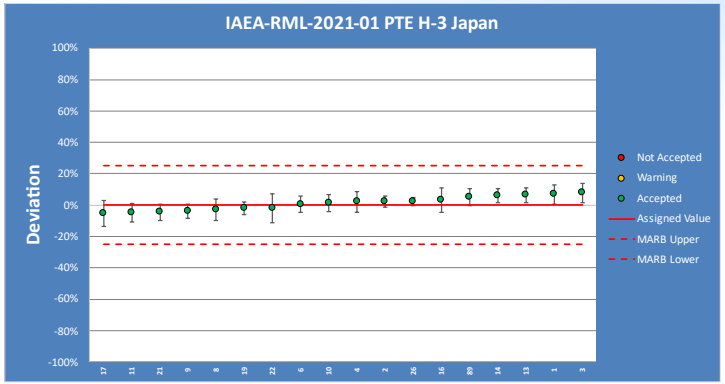


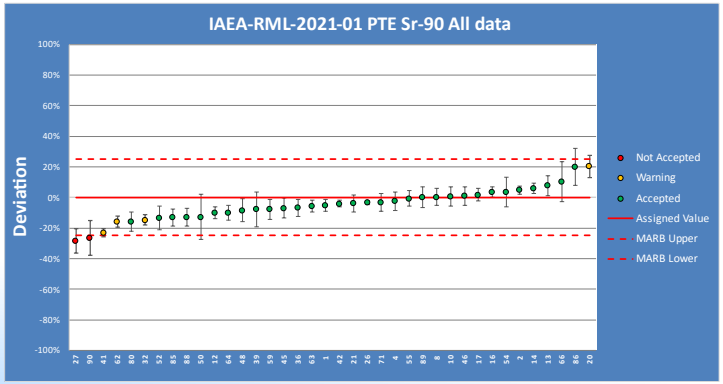
Radionuclides in seawater PTs

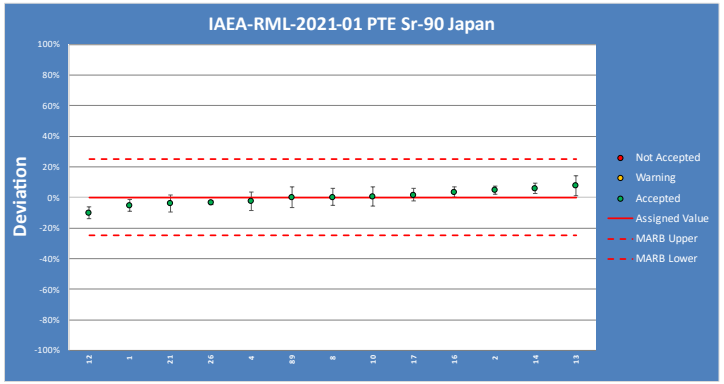
- 1 PT each year since 2012
- 2021: 85 participants (71 submitted results)
  - 24 participants from Japan
- Seawater spiked with ^{134}Cs, ^{137}Cs, ^{90}Sr, ^{3}H & a surprise gamma emitting radionuclide (Na-22)
- 3 statistical tests to evaluate submitted results
  - Relative bias (≤ MARB)
  - Zeta test (≤ 2.58, 99% confidence level)
  - Precision test

