

# ON THE LONGTERM EVALUATION OF POST-CHERNOBYL DOSE BURDENS IN KORMA COUNTY (BELARUS)

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## INTRODUCTION

After the reactor accident at Chernobyl in 1986 the development of environmental contamination and population doses was investigated by several national and international institutions. In 1991 a German three-year measuring campaign was started. The results concerning the ingestion dose by in-vivo monitoring had shown that the international annual dose limit of 1 mSv/a had only been exceeded in less than 2% of all 317,000 measured cases. In following years the expected downward trend of mean annual doses did not occur and internal doses did not continue to decrease or even increased.

Therefore, several small follow-up studies were initiated in Belarus, Russia and the Ukraine. One of these studies is the 'Korma Project' in Belarus, where two municipalities in Korma county were selected for further investigations: Vornovka, a purely agricultural municipality with the villages of Vornovka and Vissokoe, and Volincy, an agricultural and forestal municipality with the inhabited villages of Volincy, Kljapin and Kljapinskaja-Buda. The ground contamination of these two areas was between 300 kBq/m<sup>2</sup> and 630 kBq/m<sup>2</sup> in 1991. In contrast to Vornovka the municipality of Volincy is surrounded by a contaminated forest area and isolated from the main part of Korma county by a highly contaminated evacuation zone along the river Sosch.

First results were envisaged in May 2000 [1]. The study was finished last year and the results of these measurements are presented here. They are representative for smaller villages where people provide their families with locally produced food, which is in these higher contaminated districts more common than elsewhere. Today prevention measures including food restrictions installed shortly after the accident are increasingly ignored due to the poor economic situation.

The central task of this project was to get further data on the long term development of the internal and external population doses and to support the population by offering advice and information. It requires the ability to understand the problems, to emphasize real risks, to calm down exaggerated risk perceptions and to give realistic and easy to act advices. Especially children and young people in villages situated near the forest or on soil with high transfer factors should be made aware of the problems of incorporating activity.

## METHODS OF MEASUREMENT

The study includes measurements of area dose rates, radioactivity content of environmental samples ( e.g. foodstuff, soil) and body burdens.

The environmental measuring programme started by determining the area dose rate and the cesium soil contamination in each village and its surroundings. More than 12 years after the accident only the nuclide Cs-137 was to be expected. Area dose rates were measured at many different points covering the whole territory of the villages including arable land and meadows. A dose rate meter of the scintillation counter type with two measurement ranges of 0.01µSv/h – 500µSv/h and 500µSv/h – 100mSv/h was used. The soil measurements were prepared by sampling in the four points of the compass round about each village five cylindrical cores of soil within a square of 5m x 5m. The cores were 10 cm deep and 5 cm in diameter. All 5 cores were mixed into one sample which was measured with an environmental monitoring system containing a Ge semiconductor or a NaI detector.

The cesium contamination of locally produced food such as milk, vegetables, arable crops, self produced meat and forest products has been assessed using the same monitoring system.

The main component of the measuring programme consisted of a mobile whole-body device. A semitrailer and a box-type van were deployed carrying whole-body measuring assemblies of the fastscan type (Canberra) [2]. For calibration a whole-body phantom produced by the Institute for Hygiene at Sea (St.Petersburg) [3] was used.

## RESULTS AND DISCUSSION

The mean area dose rate was  $0.16\mu\text{Sv/h}$  at Vornovka,  $0.29\mu\text{Sv/h}$  at Vissokoe measured in 1998,  $0.24\mu\text{Sv/h}$  at municipality Volincy in spring 2000. Table 1 shows the measured  $^{137}\text{Cs}$  contamination of soils in these villages.

