

CONTAMINATION IN FRANCE

What are the risks ?

The CRIIRAD received over a thousand calls and requests concerning the impact of airborne contamination masses in France : What are the risks for my health ? For my children ? for the child I am expecting ? Do we need to protect ourselves? If so, how can we protect ourselves ?

In order to answer the multiple questions we received, the following constitutes the starting point of all answers that will be progressively completed and enriched. This document will be presented in a Q & A form in the very near future. Our workload is such that it is actually quite difficult for our small team to come to grasp with all the tasks that need to be tended on the different aspects of the dossier : collating and analyzing samples from France and Japan, data inventory and study of the situation in Japan, writing and editing documents, call answering, emailing, interview requests, keeping close to the situation in Japan, impact in France and abroad, etc). Please also note that prior to the accident in Fukushima, the CRIIRAD already had to face underlying difficulties due to the disparity between its resources and the magnitude of the dossiers that are handled. Nevertheless, please rest assured that we will do our utmost to provide all the answers in a timely manner. We appreciate your understanding and thank you in advance.

NB : The information provided in this document can concern other European countries. Indeed, the airborne contamination is basically the same in Germany, Switzerland, Belgium, Italy, etc. The results made available for the United States seem to show substantially higher contaminant levels (approx. 10 times). It is even more important to avoid the regular consumption of rain water and excessive consumption of vulnerable foods such as leaf vegetables, fresh milk and ricotta /cream cheese).



L I E
D E T E C T O R

CRIIRAD IS ON ALL
FRONTS

Many thanks to Philippe Zanin
for the humoristic friendship that indefectibly transpire from his drawings.

In its communiqué of March 22, 2011, written before the contamination even reached France, the CRIIRAD had attempted to evaluate the risk levels by outlining various hypotheses in order to temporarily remedy the lack of usable data. The text specified namely :

- 1.** « *irradiation risk resulting from the contaminated airborne masses will be trivial* ». This projection is now confirmed based on actual measures and is no longer an hypothesis.
- 2.** « *Risk associated to radioactive aerosols and halogens in suspension in the air should be very low* ». Doses estimates indicate that corrective actions such as home confinement and iodine supplement tablet intakes, is not justified. This forecast is now confirmed on the basis of analyses results and is no longer an hypothesis.
- 3.** « *Risk linked to ingestion of water or foods contaminated by the radioactive fallouts should remain limited*. The CRIIRAD laboratory will further and rapidly calculate quantities of radioactive fallouts deposited on the soil (dry fallouts and those propelled by precipitations) in order to assess an order of magnitude to be expected in foods and thus provide had hoc advices as necessary ».

RAIN WATER AND TAP WATER SUPPLY

In order to assess the radioactivity fallouts on the soils, the CRIIRAD Laboratory has analyzed **8 rainwater samples** collected in different regions in France. Activities in iodine 131 (sole radionuclide detected) were measured between **0,24 Bq/l** and **4,9 Bq/l**.

These low level activities do not imply that there was any risk for people who might have been under the rain without protection. However, the use of rainwater as main source of water supply for the alimentation is not recommended, particularly if consumers are young children. Note that the regulation does not consider rainwater as potable water.¹

Water channeled from underground supplies or via large rivers should not present a problem. However it would be wise to take a closer look at water bodies such as hillside lakes receiving water from one or several drainage basins.

