IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

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Information report

(Update of report of 09/10/2017)

Detection of ruthenium 106 in France and in Europe

Results of IRSN's investigations

Ruthenium 106[1] has been detected in late September by several European networks involved in the monitoring of atmospheric radioactive contamination, at levels of a few milliBecquerels per cubic meter of air. IRSN's investigations make it possible to provide information on the possible location of the source of the release as well as the order of magnitude of the quantities released.

As soon as it became aware of the first detections of Ruthenium 106 in the atmosphere in Italy on 3 October, 2017, IRSN mobilized all its means of radiological monitoring of the atmosphere and conducted regular analysis of the filters from its monitoring stations2. For the period from September 27 to October 13, only the stations of Seyne-sur-Mer, Nice and Ajaccio revealed the presence of Ruthenium 106 in trace amounts. During this period, the highest value (46 micro-Bq/m$^{3)}$, was recorded in Nice between 2 and 9 October. Since October 13, 2017, Ruthenium 106 is no longer detected in France. All IRSN measurement results between September 26 and October 19 are presented in Appendix 1.

Measurement results from European stations communicated to the Institute since October 3, 2017 have confirmed the presence of Ruthenium 106 in the atmosphere of the majority of European countries. The maximum levels observed at the beginning of October reached values of the order of one hundred milliBecquerels per cubic meter of air. **The results obtained for sampling periods later than October 6, 2017 showed a steady decrease in Ruthenium 106 levels, which is currently no longer detected in Europe.**

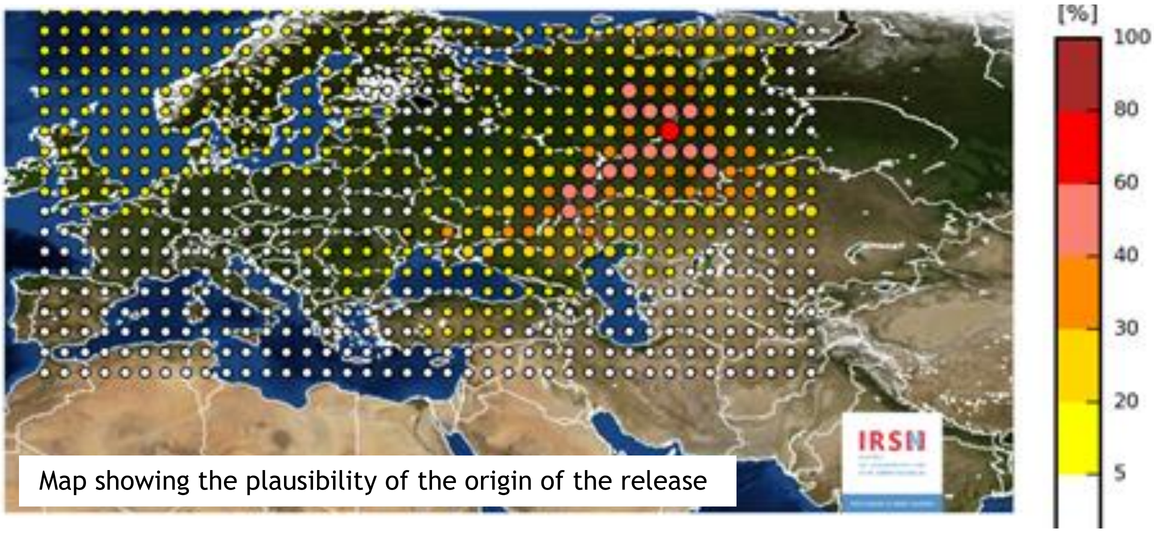
The concentration levels of Ruthenium 106 in the air that have been recorded in Europe and especially in France are of no consequence for human health and for the environment.

