



Association pour le Contrôle de la Radioactivité dans l'Ouest

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# Analysis Report

RAP110411-OCJ-EN

## ANALYSIS

**Object : Evaluation of the environmental consequences in Japan caused by the Fukushima nuclear power plant accident**

comment(s): These analyses are performed free of charge at the demand of Japanese citizens.

## REPORT ID

**RAP110411-OCJ-EN** FROM : **04/11/11** version : **01**

Number of pages : 7 (including annexs)

comment(s) :

## SAMPLES TYPES

ENVIRONMENT MATRICES (SOILS, LIQUIDS)

## QUANTITY


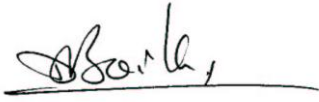
9 Samples

received : 04/04/2011

## ANALYSES PERFORMED

MEASUREMENT OF GAMMA EMITTERS RADIONUCLIDES BY GAMMA SPECTROMETRY

SEARCH FOR ARTIFICIAL NUCLIDES

VISA	
EDITOR	APPROVAL
	
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## 1. SAMPLE IDENTIFICATION

Reception date: April 4<sup>th</sup>, 2011

The samples were collected by Japanese citizens according to the regular instructions and methodology provided by ACRO. The samples characteristics are given in the table below.

N°	Nature	Collection Date (local)	Location	origine	Dimensions	Mass/Volume collected	References
1	Soil	03/31/11 1 :10 pm	Kawamata ville, Yamakiya Mukaihigashiyama 川俣町山木屋向東山	Flower bed	10 cm x 10 cm Depth 0-2 cm	311 g	110404-OCJ-01
2	Fresh water	03/31/11 2 :40 pm	Iitate Village Iidoi Takishita 飯館村飯樋滝下	River	-	500 ml	110404-OCJ-02
3	Soil	03/31/11 3 :20 pm	Iitate Village Sekine 飯館村関根	Farm	10 cm x 10 cm Depth 0-2 cm	244 g	110404-OCJ-03
4	Fresh water	03/31/11 3 :23 pm	Iitate Village Sekine 飯館村関根	Well	-	500 ml	110404-OCJ-04
5	Soil	03/31/11 3 :58 pm	Iitate Village Maeda 飯館村前田	Rice paddy	10 cm x 10 cm Depth 0-2 cm	268 g	110404-OCJ-05
6	Soil	03/31/11 3 :00 pm	Iitate Village Maeda 飯館村前田	Farm	10 cm x 10 cm Depth 0-2 cm	233 g	110404-OCJ-06
7	Rain water	03/31/11 3 :08 pm	Iitate Village Maeda 飯館村前田	Collected in a bucket after the earthquake		500 ml	110322-XFD-07
8	Soil	03/31/11 5 :00 pm	Fukushima City Ohnami 福島市大波	Rice paddy	10 cm x 10 cm Depth 0-2 cm	225 g	110404-OCJ-08
9	Soil	03/31/11 5 :50 pm	Kawamata Town Iisaka 川俣町飯坂	Rice Paddy	10 cm x 10 cm Depth 0-2 cm	243 g	110404-OCJ-09



## ANALYSIS METHOD

The analyses are performed by Gamma spectrometry (see annex 1).

The results are displayed in the following tables.

Please note that the analyses will be performed again later after the decay of short-lived nuclides. This is mandatory for checking the presence of other radionuclides (time needed for the equilibrium decay from disintegration chains, suppression of the Compton background).

