RADIATION PROTECTION OF THE ELECTRON LINEAR ACCELERATOR IN PRODUCTION OF ^{99}MO

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New Ukrainian radiation-safety standards have established a new limit on the effective dose to be 20 mSv/year (2 rem/year) instead of the previous limiting value 50 mSv/year (5 rem/year). Creation of a new high-current electron accelerator to produce medical radionuclides imposes more stringent requirements on the existing protection systems. Fig. 1 shows the transverse section of the linac building and the disposition of points, for which calculations and experimental measurements were performed.

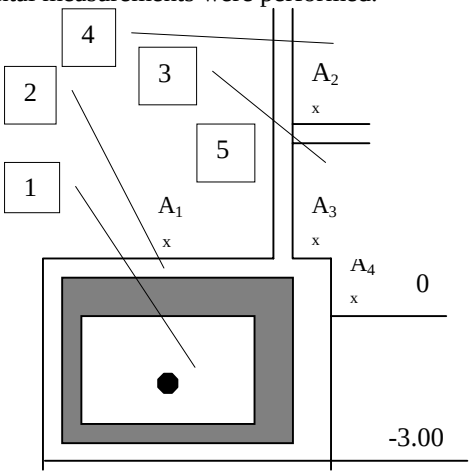

Fig. 1. Transverse section of accelerator building.
1 - tantalum converter, 2 - concrete shield,
3 - technological corridor, 4 - klystron hall,
5 - unattended room.

The absorbed dose rate due to bremsstrahlung and neutrons was calculated for tantalum, iron and aluminum targets. The tantalum target thickness was 2 mm in both calculations and measurements. The thicknesses of iron and aluminum targets were assumed to be equal to the path of 30 MeV electrons in these materials. The absorbed dose rate versus bremsstrahlung and neutrons was calculated by the formulae of refs. [1, 2]. The experimental measurements were carried out using standard devices.

The dose rate values calculated for the average accelerated-electron current of 0.8 mA and energies of 20 and 30 MeV are listed in tables 1 and 2, respectively. In both tables the absorbed dose rate is given in mrem/hour.

Table 1

	A_1	A_2	A_3	A_4
Ta	64	0,55	3,2	15,6
Fe	18,7	0,12	0,69	3,33
Al	4,7	0,03	0,17	0,53

Table 2

	A_1	A_2	A_3	A_4
Ta	150	1,3	7,5	36
Fe	37,5	0,25	1,7	6,7
Al	9,5	0,07	0,35	1,7

The results of calculations and experimental measurements with an aluminum target for an electron energy of 23 MeV and an average current of 0.42 mA are represented in table 3. It can be seen that there is an agreement between calculated and experimental data.

Table 3

	A_1	A_2	A_3	A_4
Calculation	3,24	0,02	0,12	0,57
Experiment.		0,035	0,13	1

In the tantalum target case, at an average current of 0.45 mA and an accelerated electron energy of 22.5 MeV the level of radiation in the technological corridor was determined to be 1 mrem/hour at a 1 m height from the floor and at a distance of 1 m from the shield. The calculation and experimental results for above-mentioned parameters of the beam and the tantalum target are given in table 4.

Table 4

	A_1	A_2	A_3	A_4
Calculation	45	0,42	1,5	10,8
Experiment		0,35	1,1	6

The level of neutron radiation after the shield is calculated to be not above 1n/cm^2· sec.

So, when working with a tantalum target one can expect the acceptable level of radiation in attended rooms.

REFERENCES

1. Protection against ionizing radiations. (In Russian). 2 vols. Edited by N.G. Gusev. 3rd edition, revised and completed. Moscow, Ehnergoizdat publ., 1989.
2. “Sanitary regulations for disposition and operation of electron accelerators with an energy up to 100 MeV” (in Russian), N 1858-78.