POTENTIALLY HAZARDOUS FOODS

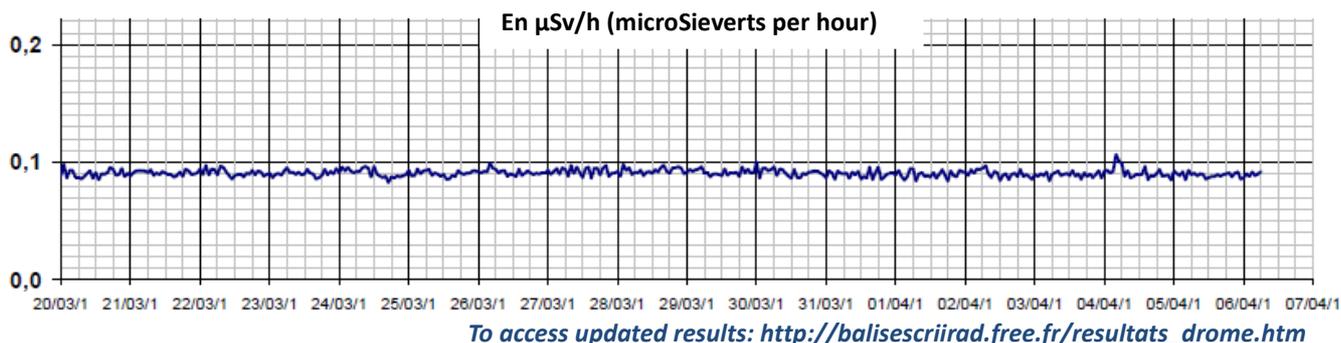
There are two probable categories of food to consider: **long leaf vegetables like salads, spinach, cabbage, chards, sorrel...** (except when they are cultivated in a greenhouse) ; **dairy milk and cream cheese (in particular goat and sheep), meat**, except for herds still in stalls. Risks are indeed quite low but if we take into consideration the duration of the contamination, the diet habits and the vulnerability of some groups of the population, we are no longer within the trivial risk, it seems prudent to avoid certain behaviors: **ensuring that foods at risk do not constitute the basis of the family alimentation on the forthcoming weeks. This is a good-sense precaution directed namely to youngsters, pregnant women and breastfeeding mothers.**

¹ The Health Ministry states : «After storing run off water from a roof into a tank, a bacterial development can occur. This is therefore non potable water as it is microbiologically contaminated (particularly water running off the roof) and chemically spoiled (pesticides in rainwater, metals or asbestos present in the roof material, etc), and does not comply with public health in terms of quality standards fixed by the regulation regarding waters for human consumption.

1. « *The risk of irradiation by contaminated airborne will be trivial* ». This forecast is now confirmed on the basis of measures and no longer an hypothesis.

The CRIIRAD uses an equipment that streams continuously the gamma dose rate (in microSievert per hour : $\mu\text{Sv/h}$). This equipment was acquired in 2009 with the support of the Rhône-Alpes region. The equipment helped determine that the increase of the airborne activity did not allow to observe a measurable increase of the ambient gamma radiation contribution.

As shown on the curb below, depicting the results recorded since Monday March 21, results fluctuate between 0,08 to 0,1 $\mu\text{Sv/h}$. No measurable increase has been observed since airborne contaminant masses reached France (around March 23 / 24).



Note that the increase of the radioactive flux recorded by the probe in the night of April 4 to 5 (i.e. on the curb the value above 0,1 $\mu\text{Sv/h}$) is due to a rain episode and an increase of the natural radiation, unrelated to the wastes from Japan.

To this effect, the CRIIRAD received dozens of mails from persons using radiometers and dosimeters who recorded an increase of the ambient radiant level or who questioned the results of the IRSN marker. Lacking sufficient time to respond to each individual file, we are suggesting several indications of general scope for the time being (information notice to the radiometer users' attention).

2. « *Risk associated to radioactive aerosols and halogens in suspension in the air should be very low* ». Dose estimates indicate that corrective actions such as home confinement and iodine² supplement tablet intakes, is not justified. This forecast is now confirmed on the basis of analyses results and no longer an hypothesis.

To determine the level of air contamination, the analyses were centered on aerosol filters and the cartridges that are equipped on airborne radioactivity surveillance tracers. They revealed the presence of Iodine 131³.

As stipulated in our communiqué of March 26, 2011, iodine 131 is mostly present in the air in the form of gas. The analyses done on the filters and cartridges of the tracers located in Avignon, Montélimar, Valence, Romans-sur-Isère et Péage-de-Roussillon show that it represents **70 to 90% of iodine 131 present in the air**. The publication of partial results, whether they be on filters that retain aerosols or on activated carbon cartridges that trap the gases, lead to under-estimate the true level of contamination : under-estimation is limited when results concern gas iodine but can attain an order of magnitude when analysis is based on dust filters.

