

Evaluation of Internal Exposure of Nuclear Medicine Staff Working with Radioiodine and Technetium

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The I-131 and Tc-99m content in the thyroid of staff members working with this radionuclides has been measured in six Departments of Nuclear Medicine performing therapy and diagnosis of thyroid disease in Poland .

The measurements of iodine and technetium content of occupationally exposed personnel were performed with portable detection unit (prod. Canberra-Packard) (Fig.1.) , which is consist with scintillation detector NaI(Tl) (size 76 x 76 mm, resolution 9%) - battery-powered, portable tube base Multichannel Analyzer Canberra UniSPEC, paired with the notebook computer and Genie-2000 Basic Spectroscopy Software.



Fig. 1. The portable unit with scintillation detector NaI(Tl) for measurement of I-131 and Tc-99m



Fig. 2. The RSD neck - thyroid phantom

Typically, detector set at a neck - to - detector distance of 10 or 15 cm, using a 300 seconds counting time. The background was measured with detector placed 15 cm away from the available RSD neck phantom, prior to or just following the count performed on the person. The measurements were performed in selected as low as possible background places. The MDA for mobile unit ranges from 10 – 50 Bq at the time measurement of 300 seconds and depends on background condition in particular units.

Categories of measured personnel according to internal contamination risk to unsealed sources of I-131 and Tc-99m:

1. Technical staff mainly performing routine diagnostic investigation
2. Nuclear medicine staff (physician, nurse) working with in vivo administration of I-131 or Tc-99m to patients
3. Hospital services staff (orderlies, cleaners) performing auxiliary activities to the patients (cleaning of the rooms, changing of bedclothes)