## 1. RESULTS 1/3 – ACTIVITY FOR SOILS (Bq/kg)

Sample identification		110404-OCJ-01	110404-OCJ-03	110404-OCJ-05	110404-OCJ-06	110404-OCJ-08	110404-OCJ-09
Registration number		110404-OCJ-01	110404-OCJ-03	110404-OCJ-05	110404-OCJ-06	110404-OCJ-08	110404-OCJ-09
Kind - species		Soil	Soil	Soil	Soil	Soil	Soil
Depth		0 - 2 cm	0 - 2 cm	0 - 2 cm	0 - 2 cm	0 - 2 cm	0 - 2 cm
<b>Sample</b>							
Date		31/03/11	31/03/11	31/03/11	31/03/11	31/03/11	31/03/11
Place		<b>Yamakiya</b>	<b>Sekine</b>	<b>Maeda</b>	<b>Maeda</b>	<b>Ohnami</b>	<b>Iisaka</b>
City, Town		Mukaihigashiyama					
Localisation		<b>Kawamata</b>	<b>litate</b>	<b>litate</b>	<b>litate</b>	<b>Fukushima</b>	<b>Kawamata</b>
surface area		<b>flower bed</b>	<b>Farm</b>	<b>rice paddy</b>	<b>Farm</b>	<b>rice paddy</b>	<b>rice paddy</b>
total mass (g)		100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>
Counting		311	244	268	233	225	243
Geometry or volume (en cm <sup>3</sup> )		61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>
analysed sample mass		80,2 g	63,4 g	91,2 g	72,3 g	84,4 g	76,8
age of the sample (days)		8,7	4,1	7	7,3	4,4	6,2
<b>Result</b>							
Reference date		31/03/2011	31/03/2011	31/03/2011	31/03/2011	31/03/2011	31/03/2011
Unit		Bq/kg	Bq/kg	Bq/kg	Bq/kg	Bq/kg	Bq/kg
<b>ARTIFICIALS RADIONUCLIDES</b>							
Zr-95 / Nb-95	64 days	INQ	INQ	INQ	INQ	INQ	INQ
Te-132 / I-132	3.2 days	3,600 ± 500	6,800 ± 800	7,300 ± 900	16,400 ± 1,900	6,700 ± 1,000	1,460 ± 200
I-131	8 days	26,500 ± 3,200	48,300 ± 4,200	43,400 ± 3,800	81,000 ± 7,000	47,000 ± 6,000	19,800 ± 1,700
Cs-134 (*)	2.1 years	6,800 ± 800	13,900 ± 1,200	17,900 ± 1,500	39,600 ± 3,300	16,300 ± 1,900	3,230 ± 280
Cs-136	1.2 days	< 20	1,020 ± 110	1,400 ± 130	2,960 ± 280	1,370 ± 180	236 ± 26
Cs-137	30 year	6,800 ± 800	13,900 ± 1,200	17,900 ± 1,500	39,600 ± 3,300	16,300 ± 1,900	3,230 ± 280
Ba-140 / La-140	12.7 days	270 ± 150	890 ± 130	830 ± 200	1,520 ± 260	INQ	104 ± 75

Note :Te-132/I-132 and Ba-140/La-140 are separate disintegration pairs and are observed at equilibrium. The indicated activity takes into account the presence of both elements.  
(\* ) The activity in Cs-134 takes into account a correction; more refined values will be given later.

