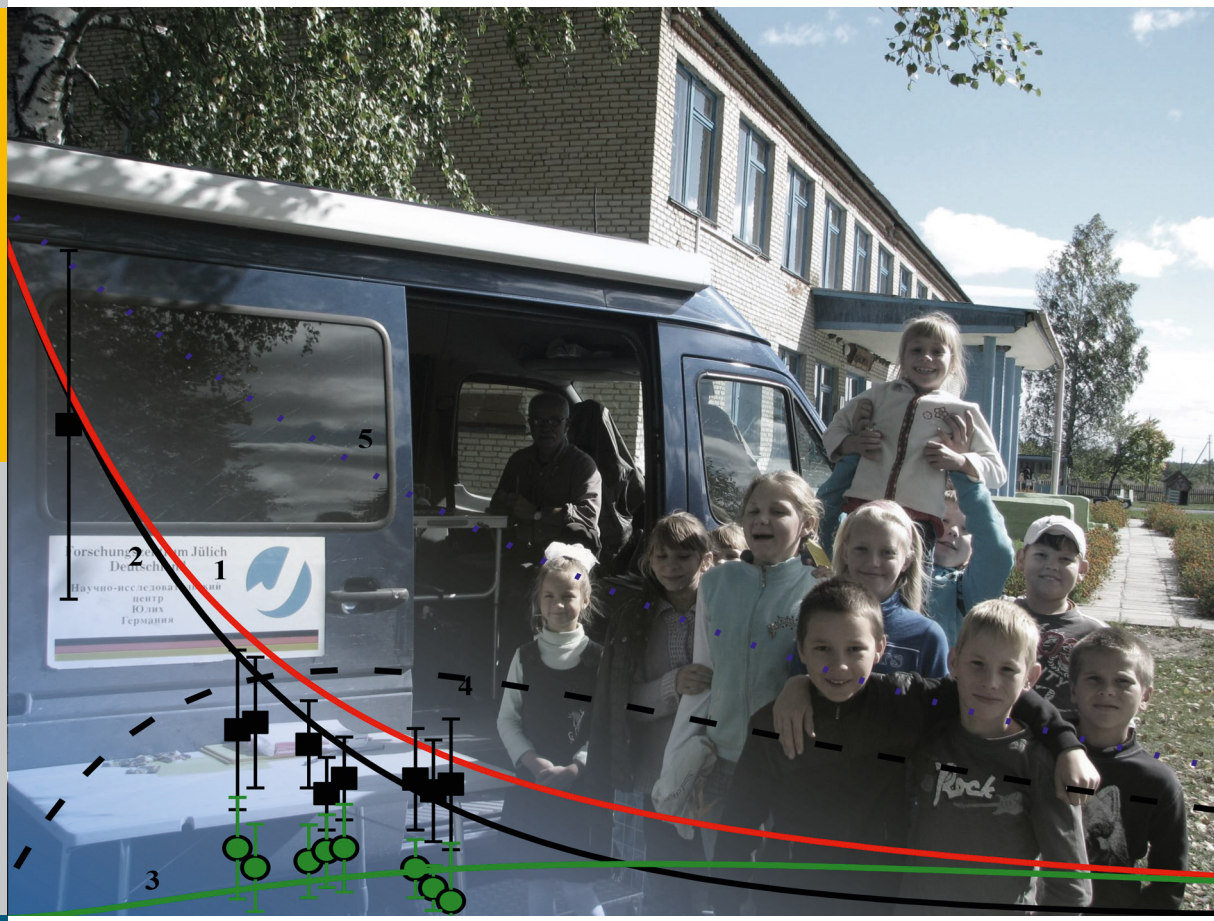
Long-Term Measurements of the Radiation Exposure of the Inhabitants of Radioactively Contaminated Regions of Belarus – The Korma Report II (1998 – 2015)

Petro Zoriy, Herbert Dederichs, Jürgen Pillath, Burkhard Heuel-Fabianek, Peter Hill, Reinhard Lennartz



Energie & Umwelt / Energy & Environment
Band / Volume 342
ISBN 978-3-95806-181-1

Member of the Helmholtz Association

JÜLICH FORSCHUNGSZENTRUM

Schriften des Forschungszentrums Jülich
Reihe Energie & Umwelt / Energy & Environment Band / Volume 342

Forschungszentrum Jülich GmbH
Geschäftsbereich Sicherheit und Strahlenschutz (S)

Long-Term Measurements of the Radiation Exposure of the Inhabitants of Radioactively Contaminated Regions of Belarus – The Korma Report II (1998 – 2015)

Petro Zoriy, Herbert Dederichs, Jürgen Pillath,
Burkhard Heuel-Fabianek, Peter Hill, Reinhard Lennartz

Schriften des Forschungszentrums Jülich
Reihe Energie & Umwelt / Energy & Environment Band / Volume 342

ISSN 1866-1793 ISBN 978-3-95806-181-1

Bibliografische Information der Deutschen Nationalbibliothek.
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der
Deutschen Nationalbibliografie; detaillierte Bibliografische Daten
sind im Internet über http://dnb.d-nb.de abrufbar.

Deutsche Version: **Langzeitbeobachtung der Dosisbelastung der Bevölkerung in radioaktiv kontaminierten Gebieten Weißrusslands – Korma-Studie II (1998 – 2015)**
erschienen als Band 315 der Reihe Energie & Umwelt
ISBN 978-3-95806-137-8

Herausgeber und Vertrieb: Forschungszentrum Jülich GmbH
Zentralbibliothek, Verlag
52425 Jülich
Tel.: +49 2461 61-5368
Fax: +49 2461 61-6103
E-Mail: zb-publikation@fz-juelich.de
www.fz-juelich.de/zb

Umschlaggestaltung: Grafische Medien, Forschungszentrum Jülich GmbH

Druck: Grafische Medien, Forschungszentrum Jülich GmbH

Schriften des Forschungszentrums Jülich
Reihe Energie & Umwelt / Energy & Environment, Band / Volume 342

ISSN 1866-1793
ISBN 978-3-95806-181-1

Vollständig frei verfügbar über das Publikationsportal des Forschungszentrums Jülich (JuSER)
unter www.fz-juelich.de/zb/openaccess.

Langzeitbeobachtung der Dosisbelastung der Bevölkerung in radioaktiv kontaminierten Gebieten Weißrusslands

– Korma-Studie II (1998–2015) –

Petro Zoriy, Herbert Dederichs, Jürgen Pillath, Peter Hill, Reinhard Lennartz, Burkhard Heuel-Fabianek

Forschungszentrum Jülich, Sicherheit und Strahlenschutz (S)

April 2016

Kurzfassung

In einem durch den Tschernobyl-Reaktorunfall kontaminierten Gebiet in Weißrussland wurden radiologische Langzeitmessungen über achtzehn Jahre (1998–2015) hinweg durchgeführt. Während die interne Strahlenexposition der Menschen in der Gemeinde Volincy – hervorgerufen u. a. durch die vorhandene Kontamination und die mit zunehmenden zeitlichen Abstand zum Unfall nachlassende Vorsicht beim Verzehr selbsterzeugter Lebensmittel – von einem hohen Niveau sehr deutlich abnahm, zeigte sich bei der externen Dosis ein differenziertes Bild. Generell ist hier zwar eine Abnahme zu beobachten, im organischen Bodenanteil nimmt die Belastung jedoch immer noch zu. Dies gilt nicht für genutzte Ackerflächen und Gärten.

Neben den Messungen erfolgte auf Basis eines sehr guten Vertrauensverhältnisses auch eine individuelle Beratung der Menschen zur Reduzierung der internen Belastung.

Als Folge der Beratungen und des Rückgangs der Aktivität in der Umwelt (Oberboden, Pflanzen) konnte die interne Dosis deutlich reduziert werden, sodass heute nur noch eine leicht erhöhte interne Strahlenexposition vorliegt, die gesundheitlich als nicht relevant anzusehen ist. Die mittlere jährliche innere Dosis ist im Jahr 2013 unter den Wert von 0,1 mSv/a gefallen. Die Gesamtdosis wird dagegen trotz Abnahme auch in späteren Zeiten noch erheblich über „normalen“ Werten liegen, was durch die externe Dosis verursacht ist.

Bisher traten keine statistisch signifikanten Anzeichen für Erkrankungen auf, die durch die Strahlenbelastung hervorgerufen wurden.

Bei regelmäßigen Kontrollen der internen Belastung und individueller Beratung zu dosisreduzierenden Maßnahmen besteht auch in naher Zukunft keine besondere Gefahr für die Bevölkerung im untersuchten Gebiet. Auch in ehemaligen Sperrgebieten ist eine Ansiedlung heute wieder denkbar, wenn geeignete Verhaltensregeln in Bezug auf die Ernährung eingehalten werden.

Long-term measurements of the radiation exposure of the inhabitants of radioactively contaminated regions of Belarus

– The Korma Report II (1998–2015) –

Petro Zoriy, Herbert. Dederichs, Jürgen Pillath, Peter Hill, Reinhard Lennartz, Burkhard Heuel-Fabianek

Forschungszentrum Jülich, Safety and Radiation Protection (S)

2016

Abstract

Radiological long-term measurements were performed between 1998 and 2015 in a region of Belarus that was affected by the Chernobyl accident.

The internal radiation exposure of the inhabitants of the village of Volincy (Korma district) — caused by the existing contamination and an increasing lack of precautions in the course of time with regard to eating home-grown food — has experienced a significant decrease from a very high level. External exposure, however, reveals a different picture. Although an overall decrease was observed, the organic constituents of the soil show an increase in contamination. This increase was not observed in soils from cultivated land or gardens.

In addition to the measurements, a relationship based on mutual trust allowed us to offer the inhabitants individual advice on how to reduce internal contamination.

As a result of this advice and the decreasing environmental contamination (topsoil and crops), the internal dose was reduced significantly. Today, internal exposure is only slightly elevated and has no significant negative influence on the health of the inhabitants. In 2013, the internal dose decreased to less than 0.1 mSv/a. Despite this, the cumulative dose will remain significantly higher than "normal" values due to external exposure.

Up to now, we have found no statistically significant signs or symptoms of diseases caused by radiation exposure.

If internal exposure is checked on a regular basis and individual advice is available, there should be no specific danger for the people in the region in the near future. Resettlement may even be possible in former closed areas provided that people comply with appropriate dietary rules.

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Introduction to Korma Report II

26 April 2016 – 30 years after the greatest nuclear disaster to date, which occurred in the Chernobyl power plant: on the date of the anniversary, scientists and public media tried to analyse and discuss the causes, consequences, and conclusions from the disaster which had been compiled throughout the world during the past three decades [1–3].

