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Evaluation of the activity of a hot particle incorporated by a worker of nuclear power plant

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1 Introduction

Nuclear power plants workers can be exposed to internal contamination via hot particles (strongly radioactive insoluble particles with a 10µm to 1mm wide diameter). At present, no theoretical biokinetic model describing the evolution of an internal contamination by these particles has been designed by the ICRP [1][2].In addition, the procedure that allows the evaluation of an internal contamination by diffuse radioactive substances cannot be applied. The objective of this work was to describe a new method to estimate the activity of a hot particle in the body.

2 Material and method

Several whole body measurements were realized using an anthropomorphic ghost called "Igor" into which a radioactive source of known activity was inserted. Igor is constituted with elementary bricks allowing to feign the various locations of a hot particle within the abdomen. These various measures allowed to establish a corrective factor in the activity measured for every location of the source.
To determine the position of the hot particle in the abdomen, two whole body measures were successively realized (Face then Back) at the contaminated worker.
The difference between these two examinations allows to estimate the particle's position. The corrective factor corresponding to the estimated position is then applied to the moderate activity.
This method was then used in a real case of internal contamination, in parallel feces analysis were realized. The activity obtained by our method was compared with the activity obtained by the feces analysis.

3 Results

In total, 24 measures were realized to consider various locations of the hot particle in the abdomen, the weight of the subject (configuration 70-90kg) and the type of radionuclides involved. The corrective factor (FC) was 1.20-1.47 (source in front position) and 0.48-0.56 (source in posterior position) in configuration 70 kg and of 0.70-1.05 and 0.48-0.56 in configuration 90 kg.
The application of this method in a real case of internal contamination allowed to estimate the activity of a hot particle between 76,800 and 90,250Bq. The activity contained in the abdomen according to the fecal examinations was 82,523Bq.

4 Conclusion

This new method allows to estimate more quickly the real activity of a hot particle and could be a complementary tool to feces analysis as collecting is sometimes troublesome.

References

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