The detection of Ruthenium 106 alone excludes the possibility of a release from a nuclear reactor which would result in the presence of other radionuclides. The origin of Ruthenium 106 is therefore to be found either in nuclear fuel cycle facilities or radioactive source production, or in the consequences of the re-entry into the atmosphere of a satellite equipped with a thermoelectric generator with ruthenium. This last hypothesis was investigated by the IAEA, which concluded that no satellite containing Ruthenium 106 has fallen back on earth during this period. As a result, IRSN has, in its investigations, made the hypothesis of a rejection from an installation.

[1] Ruthenium 106 is a radionuclide of artificial origin. It is a fission product from the nuclear industry. This radionuclide is also used in the medical field for brachytherapy treatments.
[2] In France, IRSN is responsible for monitoring the radioactivity of the atmosphere on a nation-wide scale. Its surveillance network OPERA-Air includes high-volume aerosol samplers (700 to 900 m3 of air per hour) and measurement equipment capable of detecting trace amounts of radioactivity.

Based on the meteorological conditions provided by Météo France and the measurement results available in European countries, IRSN carried out simulations to locate the release zone, to assess the quantity of ruthenium released, as well as the period and the duration of the release. The first step of these simulations was to divide the European territory into meshes of identical size. For each of these meshes, IRSN simulated a rejection of Ruthenium 106 and quantified the consistency between the simulation and the 368 measurements from 28 European countries.

The map below represents for each mesh the plausibility of the origin of the release. It summarizes the results obtained and confirms that the most plausible zone of release lies between the Volga and the Urals without it being possible, with the available data, to specify the exact location of the point of release. Indeed, it is in this geographical area that the simulation of a ruthenium release makes it possible to better reproduce the measurements obtained in Europe.



Map identifying, on the basis of the model-measurement comparison, the most plausible release zone. For a simulated release at each point of the mesh, the comparison consists in estimating the percentage of modelled data which are within a factor of 2 compared to actual measurements. The area with the highest percentage is identified as the most plausible release zone.

For the most plausible zone of release, **the quantity of Ruthenium 106 released estimated by IRSN simulations is very important, between 100 and 300 teraBecquerels**. The release, accidental with regard to the quantity released, would have occurred during the last week of September 2017.

All these results were subjected to the critical evaluation of several international experts who questioned neither the method used nor the results obtained. They were also compared with simulations made by counterpart organizations in Europe and around the world, using methods and models different from those used by IRSN. From these comparisons, it appears that, as regards with both the location of the release zone and the quantity released, IRSN evaluations are in very good agreement with those carried out by these peer organizations.

Because of the quantities released, the consequences of an accident of this magnitude in France would have required to implement locally measures of protection of the populations on a radius of the order of a few kilometres around the location of the release.

The exceeding of maximum permitted levels[3] for foodstuffs (1250 Bq / kg for Ruthenium 106 for non-milk products) would be observed over distances of the order of a few tens of kilometres around the location of the release.

The possibility of exceeding maximum permitted levels near the accident site led IRSN to study the scenario of importing foodstuffs from this area. From this analysis, **IRSN considers, on the one hand, that the probability of a scenario that would see the importation into France of foodstuffs (especially mushrooms) contaminated by Ruthenium 106 near the source of the release is extremely low and, on the other hand, the potential health risk associated with this scenario is also very low.** It does not therefore appear necessary to introduce systematic controls on the contamination of imported foods. As a precaution, random checks could nevertheless be usefully carried out.

[3] Last EURATOM Regulation 2016/52 of January 15, 2016 laying down maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other case of radiological emergency.

