Dose Assessments due to discharges of radionuclides from nuclear facilities near La Hague (France)

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INTRODUCTION

The Nord-Cotentin study (1) was carried out by a working group, supported by the Institute for Protection and Nuclear Safety (IPSN), whose participants were representatives of the operators, of the authorities, of French and international radioactivity research institutes and of environmental associations. The Nord-Cotentin study aimed :

1) to reconstruct radiation doses received by members of the public aged 0 to 24 years and living in the area, with a view to estimate the associated risk of leukaemia between 1978 and 1996 and to compare it with the results of previous local epidemiological studies,

2) to provide information to authorities in the instruction of discharge authorisation for the local nuclear facilities and especially for the reprocessing plant of COGEMA-La Hague (figure 1). The study was extended to the case of the waste disposal of the French Agency for the management of radioactive wastes (ANDRA) because it appeared that information about specific situations was strongly requested by some members of the working group.

This paper is only related to the second mission of the working group. The aim was to identify realistic locations and/or habit data leading to the highest exposure of the population living in the administrative area “canton de Beaumont-Hague”. These particular situations were called “scenarios”.

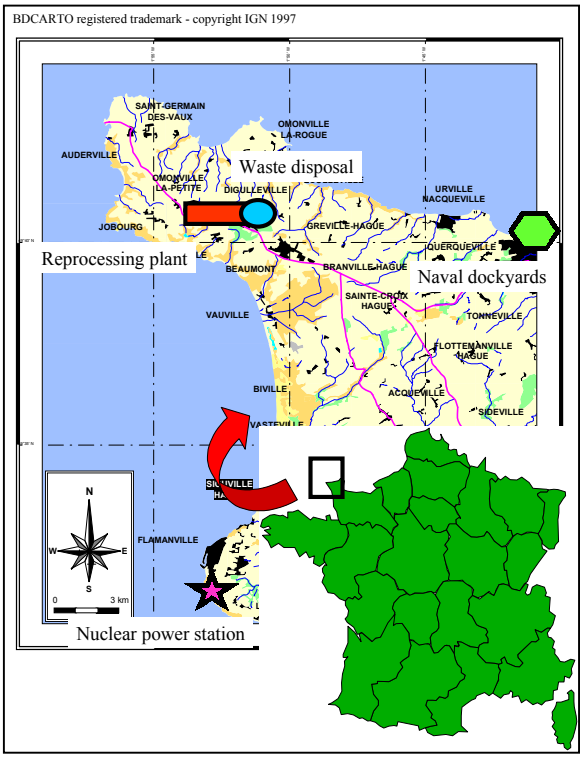

Figure 1 : Localisation of the nuclear facilities of the Nord-Cotentin Peninsula

METHODOLOGY

The identification of the scenarios was based on the knowledge of the local habit data. Results of local

habit surveys (ingestion rates, occupancies, ...) were used as often as available. Discussions between members of the working group and inhabitants of the “canton de Beaumont-Hague” improved the knowledge of the local likely habits. Two types of scenarios were defined :

1. « occasional scenarios » : likely specific habits of the local population but for which the occurrence is difficult to quantify as, for example, staying one hour close to the marine discharge pipe of the reprocessing plant or eating a crustacean catched at the extremity of the pipe ; the dose were assessed for one occurrence ;

2. « chronic scenarios » : habit data of groups of population, as for example, fishermen or farmers ; yearly doses were estimated ; these scenarios can be compared to the « critical group » of nuclear facilities operators.

OCCASIONAL SCENARIOS

The occasional scenarios defined are associated with the nuclear facilities of the Nord-Cotentin Peninsula. The installations of interest were the reprocessing plant of COGEMA and the radioactive waste shallow-land disposal of the French Agency for the management of radioactive wastes (ANDRA). Both installations are located in the “canton de Beaumont-Hague”. Levels of exposure were calculated for several age groups (children, young or adult) depending on the scenario. It was very difficult to obtain local data concerning the occasional scenarios, especially for the past. Therefore, the working group decided to calculate effective doses for one occurrence, like eating a fish from the Sainte-Hélène river or spending one hour on the Sainte-Hélène riverbanks.

Doses were estimated for scenarios associated with the waste repository itself, like walking near the site disposal, or scenarios associated with the Sainte-Hélène river which is contaminated by the repository, like using the water of the river or fishing or playing in the river.

The working group estimated the average time of a walk around the repository by assuming an average walk rate for an adult, and calculated the dose to a walker by the use of monthly results of ANDRA dosimeters between 1985 and 1996. The critical month appeared to be November 1985 but no dosimetric data were available before 1985.

Results of environmental monitoring of the Sainte-Hélène were used to find the critical year for the contamination of the Sainte-Hélène river : 1979 and 1986 for water and fishes, 1987 and 1991 for sediments.