## 2. RESULTS 2/3 – SURFACE ACTIVITY FOR SOILS (Bq/m<sup>2</sup>)

Sample identification		110404-OCJ-01	110404-OCJ-03	110404-OCJ-05	110404-OCJ-06	110404-OCJ-08	110404-OCJ-09
Registration number		110404-OCJ-01	110404-OCJ-03	110404-OCJ-05	110404-OCJ-06	110404-OCJ-08	110404-OCJ-09
Kind - species		Soil	Soil	Soil	Soil	Soil	Soil
depth		0 - 2 cm	0 - 2 cm	0 - 2 cm	0 - 2 cm	0 - 2 cm	0 - 2 cm
Sample							
Date		31/03/11	31/03/11	31/03/11	31/03/11	31/03/11	31/03/11
Place		Yamakiya	Sekine	Maeda	Maeda	Ohnami	lisaka
City, Town		Mukaihigashiyama					
Localisation		Kawamata flower bed	litate farm	litate rice paddy	litate farm	Fukushima rice paddy	Kawamata rice paddy
surface area		100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>	100 cm <sup>2</sup>
total mass (g)		311	244	268	233	225	243
Counting							
Geometry or volume (en cm <sup>3</sup> )		61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>	61cm <sup>3</sup>
analysed sample mass		80.2 g	63.4 g	91.2 g	72.3 g	84.4 g	76.8 g
Results							
Reference date		31/03/2011	31/03/2011	31/03/2011	31/03/2011	31/03/2011	31/03/2011
Unit		Bq/m <sup>2</sup>	Bq/m <sup>2</sup>	Bq/m <sup>2</sup>	Bq/m <sup>2</sup>	Bq/m <sup>2</sup>	Bq/m <sup>2</sup>
ARTIFICIALS RADIONUCLIDES							
Zr-95 / Nb-95	64 days	INQ	INQ	INQ	INQ	INQ	INQ
Te-132 / I-132	3.2 jours	111,960 ± 15,550	165,920 ± 19,520	195,640 ± 24,120	382,120 ± 44,270	150,750 ± 22,500	35,478 ± 4,860
I-131	8 jours	824,150 ± 99,520	1,178,520 ± 102,480	1,163,120 ± 101,840	1,887,300 ± 163,100	1,057,500 ± 135,000	481,140 ± 41,310
Cs-134 (*)	2.1 ans	211,480 ± 24,880	339,160 ± 29,280	479,720 ± 40,200	922,680 ± 76,890	366,750 ± 42,750	78,489 ± 6,804
Cs-136	13.2 jours	< 622	24,888 ± 2,684	37,520 ± 3,484	68,968 ± 6,524	30,825 ± 4,050	5,735 ± 631
Cs-137	30 ans	211,480 ± 24,880	339,160 ± 29,280	479,720 ± 40,200	922,680 ± 76,890	366,750 ± 42,750	78,489 ± 6,804
Ba-140 / La-140	12.7 jours	8,397 ± 4,665	21,176 ± 3,172	22,244 ± 5,360	35,416 ± 6,058	INQ	2,527 ± 1,823

Note :Te-132/I-132 and Ba-140/La-140 are separate disintegration pairs and are observed at equilibrium. The indicated activity takes into account the presence of both elements.  
(\* ) The activity in Cs-134 takes into account a correction; more refined values will be given later.

### 3. RESULTS 3/3 – VOLUME ACTIVITY FOR LIQUIDS (Bq/L)

<b>Sample identification</b>				
Registration number	110404-OCJ-02	110404-OCJ-04	110404-OCJ-07	
kind	Fresh water	Fresh water	Fresh water	
species	<b>river water</b>	<b>well water</b>	<b>rain water</b>	
<b>Sample</b>				
Date	31-mars-11	31-mars-11	31-mars-11	
Place	<b>lidoi Takishita</b>	<b>Sekine</b>	<b>Maeda</b>	
City, Town	<b>litate</b>	<b>litate</b>	<b>litate</b>	
Localisation	<b>river</b>	<b>well</b>	<b>in a bucket</b>	
surface area	-	-	-	
total mass (g)	520	520	520	
<b>Counting</b>				
Geometry or volume (en cm <sup>3</sup> )	500 ml	500 ml	500 ml	
analysed sample mass	500 ml	500 ml	500 ml	
age of the sample (days)	8.5	4.5	6	
Analysed fraction	settle	settle	settle	
<b>Results</b>				
Reference date	31/03/2011	31/03/2011	31/03/2011	
Unit	Bq/L	Bq/L	Bq/L	
<b>ARTIFICIALS RADIONUCLIDES</b>				
Zr-95 / Nb-95	64 days	< 0.8	< 0.7	INQ
Te-132 / I-132	3.2 days	<b>7.4 ± 2.9</b>	< 1.2	<b>260 ± 40</b>
I-131	8 days	<b>32.9 ± 4.4</b>	<b>11.6 ± 0.53</b>	<b>30,900 ± 2,700</b>
Cs-134 (*)	2.1 years	<b>7.1 ± 1.0</b>	< 0.6	<b>495 ± 42</b>
Cs-136	13.2 days	< 0.9	< 0.8	<b>41.0 ± 4.0</b>
Cs-137	30 years	<b>7.1 ± 1.0</b>	< 0.7	<b>495 ± 42</b>
Ba-140 / La-140	12.7 days	< 3.0	< 2.8	< 17