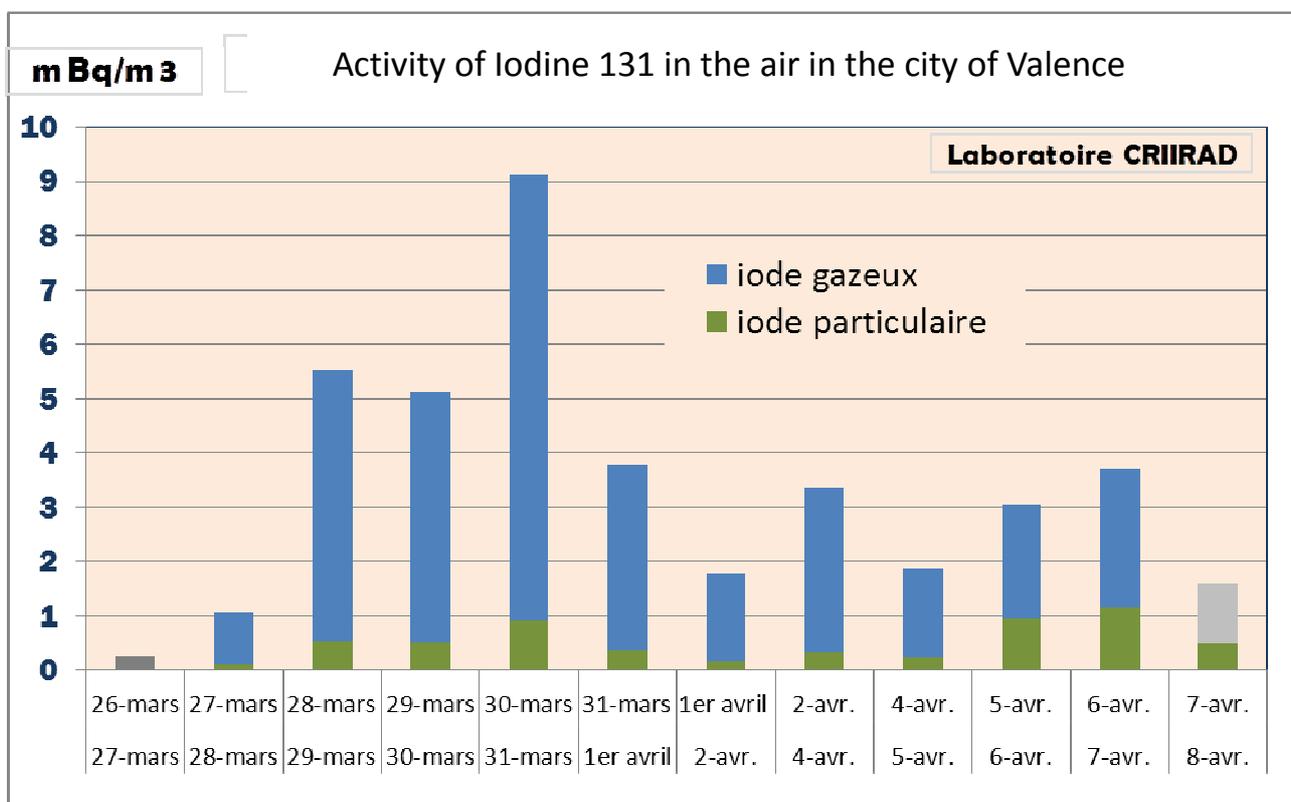
² However, the actual context can only bring each one of us to think about one's own diet balance and to check that the needs in iodine are satisfied. The thyroid gland needs natural iodine to produce the hormones needed in the organism. When the thyroid is deficient it will fix the radioactive iodine faster in the organism.

³ Cesium 134 and 137 are present but at a too low level to be detected. Xenon 133 is also present, at levels probably higher than iodine 131, but it is a rare gas that can be trapped only rarely by the filtering devices .

On the basis of the analyses of its laboratory and of the inventory of the data published by the IRSN, the CRIIRAD considers that the activity of iodine 131 in the air could have reached, and exceed 10 mBq/m³. In Valence, the activity of the air density reached 9 mBq/m³ from March 30, 15h29 to March 31, 15h18. It was probably higher, around the same date, in Montélimar : in the range of 12 mBq/m³. These figures are the highest published to date. However, it is unlikely that the maximum levels concerned specifically the Rhône Valley. It is likely that other regions suffered similar contamination levels, if not even higher.