Table 1: Update of measurement results in France (as of October 25, 2017)

Sampling station	Sampling period		Concentration in the air in Ru-106 (mBq/m^3) The results preceded by the symbol < correspond to values below the detection threshold.
Orsay *	27/09/2017	03/10/2017	< 0,007
La Seyne sur Mer *	26/09/2017	03/10/2017	**0,0074 +/- 0,0014**
La Seyne sur Mer *	03/10/2017	11/10/2017	**0,0197 +/- 0,0034**
La Seyne sur Mer *	11/10/2017	13/10/2017	**0,00155 +/- 0,0007**
Bordeaux *	25/09/2017	02/10/2017	< 0,005
Charleville-Mézières *	26/09/2017	03/10/2017	< 0,009
Ajaccio**	25/09/2017	02/10/2017	< 0,0043
Ajaccio**	02/10/2017	09/10/2017	**0,0082 +/- 0,0028**
Ajaccio**	09/10/2017	16/10/2017	< 0,009
Bugey**	25/09/2017	02/10/2017	< 0,013
Bugey**	02/10/2017	09/10/2017	< 0,031
Bugey**	09/10/2017	16/10/2017	< 0,025
Cadarache**	25/09/2017	02/10/2017	< 0,030
Cadarache**	02/10/2017	09/10/2017	< 0,012
Cadarache**	09/10/2017	16/10/2017	< 0,015
Cattenom**	25/09/2017	02/10/2017	< 0,025
Cattenom**	02/10/2017	09/10/2017	< 0,021
Cattenom**	09/10/2017	16/10/2017	< 0,060
Cruas**	02/10/2017	09/10/2017	< 0,011
Cruas**	09/10/2017	16/10/2017	< 0,050
Fessenheim**	25/09/2017	02/10/2017	< 0,023
Fessenheim**	02/10/2017	09/10/2017	< 0,021
Fessenheim**	09/10/2017	16/10/2017	< 0,018
Grenoble**	29/09/2017	02/10/2017	< 0,053
Grenoble**	02/10/2017	06/10/2017	< 0,014
Grenoble**	09/10/2017	12/10/2017	< 0,010
Grenoble**	13/10/2017	16/10/2017	< 0,015
Marcoule**	25/09/2017	28/09/2017	< 0,021
Marcoule**	28/09/2017	02/10/2017	< 0,023
Marcoule**	02/09/2017	05/10/2017	< 0,006
Marcoule**	05/10/2017	09/10/2017	< 0,011
Marcoule**	09/10/2017	12/10/2017	< 0,018
Marcoule**	12/10/2017	16/10/2017	< 0,023
Marcoule**	16/10/2017	19/10/2017	< 0,024
Nancy**	25/09/2017	02/10/2017	< 0,011
Nancy**	02/10/2017	09/10/2017	< 0,011
Nancy**	09/10/2017	16/10/2017	< 0,0046
Nice**	25/09/2017	02/10/2017	**0,0068 +/- 0,0027**
Nice**	02/10/2017	09/10/2017	**0,046 +/- 0,0078**
Nice**	09/10/2017	16/10/2017	< 0,007
Penly**	25/09/2017	02/10/2017	< 0,023
Penly**	02/10/2017	09/10/2017	< 0,022
Penly**	09/10/2017	16/10/2017	< 0,027
Prevessin (CERN) **	25/09/2017	02/10/2017	< 0,007
Prevessin (CERN) **	02/10/2017	09/10/2017	< 0,033
Tricastin**	25/09/2017	02/10/2017	< 0,026
Tricastin**	02/10/2017	09/10/2017	< 0,010
Tricastin**	09/10/2017	16/10/2017	< 0,016
Saint Alban**	25/09/2017	02/10/2017	<0,033
Saint Alban**	02/10/2017	09/10/2017	<0,024
Saint Alban**	09/10/2017	16/10/2017	< 0,026
Villeneuve d'Ascq**	26/09/2017	29/09/2017	< 0,160
Villeneuve d'Ascq**	29/09/2017	03/10/2017	< 0,059
Villeneuve d'Ascq**	03/10/2017	06/10/2017	< 0,050
Villeneuve d'Ascq**	06/10/2017	13/10/2017	< 0,012
Villeneuve d'Ascq**	13/10/2017	17/10/2017	< 0,100

* Stations located in the localities marked with an asterisk have very high air filtration flows (up to 700 m^{3}/h) dedicated to the detection of traces.

** Stations located in localities marked with two asterisks have air filtration rates of 80 m^3/h.