IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

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Information Report

IRSN publishes assessment of radioactivity released by the Fukushima Daiichi Nuclear Power Plant (Fukushima I) through 22 March 2011

To assess air contamination levels resulting from the accident affecting the FUKUSHIMA DAIICHI power plant, IRSN made a preliminary evaluation of the quantity of radioactivity that may have been released over the period from 12 to 22 March 2011 by the three damaged reactors. **This assessment is designed to give a realistic order of magnitude for the releases consistent with an interpretation of information provided by Japanese authorities and the IAEA as well as the results of field measurements using reasonably conservative assumptions.**

The assessment, which uses information available to date, is based on

- diagnostics of the state of the three reactors concerned (understanding of the situation, state of cooling systems, etc.);
- expertise acquired by IRSN through its research programmes on the behaviour of fuel that is not adequately cooled;
- information provided by Japanese authorities concerning intentional degassing of the reactor containment buildings to protect containments from the risk of degradation due to overpressure.

The assessment's conclusions were reinforced by comparing atmospheric contamination values calculated using a dispersion model with the results of field measurements taken in Japan.

Discussions also took place between the members of the European Technical Safety Organisation Network (ETSON), the United States Nuclear Regulatory Commission (NRC) and Finland's STUK.

Radioactivity released during operations to degas the reactor containment buildings concerns radioactive elements that are the most quickly released during a significant degradation of fuel (rare gases, iodine, caesium, tellurium, etc.). **In order to simplify analysis at this stage, only radioactive elements with the most significant radiological consequences were considered, using proportions usually encountered in irradiated fuel**; evaluation of radioactivity was based on the following (core composed of 400 fuel assemblies for reactor 1 and 548 for each of reactors 2 and 3):

- Rare gases: $2 \times 10^{+18}$ Bq;
- Iodine: $2 \times 10^{+17}$ Bq;
- Caesium: $3 \times 10^{+16}$ Bq;
- Tellurium: $9 \times 10^{+16}$ Bq.

For purposes of comparison, these values represent on the order of 10% of the releases estimated during the Chernobyl accident for these various groups of radioactive elements. It should however be noted that:

- this is an initial assessment based on data available as of **22 March** 2011;
- the quantities of radionuclides presumed discharged, given in Bq, alone are insufficient to make assumptions about radiological consequences, which largely depend on meteorological conditions (part of the discharge was dispersed over the Pacific Ocean).

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Finally, release kinetics as a function of weather has been defined in alignment with dose rate peaks observed at the edge of the site to furnish input data for atmospheric dispersion models used by IRSN on the regional level and Météo France for assessments for the northern hemisphere.

Detailed release composition used to estimate air contamination levels

Isotope	Total (Bq)
Kr-85	2 E+16
Kr-85m	1 E+14
Kr-87	7 E+11
Kr-88	5 E+13
Xe-133	2 E+18
Xe-133m	2 E+16
Xe-135	2 E+16
Xe-138	9 E+01
Kr-83m	1 E+13
Xe-131m	2 E+16
Xe-135m	6 E+14

Isotope	Total (Bq)
I-131	9 E+16
I-132	7 E+16
I-133	2 E+16
I-134	4 E+11
I-135	2 E+15
I-129	2 E+09
I-132m	2 E+10
I-128	4 E+04
I-130	5 E+13

Isotope	Total (Bq)
Cs-134	1 E+16
Cs-136	6 E+15
Cs-137	1 E+16
Cs-138	3 E+09
Cs-134m	1 E+12

Isotope	Total (Bq)
Rb-88	5 E+13
Rb-89	3 E+02
Te-133m	4 E+10
Te-134	6 E+09
Sb-130	1 E-15
Sb-125	6 E+14
Sb-127	4 E+15
Sb-128	1 E+10
Te-127	5 E+15
Sb-128m	1 E+13
Sb-129	4 E+13
Te-129m	7 E+15
Sb-131	8 E+05
Te-125m	1 E+14
Te-132	6 E+16
Te-127m	1 E+15
Te-131	5 E+14
Te-131m	2 E+15
Te-133	7 E+09
Br-83	2 E+12
Br-84	7 E+07