PT 2021 results

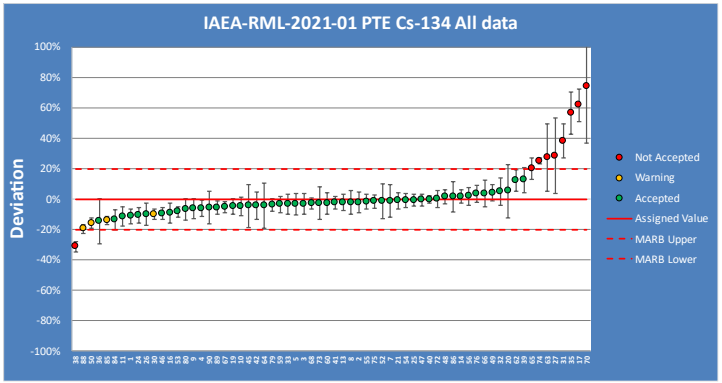


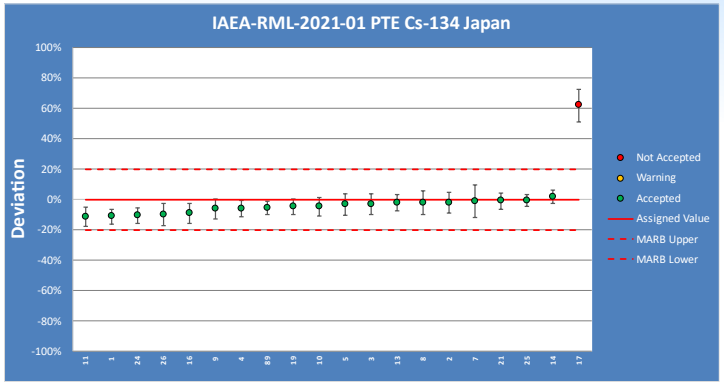


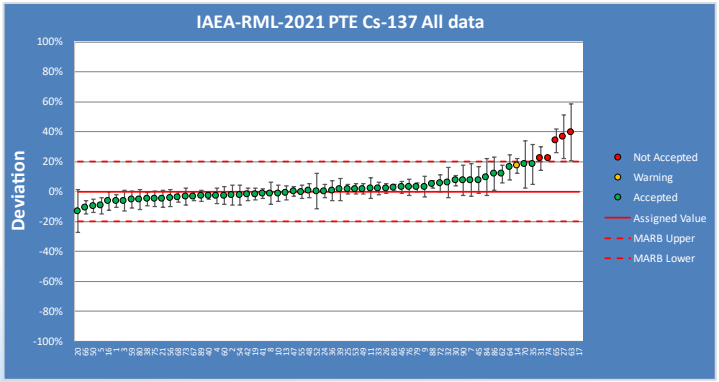


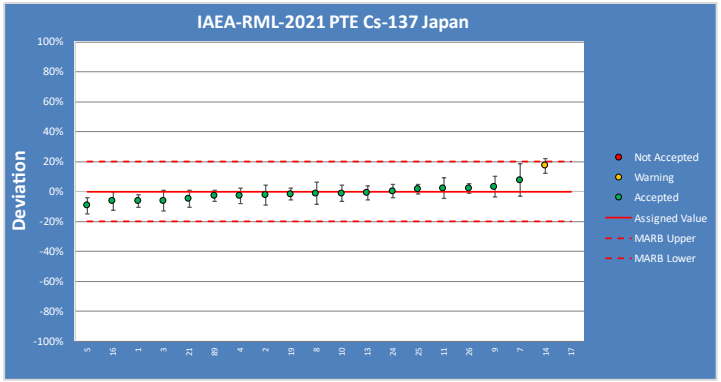


PT 2021 results

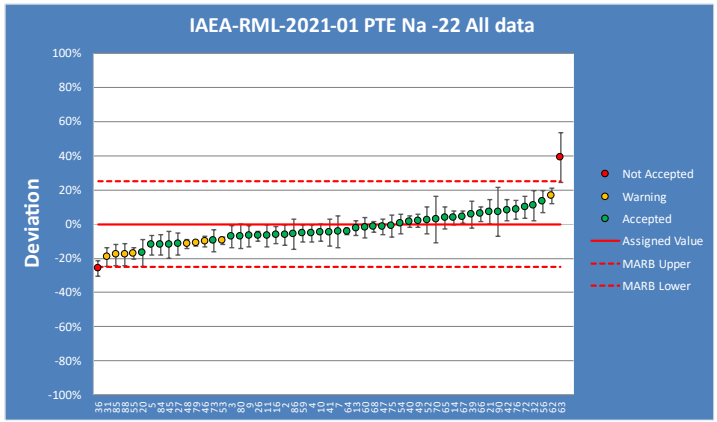


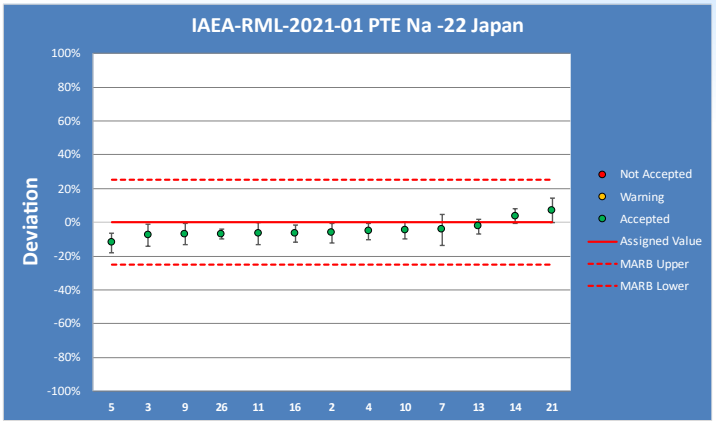






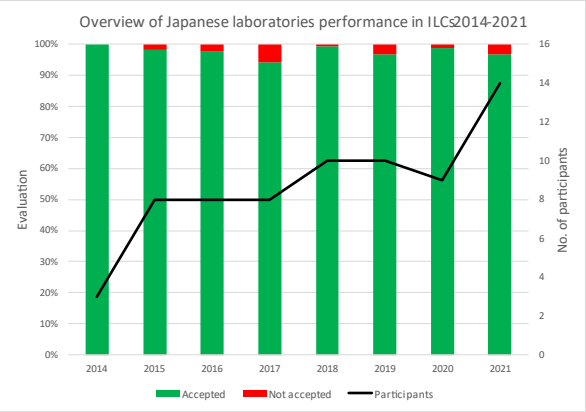
PT 2021 results

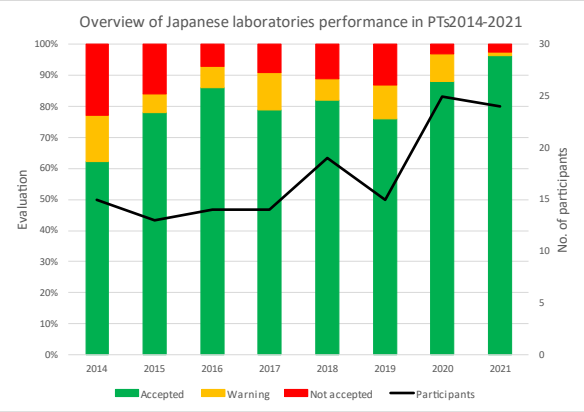




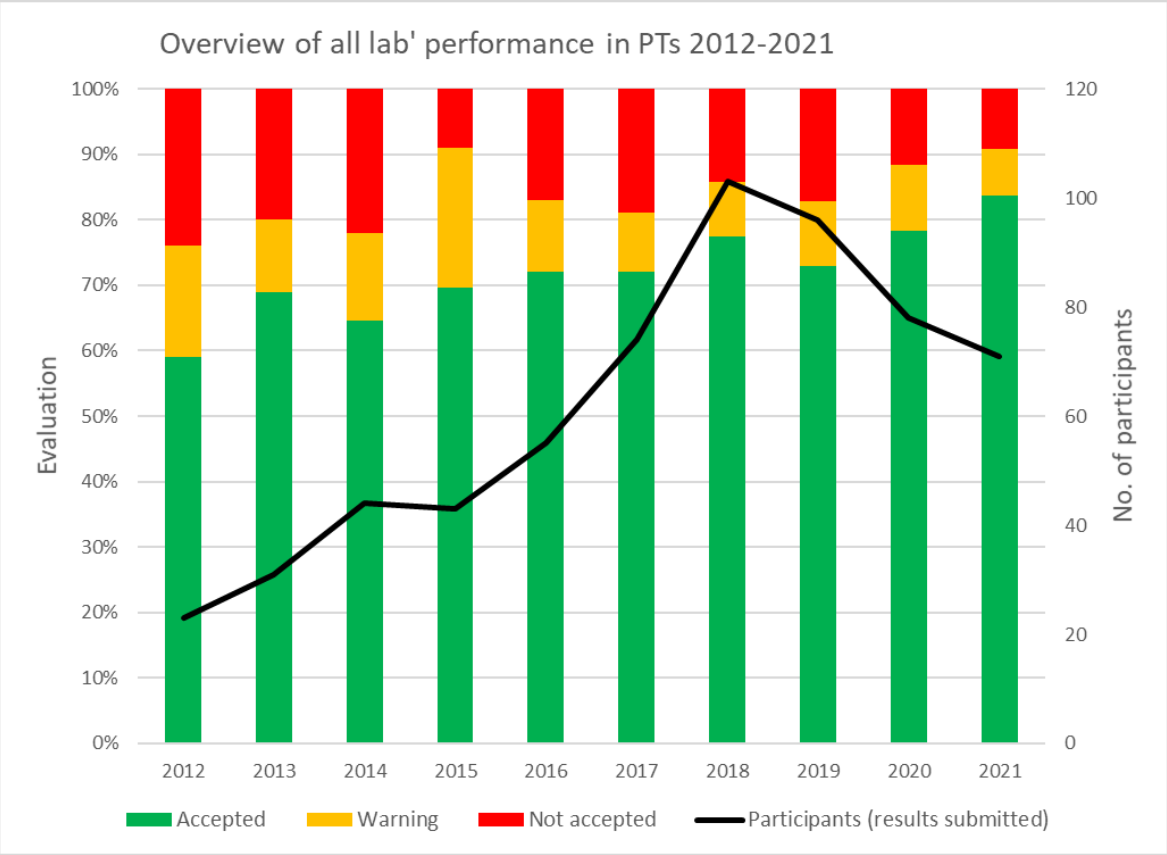
Conclusions – Japan

- Participating Japanese labs continue to report reliable & comparable results
- Sample collection procedures follow appropriate methodological standards required for representativity





Conclusions – all labs



Corroboration of source & environmental monitoring related to ALPS