Several scenarios which can occur near the marine discharge pipe of COGEMA were also studied like fishing, walking, scuba diving. The working group reconstituted the tides to calculate how many hours per year the marine discharge pipe was emerged and to estimate the relevance of these scenarios. The doses were estimated by the use of radioactivity measurements made by the French authorities and the operators and which were consistent with the measurements made by the environmental associations.

The effective dose due to the intake of crustaceans catched at the extremity of the pipe was also estimated. The possible activity of such crustaceans in the past, especially for the years when the activity released in the sea by COGEMA was the most important, was extrapolated from the measurements made by environmental associations in 1997. Effective doses due to several hypotheses of ingestion rates were calculated.

Figure 2 : Localisation of the scenarios

CHRONIC SCENARIOS

The chronic scenarios identified can maximise the effective dose due to marine releases of the reprocessing plant ; are concerned the fishermen from Goury or from the Huquets who collect seafood in areas near the end of the marine discharge pipe (figure 2). Scenarios can also maximise the effective dose due to atmospheric releases of the reprocessing plant : are concerned the adults or the farmers who live close to the reprocessing plant in Digulleville, in Pont-Durand or at 1500 m of the atmospheric outlet and who eat local agricultural products. For these scenarios, the effective doses were calculated for each year since the beginning of radioactive releases in 1966 and up to 1996.

For each scenario, relevant behaviours or habit data were discussed on the basis of local data : habit surveys, knowledge of the fishing areas ... The working group considered extreme behaviours, like extreme ingestion of some categories of foods. Contamination of the environment predicted by transfer models was validated by environmental measurements as often as possible.

Then, doses associated with chronic and occasional scenarios can be compared with the average dose received by an adult of the public living near the La Hague site (between 0,2 µSv and 18 µSv per year for the

period 1966-1996) to quantify the increase of dose due to the scenarios. This approach can be considered as a sensitivity analysis in relation with the life habits and the geographical situations of critical groups.

RESULTS

Effective doses calculated for each scenario are presented in table I. Only doses for the year (or month) when the exposure was the highest are reported.

Table I : Effective dose associated with various scenarios

	Description of the scenario		Effective dose
occasional scenarios	Using the Sainte-Hélène water in 1979	/occurrence	10 µSv
	Fishing in the Sainte-Hélène in 1986	/occurrence	2 µSv
	Playing in the mouth of the Sainte-Hélène in 1987	/occurrence	10 µSv
	Walking near the waste disposal in November 1985	/occurrence	0,5 µSv
	Fishing near the release pipe	/occurrence	20 µSv
	Walking near the release pipe	/occurrence	7,5 µSv
	Walking in the "Anse des Moulinets"	/occurrence	< 1 µSv
	Scuba diving near the release pipe	/occurrence	2,5 µSv
	Eating a crab catched near the pipe extremity in 1985[1]	/occurrence	313 µSv
chronic scenarios	Fisherman in the Huquets in 1985[2]	/year	226 µSv
	Farmer in Pont-Durand in 1996	/year	51 µSv
	Fisherman in Goury in 1985[3]	/year	41 µSv
	Adult in Digulleville in 1996	/year	8 µSv
	Adult at 1500m of the reprocessing plant in1996	/year	24 µSv

CONCLUSION

Doses associated with the occurrence of an « occasional scenarios » (one time in the year) are similar to the average yearly exposure, except for the maximum scenario, associated with the consumption of crustaceans catched at the extremity of the marine discharge pipe (about 300 µSv for one occurrence in 1985). To go further in such an analysis, more should be known about the frequency of each "occasional scenario" and local surveys must be performed. However these results are useful for the population as far as they are concerned with some specific life habits.

Doses associated with « chronic scenarios » have been maximum in the past due to marine discharges (about 250 µSv in 1985). A professional activity which leads to a higher ingestion of a category of food and which is performed in the areas the most exposed to the radioactive discharges can lead to an exposure ten times higher than the average exposure.

These results can be compared with the calculations of the operator, especially for the regulatory critical group of the local population. In particular, effective doses in some specific situations like "fisherman in the Huquets" or "farmer in Pont-Durand" can be higher than those estimated by the operators whose critical groups are "fisherman in Goury" and "adult in Digulleville". This study, which can be considered as a sensitivity analysis of doses in relation with specific life habits and geographical situations, raises questions about the choice of the regulatory critical group and show that a debate on accurate definition of critical group is necessary.

[1] The level reported is the maximum effective dose calculated with the diets considered as realistic by the majority of the working group.
[2] In 1996, effective dose for a fisherman in the Huquets is estimated to 26 µSv.
[3] In 1996, effective dose for a fisherman in Goury is estimated to 5 µSv.

REFERENCES

1. Groupe Radioécologie Nord Cotentin. Rapport détaillé, Vol. 1-4, Paris, France (1999).