Table 1 : Detected and calculated mean  $^{137}\text{Cs}$ -contamination of soil. The calculated values are obtained by subtraction of natural background from the area dose rate and division by the area dose factor DF [4]

Village	Mean Value of Belarusian contamination map	calculated from area dose rate	determined from soil samples
	1991	1998	
	[ kBq/m <sup>2</sup> ]	[ kBq/m <sup>2</sup> ]	[ kBq/m <sup>2</sup> ]
Vornovka	244	125	130
Vissokoe	630	305	192
		1999	
Municipality Volincy	420	206	101

A comparison of the soil contamination as measured by soil samples in 1998 or 1999 or by dose rate calculations with the Belarusian contamination map of January 1991 shows that during the last eight years the soil contamination dropped by nearly 50%. This can be explained partly by radioactive decay. The migration of activity into deeper layers of soil may also play a role. The difference between detected and calculated contamination is to be explained by activity bound at and in plants, which influences the migration and contributes considerably to the area dose rates.

The  $^{137}\text{Cs}$ -contamination of vegetable, arable crops and self-produced meat is here mostly negligible, for example potatoes had a burden of  $5.0\text{ Bq/kg} - 13.3\text{ Bq/kg}$  vegetable  $5\text{ Bq/kg} - 7\text{ Bq/kg}$ . Milk had a low burden ( $<100\text{Bq/dm}^3$ ) if contaminated areas of pasture and fodder plants were avoided. But due to the severe economic situation many people forget all precautions and return to their former habits and use also higher contaminated pastures for milk production. In late summer and autumn mushrooms and wild berries, which are particularly highly contaminated ( $>70\text{kBq/kg}$ ), enrich the diet. Game is highly contaminated too. Elk was detected with a burden of  $0.75-0.95\text{ kBq/kg}$ , deer with  $0.75-7.2\text{ kBq/kg}$  and boar with  $21.8\text{ kBq/kg}$ .

The body burdens are quite different for the two municipalities investigated (Figure 1): the mean value from 1997 to 2000 at the municipality of Vornovka was about 3 kBq. The level was significantly higher at Volincy where the mean value between 1998 and 2002 is about 10kBq.

At the municipality of Volincy the average value of the internal contamination increased from 11.9kBq in October 1998 to 37.9kBq in early summer 1999. Due to this high value it was decided to observe the municipality Volincy more detailed.

Figure 2 contains the measured body burdens at the village of Volincy in June 1999. The solid line shows the mean value of incorporated activity as a function of age. The highest mean body burdens were observed in the age group from 26 to 30 years. In the village of Volincy the highest body burdens was found with values up to 660kBq. Most likely, these incorporations were due to eating game meat. In that economic situation a ban of game meat would not be possible. Therefore we suggested a restriction with care of consumption.

From autumn 1998 till spring 2001 the measurement of incorporated activity at Volincy was repeated several times. Figure 3 shows the development of body burden in the municipality Volincy for different age groups. From spring 1999 – spring 2001 the level decreased by about a factor of five, which is in good agreement with the assumption that there was nearly no further intake and the body activity decreased according to the biological half-life.

Spring 2001 the population of Volincy was informed about the end of the project. But in May 2002 the project was accomplished by a test measurement of body burden in this municipality. The results as given in figure 1 and 4, show for spring 2002 an significant increase of incorporation up to a value slightly higher than that of spring 2000. This shows that the suggested measures are not adhered rigidly and take less affect if they are not observed continuously by measurements.

## CONCLUSION

The radiological situation in the two municipalities Vornovka and Volincy is very different. The results for the municipality of Vornovka suggest that in pure agricultural regions the radioactive contamination is under control and the way of life returns to normality. At most, certain slight restrictions may be necessary. The total dose for adults and children is not so high as to give cause for concern and restrictions.

In the municipality of Volincy lying in a forest region the internal exposure is still a problem and contributes significantly to the total dose. For a reduction of the internal dose, restriction on food consumption should be observed especially for young people. But a general ban of forest products would not be acceptable by the population due to the bad economic situation. Therefore, individual advice and personal rules of conduct have to be given to all persons affected.

The values of incorporation measured in spring 1999 show that the population in Volincy incorporated much activity during winter. Obviously, the population incorporated much activity from game meat that was hunted during the winter. It appears that the high incorporations in spring 1999 shocked the people and opened them for advice. The results for the incorporation values after spring 1999 show a permanent decrease for children. Also for adults we found during the measuring campaign 1999 to 2001 a permanent decrease of incorporations in spring.

