Radionuclide dispersion and hydrodynamics of Ilha Grande Bay (Angra dos Reis, RJ) simulated from hypothetical accidental releases of liquid wastes

F. F. Lamego Simões Filho[1], C. M. F. Lapa[1], A. S. Aguiar[1], A. D. Soares[1]
e-mail: flamego@ien.gov.br

[1] *Division of Nuclear Engineering - IEN*

Keywords: transport modeling, hydrodynamic circulation, nuclear accidental releases

Introduction

This study has the aim to assess the impact of accidental release of radionuclides postulate from a nuclear power reactor through environmental modeling of aquatic resources. In order to do that it was used computational models of hydrodynamic circulation and transport for the simulation of tritium dispersion caused by an accidental release in Ilha Grande Bay from the site of the future third plant in two circulation scenarios [1-2]. The main difference between the scenarios is based on the enhancement of dilution of the highest concentrations in the last one. This dilution enhancement resulting in decreasing concentrations was observed only during the first two weeks, when they ranged from $1x10^9$ to $5x10^5$ Bq/m³ close to the Itaorna beach spreading just to Sandri Island. After 180 days, the plume could not be detected anymore in the bay, because their activities would be lower than the minimum detectable value (< 11 kBq/m³).

Discussion and conclusion

Model results were remarkably good in reproducing registered water level variations in all situations. Tidal components and meteorological oscillations were almost perfectly matched by computational modeling with SisBAHIA® [3]. Results were very accurate even during the occurrence of unusual and rapid oscillations. Model results were very good in reproducing the tidal and local wind components of the registered currents. However, they were not good in representing residual currents. This is quite an interesting fact that should be exploited in future research.

Transport modeling results showed a fast dilution of tritium in Ilha Grande Bay according to the circulation scenario, becoming more diluted in case of the recirculation of seawater promoted by the maintenance of pumping and discharging operations [4]. However, the reference limit is exceeded at least during the first 10 days after the accident. The increase of the pumping rate during this period should be considered as an action to speed up the dilution and to mitigate the impact of the accident. However, according with the linear non threshold (LNT) paradigm, the impact of lower concentrations of tritium converted to organically bound form (OBT) and ingested by human populations and biota of tropical environments, remains unknown [5-6]. Some further experimental works with tropical biota are necessary to assess this issue.

References

[1] P. C. C Rosman,. "Referência Técnica do SisBaHiA".http://www.sisbahia.coppe.ufrj.br/SisBAHIA_RefTec_V8.pdf (2009).
[2] COPPETEC. Environmental aspects concerning Angra 3. Final Report. PENO-4841. (2004)
[3] P.C.C. Rosman, Modeling Shallow Water Bodies via Filtering Techniques. Ph.D. Thesis, Dept. of Civil Engineering, Massachusetts Institute of Technology (1987).
[4] FSAR, Final Safety Analysis Report. Central Nuclear Almirante Álvaro Alberto – Unidade 2. Rev. 28 . Eletronuclear - Eletrobras S.A. (1999).
[5] C-An Huh, et al. " Marine environmental radioactivity near Nuclear Power Plants in Northern Taiwan", Journal of Marine Science and Technology, Vol. 12, No. 5, pp. 418-423, (2004).
[6] D. R. F. Halerman, Water Quality Control. Massachusetts Institute of Technology (1987).