Ever since the 1990s, Forschungszentrum Jülich in Germany has also contributed to understanding and investigating the radioactive contamination in the affected regions of Chernobyl. In 2009, a group of scientists headed by project leader Dr. Herbert Dederichs from Forschungszentrum Jülich's Safety and Radiation Protection Division published the Korma Report, a study on the work carried out in the Korma district of Belarus [4]. In view of the data obtained and results achieved throughout many years, it was decided to continue the project. Since then, investigations in the relatively heavily contaminated Korma district have been continued by means of new campaigns. The present report (Korma Report II) contains data updated to the year 2015 as well as new conclusions concerning the areas affected by the Chernobyl disaster.

1.2 Background

On 26 April 1986, the greatest nuclear disaster to date occurred in reactor no. 4, one of four reactors in the Chernobyl power plant, which at the time was part of the Soviet Union [5]. At the time of the accident, all four reactor blocks (of the type RBMK-1000) were in operation, each with a power output of 1000 MW. Radioactive fission products, which leaked out of reactor no. 4 during the core meltdown, entered the atmosphere. Due to the course of the accident and the associated heat build-up, the fission products spread over a wide area.

In addition to parts of Ukraine, large areas in Belarus and Russia were contaminated (Figure 1-1). Consequences of the release of radionuclides were also measurable in northern and western Europe.

In the years 1991–1993, a measuring programme was developed in cooperation with the German Commission on Radiological Protection and carried out at the instigation of the then Federal Ministry for the Environment (BMU). Approximately 320,000 persons in the successor states of the Soviet Union – Russia, Ukraine, and Belarus – were examined for incorporation. At more than 240 measuring sites, incorporation data from more than 240,000 people were collected [6]. Simultaneously, accompanying environmental measurements were taken [7, 8]. Forschungszentrum Jülich and its Safety and Radiation Protection division (GB S) had a leading role. After the project was concluded, individual small-scale research projects to observe long-term development were carried out in highly contaminated districts in the successor states of the Soviet Union.

Figure 1-1: Map of closed zones and control zones after the Chernobyl disaster (source: Central Intelligence Agency CIA: Handbook of International Economic Statistics. 1996) including the area under investigation, the Korma district ("Kreis Korma")

One of these projects – a project addressing the systematic differentiation of contaminated and non-contaminated agriculturally used land in the Korma district (*Systematische Differenzierung kontaminierter und nicht kontaminierter landwirtschaftlicher Nutzflächen im Kreis Korma*), which was also funded by BMU – investigated the long-term development of the radiation burden of selected settlements in the highly contaminated zones of the Korma district [9]. This project was carried out by Forschungszentrum Jülich in collaboration with Belarusian scientists. It examined the expedience and acceptance of protection and relief measures as well as determining the feasibility of a concept to limit dose rates to 1 mSv/a in the long term. The correlation between radiation burden and people's health was also examined.

While no noticeable abnormalities were detectable in adults, children appeared to display some. Disorders of the metabolism and the immune system as well as thyroid diseases occurred in children from the Volincy municipality. Particularly for the latter, a connection to radiation is conceivable – with all reservations. However, according to present knowledge, it should be stated that these are individual cases which may be down to coincidence since the number of test subjects is too small for an epidemiological statement.

1.3 Objectives

One of the results of the BMU project mentioned above was the finding that the measurement period was too short to reliably detect influences on health as a function of radiation exposure and to accurately describe the long-term trends of radiation exposure. Further medically tracking this trend while simultaneously monitoring incorporation over a longer period as well as a comparison with less contaminated settlements was desirable to describe the long-term trends of radiation exposure. Additionally, it seemed necessary to statistically compare the population's health in highly contaminated municipalities with that of less contaminated municipalities. In order to address these issues, Forschungszentrum Jülich developed a project concerning the influence of external and internal radiation exposure on the health of the Volincy population (*"Einfluss der äußeren und inneren Strahlenexposition auf den Gesundheitszustand der Bevölkerung der Gemeinde Volincy, Kreis Korma, Weißrussland"*), which was implemented between 2004 and 2007, supported by the Walter Gastreich foundation (part of the organization Stifterverband für die Deutsche Wissenschaft e.V.).

During further measurement campaigns, which were also supported by the Walter Gastreich foundation, more data were collected between 2010 and 2015.

The new findings are of general interest since the radiological examinations of these settlements can be transferred directly to other locations. This also applies to findings on behavioural and dietary habits in rural areas against the backdrop of changed attitudes and behaviour of affected population in highly contaminated regions.

Furthermore, due to the sufficiently high population density in the Korma district, the findings also permit conclusions to be drawn on emergency procedures in rural areas of western Europe with respect to the behaviour of and guidance for the population during the late resettlement phase.

1.4 Location

The Korma district is situated approximately 70 km north of the city of Gomel in Belarus, a region highly contaminated in some parts (Figure 1-2). The ^{137}Cs contamination reached 2,035 kBq/m² (55 Ci/km²) at one location in the district. Two regions of the district with a total of five settlements, including the towns of Solotomino and Strumen, were evacuated since the contamination was above 1,480 kBq/m² (40 Ci/km²) there. Due to the inaccessibility caused by the interconnection of the closed zones and poor infrastructure, eight further settlements were abandoned by the inhabitants.

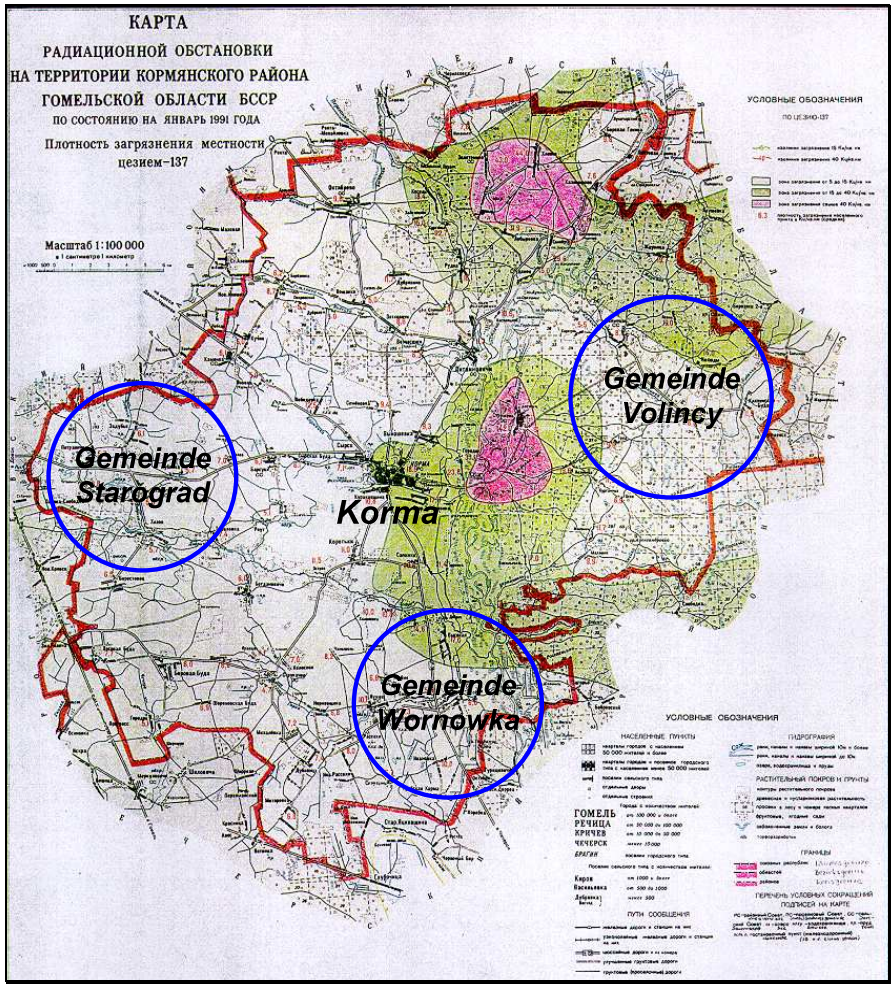


Figure 1-2: Korma district, Gomel province, Belarus, with the location of the municipalities of Volincy and Starograd (Source: Комитет геодезии и картографии СССР, Москва, 1991, amended)

The municipality of Starograd with the towns of Sadubje and Chisov is located in the west of the district (Figure 1-3). All of the settlements named are located in an agriculturally used region. There are small woods in the area of these settlements and a larger forest in the south west.

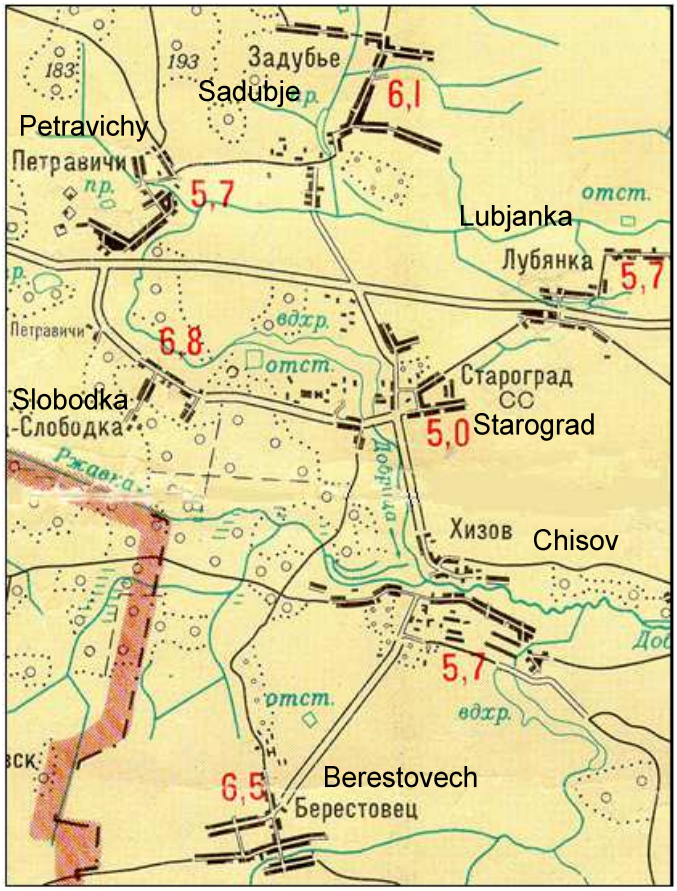


Figure 1-3: The Starograd municipality with contamination values of 1990 (Ci/km²) (Source: Комитет геодезии и картографии СССР, Москва, 1991, amended)

After the Chernobyl accident, the mean soil contamination in the Starograd municipality was measured to be 219 kBq/m² (5.9 Ci/km²); the most severely contaminated location exhibited a value of 251 kBq/m² (6.8 Ci/km²).