The increase in spring 2002 may be due to decreasing care and attention for contaminated food (e.g. game meat).

The project showed, that individual advice, clear information and periodic control of body burden is able to reduce doses and promote confidence of the inhabitants to the staff members so that rules of conduct may be accepted in the long run. But this must be maintained continuously.

## REFERENCES

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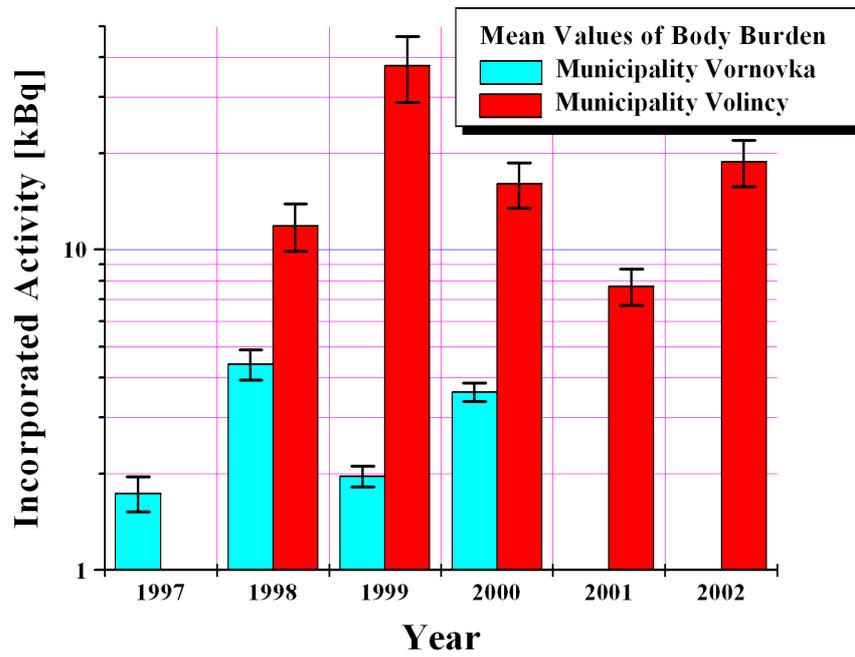


Fig. 1: Mean values of incorporated activity in the municipalities Vornovka and Volincy

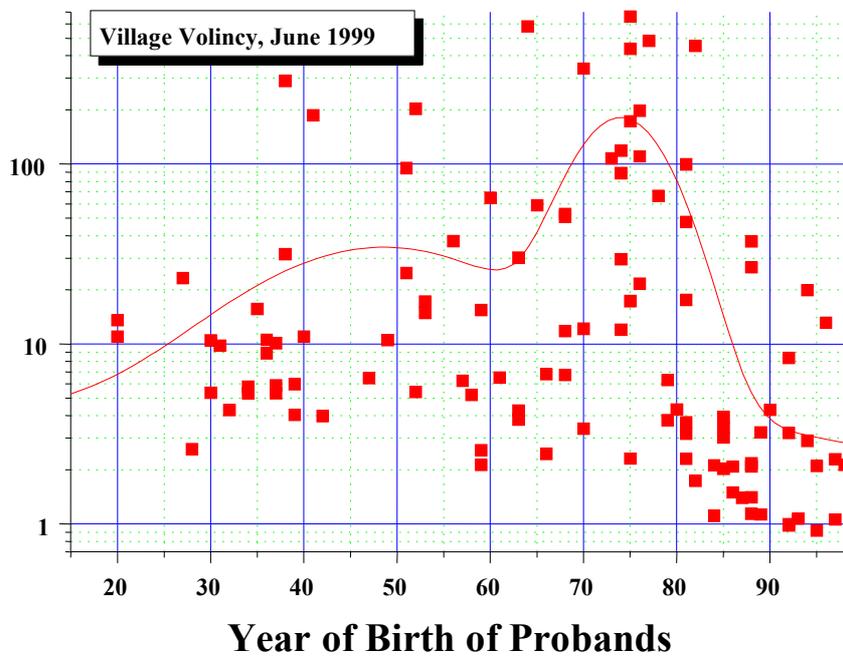


Fig. 2 : Measured data of incorporated activity in the village of Volincy, June 1999

