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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**

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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 4th, 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 | | | | | | | |
|--|-----------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| 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 | Iisaka |
| City, Town | | Mukaihigashiyama | | | | | |
| Localisation | | Kawamata | litate | litate | litate | Fukushima | Kawamata |
| surface area | | flower bed | Farm | rice paddy | Farm | rice paddy | rice paddy |
| total mass (g) | | 100 cm ² | 100 cm ² | 100 cm ² | 100 cm ² | 100 cm ² | 100 cm ² |
| Counting | | 311 | 244 | 268 | 233 | 225 | 243 |
| Geometry or volume (en cm ³) | | 61cm ³ | 61cm ³ | 61cm ³ | 61cm ³ | 61cm ³ | 61cm ³ |
| 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 |
| Result | | | | | | | |
| 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 |
| ARTIFICIALS RADIONUCLIDES | | | | | | | |
| 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/m²)

| 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 ² | 100 cm ² | 100 cm ² | 100 cm ² | 100 cm ² | 100 cm ² |
| total mass (g) | | 311 | 244 | 268 | 233 | 225 | 243 |
| Counting | | | | | | | |
| Geometry or volume (en cm ³) | | 61cm ³ | 61cm ³ | 61cm ³ | 61cm ³ | 61cm ³ | 61cm ³ |
| 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 ² | Bq/m ² | Bq/m ² | Bq/m ² | Bq/m ² | Bq/m ² |
| 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)

| Sample identification | | | | |
|--|------------------------|-------------------|--------------------|-----------------------|
| Registration number | 110404-OCJ-02 | 110404-OCJ-04 | 110404-OCJ-07 | |
| kind | Fresh water | Fresh water | Fresh water | |
| species | river water | well water | rain water | |
| Sample | | | | |
| Date | 31-mars-11 | 31-mars-11 | 31-mars-11 | |
| Place | lidoi Takishita | Sekine | Maeda | |
| City, Town | litate | litate | litate | |
| Localisation | river | well | in a bucket | |
| surface area | - | - | - | |
| total mass (g) | 520 | 520 | 520 | |
| Counting | | | | |
| Geometry or volume (en cm ³) | 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 | |
| Results | | | | |
| Reference date | 31/03/2011 | 31/03/2011 | 31/03/2011 | |
| Unit | Bq/L | Bq/L | Bq/L | |
| ARTIFICIALS RADIONUCLIDES | | | | |
| Zr-95 / Nb-95 | 64 days | < 0.8 | < 0.7 | INQ |
| Te-132 / I-132 | 3.2 days | 7.4 ± 2.9 | < 1.2 | 260 ± 40 |
| I-131 | 8 days | 32.9 ± 4.4 | 11.6 ± 0.53 | 30,900 ± 2,700 |
| Cs-134 (*) | 2.1 years | 7.1 ± 1.0 | < 0.6 | 495 ± 42 |
| Cs-136 | 13.2 days | < 0.9 | < 0.8 | 41.0 ± 4.0 |
| Cs-137 | 30 years | 7.1 ± 1.0 | < 0.7 | 495 ± 42 |
| 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 | Measurement of gamma emitters nuclides by gamma spectrometry |
| 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 “<” 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> |
|------------|---|

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"> - Measurement of gamma-emitters radionuclides in biological matrices - Tritium measurement in waters |
| Décision n°DEP-DIS-346-2008 de l’Autorité de Sûreté Nucléaire | <ul style="list-style-type: none"> - Radon concentration (volume activity) in public places |
| Décision n°CODEP-DEU-2010-031543 du 15/06/10 de l’Autorité de Sûreté Nucléaire | <ul style="list-style-type: none"> - Measurement of gamma-emitters radionuclides in waters - Uranium isotopes in soils - Thorium isotopes in soils - Radium-226/228 and decaying partners in soils. |