In comparison to the western areas of the Korma district, the areas east of the Sozh River are more severely contaminated. The closed zone of Strumen, which is completely uninhabited, is located there, and further to the east the municipalities of Volincy, Kljapin, and Kljapinskaja-Buda (Figure 1-4). The area is surrounded by the severely contaminated settlements Strumen, Solotomino, and Krasnapolje, and can only be reached via a pontoon bridge and a road leading through the Strumen closed zone (Figure 1-5). It is thus largely isolated from all the surrounding areas. The core population of Volincy – approximately 320 inhabitants – is very down-to-earth and not very mobile. With respect to food, the level of self-sufficiency is extremely high.

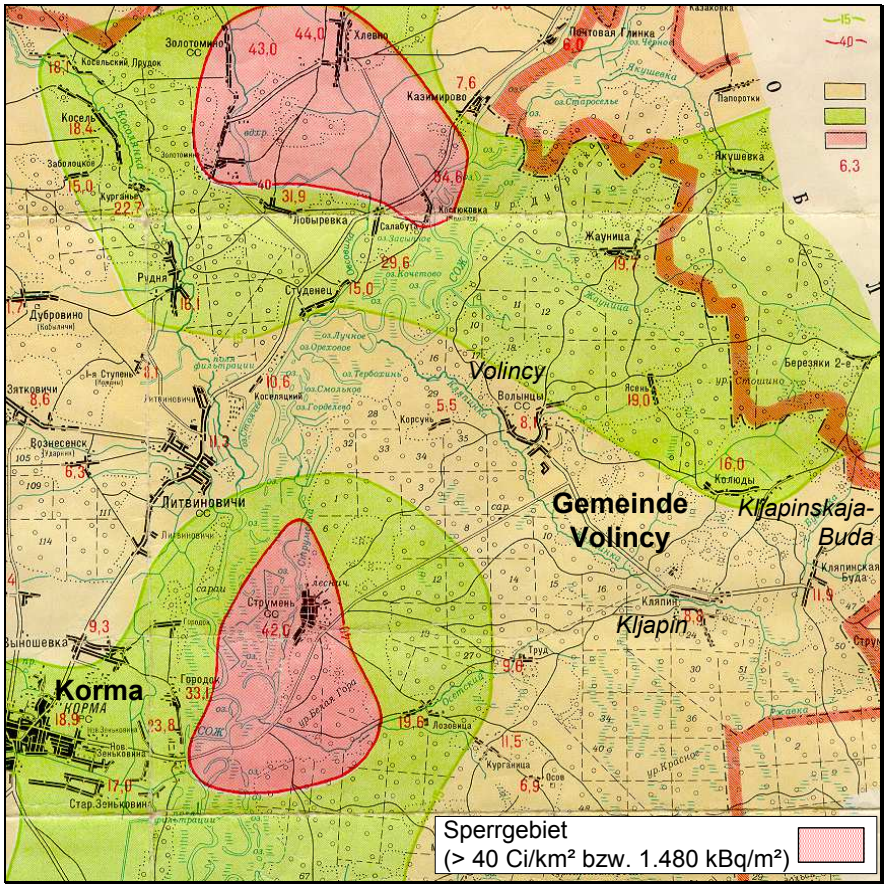


Figure 1-4: The Volincy municipality with closed zones (values in Ci/km²) (Source: Комитет геодезии и картографии СССР, Москва, 1991, amended)

All the other villages of the municipality of Volincy and also the other villages of the former municipality of Strumen outside the closed zone were abandoned by the population. The settlement of Koljud was recently resettled by two families.

The Volincy municipality is oriented not only towards agriculture but also towards forestry since it is located in the forest belt of the Korma district. In January 1991, in the presently settled core region which is used agriculturally, the municipality displayed a soil contamination of 204–592 kBq/m² (5.5–16 Ci/km²).

The Starograd–Volincy comparison may permit conclusions on the dose burden of populations in similarly structured municipalities which may be either more or less forestry-oriented. This is why parallel measurements were conducted in the Volincy and Starograd municipalities.

1.5 Methodology

The radiological investigation in the municipalities of Starograd and Volincy was conducted in three parts:

1. Investigation of the external radiation exposure

   For this purpose, soil contamination and local dose rate were measured.

2. Examination of home-produced food

   The term home-produced food includes all foodstuffs originating in forests as well as produce from fields, gardens, and animals kept for food. The contamination values of these products can provide information on the population's internal dose in advance.

3. Full-body examination of the population

   In order to obtain a conclusive estimate of the radiation burden caused by incorporation, a full-body examination of the population should be conducted throughout a defined period of several years so that incorporation trends are clearly visible. For the municipality of Volincy, this period of data acquisition extends over a total of ten years because the values obtained in an earlier project can be included. Furthermore, the measurements should always take place at the same time of year to preclude seasonal influences, particularly the incorporation increase caused by the consumption of mushrooms and berries gathered in forests.

Another important aspect was the advisory function of Forschungszentrum Jülich's measuring team. As part of an earlier project, which included giving advice and making individual behavioural recommendations and led to a decrease in internal radiation exposure, a state of mutual trust was achieved between the team and the population of the Volincy municipality. The people participating in the measuring programme were provided with individual behavioural measures for life in these settlements and on dose reduction. At the same time, the regularly conducted measurements helped reduce intense fears, phobias, and psychological stress in the population by providing a sense of listening to concerns and providing assistance.

Additionally, the local medical institutions were aided in their educational activities and their measures to support the population in overcoming the health consequences of the Chernobyl disaster.

In parallel to Forschungszentrum Jülich's measuring programme, doctors at Korma hospital have been continuously observing the development of the population's health in the long term so that any influences of radiation exposure could be recorded reliably and long-term trends of radiation exposure accurately described. Therefore, the health of the population of the Volincy municipality is to be statistically compared with that of the less contaminated municipality of Starograd.

1.6 Measuring systems utilized

In areas difficult to access (Figure 1-5), such as the closed zones beyond the Sozh River and the municipality of Volincy, only measuring vehicles can be utilized whose local handling is flexible. This issue requires the measuring system to be robust and manageable as well as sufficiently accurate [10].

Based on the experience gained in the rural areas of Belarus, Forschungszentrum Jülich developed the SM2 whole-body counter (Figure 1-6), designed for a light-duty measuring vehicle (Figure 1-5), which can be deployed rapidly and flexibly in contaminated areas in case of nuclear emergencies.

The fundamental design of the whole-body counter was based on the whole-body counter KFA-3 [11], using 50 mm lead bricks with a total weight of 0.8 t, shaped like a stretcher. This shielding had previously proved appropriate for local conditions in contaminated areas of eastern Europe. For the detection of radiation in an energy range of 0.1–2 MeV, two large NaJ(Tl) detectors with dimensions of 10cm x 10cm x 40 cm each were used in parallel.

Figure 1-5: The measuring vehicle, equipped with a mobile whole-body counter, accessing the measuring area (municipality of Volincy) in Belarus by crossing a pontoon bridge and eroded roads

The position of the detectors underneath the stretcher surface was optimized. Measurements are taken while the subjects are lying down, with the detectors located at their backs. Figure 1-6 shows a cross-section of the SM2 whole-body counter. Data are recorded by NanoSpec multichannel analysers manufactured by Target, using a computer on board the measuring vehicle. Commercial software for incorporation measurements serves to both control the measurements and analyse the data. Calibration was carried out by means of a whole-body phantom [12], which was also utilized to determine correction factors for the weight dependency of the measuring geometry.

Depending on the measurement time of one minute, the background radiation, and the physique of the test subject, the detection limit for the body content of ^{137}Cs is approximately 100 becquerel.

The local dose rate was determined by means of the MAB-500 instrument (Figure 1-7), manufactured by the Munich company mab solutions GmbH. This device is a portable, battery-powered dose and dose-rate measuring instrument which is very well suited for field measurements. It consists of a probe with a tissue-equivalent plastic scintillation detector, which is connected to a photomultiplier that is temperature-compensated in the range of -20 °C and +40 °C. The probe can be either connected directly in the instrument or operated via a connecting cable. The scintillator is suitable for energy-independent measurements in the energy range of 33–7.5 MeV. The measuring range is 0.05–100 mSv/h. The duration of a measuring cycle can be individually set.

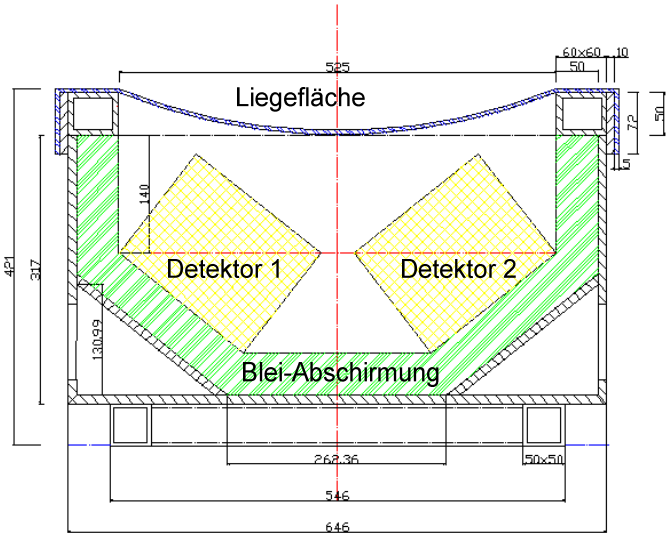


Figure 1-6: Cross-section of the SM2 whole-body counter

The local dose rate was determined in two steps:

1. Measurement of the local dose rate with the detector not shielded on any side
2. Measurement of soil radiation

In order to minimize the amount of disturbing background radiation during soil measurements, the instrument was equipped with an 18 mm lead cover both laterally and at the back. Moreover, the MAB-500 detector (Figure 1-7) can be completely shielded with an 18 mm lead cover so that only the high-energy component of cosmic radiation – which leads to a falsification during soil measurements – is measured. These measurements were conducted several times a day and whenever the weather changed. They were used to correct the soil measurements.

The detector was mounted into a bracket device so that the distance between detector and ground was 1 m. The orientation of the detector was such that the surface normal pointed to

the ground, thus making it sensitive only to soil activity. Figure 1-7 shows the detector in operation during a soil measurement.