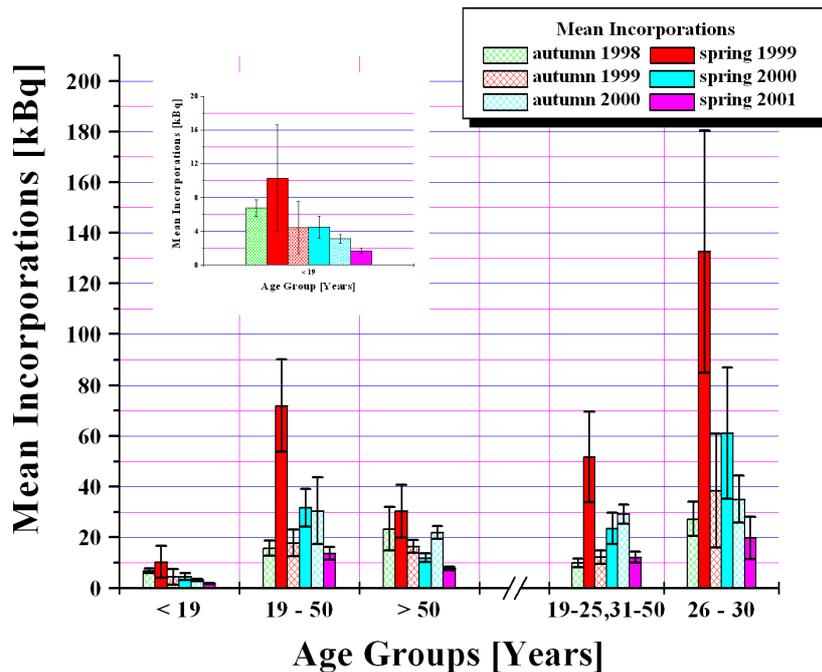


Fig. 3: Mean values of incorporated activity of age groups in the municipality Volincy: in the upper part left for children and youth people, right part separation of the age group 19 – 50 years.

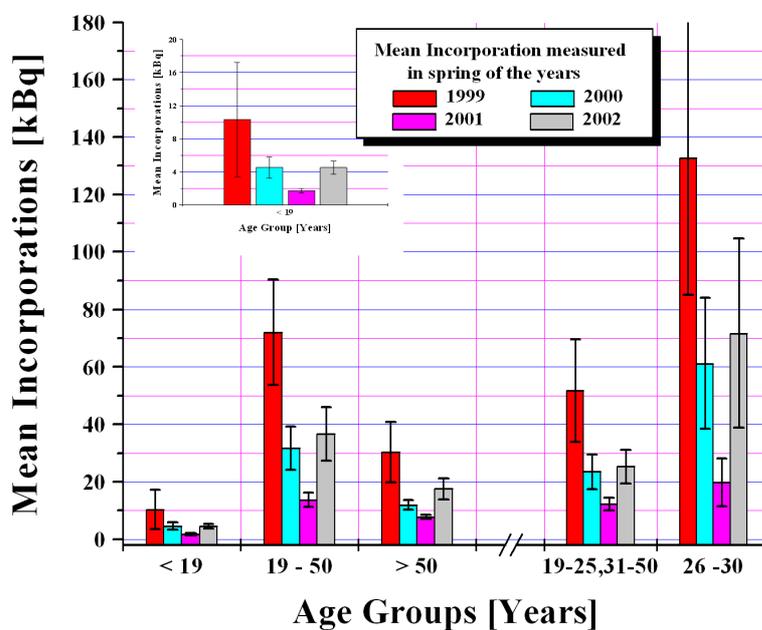


Fig. 4: Spring mean values of incorporated activity of age groups in the municipality Volincy