IAEA review of Government of Japan's planning for discharges of ALPS treated water

Assessment of Radiation Protection and Safety	• Review TEPCO's implementation plan and supporting documentation. • Focus on technical considerations such as source characterization, safety related aspects of the approach, occupational radiation exposure, and the radiological environmental impact assessment.
Regulatory Activities and Process	• Review NRA actions and processes relevant to the project. • Focus on safety objectives, regulatory requirements, regulatory assessment, and regulatory inspections.
Independent Sampling, Data Corroboration, and Analysis	• Independent sampling and analysis to corroborate data from Japan. • Perform analysis of ALPS treated water and environmental samples. • Corroborate monitoring results for occupational exposure.

Corroboration of source & environmental monitoring related to ALPS

- Through independent verification, ensure that the radiological basis of planning for the discharge of ALPS treated water is sound
  - Source & environmental monitoring

- Provide confidence in the accuracy of data resulting from source & environmental monitoring undertaken by TEPCO/Government of Japan

- Enhance transparency for all interested parties

Contributing IAEA labs

- Marine Environment Laboratories, Radiometrics Laboratory (RML), Monaco
- Terrestrial Environmental Radiochemistry Laboratory (TERC), Seibersdorf, Austria
- Isotope Hydrology Laboratory (IHL), Vienna, Austria