The ^{137}Cs burden was estimated for the soil samples. These estimates were based on the assumption that the entire activity within a 10 cm surface layer is located at the surface and thus contributes fully to the external dose burden [13]. Soil samples of 10 cm diameter and 10 cm depth each were taken at the corners and the centre of a square of 5x5 m² [14]. The samples from each location were mixed, separated into organic and mineral components, and weighed. Only a representative part of the sample material was measured by Forschungszentrum Jülich in order to determine the ^{137}Cs contamination. By means of the total and partial weights as well as the size of the sample extraction areas, the soil contamination per m² can be determined for the organic and mineral portions.

Figure 1-7: Soil measurement (local dose) with the MAB-500 measuring system

Additionally, foodstuffs such as milk, mushrooms, potatoes, eggs, fish, etc. were collected in the village of Volincy and its surroundings and examined for their ^{137}Cs content.

The ^{137}Cs content was measured by determining radiation using a measuring instrument developed at Forschungszentrum Jülich based on a 2″x2″ NaI(Tl) scintillation detector shielded by three lead rings to minimize background radiation (Figure 1-8).

Figure 1-8: Food measuring instrument with NaI(Tl) detector and lead shielding

2 External Radiation Exposure

2.1 Municipality of Volincy

The municipality of Volincy comprises the villages of Volincy, Kljapin, and Kljapinskaja-Buda (Figure 1-4). They are located within a periodic control zone (contamination < 555 kBq/m²). Other villages of the municipality, such as Schaunitza and Jasen, which lie in a permanent control zone (contamination 555–1.480 kBq/m²) were voluntarily abandoned by the population. Koljud, which is also located in the permanent control zone, was resettled by two families in 2005. The 1991 contamination maps of the republic of Belarus also show, however, that a part of the village of Volincy should also be included in the permanent control zone. The value of 300 kBq/m² (8.1 Ci/km²) given on the map cannot therefore be used to determine the mean soil contamination.

Local dose rates were recorded and soil samples taken at several locations in the villages of the Volincy municipality (Table 2-1).

Table 2-1: Number of soil sample locations in the Volincy municipality

Village	Soil sample locations
Volincy	10
Kljapin	7
Kljapinskaja-Buda	3
Koljud	3

For the determination of the local dose rate of individual villages, forested areas were excluded.

In the years 2000 and 2001, measurements were taken at only three points in Kljapin because the team was not informed until later of one part of the village, located in a secluded area in the forest. The number of measuring points was then increased to seven.

In some years, samples could not be collected from all of the points because some proved to be inaccessible due to covering with firewood or other obstacles.

2.1.1 Surface contamination in the municipality of Volincy

In addition to local dose rates, soil samples were taken at the same locations from the year 2000 onward. The samples were separated into mineral and organic components and analysed only for the element ^{137}Cs since all other relevant elements released as fission products are no longer measurable. The results from each village were averaged excluding any forested areas.

Table 2-2 shows the development of the soil contamination in the individual villages as well as the entire municipality of Volincy over the years 2000–2006, supplemented by the values obtained in the new measurement campaigns during the years 2010–2015. The values for the entire municipality do not include the values from the village of Koljud since it is located in the permanent control zone and has only been inhabited in some parts since 2005.

When the normalized values of the entire municipality are plotted in a diagram, the development of the surface contamination can be shown by means of a model for determining the course of the "effective" soil contamination [13] (Figure 2-1).

Surface contamination is assumed for depths of up to 10 cm.

The calculations showed that the initial ^{137}Cs contamination amounted to N_0 = 545 kBq/m². The migration coefficient amounts to $\lambda_m = 0.06418\ a^{-1}$ and the retransfer coefficient to $\lambda_T = 0.028\ a^{-1}$. For the individual villages, the initial ^{137}Cs contamination was calculated as follows:

- Volincy 555 kBq/m²
- Kljapin 480 kBq/m²
- Kljapinskaja-Buda 600 kBq/m²

Table 2-2: ^{137}Cs soil contamination in the municipality of Volincy (*values from new measurement campaigns)

Year		Volincy	Kljapin	Kljapinskaja-Buda	Municipality of Volincy	Koljud
		[kBq/m²]	[kBq/m²]	[kBq/m²]	[kBq/m²]	[kBq/m²]
Belarusian register 1990/1991		375	325	426	376	592
2000	mineral	142.1	107.2	181.7	143.7	
	organic	62.1	54.6	44.1	53.6	
	total	204.2	161.8	225.8	197.3	
2004	mineral	153.0	113.0	129.0	131.7	
	organic	28.6	35.5	63.8	42.6	
	total	181.9	149	193.3	174.7	
2005	mineral	82.5	99.7	99.2	93.8	149.9
	organic	54.8	34.0	63.1	50.6	132.5
	total	137.3	133.8	162.2	144.4	282.4
2006	mineral	115.5	84.1	116.2	105.3	261.1
	organic	56.0	37.2	65.4	52.9	62.1
	total	171.5	121.3	181.7	158.2	323.2
2010*	mineral	131.1	73.6	40.0	96.0	351.5
	organic	33.8	18.1	4.2	23.6	77.9
	total	165.0	91.7	44.1	119.6	429.4
2011*	mineral	70.1	73.0	114.3	72.7	197.2
	organic	17.6	17.6	30.8	19.0	39.1
	total	87.8	90.5	145.1	91.7	236.2
2012*	mineral	125.7	82.1	88.4	105.7	253.2
	organic	12.6	11.5	14.3	14.4	35.3
	total	138.3	93.6	102.8	118.1	288.5
2013*	mineral	109.5	73.1	123.9	97.6	241.7
	organic	18.2	11.6	16.0	15.6	42.9
	total	127.8	84.7	139.8	113.2	284.5
2014*	mineral	93.0	70.5	110.3	86.5	191.3
	organic	15.0	12.9	7.4	13.4	31.2
	total	108.0	83.4	117.7	100.0	222.5
2015*	mineral	103.4	85.2	85.3	95.3	216.3
	organic	10.8	8.5	10.0	9.9	27.0
	total	114.2	93.7	95.3	105.2	243.0

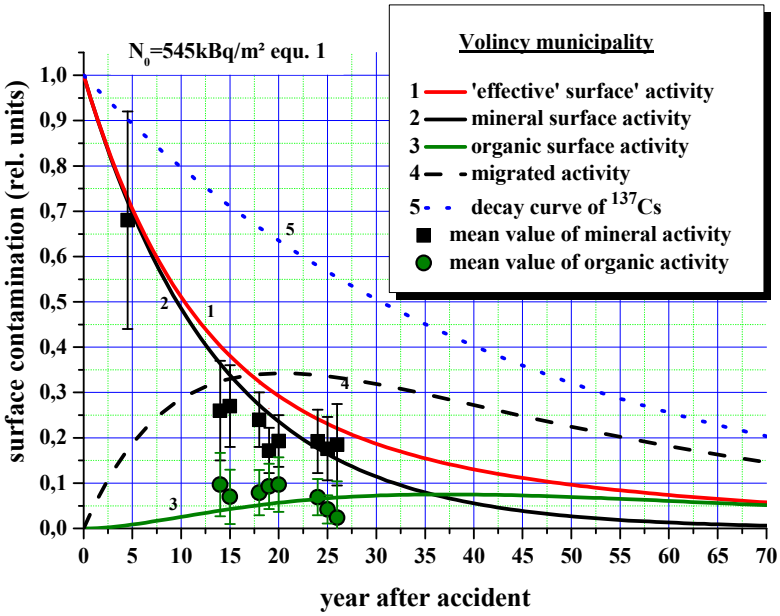


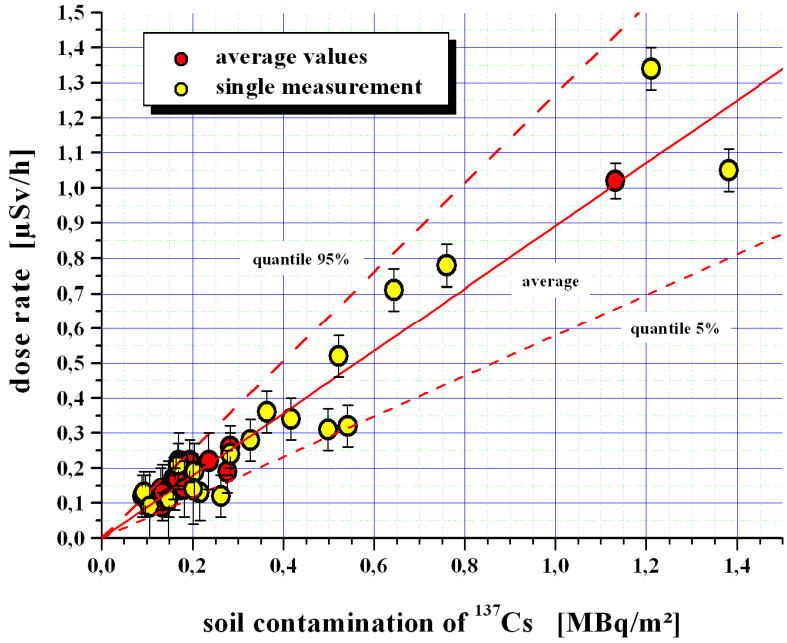
Figure 2-1: Development of the averaged surface contamination in the municipality of Volincy

After 20 years, the mineral-bound activity level has decreased to around 17 % of its initial activity. After 55 years, it will have decreased so much that it can then be viewed as non-existent. The organically bound activity level amounts to around 9 % after 20 years. It will continue to rise until it reaches its maximum of around 11 % 32 years after the accident. Later, after around 50 years, it will decrease according to the decay constant of ^{137}Cs. As can be seen in Figure 2-1, final verification requires measurements taken over long periods of time.

2.1.2 Determining the area dose factor

In addition to the mean surface contamination and the mean local dose rate, separate measurements of contamination and local dose rate were also conducted. The local dose rate was determined solely through the area contamination by suppressing the component of cosmic radiation by means of the lead covering around the detector and subtracting from the measured data the remaining component, which was determined in separate measurements.

Due to the high contamination of the organic components, it is appropriate to use the “effective” surface contamination with the associated area dose factor to calculate the external dose. Thus, the pure soil local dose rate was determined as a function of the “effective” surface contamination – the sum of mineral and organic components.



red measuring points: average values, yellow measuring points: single measurements

Figure 2-2: The soil local dose rate (dose rate) as a function of the "effective" surface contamination (soil contamination)

The data were collected not only in inhabited areas but also in forests in the Strumen closed zone and the abandoned villages of Kostjukovka and Chlewno in the Solotomino closed zone. The tree and brush activity component affecting the detector, which was previously measured separately, was subtracted from the forest data. Data from both averaged and single measurements were used.

The regression line results in:

$$\text{LDR (local dose rate) [µSv/h]} = (0.893 \pm 0.176) * C$$

with C = "effective" surface contamination [MBq/m²].