The analyses results inventory published in the information bulletins of the IRSN⁴ show that only too few complete results are actually available. We have inserted them on the **map of France related to the (total) activity of iodine 131 in the air**⁵. The lack of a sufficient number of usable results, the relation gas iodine/particulate iodine will have to be matured. Perhaps it will be then possible to exploit the filter analyses and to estimate the true activity in the air for the entire country.

The follow up on the radiologic quality of the air in the Valence area shows that the activity of iodine 131 has gone beyond 1 mBq/m³ on March 27-28, 5 mBq/m³ from 28 to 30 March, to reach a maximum of 9 mBq/m³ on 30-31 march. Since then, concentrations have decreased but remain between 1 and 4 mBq/m³. Values in grey are under the limit of detection.



The aerosol filter corresponds to the deposits from 29 March to April 4 has been analyzed to define the activity of iodine 131 present in the air in a particulate form (associated to micro particles that are called aerosols). The average activity of iodine 131 is of 0,45 mBq/m³. This value allowed us to determine, over the

⁴ The IRSN information bulletins n°3 à n°10 have been analyzed (no results in n°1 et 2) : [Bulletin n°1 - 24 mars 2011](#) ; [Bulletin n°2 - 25 mars 2011](#) ; [Bulletin n°3 - 26 mars 2011](#) ; [Bulletin n°4 - 27 mars 2011](#) ; [Bulletin n°5 - 28 mars 2011](#) ; [Bulletin n°6 - 29 mars 2011](#) ; [Bulletin n°7 - 30 mars 2011](#) ; [Bulletin n°8 - 31 mars 2011](#) ; [Bulletin n°9 - 1er avril 2011](#) ; [Bulletin n°10 - 2 avril 2011](#).

⁵ La première version de cette carte (mise en ligne le 5 avril) indiquait que le résultat de l'IRSN pour le site du Vésinet (78) comportait une anomalie (nous pensions à une erreur de date). Cette mention était erronée. Elle a été corrigée sur la base des informations transmises par l'IRSN. Nous prions cet organisme et les internautes de bien vouloir nous en excuser.

eight days, the proportion of gas iodine (89%) and of particulate iodine (11%). These ratios allowed to compute the probable activity of particulate iodine which added to the gas iodine give the total activity of the iodine 131 in the air. These values resulting from calculations are inserted in italic in the table below.

Analysis result from the CRIIRAD Laboratory
Air sampled by the tracers of the atmospheric radioactivity surveillance network
 (non exhaustive extract)

Localisation de la balise		Filtration de l'air		Gaz dans	Aérosols	Activité totale	Gaz /	Gaz /
Commune	Département	Début	Fin	cartouche	sur filtre	de l'iode 131	Total	Aérosols
Péage / Romans	Isère / Drôme	28-mars	31-mars	5,74	0,76	6,5 mBq/m ³	88%	8
Montélimar	Drôme	28-mars	1er avril	7,00	0,57	7,6 mBq/m ³	92%	12
Avignon	Vaucluse	28-mars	1er avril	0,99	0,42	1,4 mBq/m ³	70%	2
Romans-sur-Isère	Drôme	31-mars	2-avr.	2,86	0,55	3,4 mBq/m ³	84%	5
Valence	Drôme	28-mars	29-mars	4,98	0,45	5,5 mBq/m ³	89%	9
		29-mars	30-mars	4,62		5,1 mBq/m ³		
		30-mars	31-mars	8,23		9,1 mBq/m ³		
		31-mars	1er avril	3,40		3,8 mBq/m ³		
		1er avril	02-avr	1,60		1,8 mBq/m ³		
		2-avr.	04-avr	3,02		3,4 mBq/m ³		
		4-avr.	05-avr	1,65		1,8 mBq/m ³		

The results of the analysis related to **iodine 131 present in the air in a gas form** are presented on a distinct map. When several results are available (CRIIRAD, CEA Cadarache, ILL...), only the highest values are reported.

On the basis of the results of the analyses conducted to date, the CRIIRAD has undergone a series of dose calculations in order to determine if the risk levels could be considered as trivial or if they justified the implementation of protection measures.