+ ALMERA & Japanese labs

Corroborate source monitoring

- 3 ILCs planned prior to start of discharges of ALPS treated water
  - Pilot: Test samples collected in Feb 2022
  - 1st ILC: Sampling in Mar 2022
  - 2nd & 3rd ILCs: Sampling Oct 2022
- 2 objectives to ILCs
  - Statistical comparison of TEPCO's results with those of IAEA & ALMERA labs
    - H-3, "seven major radionuclides" (Sr-90, I-129, Co-60, Ru-106, Sb-125, Cs-134, Cs-137), C-14, Tc-99, gross α & β
  - Radiological characterisation of samples of ALPS treated water
    - Activity concentrations for any other radionuclide that may be present (or detection limits)
    - High yield fission & activation products/ actinides

Sampling of ALPS treated water

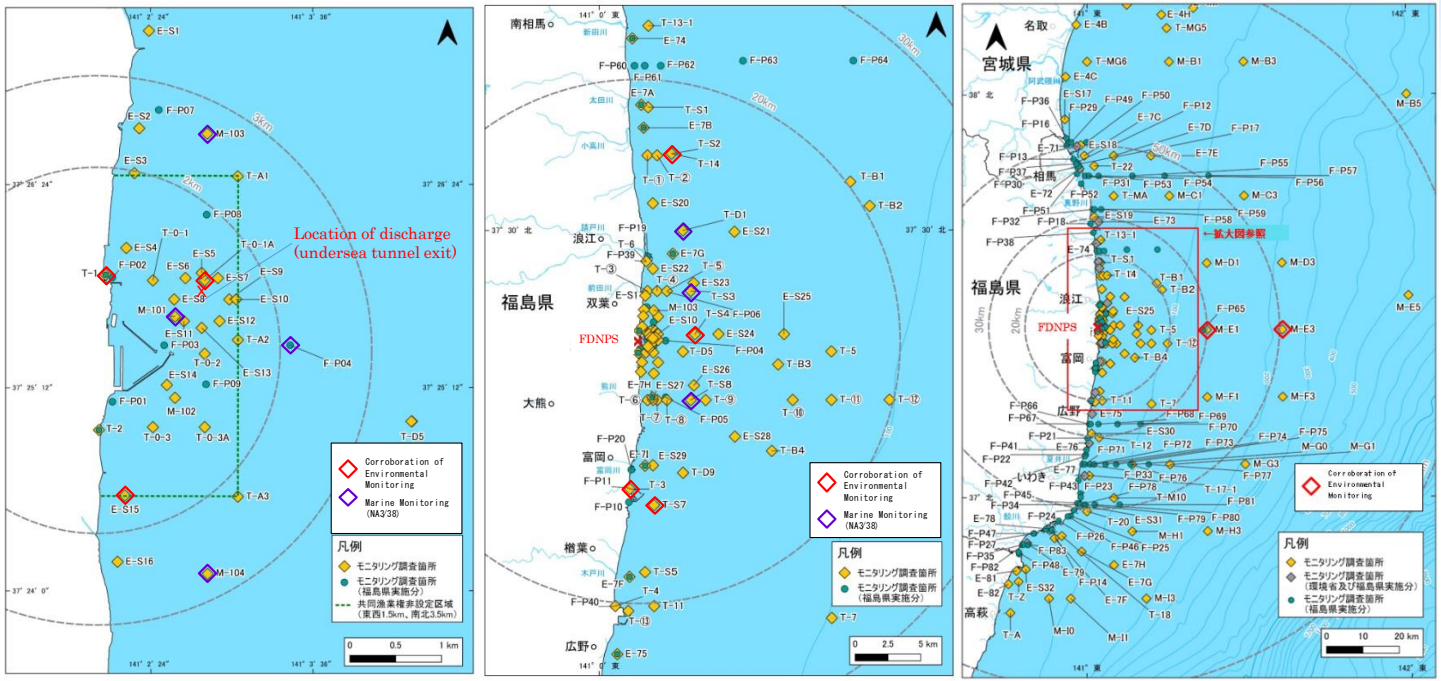
Analyses undertaken by IAEA & ALMERA labs – source monitoring

