



Association pour le Contrôle de la Radioactivité dans l'Ouest
Independent laboratory of radioactivity analysis







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Analysis Report

RAP110908-GPJ-01

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DEMAND	
	GREENPEACE INTERNATIONAL
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OBJECT	EVALUATION ON THE ENVIRONMENTAL CONSEQUENCES IN JAPAN OF THE FUKUSHIMA NUCLEAR POWER PLANT ACCIDENT <u>ANALYSIS OF MATRICES OF THE MARINE ENVIRONMENT (FISH & SEA WEEDS)</u>
REPORT ID	
IDENTIFICATION	RAP110908-GPJ-01
DATE	September 8, 2011
PAGE NB	6 (including appendices)
SAMPLES	
	19 SAMPLES
ANALYSES REALISEES	
TYPE	MEASUREMENT OF GAMMA EMMITERS RADIONUCLIDES BY GAMMA SPECTROMETRY SEARCH FOR ARTIFICIAL NUCLIDES

VISA									
	<table border="1"><tr><td>EDITOR</td><td>APPROVAL</td></tr><tr><td></td><td></td></tr><tr><td>NAME</td><td>NAME</td></tr><tr><td>Antoine BERNOLLIN</td><td>Mylène JOSSET, Analysis Supervisor</td></tr></table>	EDITOR	APPROVAL			NAME	NAME	Antoine BERNOLLIN	Mylène JOSSET, Analysis Supervisor
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NAME	NAME								
Antoine BERNOLLIN	Mylène JOSSET, Analysis Supervisor								

1. Samples identification

The samples characteristics are given in the table below.
Samples were sent to ACRO laboratory by express mail in a cool box.

N°	Greenpeace references	Sample type	Species	Collection Date	Location	ACRO references
1	1-21/08/11	fish	GINZAKE (Silver Salmon, <i>Oncorhynchus kisutch</i>)	21-Aug-11 09:30 (purchased)	Temp. Yuriage-market in Natori, Miyagi	110830-GPJ-01
2	2-21/08/11	Dried seaweed	BARANORI (dried product) (assorted seaweed)	21-Aug-11 09:30 (purchased)	Temp. Yuriage-market in Natori, Miyagi	110830-GPJ-02
3	3-21/08/11	seaweed	SUJI AONORI (<i>Enteromorpha prolifera</i>)	21-Aug-11 12:00	Yuriage-Port	110830-GPJ-03
4	4-21/08/11	fish	MAGAREI (Littlemouth flounder, <i>Pleuronectes herzensteini</i>)	21-Aug-11	Yuriage-port	110830-GPJ-04
5	6-22/08/11	fish	AINAME (fat greenling, <i>Hexagrammos otakii</i>)	21-Aug-11	Onahama-port	110830-GPJ-05
6	7-22/08/11	fish	MAAJI (Japanese horse-mackerel, <i>Trachurus japonicus</i>)	21-Aug-11	Onahama-port	110830-GPJ-06
7	9-22/08/11	fish	MASABA (Chub mackerel, <i>Scomber japonicus</i>)	21-Aug-11	Onahama-port	110830-GPJ-07
8	12-22/08/11	fish	KUROSOI (rockfish, <i>Sebastes zonatusschlegeli</i>)	19-Aug-11	Offshore Hirakata	110830-GPJ-08
9	13-22/08/11	fish	AKAMEBARU (Rockfish, <i>Sebastes inermis</i>)	19-Aug-11	Offshore Hirakata	110830-GPJ-09
10	14-22/08/11	fish	SODAGTSUO / MARUSOUDA (Bullet mackerel, <i>Auxis rochei</i>)	19-Aug-11	Offshore Hirakata	110830-GPJ-10
11	15-22/08/11	fish	HAANAGO (<i>Conger myriaster</i>)	22-Aug-11 11:45	Hisanohama-Port	110830-GPJ-11
12	16-22/08/11	seaweed	AKAMOKU (<i>Sargassum horneri</i>)	22-Aug-11 11:45	Hisanohama-Port	110830-GPJ-12
13	17-22/08/11	seaweed	NAGAAOSA (<i>Ulva arasakii</i>)	22-Aug-11 11:45	Hisanohama-Port	110826-GPJ-01
14	18-22/08/11	seaweed	MAKONBU (kelp, <i>Laminariaceae</i> Bory)	22-Aug-11 11:45	Hisanohama-Port	110826-GPJ-03
15	19-22/08/11	fish	MAHIRAME (Bastard halibut, <i>Paralichthys olivaceus</i>)	22-Aug-11 13:40 (purchased)	Offshore Hirakata	110830-GPJ-13
16	20-22/08/11	seaweed	NAGAAOSA (<i>Ulva arasakii</i>)	22-Aug-11 14:30	Hirakata-Port	110826-GPJ-02
17	21-22/08/11	seaweed	MAKONBU (kelp, <i>Laminariaceae</i> Bory)	22-Aug-11 14:30	Hirakata-Port	110830-GPJ-14
18	22-22/08/11	fish	MAHIRAME (Bastard halibut, <i>Paralichthys olivaceus</i>)	22-Aug-11 16:40 (purchased)	offshore Oarai ~ Kashima	110830-GPJ-15
19	23-22/08/11	Dried fish	CHIRIMEN (dried product) (juvenile sarnines)	22-Aug-11 16:40 (purchased)	offshore Oarai ~ Kashima	110830-GPJ-16

2. Analysis method

The whole sample is homogenized, and a representative part is taken to be conditioned in a geometry adapted to the gamma measurement.