We undertook an evaluation of a dose that would receive a person breathing an air contaminated by iodine 131 activity reaching up **20 mBq/m³** and supposing a permanent exposition over a period of **40 days** from march 22 to April 30 (an upper bound hypothesis for the time being).

Depending on the age, the incorporated activity when breathing varies between **4 Bq (toddler child) and 23 Bq (adults)**. This corresponds to radiant doses inferior to **0,4 µSv**, hence a few percents from the threshold limit of **10 µSv/annum** from which the regulation of the European Union considers that risk levels are no longer trivial and that measures to reduce the expositions must be examined. These values represent an even lower fraction of the dose threshold limit of 1 mSv/annum (<0,04%).

[See detailed explanations in appendix : doses induced by inhalation iodine 131](#)

Going home to protect oneself from these very low levels of contamination is neither justified nor useful. **As long as an atmospheric contamination extends over several days, all the more over several weeks, confinement is not an appropriate answer** : either it is inefficient – most general case – the air in houses being auto renewed within a few hours (from less than an hour to up to 8 or 10 h maximum depending on the impermeability of the construction) ; either it is efficient, and this is a problem as the volume of the air in a house must be renewed completely at least every 3 hours. The renewed air allows to evacuate different pollutants (odors, humidity, smoke from tobacco, household detergent releases, solvents, formaldehydes, ...) and in particular nitrogen dioxide (CO₂, CO, NO_x) that accumulate with the use of gas induced apparels or chimneys. We must underline as well that the confinement will increase the concentration in radon, a natural radioactive gas which has an attested carcinogenic effect.

To conclude, it is not recommended to confine oneself in a home. The radiologic risk is trivial, even lower than those related to problems linked with the accumulation of polluted air (pollutants and radon, a natural radioactive gas).

3. « Risk linked to ingestion of water or foods contaminated by the radioactive fallouts should remain limited. The CRIIRAD laboratory will further and rapidly calculate quantities of radioactive fallouts deposited on the soil (dry fallouts and those propelled by precipitations) in order to assess an order of magnitude to be expected in foods and thus provide had hoc advices as necessary ».

➤ RAIN WATER AND TAP WATER SUPPLY

In order to assess the radioactivity fallouts on the soils, the CRIIRAD Laboratory has analyzed **8 rainwater samples** collected in different regions in France. When traversing contaminated airborne masses rainwater amasses particles and soluble radioactive gases (case of gas iodine). Activities in iodine 131 (sole radionuclide detected) were measured between **0,24 Bq/l** (rainfall in Annecy on March 29-29) and **4,9 Bq/l** (rainfall at around 20 km from Toulouse between March 27 and March30).

Localisation du prélèvement		Pluie collectée		Date d'analyse	Césium 137 (Bq/l)	Césium 134 (Bq/l)	Iode 131 (Bq/l)	Américium 241 (Bq/l)
Département	Commune	du	au					
Gironde	St Medard-en-Jalles	26/03/11 00:00	27/03/11 00:00	31/03/11	< 0,22	< 0,19	3,2 ± 0,9	< 0,41
Finistère	Quimper	27/03/11 17:40	27/03/11 20:15	31/03/11	< 0,10	< 0,08	0,49 ± 0,24	< 0,27
Haute Savoie	Annecy	27/03/11 19:00	28/03/11 07:00	30/03/11	< 0,10	< 0,08	0,24 ± 0,18	< 0,06
Ardèche	Toulaud	27/03/11 10:30	28/03/11 08:00	28/03/11	< 0,18	< 0,09	0,73 ± 0,38	< 0,19
Haute-Garonne	Castelnau d'Estrétefonds	27/03/11 12:00	30/03/11 13:00	03/04/11	< 0,45	< 0,37	4,9 ± 1,4	< 0,73
Haute-Corse	Lama	28/03/11 11:00	28/03/11 14:00	30/03/11	< 0,94	< 0,91	1,9 ± 1,5	< 1,4
Seine et Marne	Avon	29/03/11 16:30	31/03/11 09:00	01/04/11	< 0,09	< 0,09	1,2 ± 0,3	< 0,13
Nord	Verchain Maugre	30/03/11 15:00	31/03/11 15:00	04/04/11	< 0,15	< 0,12	0,66 ± 0,42	< 0,27

The CRIIRAD has inventoried analyses results published by the IRSN in several of its bulletins⁶ : twenty results are available. Activities are comprised between **0,246 Bq/l** (rainfall collected in Orsay on March 27) and **3,1 Bq/l** for the rainfall collected at the CENBG, south of Bordeaux, in Gradignan, on March 30. The results (CRIIRAD, IRSN and other laboratories) have been reported on a **map of France**.

