

Airborne Monitoring in Czech Republic

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INTRODUCTION

After the Chernobyl's reactor accident at the Chernobyl nuclear power plant it was necessary among other things to rapidly assess the contamination of Czechoslovakia's territory of that time. The explorations were running by means of measurements of the soil samples taken on the whole territory, but these measurements were very prolonged. Therefore testing of aerial measurement with helicopter and plane was started immediately. Unfortunately there was not suitable instrumentation for this measurement. This problem was reflected in first results from 1986. Measurements consisted in a determination of dose rates on a board of helicopter as a simple indicator of surface contamination.

MEASUREMENTS IN YEARS 1992 – 2000

For later measurements aerial spectrometric system designed for geological exploration was used. The system measured mainly natural radionuclides and for stabilisation was used ^{137}Cs source. This artificial radionuclide is typical for NPP accident so the use of the system could be only limited. Thus the purchasing of the new system followed, which enabled us to measure (and recalculated) dose rate at 1m above ground and specific activity of natural and some artificial gamma radionuclides (including ^{137}Cs). The monitoring of the NRPI was running in the years from 1992 to 1996 in the areas, where the fallout after the Chernobyl's accident was expected to be enhanced. The results were stated in the form of isolines.

In 1990 the PICODAS company penetrated into the Czech market, which took a lot of measurements on the territory of the republic, whether for reasons development and calibration of its ENMOS (IRIS) system or on the order for the Armed Forces of the Czech Republic or within the research. The system enabled interpreting the final activities and doses just as the system of Geofyzika and displayed them in the form of raster maps.

MEASUREMENTS IN YEARS 2000 – 2007

Since 2000 all measurements had been performing by NRPI. At first a dose equivalent rate was measured aboard a helicopter, but within few months after the purchase of new IRIS spectrometry system measurements similar the measurements of PICODAS company have already been realized.

Today the gamma ray spectrometry system of IRIS includes 4 scintillation crystals (NaI(Tl)) with a total volume of 16 liters and the energy range from 0.4 to 3 MeV. A component of the system is the navigation system and an altimeter for subsequent corrections to the height of flight.

The number of measurements was running in the areas affected by extraction and processing of uranium ore and in the areas with higher fallout as a consequence the Chernobyl's accident.

At the present time it is intended to use an aerial spectrometry at the NRPI for surface contamination monitoring and dose rates in the case of radiation accident, i.e. an accident at a nuclear power plant, terrorist act or loss of emitter. However, measurements would be running simultaneously with ground measurements of dose rates and specific activities and possible soil sampling. To subsequently assess these measurements a compatibility of all measured data is needful. It was specified an area - polygon where such comparison measurements may be performed. An area of approximately rectangular pattern with an area of $6 \times 10 \text{ km}^2$ was

chosen. It is located in a well-accessible central part of the CR. The area surface is moderately undulating, the altitude is between 250 m up to 520 m above the sea-level. The vegetation mainly includes meadows and fields; forests cover 20% of the area. On the given area, there is – besides natural radionuclides (^{40}K , U-series and Th- series) - also ^{137}Cs (activities vary between 3.5 – 8 kBq/m²) due to Chernobyl nuclear power station accident.

For ground spectrometry measurements the semiconductor detector (25% efficiency) was used; for aerial measurements the system of IRIS placed on board of helicopter of BELL 412 or MI 17. A dose equivalent rate was measured by scintillation detector GR 135 MiniSpec (Exploranium). The results of comparison between aerial and ground measurements are in Table 1.

Table 1. The results of airborne and ground monitoring (Air – airborne; Lab – laboratory measurement of soil samples)

Locality	D [nGy/h]			^{137}Cs [kBq/m ²]				
	GR135	Airborne	Air/GR135	in situ	Airborne	Lab.	Air/In situ	Air/Lab
1	63	63	1.00	6.7	6.2	6.1	0.93	1.02
2	92	100	1.09	4.4	3.4	3.5	0.77	0.97
3	93	83	0.89	4	2.6	3.3	0.65	0.79
4	123	104	0.84	1.4	1.4	0.9	1.00	1.56
5	138	105	0.76	0.9	1.6		1.78	
6	111	57	0.51	11.4	5.8		0.51	
7	98	62	0.63	10.0	4.0		0.40	
8	107	80	0.75	4.4	2.2	4.3	0.50	0.51
9	109	78	0.72	2.9	2.8		0.97	
10	87	57	0.66	3.3	3.4	3.1	1.03	1.10
11	107	67	0.63	7.7	7.8		1.01	
12	92	59	0.64	10.5	6.9		0.66	
Average			0.8±0.2				0.9±0.4	1.0±0.3

During the comparison a problem with the frost cover protection system as a required equipment of MI 17 helicopter (containing a pure source of ^{90}Sr) appeared. From the view of protection of crew against radiation the emitter is not significant. Unfortunately, the measured spectrum was considerably deformed by the bremsstrahlung of the source. For this reason the polygon was monitored as well by means of BELL 412 helicopter (in cooperation with the Police of the Czech Republic) too and the results of both measurements were compared in the form of grid maps. For the same reason on selected flight line a comparison between the course of dose rate and activities of the measured radionuclides was made. The maps from both helicopters and the course on the line will be shown in the poster, in Fig. 2 – 3 there are courses of dose rate resp. ^{137}Cs on selected line.

