Source term assessment of Argonaut Reactor Accidental Release

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The presence of a nuclear research facility at the campus of Federal University of Rio de Janeiro is a cause of concern with regard to the radiological safety of the surrounding community, even though this facility has been securely operating for more than 50 years. Thus, the aim of this paper is to assess the potential source term from Argonaut reactor accidental release [1]. A recent accident scenario reassessment concluded that severe physical damage of the core by failure of a handling crane after reactor shutdown should be the emergency situation with the greatest potential risk. This would lead to breaking of the aluminum coating and the nuclear fuel plates with their release to the reactor hall. After screening all the inventory, nine nuclides were selected and divided in two groups. The first group was represented by six radioiodine nuclides (^{130}I through ^{135}I) while the second one was composed of three noble gases (^{85}Kr, ^{85m}Kr, and ^{133}Xe). The release rates of the considered radionuclides are based on two constant rates: constant of decontamination ω and constant of radionuclide decay λ. The atmospheric dispersion model used in this work is detailed in "PAVAN: An Atmospheric-Dispersion Program for Evaluating Design-Basis Accidental Release of Radioactive Materials from Nuclear Power Stations" [2]. The program calculates a set of values known as dispersion factors (*X/Q*) to estimate the relative air concentration, using a joint frequency distribution of wind direction and speed in a given class of atmospheric stability. The calculations of the X/Q values are based on normal distribution around the center of the radioactive plume (Gaussian model). This procedure includes consideration of plume meander and directional dependence of dispersion and wind frequencies for various locations (Figure 1) around exclusion area boundaries (EABs) and the low population zone (LPZ). The results showed that the only relevant concentrations are the ones from the iodine isotopes, showed in the box-plots for the scenario of 0-2 hours (Figure 2).

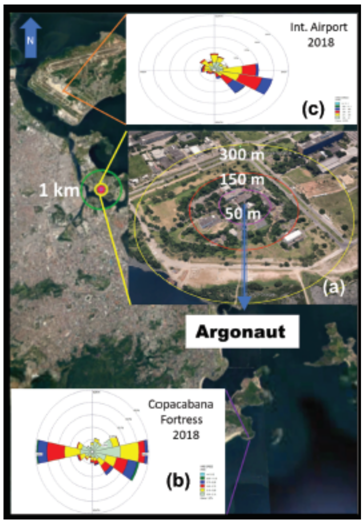

Figure 1- Satellite image of the study area, showing the EABs and LPZ

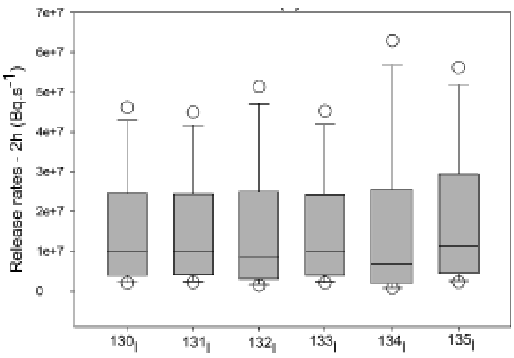

Figure 2. Box-plots of iodine isotopes for 0-2h

The air concentrations of the noble gases ^{85m}Kr, ^{133}Xe, and ^{135}Xe are on average one order lower than iodine, except for 1-km distance, where they are two orders lower. The coefficients of variation of air radionuclide concentrations are, on average, 0.2 and 0.8, respectively, for radioiodine and noble gases.

References

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[2] "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," NUREG-0800, Sec. 2.3.4, "Short-Term Atmospheric Dispersion Estimates for Accident Releases," U.S. Nuclear Regulatory Commission (2007).