HOT-CELL OPTIMIZATION USED IN PRODUCTION AND DISTRIBUTION OF ^{153}Sm

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ABSTRACT

The purpose of this paper is to optimize the shielding lead thickness necessary to the hot-cell used in the production and distribution used in the ^{153}Sm - label compound, ethilenediaminetetramethilene phosphoric acid (EDTMP) that will be constructed in radioisotope production plant. of Instituto de Pesquisas Energéticas e Nucleares", of "Comissão Nacional de Energia Nuclear" (IPEN-CNEN/SP). For this study, we considered the following attributes: number of people exposed, the magnitude of individual doses due to normal exposures, collective dose and activity handled. For the optimization we will utilize the analytical quantitative decision-aiding techniques such as cost-benefit analysis and differential cost-benefit analysis, for taking account of all protection and safety attributes in a systematic way.

INTRODUCTION

The ^{153}Sm-EDTMP is a label compound that is absorbed in the bone and has been applied to patients as a relief for pain. The IPEN-CNEN/SP is assembling a hot cell for production and distribution of this label compound to support weekly quantities of 1.85 GBq (5Ci).

We have considered as basic case for the hot cell shielding thickness, the option of protection one (01), that attends the dose limit established by CNEN[1] , and the actions taken led to the introduction of shielding in the hot cell frame, in a way to keep the annual dose lower than 40 mSv. This value was calculated considering a 25% error in the measurements.

Starting with the basic case, we have identified other options, trying to reduce the dose to satisfy the 20 mSv annual medium for five (05) years established by ICRP[2], the 15 mSv per year to cease the individual monitoring, the 4 mSv to cease the routine area monitoring and 1 mSv to not exceed the dose limits for public exposure.

The major radioprotection problems in optimization studies are related to the main attributes: the observed dose and the costs associated to reduce this doses. The adoption of other option different from that elected as optimum case, should consider the availability of financial resources.

RESULTS

The optimization study in ^{153}Sm-EDTMP production hot cell is shown in Table I where has been built with the aid of cost-benefit analysis decision-aiding techniques.

From the Table I results, we can see:

1) If we take the international standard alpha value, adopted in Brazil, of US$10000/person-Sv, the optimum option is the number eigth (08).We can also observe in column six (06), that the individual dose for this option is 0.55 mSv per year, which is about half of annual dose allowed for the general public.

2) Considering that IPEN-CNEN/SP has a hot cell with a shielding thickness considered in the option thirteen(13), we could verify the activity capacity of this hot cell for the ^{153}Sm, in a way to give the same dose observed in the optimized cell, option eight (8), column six (6). In option thirteen (13), column four (4), Table I, we can verify that the hot cell capacity is 18.5 TBq (500 Ci), what means 100 times bigger than the today's prevision.

We find interesting to reproduce the calculations that generated the Table II, using the aiding technique for decision making named cost-benefit differential analysis, because their results practically show as the study sensibility of alpha value.

From the Table II, we can see:

3) The optimum option is still number 8, as it should be, because the results are independent of the technique used.

4) If we had used the real alpha value for our country, which is US$3000.00/person-Sv, the optimum option the number 05 (five) with an annual dose of 1.9 mSv, bigger than the annual limit dose for the public but lower than the value necessary for the workplace monitoring with routine function and the saving in the radiological protection expenses should be US$36.20 per year.

5) If we use the european alpha value, US$20000.00/person-Sv, the option 11 (eleven) should be the optimum and the annual dose would be 28.8 μSv. This value is very close to 10 μSv/year, the exemption value, but the annual cost , X, should be US$16.1 per year, greater than that of the option 08 (eight).

REFERENCES

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