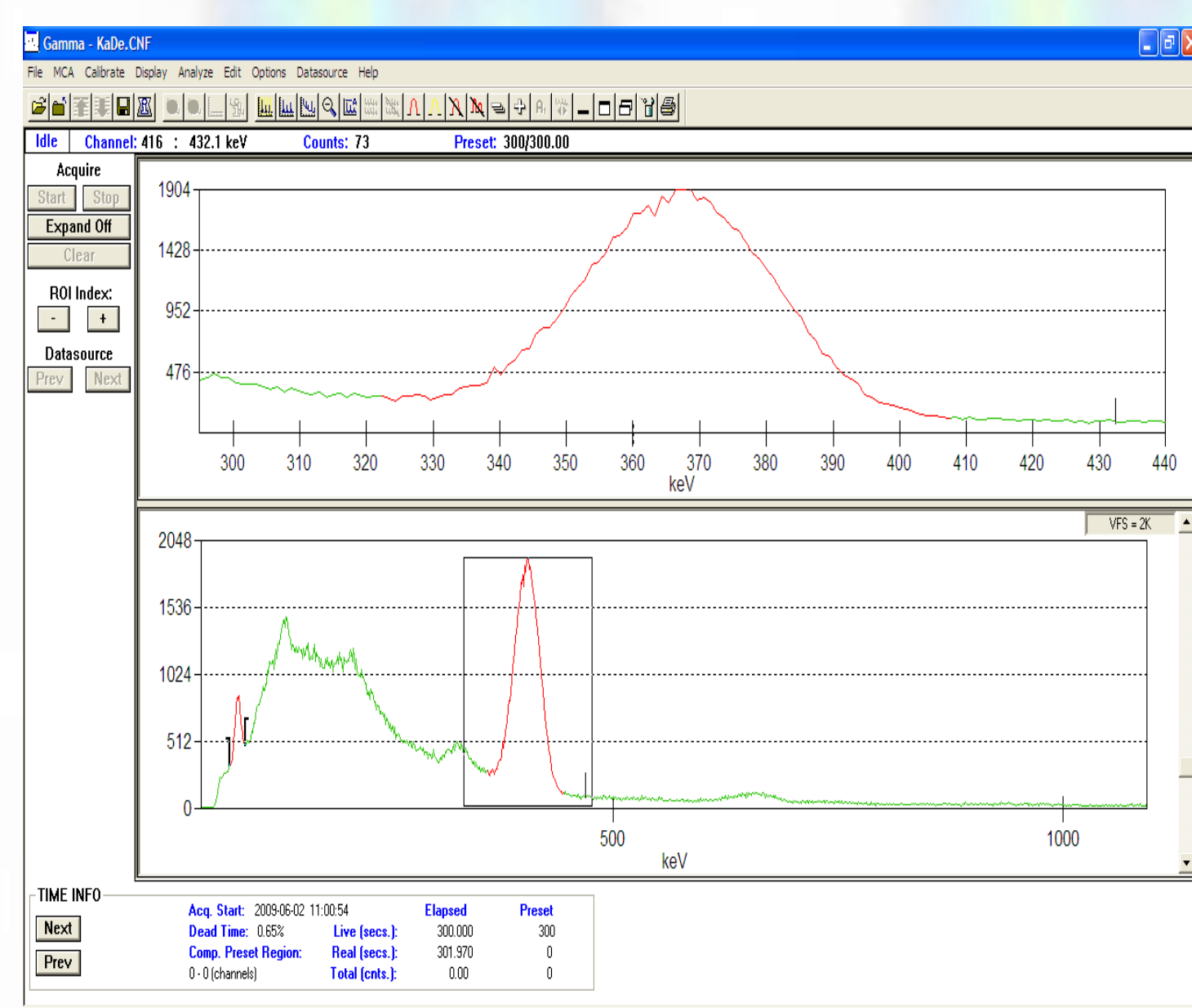


Fig. 3. Spectrum of I-131 with photopeak of 364keV collected at thyroid of exposed worker in Medical Unit

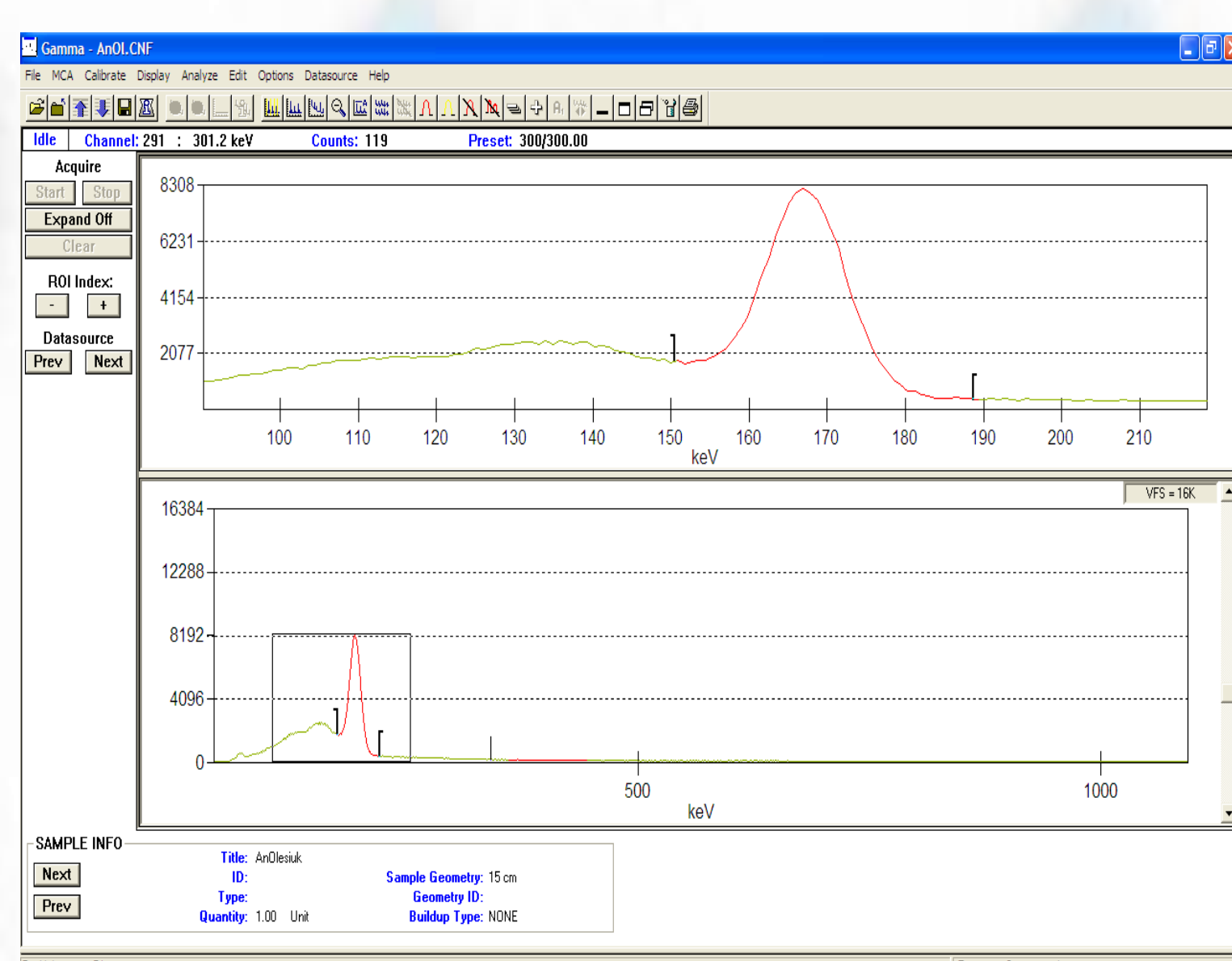


Fig. 4. Spectrum of Tc-99m with photopeak of 140keV collected at thyroid of exposed worker in Medical Unit