Figure 2-2 shows the dependence of the measured soil local dose rate on the "effective" surface contamination.

If only the activity of the mineral component of soil activity is taken into consideration, then the linear regression coefficient, amounting to m = 1.114 [µSv m²/MBq h], is approximately 25 % higher than the linear regression coefficient of the "effective" surface contamination.

2.1.3 Development of the local dose rate in the Volincy municipality

The averaged values of the local dose rate in the villages of the Volincy municipality as well as the village of Volincy itself are listed in Table 2-3; the village of Koljud once more has to be viewed separately. The single values in the individual villages are scattered over a larger range (±0.16 µSv/h). Control measurements outside the relevant measuring points show that

there are no radioactive spots within the village. The part of the village that should be located within the permanent control zone shows the highest mean value of 0.33 ±0.07 µSv/h. This area is located directly at the edge of the forest which merges into the large closed zone near the town of Krasnapolje, Mogiljev province.

Table 2-3: Mean values of the local dose rate in the Volincy municipality

Year	Volincy		Kljapin		Kljapinskaja-Buda		Volincy municipality		Koljud	
	[µSv/h]		[µSv/h]		[µSv/h]		[µSv/h]		[µSv/h]	
	mean	scatter	mean	scatter	mean	scatter	mean	scatter	mean	scatter
1999	0.22	0.15	0.16	0.05	0.27	0.16	0.22	0.14		
2000	0.31	0.08	0.25	0.05	0.29	0.12	0.28	0.09		
2001	0.26	0.05	0.21	0.03	0.27	0.09	0.25	0.07		
2004	0.21	0.05	0.17	0.02	0.22	0.06	0.20	0.05		
2005	0.23	0.05	0.16	0.02	0.25	0.06	0.22	0.05	0.40	0.06
2006	0.19	0.09	0.16	0.02	0.17	0.08	0.18	0.09	0.32	0.05
2010	0.15	0.07	0.08	0.03	0.06	0.03	0.11	0.07	0.38	-----
2011	0.08	0.04	0.07	0.03	0.13	0.01	0.08	0.03	0.21	0.08
2012	0.12	0.05	0.08	0.03	0.09	0.05	0.11	0.04	0.26	0.12
2013	0.11	0.05	0.08	0.02	0.12	0.001	0.10	0.04	0.25	0.08
2014	0.10	0.04	0.07	0.05	0.11	0.002	0.09	0.04	0.20	0.01
2015	0.10	0.05	0.08	0.03	0.09	0.06	0.09	0.04	0.22	0.06

Initially, no clear trend through the years of the measurement campaigns can be recognized in the values of Table 2-3. Once they are viewed in Figure 2-3, however, a trend can be calculated using the development of the “effective” surface contamination. The curve plotted in Figure 2-3 is the sum of cosmic radiation and the conversion from the development of the “effective” surface contamination. The same also applies to the individual villages within the municipality (see Figure 2-4).

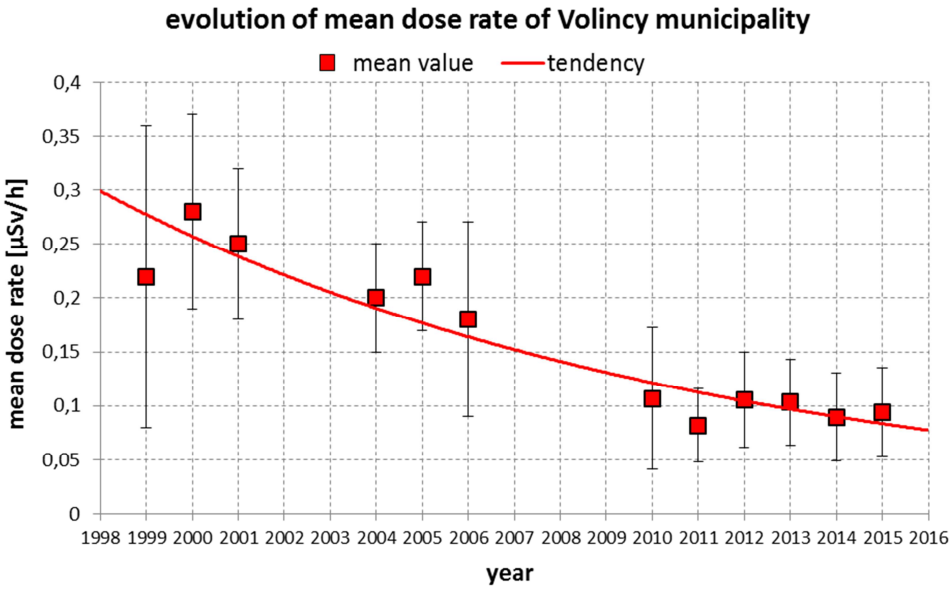


Figure 2-3: Evolution of the mean local dose rate in the Volincy municipality

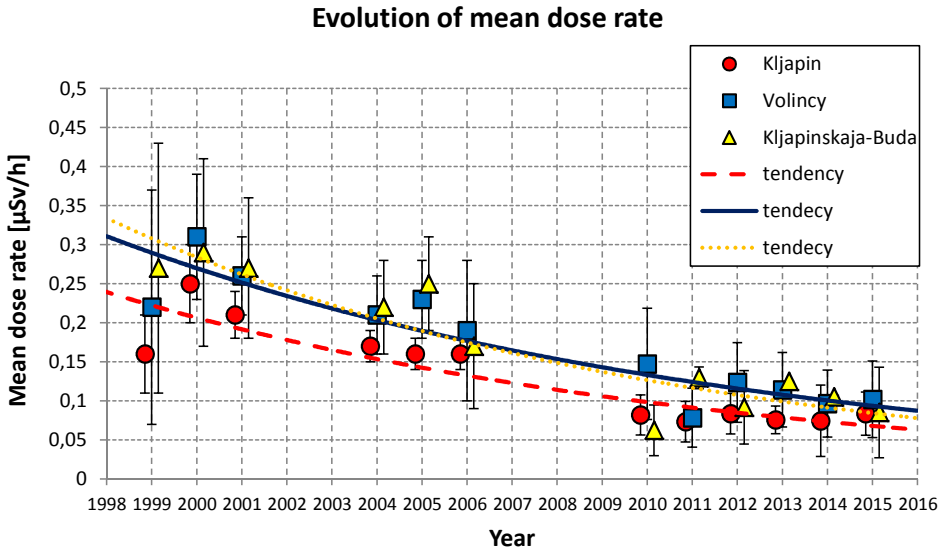


Figure 2-4: Evolution of the mean local dose rate in the villages of the Volincy municipality

The differing levels of the curves result from the various initial concentrations of ^{137}Cs, which are given in section 2.1.1.

Using the curve of the averaged surface contamination as a basis for the evolution of the mean local dose rate of the Volincy municipality, it is apparent that the local dose rate will

have fallen to 0.02 µSv/h by 2035. In order to directly determine the personal dose from the external radiation, a limited number of thermoluminescence dosimeters (TLDs) were distributed in May 2005. Some were to be worn by people and others deposited in buildings. One of the dosimeters was installed in the school, the only stone building. The dosimeters were collected in October 2005. The measured values were extrapolated to one year and plotted as the external annual dose in Figure 2-5. Furthermore, the incorporated ^{137}Cs activities of the corresponding people and the averaged annual doses of the individual villages in the municipality are plotted in Figure 2-5. The values suggest that not all of the people actually wore their dosimeters. Within a margin for error of 15 %, the values for both people and buildings are of the same order of magnitude.

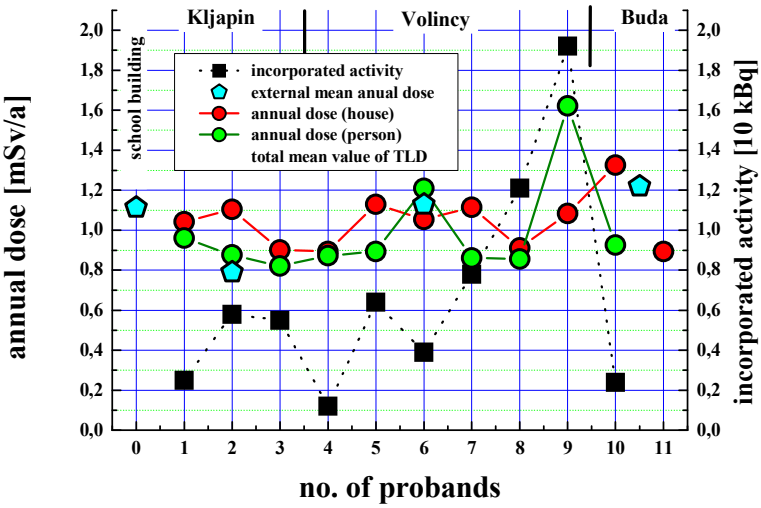


Figure 2-5: External annual dose for 2005, based on TLD measurements

When all measured values of one village are averaged and compared to the external annual dose, then the values shown in Table 2-4 result from the ratio between TLD annual dose and local annual dose.

Table 2-4: Comparison of the variably determined external annual dose and its quotient in the Volincy municipality

Village	TLD annual dose [mSv/a]	Local annual dose [mSv/a]	Quotient TLD annual dose/local annual dose
Volincy	1.03	1.13	0.91
Kljapin	1.02	0.78	1.31
Kljapinskaja-Buda	1.11	1.21	0.92

While the values differ greatly in Kljapin, the difference can be regarded as small in the villages of Volincy and Kljapinskaja-Buda. This effect becomes apparent in the quotient.

In 2006, TLDs were only installed in buildings in order to avoid the uncertainties of TLDs worn by people. Furthermore, the seasonal fluctuations in environmental pollution such as that which can be observed in incorporations should be suppressed. The dosimeters were positioned in similar locations in all houses to avoid excessive scatter caused by differing positions within houses. The entrance hall of the houses was selected for the TLDs, which were installed at a height of 2 m. An additional TLD was installed at a secure location on a tree outside the houses in the village of Kljapin. The TLDs remained at these locations for one year. The result is shown in Figure 2-6.