CONCLUSION

It is evident from the final figures and tables that all measurements compared within this work are compatible. The aerial measurements (at the flight height of 100 m above ground) differ from the ground ones to maximum of 50 % (Table 1), at lower levels of flight the results were better still – 20 %. This result is acceptable, especially for reasons that an aerial monitoring is aimed at the event of radiation accidents to search areas, which should be measured more

closely on the immediate ground or where samples should be taken for subsequent measurements in a laboratory. Moreover specific activity at the polygon varied around the detection limit (unfortunately, more suitable areas are not available in the Czech Republic). Nevertheless it would be well in the future to learn an influence of vegetation on a measured area (forests – fields – pastures) and crossing from one area to other one (it could be explain the large difference between the point 5 and 6 in Tab. 1, because both were measured on the edge of forest).

The original doubts concerning of the influence of the frost cover protection system on assessment of surface activities of ^{137}Cs did not realize (the bremsstrahlung of ^{90}Sr does not affect in the field of natural radionuclides). However, there is a need to measure precisely and subtract the background. Subsequently, it will allow a deconvolution of the measured spectrum.

Figure 1 Courses of dose rate [nSv/h]

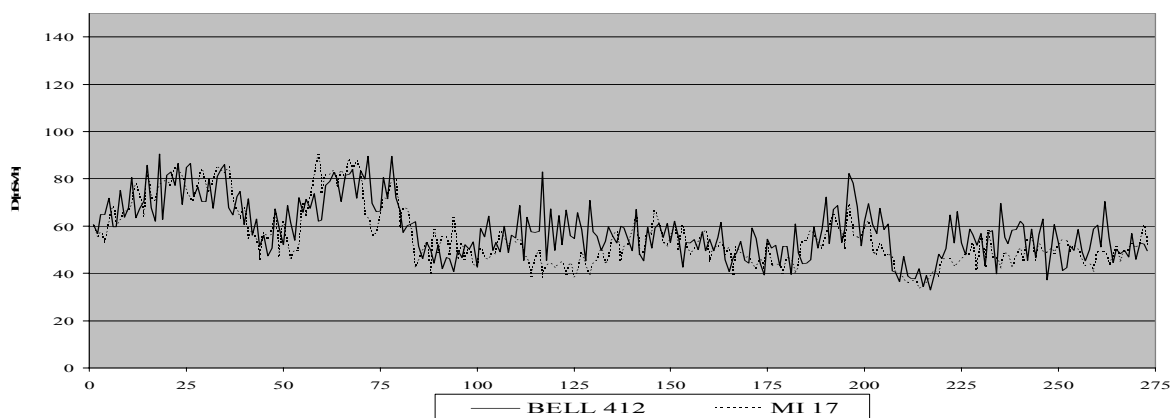
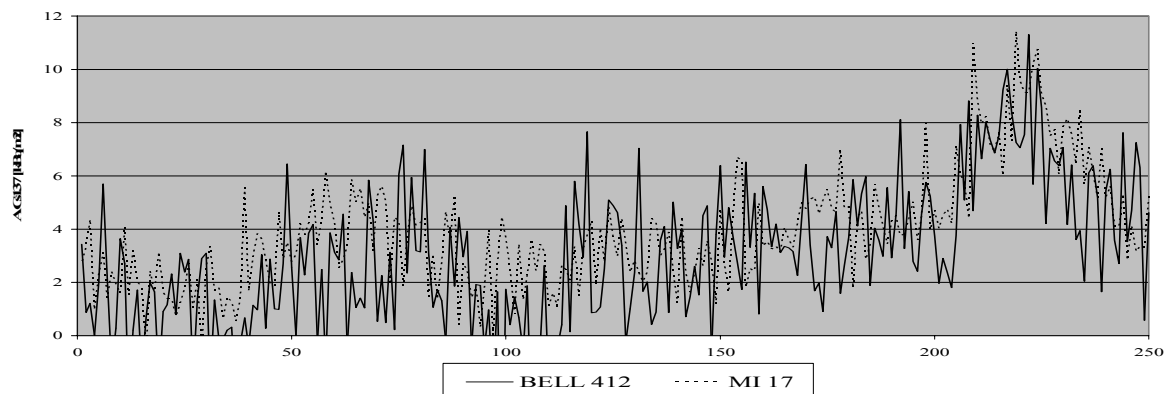


Figure 2 Courses of specific activity of ^{137}Cs [kBq/m²]



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