Direct comparison
H-3, 7 major radionuclides, C-14, Tc-99, gross alpha/beta
H-3
C-14
Gamma (Co-60, Ru-106, Sb-125, Cs-134, Cs-137)
Sr-90
Tc-99
I-129
Gross alpha/ beta

Radiological characterisation
Beta: *Fe-55, Ni-59,* Ni-63
Gamma (*Cd-113m,* Sn-126, Ba-133, Pm-146, Eu-152, Eu-154, Eu-155)
Actinides (Th, U, Np, Pu, Am, Cm, Pa, Ra) *

* *U-233,* U-234, U-235, U-236, U-238, *Np-236,* Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, *Am-242m, Am-243*, Cm-243, Cm-244, *Cm-245*, Cm-246, Th-230, Th-232, Pa-231, *Pa-233,* Ra-226, Ra-228

Sampling for corroboration of environmental monitoring



Maps provided by NRA

Marine environmental monitoring

- Collecting seawater & sediment at offshore FDNPS (NRA/JCAC)

Marine environmental monitoring

- Collecting fish & seaweed offshore FDNPS (MOE/JCAC)

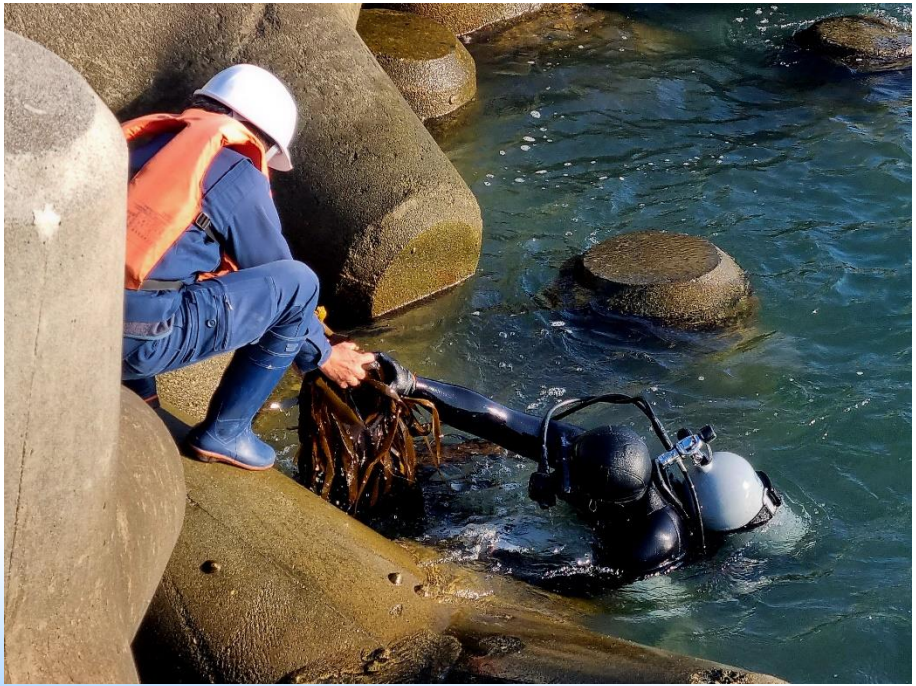
Marine environmental monitoring

- Collecting fish from Hisanohama market (FAJ/MERI)



Marine environmental monitoring

- Collecting fish & seaweed offshore FDNPS (MOE/JCAC)



Analyses to be undertaken by participating labs

	Detection limit	Unit
Seawater		
H-3	100	mBq/L
Co-60	3	
Ru-106	1200	
Sb-125	500	
Cs-134, Cs-137	1	
Sr-90	1	
I-129	10	
Sediment		
Gamma (Co-60, Ru-106, Sb-125, Cs-134, Cs-137)	1 (Cs-134, Cs-137)	Bq/kg d.w.
Fish		
H-3 (OBT, FWT)	0.5/0.1	Bq/L
C-14	2	Bq/kg f.w.
Seaweed		
I-129	0.1	Bq/kg f.w.

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Thank you!