Note :Te-132/I-132 and Ba-140/La-140 are separate disintegration pairs and are observed at equilibrium. The indicated activity takes into account the presence of both elements.  
(\* ) The activity in Cs-134 takes into account a correction; more refined values will be given later.

## ANNEX 1

ANALYSIS	
TITLE	<b>Measurement of gamma emitters nuclides by gamma spectrometry</b>
TREATMENT	The raw sample is homogenised. A representative part is taken to be conditioned in a geometry adapted to the gamma measurement.
MATERIAL	High-Purity Germanium (HPGe), type N coaxial , 32% efficiency, mounted in a vertical cryostate. The samples are placed in a 10-cm thick lead shielding. Data are readout by a digital acquisition system (DSPEC-ORTECH). The energy range is taken as 27-2000 keV. The containers are plastic round boxes with a fiducial volume of 61ml (ref. 7215) and standard geometries of 500ml.
UNITS	The measured quantity is the activity in becquerel (Bq) per kilogram of raw material (raw kg), in becquerel (Bq) per liter (L) and becquerel (Bq) per squared meter (m2)

## RESULTS

IN GENERAL	<p>Measurements are performed with identical geometries as thoses of the standard (calibrated) sources. They concern gamma-emitters radionuclides displaying one or several emission peaks within the reference energy range. Among all the radionuclides detected in the samples, only the most abundant are displayed in the tables, without any specific demand from the client. In all cases, the tables display at least all detected artificial radionuclides.</p> <p>Only elements with activity larger than the decision threshold are given. On the contrary, for the specified radionuclides, the detection limit –LD- (detection limit) is indicated, with the inferior “&lt;” sign. When it is not possible to deduce a satisfying detection limit LD, the data are replaced by the sign “-“. When an element has been detected but cannot be quantified properly, the mention “Identified but Not Quantified” (INQ) is reported. The measured activity of each radioelement is given with its absolute uncertainty calculated within a 95% interval of confidence (2 times the standard deviation). Each expressed activity, including the detection limit, is calculated at the reference date indicated in the table (collection date and time).</p>
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## ANNEX 2

INFORMATION ABOUT THE LABORATORY ACRO	
Measurements capacities	The ACRO laboratory can measure radon concentration in the air, tritium (HTO) in liquids and gamma radionuclides in all kind of matrices. Other measurements are under development. The measurement protocols are in accordance to the actual French and International standards (ISO/CEI 17025).
QUALIFICATION	
The laboratory is legally authorized for radioactivity measurements in the environment and the radon measurement in air by the French nuclear safety authority.	
Décision n°DEP-DEU-0704-2009 du 8/12/09 De l’Autorité de Sûreté Nucléaire	<ul style="list-style-type: none"> <li>- Measurement of gamma-emitters radionuclides in biological matrices</li> <li>- Tritium measurement in waters</li> </ul>
Décision n°DEP-DIS-346-2008 de l’Autorité de Sûreté Nucléaire	<ul style="list-style-type: none"> <li>- Radon concentration (volume activity) in public places</li> </ul>
Décision n°CODEP-DEU-2010-031543 du 15/06/10 de l’Autorité de Sûreté Nucléaire	<ul style="list-style-type: none"> <li>- Measurement of gamma-emitters radionuclides in waters</li> <li>- Uranium isotopes in soils</li> <li>- Thorium isotopes in soils</li> <li>- Radium-226/228 and decaying partners in soils.</li> </ul>