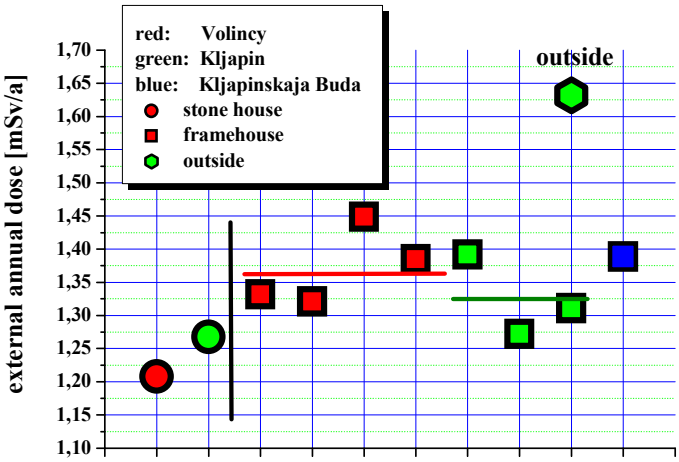


Figure 2-6: External annual dose of 2006–2007, based on TLD measurements

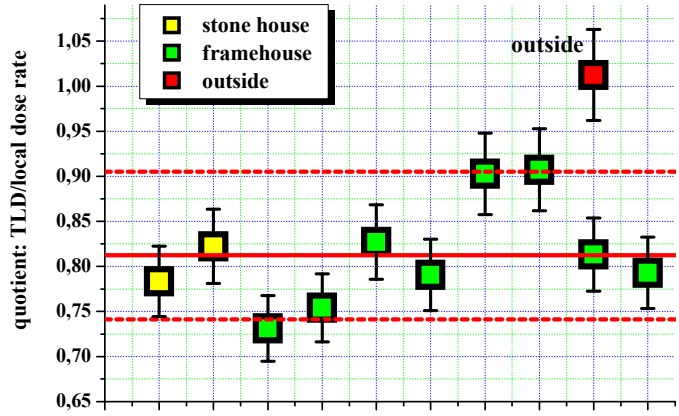


Figure 2-7: Ratio between the external annual dose determined by means of TLDs (2006–2007) and the LDR dose.

A comparison between the annual dose determined by TLD measurements and the values calculated from LDR measurements reveals that the dose in buildings – constructed either from wood or stone – is on average 18 % lower than the mean external dose (see Figure 2-

7). The value of the TLD external measurement corresponds closely to the annual dose rate determined by the LDR measuring instruments.

2.2 Municipality of Starograd

The municipality of Starograd comprises the villages of Starograd, Sadubje, Petravichy, Lubjanka, Chisov, and Paseka-Slobodka. They are located within a periodic control zone (^{137}Cs contamination < 555 kBq/m²). In the 1991 Belarusian register, the villages are listed as between 185 kBq/m² in the village of Starograd and 252 kBq/m² in Paseka-Slobodka (Figure 1-3). The population's radiation burden is relatively low. Since comparative measurements were only taken for the municipality of Volincy, it was decided to take measurements in the individual villages of the municipality for the first time. Due to the low measured values, the measurement points were not spread across the entire area; instead, the local dose rate and surface contamination were measured in the villages of Starograd and Chisov to represent the whole municipality. The measurements were performed in 2005 for the first time.

The following values were determined for the municipality of Starograd:

- Mean local dose rate: 0.15 ±0.02µSv/h
- Mean "effective" surface contamination: 107 kBq/m²
- Mineral component: 95 kBq/m²
- Organic component: 13 kBq/m²

A direct comparison is possible with the village of Vornovka (municipality of Vornovka), located in the south of the district (see Figure 1-2). The local dose rate and soil contamination were measured there in 1998 and 2006 during measurement campaigns conducted by Forschungszentrum Jülich. The village has the same soil contamination as the municipality of Starograd and is also purely agriculturally oriented.

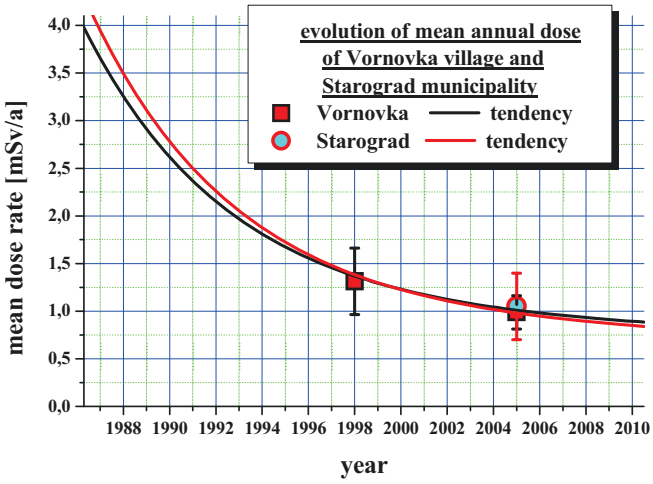


Figure 2-8: Potential development of the local dose rate in the Starograd municipality

Since values of the soil contamination in the village of Vornovka were available from two years and very similar to those of Starograd, development of the “effective” surface contamination of the village of Vornovka was estimated and the values used for the curve determining the evolution of the local dose rate of the municipality of Starograd.

Figure 2-8 shows the potential development of the local dose rate of the municipality of Starograd. According to this estimate, the mean local dose rate amounts to 90 nSv/h in 2006 and will decrease to 70 nSv/h by 2030. The current value thus corresponds to that of an uncontaminated location.

3 Radiation Burden of Home-Produced Food in the Volincy Municipality

In addition to determining soil contamination (Section 2), it is of particular interest to study the contamination of foodstuffs produced and eaten by the population since this permits initial estimates as to the internal dose burden before further investigations. Examinations of the radiation burden of food products offer a suitable approach for behavioural recommendations and measures for dose reduction. Simultaneously, it is examined whether the foodstuffs comply with the Belarusian limit values. The valid limits values are listed in Table 3-1 below.

Table 3-1: Belarusian limit values of the ^{137}Cs burden for various foodstuffs from 1999 onwards [15]

Product	Limit $[Bq/kg]_{solid}/[Bq/l]_{liquid}$
Milk	100
Potatoes	80
Berries	185
Meat	180
Other (vegetables etc.)	185
Mushrooms (fresh)	370
Mushrooms (dried)	2,500
Hay	370

Only food products which the population brought along to be examined voluntarily could be studied for activity since a compulsory requirement for food products to be submitted would have greatly disturbed the trust built up over the years. In the years 1999 and 2000, foodstuffs from the municipality of Volincy were largely measured in the laboratories of the Institute of Radiobiology in Minsk, with only a small proportion being measured in situ at the environmental measuring site of Forschungszentrum Jülich's measuring team [9].

The measurements from 1999 and 2000 revealed that field and garden produce from all villages in the municipality lay far below the permitted limit values. Thus, apart from a few samples whose radiation burden was almost undetectable (< 5 Bq/kg), further examinations of field and garden produce were carried out in 2004–2006 and in 2015.

As was the case in the years 1999 and 2000, a special emphasis was placed on the radiation burden in cow's milk. In the years 2004–2006, 16 milk samples were tested, and 3 in 2015. Table 3-2 shows the values.

Table 3-2: ^{137}Cs activity level of milk samples from the Volincy municipality

2004		2005		2006		2015	
Sample weight [g]	Activity level [Bq/l]	Sample weight [g]	Activity level [Bq/l]	Sample weight [g]	Activity level [Bq/l]	Sample weight [g]	Activity level [Bq/l]
382	51.2	750	50.0	358	25.1	693	12.9
376	35.6	386	39.6	382	21.4	682	16.4
354	34.3	372	40.1	332	42.0	672	6.8
388	29.6	463	44.1	350	15.9	688	< 1
391	47.1	724	68.1	390	< 10		
				372	< 10		

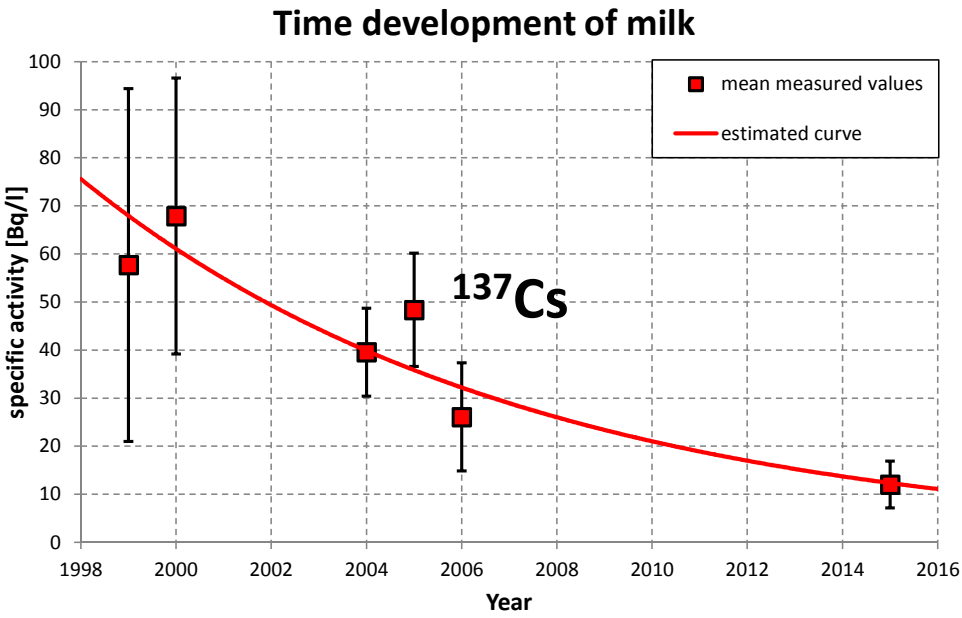


Figure 3-1: The development of the activity level of milk in the Volincy municipality 1998–2015

The milk values are particularly noteworthy because they give an indication of the activity level in children. Due to the low activity level in field and garden produce, home-produced milk is one of the main contributors to activity levels. Figure 3-1 shows the mean measured radiation burden values per litre of milk. They are representative because the origins of the milk samples were spread evenly across the entire municipality. Milk samples were always supplied when potentially heightened radiation burdens were feared by families. It should further be noted that no family came more than once. The curve was determined empirically.

Assuming a consumption of 250 ml milk per day, the mean annual activity intake through milk decreased from 6.21 kBq in 1999 to 2.13 kBq in 2006 and to 1 kBq in 2015. These values and assumptions would mean an internal annual dose of 74 µSv/a for an adult and

61 µSv/a for a six-year-old child in 1999. For 2015, an adult's annual dose would have decreased to 13 µSv/a – a decrease to one sixth – and a child's to 11 µSv/a, which corresponds to about one fifth.

In contrast to field and garden produce, the specific activity levels of some foodstuffs from the forest lie significantly above the limit values set by the government. Table 3-3 gives an overview of the values measured.

The measurements of ^{137}Cs in foodstuffs from the village of Volincy and its environs were conducted with the new measuring instrument in 2015. Several samples were taken and analysed for each kind of foodstuff gathered. Due to the currently small number of cows in the entire village of Volincy and its environs, only three samples of milk were collected. The majority of the population buy their milk in local shops, where it is transported from the city of Korma. One sample of milk was also bought in such a shop and its ^{137}Cs contamination measured.

