

MONITORING OF RADIOACTIVE LIQUID EFFLUENTS GENERATED AT INSTITUTO DE PESQUISAS ENERGÉTICAS E NUCLEARES AND ENVIRONMENTAL BEHAVIOUR OF RADIONUCLIDES IN THE ECOSYSTEM OF PINHEIROS RIVER

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ABSTRACT

In order to allow an assessment of the environmental impact due to the operation of the IPEN's facilities and an evaluation of the adequacy of the effluent emission control system, a continuous effluent monitoring program has been carried out. During the year of 1990, the total activity discharged was 7.7×10^8 Bq, diluted on 1.4×10^3 m³ of water. The effective dose equivalent in the critical group was 6.8×10^{-5} mSv, mainly due to the exposure to Co-60, Cs-137 and Cs-134. It should be emphasized, however, that none of these radionuclides has been detected in the environmental samples.

INTRODUCTION

All the radioactive liquid effluents generated at Instituto de Pesquisas Energéticas e Nucleares (IPEN) are discharged, after an adequate treatment, into the aquatic system of Pinheiros river. In order to control such releases into the environment, an effluent monitoring program has been established on a routine basis. In this paper, results of the source-term are presented concerning the period from January/88 to December/90 together with the estimate of the effective dose equivalent to the general public. Data relative to the levels of radioactivity in environmental samples collected in the ecosystem of Pinheiros river during the year of 1989, are also presented.

LIQUID EFFLUENT RELEASE SOURCE-TERM FOR THE PERIOD FROM JANUARY/88 TO DECEMBER/90

The liquid effluents from most of the IPEN's facilities or laboratories are stored and controlled in their respective retention tanks. Each batch of the effluents generated is sampled and measured by gamma spectrometry using a HPGe detector. If the samples contain uranium and/or thorium, the activity of these radionuclides is measured by neutron activation or spectrophotometric analysis. The total activity together with the total volume of water released during the period from January/88 to December/90 is summarized in Table I.

After proper operational controls at the source, a decision is made about discharge of each batch into the sewage system of the Institute, according to the national regulatory rules⁽¹⁾.

EVALUATION OF THE RADIATION DOSE TO THE INDIVIDUALS OF THE PUBLIC

All the low-level liquid effluents authorized for release are discharged into the Pinheiros river. These releases are made through the sewage system of the Institute. The effluents enter into the river at two separated points, two kilometers apart, through two sewage lines; one of them outflows direct into Pinheiros river and the other one outflows into Jaguaré stream before reaching Pinheiros river.

At the moment there is complete lack of aquatic life in this river due to the high quantity of sewage discharged continuously and due to severe industrial pollution. There is no use of the water neither for human consumption nor for irrigation purposes. Only some factories localized at the river borderlines pump the water for industrial machine refrigeration.

In this case, the main exposure pathway to be considered is the gamma external irradiation of the individuals of the public who work at the river bank near the discharge point. The dose received by this critical group was evaluated according to the IAEA model ⁽²⁾ and using adequate dose factors ⁽³⁾. It was assumed a continuous release of liquid effluents into the river. The final results of the annual effective dose equivalent are presented in Table I. The main radionuclides which contributed to exposure during the period from January/88 to December/90 were Co-60, Cs-137 and Cs-134.

MEASUREMENT OF ACTIVITIES IN WATER AND SEDIMENTS OF PINHEIROS RIVER

Samples of water and sediments were collected at five points of Pinheiros river and analyzed by gamma spectrometry; uranium contents were determined by fluorimetry. The points of monitoring are described below:

- Point 1: Control point, localized about 3 km upstream from the first effluent discharge point.
- Point 2: First effluent discharge point, localized at the mixing point where Jaguaré stream joins the river flow.
- Point 3: Second effluent discharge point about 2 km downstream from Point 2.
- Point 4: Morumbi bridge, about 4 km downstream from Point 3.
- Point 5: Discharge point of Pinheiros river into Billings reservoir, about 10 km downstream from Point 4.

Only natural radionuclides were detected in these environmental samples, as follows: Ra-228, Ra-226, Be-7 and K-40, with activities corresponding to the background levels.

These measurements are made only periodically since sufficient data has been accumulated during the last years, so that the control of radiation doses to members of the public might be reduced solely to the monitoring at the points of discharge of the Institute.

TABLE I - Results of the total activity in the liquid effluents released during the period from January/88 to December/90 and total effective dose equivalent (H_E) in the critical group.

year	total activity released (Bq/y)	total volume (m^3/y)	H_E (mSv/y)
1988	2.0×10^9	2.4×10^3	2.7×10^{-5}
1989	4.0×10^9	1.2×10^3	5.6×10^{-5}
1990	7.7×10^8	1.4×10^3	6.8×10^{-5}

CONCLUSIONS

Results of dose calculations in the critical group showed that radiological consequences to the environment due to radionuclides releases into the Pinheiros river through IPEN's sewage system are negligible at the moment. The levels of radioactivity found in water and sediments river samples are in agreement with the expected values, considering that the effluents released are diluted in a high volume of water by the time they reach the receptor river.

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