The analyses are performed by gamma spectrometry (High purity Germanium detector) on raw material (see appendix 1). The results are displayed in the 3 following tables.

3. RESULTS

3.1 Mass activity of fish flesh (2 tables)

Sample identification							
ACRO Sample number registration		110830-GPJ-01	110830-GPJ-04	110830-GPJ-05	110830-GPJ-06	110830-GPJ-07	110830-GPJ-08
Type		fish	fish	fish	fish	fish	fish
Species		GINZAKE (Silver Salmon, <i>Oncorhynchus kisutch</i>)	MAGAREI (Littlemouth flounder, <i>Pleuronectes herzensteini</i>)	AINAME (fat greenling, <i>Hexagrammos otakii</i>)	MAAJI (Japanese horse-mackerel, <i>Trachurus japonicus</i>)	MASABA (Chub mackerel, <i>Scomber japonicus</i>)	KUROSUI (rockfish, <i>Sebastes zonatus</i>)
Greenpeace sample number registration		1-21/08/11	4-21/08/11	6-22/08/11	7-22/08/11	9-22/08/11	12-22/08/11
Sampling							
date		21-Aug-11	21-Aug-11	21-Aug-11	21-Aug-11	21-Aug-11	19-Aug-11
place		Temp. Yuriage-market in Natori, Miyagi	Yuriage-port	Onahama-port	Onahama-port	Onahama-port	offshore Hirakata
Counting							
Geometry (ml)		500	50	300	300	50	50
Sample mass analysed (g)		468.1	51.4	295.2	310.5	53.5	52.5
analysed state		fresh	fresh	fresh	fresh	fresh	fresh
Counting date		August 31, 2011	September 1, 2011	September 1, 2011	September 1, 2011	August 31, 2011	September 3, 2011
Results							
Reference date		August 21, 2011	August 21, 2011	August 21, 2011	August 21, 2011	August 21, 2011	August 19, 2011
Unit		Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight
ARTIFICIALS RADIONUCLIDES							
Ag-110m	250 days	< 0.8	< 3	< 2	< 2	< 3	< 3
Te-129m	33,6 days	< 22	< 80	< 60	< 36	< 72	< 68
I-131	8 days	< 2	< 5	< 6	< 3	< 4	< 6
Cs-134	2.1 years	4.7 ± 0.7	10.9 ± 1.9	109 ± 13	30.4 ± 3.8	24.3 ± 3.3	52 ± 6
Cs-137	30 years	5.7 ± 0.9	13.1 ± 2.1	134 ± 16	36.4 ± 4.5	29.8 ± 4.0	63 ± 8

Sample identification							
ACRO Sample number registration		110830-GPJ-09	110830-GPJ-10	110830-GPJ-11	110830-GPJ-13	110830-GPJ-15	110830-GPJ-16
Type		fish	fish	fish	fish	fish	fish
Species		AKAMEBARU (Rockfish, Sebastes inermis)	SODAGTSUO / MARUSOUDA (Bullet mackerel, Auxis rochei)	HAANAGO (Conger myriaster)	MAHIRAME (Bastard halibut, Paralichthys olivaceus)	MAHIRAME (Bastard halibut, Paralichthys olivaceus)	CHIRIMEN (dried product) (juvenile sarnines)
Greenpeace sample number registration		13-22/08/11	14-22/08/11	15-22/08/11	19-22/08/11	22-22/08/11	23-22/08/11
Sampling							
date		19-Aug-11	19-Aug-11	22-Aug-11 11:45	22-Aug-11 13:40 (purchased)	22-Aug-11 16:40 (purchased)	22-Aug-11 16:40 (purchased)
place		offshore Hirakata	offshore Hirakata	Hisanohama-Port	Offshore Hirakata	offshore Oarai Kashima	offshore Oarai Kashima
Counting							
Geometry (ml)		300	50	50	300	300	500
Sample mass analysed (g)		302.5	53.3	49.0	290.2	301.1	269.7
analysed state		fresh	fresh	fresh	fresh	fresh	dry
Counting date		September 7, 2011	September 2, 2011	September 3, 2011	September 8, 2011	September 6, 2011	September 2, 2011
Results							
Reference date		August 19, 2011	August 19, 2011	August 22, 2011	August 22, 2011	August 22, 2011	August 22, 2011
Unit		Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg dry weight
ARTIFICIALS RADIONUCLIDES							
Ag-110m	250 days	< 2	< 3	< 3	< 0.8	< 0.7	< 2
Te-129m	33,6 days	< 56	< 76	< 68	< 26	< 20	< 36
I-131	8 days	< 10	< 5	< 4	< 4	< 2	< 2
Cs-134	2.1 years	161 ± 19	5.7 ± 1.4	25.3 ± 3.4	86 ± 10	20.6 ± 2.5	< 1
Cs-137	30 years	195 ± 23	6.1 ± 1.4	32.2 ± 4.2	104 ± 12	25.0 ± 3.0	< 1