These low level activities do not imply that there was any risk for people who might have been under the rain without protection. If your children played under the rain, in a puddle, if they their hair and skin were wet, etc. there is no reason to be concerned.

The problem is different regarding Rainwater CONSUMPTION.

Many people asked us if they could continue using the water in their water tank for domestic use (water collected under the roof of their homes). Considering the contamination levels that have been measured to date, punctual consumption of several glasses is not hazardous. On the other hand, if the collected water is the principal source of consumption on a period of 15 days to 3 weeks, the dose could reach the threshold limit (or even beyond) from which the risk is no longer considered as trivial, in particular if consumers are young children. They are very low levels that nevertheless should be avoided⁷. It is reminded that the

⁶ The IRSN information bulletins n°3 à n°10 have been analyzed (no results in n°1 et 2) : [Bulletin n°1 - 24 mars 2011](#) ; [Bulletin n°2 - 25 mars 2011](#) ; [Bulletin n°3 - 26 mars 2011](#) ; [Bulletin n°4 - 27 mars 2011](#) ; [Bulletin n°5 - 28 mars 2011](#) ; [Bulletin n°6 - 29 mars 2011](#) ; [Bulletin n°7 - 30 mars 2011](#) ; [Bulletin n°8 - 31 mars 2011](#) ; [Bulletin n°9 - 1er avril 2011](#) ; [Bulletin n°10 - 2 avril 2011](#).

⁷ It is possible that the filtering of water leads to an efficient decontamination but there is no certainty on this issue and it is best to remain cautious.

Health ministry does not consider rainwater as potable water and warns against risks associated to its consumption.

If you cannot avoid using the water collected from roof run offs for the irrigation of your garden, be sure to humidify the soil and not the plant leaves: absorption is substantial and rapid on foliar surfaces; and lower and slower on the root system of the plants.

A great number of requests regard tap water distribution. When homes are supplied from ground water, the current contamination is of no consequence. The activities deposited are low, dilution capacity of the underground aquifers is substantial and radioactive iodine will probably disintegrate before it reaches them, even if the ground water is shallow. Conclusion is the same for potable water from river water treatment distribution. In order for the incidence to be noticeable, there would need to have abundant and continuous rainfalls, susceptible to represent **over a period of time** an important percentage of the water flow rate. This is unlikely to happen and it does not reflect the current meteorological conditions. On the other hand, it would seem wise to examine the situation of water bodies such as hillside lakes receiving water from one or several drainage basins. They are obviously more exposed than circulating water. Analyses should allow to invalidate rapidly this doubt.

➤ **POTENTIALLY HAZARDOUS FOODS**

Since several days, questions from our correspondents focus namely on the impact of radioactive fallouts on foods : Are they contaminated ? if so, which ones ? Should we avoid eating them ? Is it dangerous for children ? for an expecting woman ? for a breastfeeding mother ?

There are two sorts of risk foods : those contaminated by direct deposit and those contaminated by transfer (dairy milk, meat).

- The importance of the contamination depends, on the deposited activity (dry or humid deposits) but also from the vegetative state of the plant and the available absorption surfaces : **plants with large leaves like salads, spinach, cabbage, chards, sorrel...** are among the food products the most exposed (except if cultivated in a greenhouse). Considering the air contamination level, the transfer coefficients of air to soil and to rain and air to rain to plants, the activity of iodine 131 of these vegetables should reach a few Becquerel's per kilogram, even several dozens of Bq/kg.

Let's precise that the radioactive particles deposited on foliar surfaces are rapidly metabolized by the plant (translocation phenomenon) and the fact of rinsing the plant is not effective. Some culinary techniques can however eliminate part of the radioactivity.