TABLE. The I-131 and Tc-99m content and effective doses assessment for personnel of Nuclear Medicine Units

Medical Unit No.	Category	Range of I-131 content in thyroid [Bq]	Mean value of I-131 content in thyroid [Bq]	Effective dose equivalent from inhalation of I-131 [mSv]	Mean value of Tc-99m content in thyroid [Bq]	Per cent of occupational exposure limit
1	1	50 - 100	70	0.38	< MDA*)	2%
	2	50 - 70	60	0.35	< MDA	
	3	50 - 60	60	0.35	< MDA	
	All	50 - 100	65	0.37	< MDA	
2	1	60 - 80	70	0.38	< MDA	2%
	2	50 - 75	60	0.35	< MDA	
	3	60 - 80	70	0.38	< MDA	
	All	60 - 80	70	0.38	< MDA	
3	1	70 - 400	250	1.50	< MDA	4%
	2	50 - 180	120	0.70	2000	
	3	60 - 100	80	0.40	< MDA	
	All	50 - 400	150	0.80	< MDA	
4	1	60 - 200	150	0.80	< MDA	4%
	2	60 - 220	180	1.05	< MDA	
	3	70 - 180	120	0.70	< MDA	
	All	60 - 220	150	0.80	< MDA	
5	1	80 - 70000	23000	125.00	< MDA	250%
	2	170 - 35000	1000	6.00	< MDA	
	3	100 - 5000	2300	12.50	< MDA	
	All	80 - 70000	9000	50.00	< MDA	
6	1	70 - 200	150	0.80	< MDA	4%
	2	100 - 200	170	1.00	1500	
	3	80 - 180	135	0.78	< MDA	
	All	70 - 200	150	0.80	< MDA	
7	1	50 - 150	120	0.70	< MDA	4
	2	60 - 200	150	0.80	4800	
	3	100 - 200	160	0.90	< MDA	
	All	50 - 200	150	0.80	< MDA	
8	1	60 - 210	160	0.90	< MDA	4.5
	2	100 - 260	180	1.10	3000	
	3	90 - 200	140	0.75	< MDA	
	All	60 - 260	160	0.90	< MDA	
9	1	70 - 400	250	1.50	< MDA	6
	2	100 - 400	300	1.60	5500	
	3	80 - 180	120	0.70	< MDA	
	All	70 - 400	210	1.30	< MDA	
10	1	70 - 200	150	0.80	< MDA	5
	2	100 - 350	220	1.30	1800	
	3	80 - 220	160	0.90	< MDA	
	All	70 - 350	170	1.00	< MDA	

*)MDA (minimum detectable activity) for Tc-99m equal 45 Bq

RESULTS:

The measurements of radioiodine content in the thyroid were performed in ten medical units that use I-131 for therapy and diagnosis of thyroid disease. About of one hundred and fifty exposed persons were investigated. The results of measurements are presented in TABLE.

All individuals actively working with iodine show measurable amounts of the radioiodine in their thyroids (Fig.3.). The average measured activity in the thyroid of the nuclear medicine staff was found to be equal at average 550 Bq within the range from 30 Bq to 70000 Bq. The average and range of I-131 activity measured in thyroids for all medical units were: 1400 Bq, (100 Bq - 70000 Bq), 400 Bq, (30 Bq - 3000 Bq), 140 Bq, (50 Bq - 1000 Bq) for) for categories 1, 2, 3 respectively. Nevertheless the 1 and 2 categories show higher I-131 thyroid level comparing to category 3.

The mean value of Tc-99m content in thyroid of nuclear medicine staff was about 1500 Bq (range from 100 Bq to 17000Bq).

CONCLUSIONS:

Base on results of measurements, the Effective Dose Equivalent for particular person due to inhalation of I-131 was calculated with somewhat a conservative assumption that I-131 thyroid content remains constant during the whole year. For the occupational exposure limit of 20 mSv. It gives the reference I-131 thyroid level is equal to 7 kBq. Calculated average Effective Dose Equivalent for particular medical is below 50 per cent of 20 mSv/year.