During the campaigns 2013–2015, other foodstuff samples such as eggs, honey, potatoes, wild berries, fish, mushrooms (dried and fresh), and drinking water were bought or gathered in the village of Volincy and its environs. All samples were directly measured by the NaI scintillation measurement instrument constructed by Forschungszentrum Jülich. This new mobile device is capable of achieving a detection limit of less than 1 Bq/kg. Relevant results on ^{137}Cs activities in the samples analysed are shown in Table 3-3.

During the past few years, it was not possible to take samples of game from contaminated regions due to the strict governmental protection of wild animals.

The large variations partly depend on the location where they were gathered, and for wild animals on where their territories are located. The radiation burden of mushrooms cannot be explained directly. Certainly, different types of mushroom incorporate different amounts of ^{137}Cs since they have different transfer factors. However, the same type of mushroom was found in directly neighbouring areas in the same forest area and at the same time but with differing ^{137}Cs activity levels.

As mentioned above, the mean values of the field and garden produce measured lie below the detection limit of 5 Bq/kg. A comparison between field and garden produce and forest foodstuffs shows clearly that internal body activity is almost exclusively caused by foodstuffs from forests. Complete avoidance of forest foodstuffs can, however, hardly be enforced because they represent a non-negligible part of the diet in rural areas. Taking into consideration some protection measures, such as reducing the intake of game, pretreating mushrooms with brine, and choosing the forest locations in accordance with contamination criteria, then a limited consumption of forest foodstuffs is possible.

Table 3-3: Radioactivity (^{137}Cs) of forest foodstuffs in Volincy and its environs

Product	Description	Specific activity [Bq/kg]	Location	Campaign
Honey	wild	11	Northern Volincy, forest	2002–2006
	wild	11.2	Southern Kljapin, forest	2002–2006

	wild	170	Koljut	2013-2015
Elk	meat	320–1,300	Sozh River, environs	1999-2001
	meat	750	Sozh River, environs	2002–2006
Wild boar	meat	21,800	Strumen closed zone	1999-2001
	meat	1,430	Northern Volincy, forest	2002–2006
Mushrooms	leccinum (fresh)	11,850	Koljut	2002–2006
	boletus (dried)	20,924	Southern Kljapin, forest	2002–2006
	mixed (fresh)	7,434	Koljut	2002–2006
	leccinum (fresh)	11,000	Kljapin	2002–2006
	chanterelles (fresh)	400-433	Volincy, environs	2013-2015
	leccinum (fresh)	650	Koljut	2013-2015
	mixed (dried)	2,200	Volincy, environs	2013-2015
Berries	cranberries	1,000	Strumen closed zone	1999-2001
	cranberries	54	Northern Volincy, forest	2002–2006
	cranberries	246	Volincy, environs	2013-2015
Other	potatoes	< LOD	Volincy	2013-2015
	eggs	< LOD	Volincy	2013-2015
	drinking water	< LOD	Volincy, Kljapin, Koljut	2013-2015
	fish	< LOD	Sozh River	2013-2015

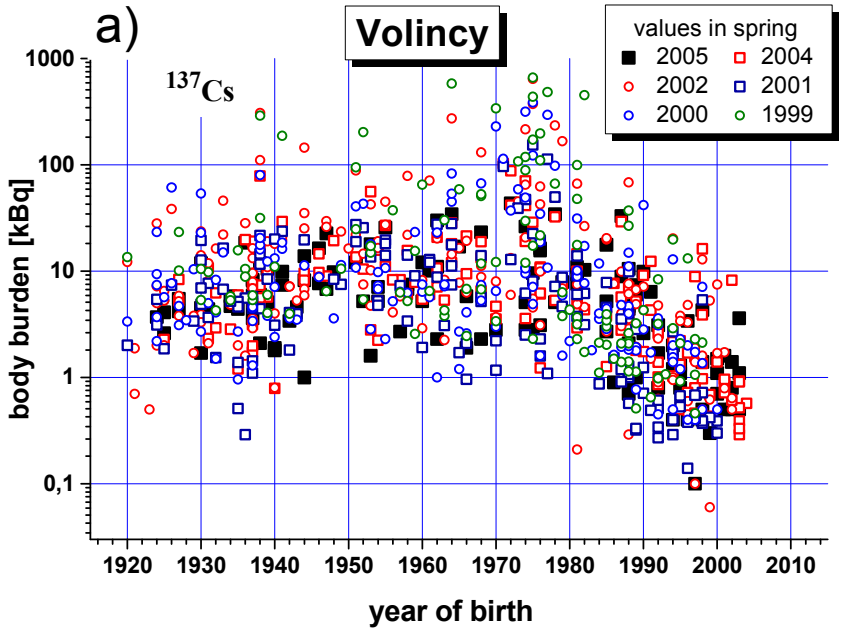
LOD = limit of detection: 1 Bq/kg

4 The Dose in the Municipalities of Volincy and Starograd

4.1 Internal radiation exposure in the municipality of Volincy

Due to the fact that the population's internal dose burden depends greatly on which village of the municipality of Volincy they live in as well as on their age, it is reasonable to not determine a mean annual dose rate for the entire population of the municipality. All measured values are documented in Appendix 1, including the number of test subjects and their dates of birth.

In Figure 4-1 to 4-3, the values of individual body activity for the various villages are plotted for the years 1999–2005 (a) and 2006–2015 (b).



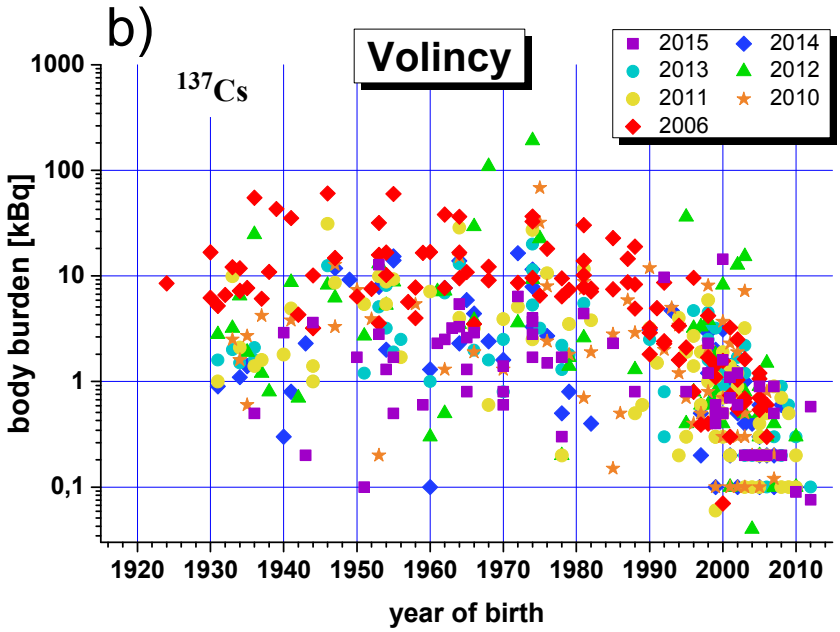


Figure 4-1 a) and b) Body activity (^{137}Cs) of the population of Volincy village

As can be seen from the figures, the highest body activity is in the village of Volincy, while the lowest is in Kljapin. On average, it was around four times higher in Volincy village compared to other villages; in 2005 it was still twice as high. In 2015, the mean values in all villages investigated were around the same. Furthermore, activity intake seems stable, solely the peaks of the past few years, brought about by individual persons, have disappeared.

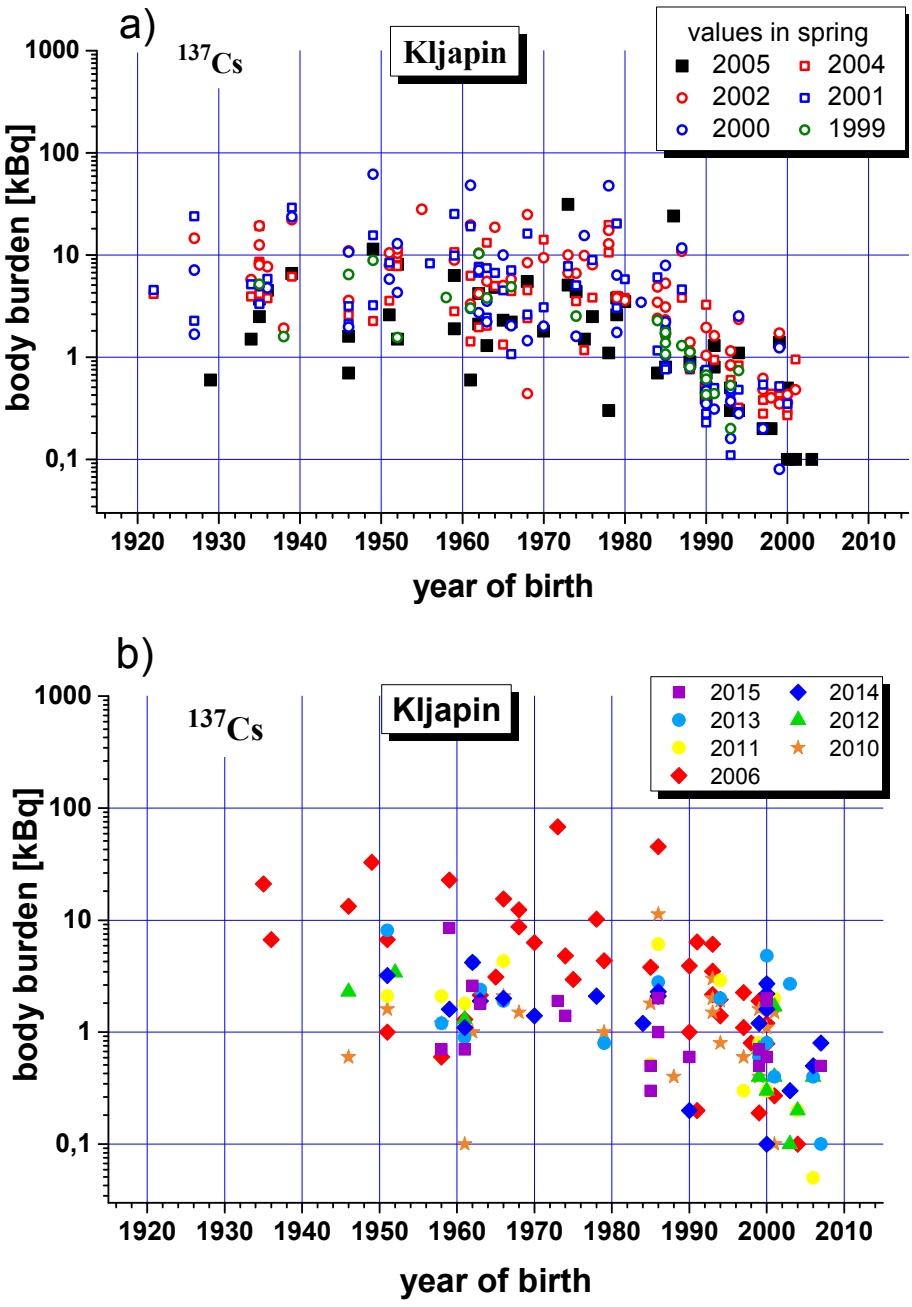


Figure 4-2 a) and b) Body activity (^{137}Cs) of the population of Kljapin village