3.2 Mass activity of seaweeds

Sample identification							
ACRO Sample number registration	110830-GPJ-02	110830-GPJ-03	110830-GPJ-12	110826-GPJ-01	110826-GPJ-03	110826-GPJ-02	110830-GPJ-14
Type	seaweed	seaweed	seaweed	seaweed	seaweed	seaweed	seaweed
Species	BARANORI (dried assorted seaweed)	SUJI AONORI (Enteromorpha prolifera)	AKAMOKU (Sargassum homeri)	NAGAAOSA (Ulva arasaki)	MAKONBU (kelp, Laminariaceae Bory)	NAGAAOSA (Ulva arasaki)	MAKONBU (kelp, Laminariaceae Bory)
Greenpeace sample number registration	2-21/08/11	3-21/08/11	16-22/08/11	17-22/08/11	18-22/08/11	20-22/08/11	21-22/08/11
Sampling							
date	21-Aug-11 09:30 (purchased)	21-Aug-11 12:00	22-Aug-11 11:45	22-Aug-11 11:45	22-Aug-11 11:45	22-Aug-11 14:30	22-Aug-11 14:30
place	Temp. Yuriage-market in Natori, Miyagi	Yuriage-port	Hisanohama-Port	Hisanohama-Port	Hisanohama-Port	Hirakata-Port	Hirakata-Port
Counting							
Geometry (ml)	300	500	300	300	300	300	500
Sample mass analysed (g)	62.8	436.0	274.4	254	239	274	395.5
analysed state	dry	fresh	fresh	fresh	fresh	fresh	fresh
Counting date	September 5, 2011	September 5, 2011	September 7, 2011	August 29, 2011	August 30, 2011	August 29, 2011	September 6, 2011
Results							
Reference date	August 21, 2011	August 21, 2011	August 22, 2011	August 22, 2011	August 22, 2011	August 22, 2011	August 22, 2011
Unit	Bq/kg dry weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight	Bq/kg fresh weight
ARTIFICIALS RADIONUCLIDES							
Mn-54	312 days	< 3	< 0.6	0.96 ± 0.37	< 1.2	< 1.0	< 0.6
Co-60	5.3 years	< 3	< 0.6	0.83 ± 0.34	< 1.2	< 1.0	< 0.6
Ag-110m	33 days	< 4	< 1	6.9 ± 1.2	< 1.5	< 1.5	< 0.8
Te-129m	33.6 days	< 88	< 24	32 ± 15	< 40	< 40	< 22
I-131	8 days	< 6.0	< 2	< 4	< 3	2.3 ± 1.1	< 1
Cs-134	2.1 years	< 2	5.0 ± 0.8	90 ± 10	54 ± 5	53 ± 5	33.4 ± 3.0
Cs-137	30 years	< 3	5.1 ± 0.8	106 ± 12	61 ± 6	66 ± 6	39.3 ± 3.5

APPENDIX 1

ANALYSIS	
TITLE	Measurement of gamma emitters nuclides by gamma spectrometry
TREATMENT	The fresh sample is homogenized. 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 cryostat. The samples are placed in a 10-cm thick lead shielding. Data are readout by a digital acquisition system (DSPEC-ORTEC). The energy range is taken as 27-2000 keV. The containers are normalized geometries with volumes of 500ml (SG500), 300ml (round boxes) and 50 ml (SG50), adapted to the available quantity.
UNITS	The measured quantity is the mass activity in Becquerel (Bq) per kilogram of fresh weight (kg fresh weight).

RESULTS	
IN GENERAL	<p>Measurements are performed with identical geometries as those 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>

APPENDIX 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 and quality procedures standards (ISO/CEI 17025).
QUALIFICATION	
The laboratory is qualified for radioactivity measurements in the environment by the French nuclear safety authority (ASN)	
Agreements :	
DEP-DEU-0704-2009	<ul style="list-style-type: none"> - Measurement of gamma-emitters radionuclides in biological matrices - Tritium measurement in waters
CODEP-DEU-2010-031543	<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.
CODEP-DEU-2011-031763	<ul style="list-style-type: none"> - Measurement of gamma-emitters radionuclides in soils