- **Dairy milk, cream cheese and meat** issued from herds that are still in stalls do not constitute any problem. Moreover, some herds are currently taken to grazing lands but the essential of their nutriment is still provided by cereals and hay. In this case, the incidence in the ingestion of contaminated grass remains trivial. Animals in grazing fields can eat grass over large surfaces and consume radioactive material absorbed by the plant cover. Part of the contaminants is rapidly eliminated while some stay fixed in their organs, depending on metabolic characteristics of each radionuclide. Radioactive iodine is concentrated in the animals' thyroid gland and is also fixed in mammary glands then transferred to the milk. We find it again in the meat products in lower concentration.
- The transfer factor from the grass to the milk varies largely whether it is cow milk or goat and sheep milk, the latter having a greater contamination magnitude order compared to cow milk. The radioactivity of the cheese products depends on manufacture methods and maturing delays.

Must I be careful on my dietary intake ?

The answer to this question remains a private choice.

The risks are indeed low but if we take into consideration the possible duration of the contamination, the

particular eating habits, and the vulnerability in some population groups (children, pregnant women, breastfeeding mothers) we no longer are in the trivial realm and it wise to avoid unnecessary risks in behaviors.

The Euratom regulation 96/29⁸ defines the general principles of radioprotection en force in Europe. It stipulates that the impact of a nuclear activity can be considered as trivial if the radiation dose that it induces does not exceed **10 µSv/an**⁹. Beyond this value, necessary actions must be undertaken to reduce expositions. In the case of the radioactive fallouts on the FUKUSHIMA DAIICHI PLANT, it is essentially about limiting the ingestion of **iodine 131**.

The quantity of iodine 131 susceptible to deliver a dose of 10 µSv varies greatly on the age of the consumer. **Toddlers** under the age of (0 – 2 ans) are the most vulnerable: ingestion of fifty Becquerels of iodine 131 is enough to deliver to the organism a dose of 10 µSv. If risk foods (leaf vegetables, dairy products and cream cheese...) contain between **1 to 10 Bq/kg**, or more, it is then possible to imagine that within a period of 2 to 3 weeks the limit standard of 10 µSv/annum is reached.

It is however easy to limit the exposition to trivial levels by ensuring that these foods do not constitute à the basis of the family diet throughout the month of April. One might prefer long conservation milk to fresh milk, a reasonable intake of sheep cheese, cards, salads or spinach. These good sense measures particularly concern children, pregnant women and breastfeeding mothers.

NB : The reference value used by the CRIIRAD is the cut-off point of the level called « trivial » i.e. : 10 µSv/yr (or 0,01 mSv/yr). It must not be confused with the maximum standard level of 1 mSv/yr which is 100 times higher. Even if we imagined a dietary intake centered on foods that concentrate contaminants, the exposition levels in France should remain much lower to this value. For the inhabitants of the West Coast of the United States, the situation is far more different.

For more detailed explanations, read :
[Doses induced by Iodine 131 ingestion](#)

How long will the contamination last ?

To date, we can only forecast a minimal duration : huge amounts of radioactive material are released by the FUKUSHIMA DAIICHI plant since Saturday March 12, 2011. On Tuesday April 5, 24 days after the accident, the releases continue. This means that the contaminated airborne masses in Europe will last just as long, with a delay linked to the movement of radioactive aerosol gases over some 15 000 km.

The west coast of the United States receives 6 to 10 days before France the impact of the radioactive waste from the FUKUSHIMA DAIICHI PLANT. Given the available results, we can expect at least over the next week, activities slightly lower but nevertheless steady.

The technical report from the operating company (TEPCO) and the Japanese nuclear safety authorities (NISA) fear releases over several more days, even weeks. If more fires are declared or if the operators are forced to release more steam in order to avoid hydrogen explosions, new massive waste releases will occur. In France, the impact will remain low and the safety measures relatively easy to implement. **In Japan, it is entirely different.**

⁸ Regulation of the Counsel 96/29/Euratom of 13 mai 1996 setting the standard norm for workers and public health and safety against ionizing radiation dangers.

⁹ The criteria of decision on the exemption of activities that generate an exposition to ionizing radiation are in fact double: none in the public can receive a dose superior to 10 µSv/yr and the collective dose does not exceed 1 Man.Sievert (meaning that the number of persons exposed remain (relatively) limited).