EVALUATION OF THE RADIOLOGICAL IMPACT IN THE ENVIRONMENT AROUND *IPEN's* (*) FACILITIES

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Abstract

In order to control the discharges of radioactive material generated by the IPEN's facilities, an effluent monitoring program was established on a routine basis. This control is carried out by measuring the activity of the radionuclides present in the effluents (sourceterm) using gamma spectrometry and/or neutron activation analysis. The results obtained are then compared with the operational limits adopted, when a decision is made upon the discharge of the effluents. In this paper the data concerning the sourceterm from 1988 to 1991 as well as the effective dose in the critical group are presented. All the results are below 1/10 of the limits of dose recommended by the Radiological Protection Standards. These data together with those obtained from the environmental monitoring program prove that the radiological impact due to the discharges of radioactive effluents by the IPEN's facilities is negligible.

1. Introduction

The Environmental Monitoring Division of IPEN has established on a routine basis an environmental monitoring (5) program in order to determine the amount of radioactive material discharged to the environment as well as to detect a non planned release (above the pre-selected operational limits). In this report the results concerning the sourceterm released from 1988 to 1991 are presented. The effective dose in the critical group as evaluated by using the sourceterm and a generic model(3) which describes the transfer of the radionuclides into the ecosystem. The analysis of these results showed that the radiological impact around IPEN's facilities is negligible.

2. The Nuclear and Radioactive Facilities Available at IPEN

The nuclear and radioactive facilities available at IPEN which contribute to the liquid and gaseous sourceterm are: the swimming pool research reactor IEA-R1, which operates at a nominal power of 2 MW, responsible for medical, engineering, industrial and research purposes and a Centre for the production of labelled compounds and radioisotopes such as I-131, P-32, Cr-51 used in nuclear medicine.

Other facilities such as the decontamination laboratory and a centre for development of the main steps of the nuclear fuel cycle, give rise only to liquid effluents.

3. Radioactive Effluents Monitoring System

The liquid effluents are kept in special tanks. These effluents are sampled (1 liter) and sent to the Environmental Mo nitoring Division for the determination of the radioactive contents. The activity is measured by using a hyperpure germanium detector with 15% efficiency, coupled to a 4096 multi-channel analyser. The samples which contain uranium are analyzed by neutron activation analysis. The final results are corrected for the total volume available in the tank. The activity obtained is compared with the daily discharge limits adopted by the Brazilian Nuclear Energy Commission(1) and a decision is made upon its discharge to the environmental. After the authorization has been given the effluents are directly discharged in the sewage system and flow to Pinheiros river. There are no evidence of aquatic life in Pinheiros river since it receives continuously a considerable amount of industrial and domestic water.For that reason the river water is not used for irrigation purposes, not used as drinking water supply for the population(5). Only some factories located at the river bordeline pump the water for industrial machines refrigeration.

The gaseous effluents are continuously monitored by using a air sampler coupled to a flux meter. This system is conected off line in the stack. The airbone and gaseous effluents are collected through a filters system arranged after the pump. The filters are routinely measured by using the same equipment already described for the liquid effluents. The results are corrected for the air flux in the stack.

4. Sourceterm Data From 1988 to 1991

The liquid effluent activity discharged per year by IPEN's facilities is presented in table 1. From this table, were excluded, the radionuclides wich activity contributed with less than 1% per year and which were not considered critical.

Table 1: Liquid effluents activity discharged per year(1988-1991)

Radionuclídes	Total activity released (Bq)			
	1988	1989	1990	1991
Na-24	$3,1.10^7$	$9,9.10^6$	$8,8.10^7$	$1,2.10^7$
Co-58	-	$1,3.10^6$	$5,7.10^6$	$1,3.10^6$
Co-60	$1,6.10^8$	$3,4.10^8$	$4,4.10^8$	$3,8.10^8$
Zn-65	$1,8.10^7$	$1,7.10^7$	$5,4.10^5$	-
Tc-99m	$4,1.10^5$	$2,6.10^6$	$1,1.10^7$	$1,3.10^6$
Ag-110m	$2,3.10^6$	$9,9.10^5$	-	-
I-131	-	$4,4.10^7$	$6,6.10^7$	$2,4.10^7$
Cs-134	$8,9.10^6$	$1,5.10^7$	$6,6.10^7$	$2,4.10^7$
Cs-137	$7,5.10^7$	$1,4.10^8$	$1,2.10^8$	$6,4.10^7$
U-nat	$1,5.10^8$	$2,3.10^9$	$8,0.10^5$	$9,7.10^7$
Total volume released (m^3)	2421	1242	1377	1088

The gaseous and airbone effluents activity discharged from 1988 to 1991 is presented in table 2. Just I-131 was detected which activity above the discharge limits adopted (1).

Table 2: Gaseous and airbone activity discharged per year (1988-1991)

Year	I-131 activity released (Bq)	
	Gaseous	Airbone
1988	$6,5.10^{10}$	$5,6.10^{6}$
1989	$9,3.10^{9}$	$8,2.10^{6}$
1990	$1,7.10^{10}$	$9,4.10^{6}$
1991	$1,1.10^{10}$	$5,2.10^{6}$

5. Effective dose in the critical group

As was pointed out he Pinheiros river water is not used for irrigation purposes or for drinking water consumption. Therefore, for the liquid effluents, the only contamination pathway to be considered is the dispersion and sedimentation of the radionuclides, giving rise to the gamma external irradiation. The critical group is formed by those individuals of the public that work at the river bank near the discharge point(4).

For gaseous and airbone effluents, the critical group is formed by the people living 3000 m away from the discharge point in the north-west diffusion section. The main exposure pathway is the gamma external irradiation due to the deposition of radionuclides on the ground(2).

The anual effective dose in both cases was calculated for each radionuclide listed in table 1 and 2. These estimates have been carried out by using the IAEA transfer model(3), and by applying the proper dosimetrie factors(3,5).

The effective doses in both critical groups are showed in table 3 and 4, for liquid and gaseous effluents, respectively.

Table 3: Effective dose in the critical group due to liquid effluents discharge.

Year	Effective dose (mSv/year)
1988	$2,7.10^{-5}$
1989	$5,6.10^{-5}$
1990	$7,0.10^{-5}$
1991	$5,6-10^{-5}$

Table 4: Effective dose in the critical group due to gaseous and airbone effluents discharge.

Year	**Effective dose (mSv/year)**
1988	$1,1.10^{-3}$
1989	$1,6.10^{-4}$
1990	$2,9.10^{-4}$
1991	$1,9.10^{-4}$

6. Conclusion

During the last 4 years no considerable changes were observed in the operation conditions of the IPEN facilities, as showed the results of the sourceterm in table 1 and 2.

The radionuclides which more contributed for the effective dose due to the liquid effluents discharge were Co-60 (79,9%), Cs-137 (18,2%) and Cs-134 (1,4%). These radionuclides come from the treatment process of the reactor pool water.

As was already point out, I-131 was the only radionuclide detected in the gaseous and airbone effluents arising from the radioisotope and labelled compounds production.

The effective dose in the critical group has been always below 1/10 of the dose limit recommended by the Radiation Protection Standards[1]. Therefore the environmental impact due to the normal operation of the IPEN's facilities is negligible.

References

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