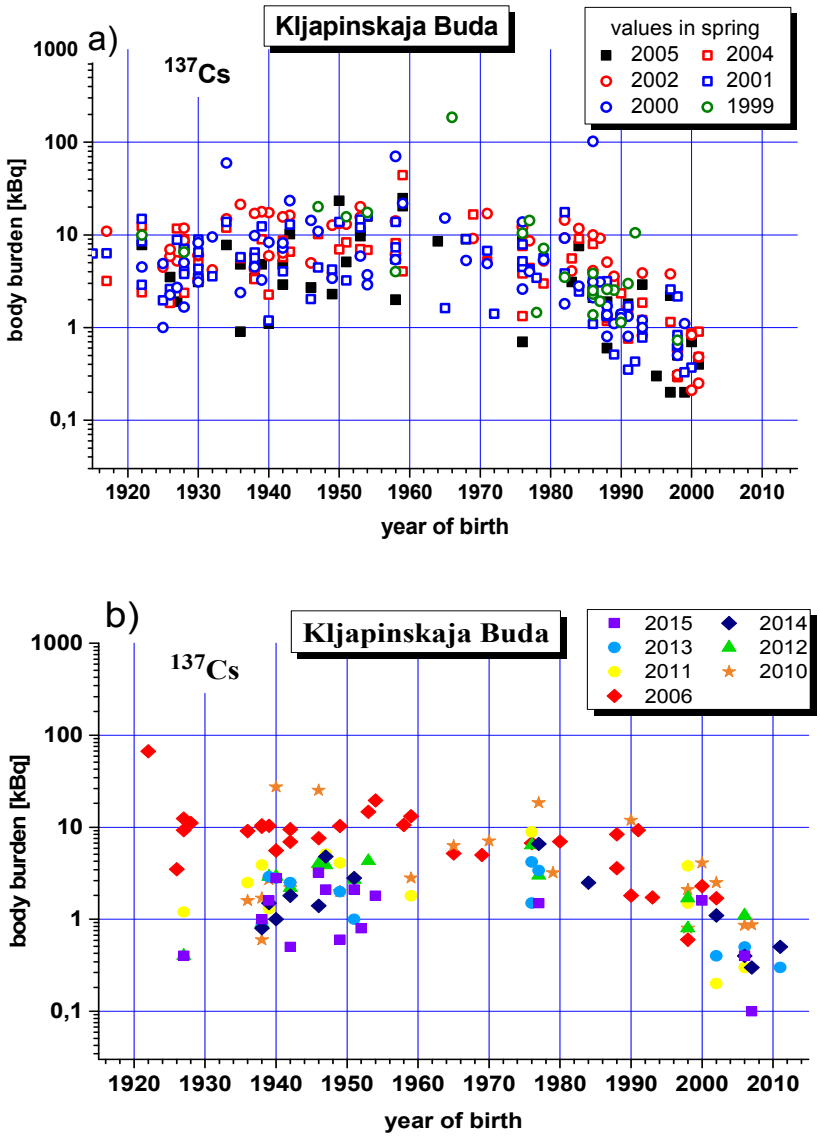


Figure 4-3 a) and b) Body activity (^{137}Cs) of the population of Kljapinskaja-Buda village

Body activities of several hundred kilobequerel of ^{137}Cs were measured on a number of occasions. No reason for the differing internal radiation burden of the individual villages can be found. Only general statements can be given as an explanation. The population structure varies greatly: many inhabitants of Kljapin are employed at the school, be it as teachers or other personnel, while inhabitants of the other two villages mostly work in agriculture or forestry and the share of persons with no steady income is larger. It must also be taken into consideration that in the village of Volincy, the population group born between 1960 and 1980 was particularly severely contaminated. This population group is not very large in Klja-

pinskaja-Buda. Among children and adolescents, the radiation dose is higher in the village of Volincy than in the other villages.

Due to the differing body burdens (Figure 4-1–Figure 4-3), it is reasonable to divide the population of the municipality into three age groups:

- children and adolescents: < 19 years,
- persons of 19–35 years,
- older people: < 35 years.

Considering the arithmetic mean values of the body activity measured in each campaign, broken down into villages and the different age groups of the population, the result is the time course shown in Figure 4-4.

This course shows an almost continuous decrease since 1998, with the exceptions of the turn of the year 2001/2002 and the increases in the mean body burden in 2006 and 2012.

An explanation for the first sudden rise could be the termination of the project in 2001, which was also announced to the population at the time. It is possible that this led to the assumption among the population that the situation had normalized or even that no more “controls” would be carried out and that thus a gradual return to the old living habits was acceptable.

Another explanation for such an increase could be good seasons for mushrooms or berries from the surrounding forests; the great variations in ^{137}Cs content in the same type of mushroom/berry in different years is shown in Table 3-3. The relatively high inaccuracy due to the “hot spot” (few people with extremely high ^{137}Cs contents in their bodies, up to several hundred kBq) could also contribute to these increases in the time periods mentioned above.

Furthermore, a few people with extremely high ^{137}Cs incorporation also lead to great statistical inaccuracy for the mean value so that sudden rises are only assumed.

Overall, the values show that in the period 1998–2015, the mean values in body activity decreased by approximately 90 % in the village of Volincy and by approximately 85 % in the villages of Kljapin and Kljapinskaja-Buda.

In order to record the “summer effect”, an additional measurement campaign was conducted in the municipality of Volincy in autumn 2005 (October). There was no significant rise. The sharpest increases of 3.7 kBq in Kljapin and 3.3 kBq in Kljapinskaja-Buda was recorded for the age group > 35 years. In the age group ≤ 35 years, the largest increase amounts to 2.1 kBq in the same villages.

Contrary to expectations for the village of Volincy, the age group ≤ 35 years displayed a decrease while the age group > 35 years recorded an increase of only 1.9 kBq. In spring 2006, it was not possible to conduct a measurement campaign in the municipality of Volincy since it was inaccessible for the measuring vehicles due to flooding of the Sozh River (Figure 1-5). This is why a measurement campaign was conducted in the autumn instead. As can be seen from the figure, there is no significant increase in comparison to the autumn of the preceding year.

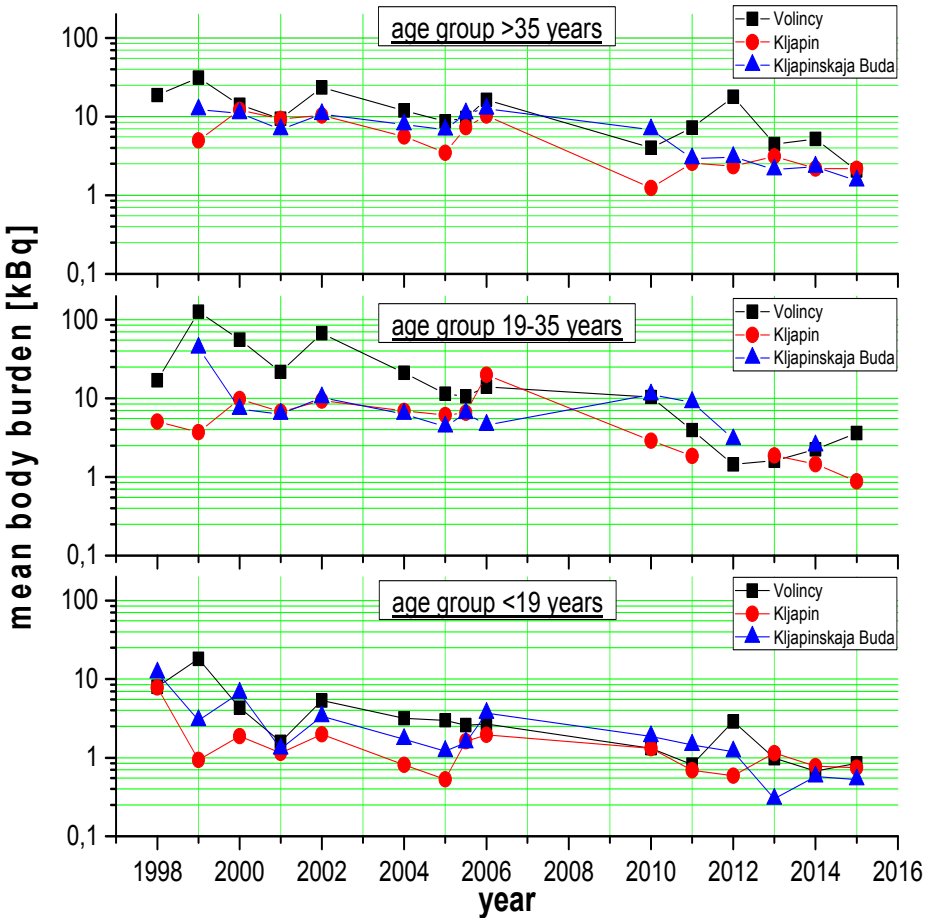


Figure 4-4: Time course of the mean values of the body activity (^{137}Cs) in the municipality of Volincy, broken down into villages and age groups.

Only the age group > 35 years displayed a somewhat more pronounced increase. An explanation for the slight increase from the preceding year is the consumption of mushrooms since the end of the mushroom season was imminent and had been better than in previous years.

The age group < 19 years was in the best situation: during all measurement times (1998–2015), the group's mean value of ^{137}Cs body burden was less than 10 kBq, and less than 1 kBq in the last few years. It should be noted that the children always had their lunch at the school. The parents never gave their children food from the forest if there was any danger of contamination (the parents know approximately where the foodstuffs were gathered). There are some people who sometimes eat game but do not allow their children to do so. Their explanation was that they were already old and contaminated and this would not have any influence on them while their children should avoid such foodstuffs.

4.2 Internal radiation exposure in the municipality of Starograd

The radiological situation regarding the incorporation of ^{137}Cs in the municipality of Starograd can be viewed as normal, that is not giving rise to concern, in comparison to the Volincy municipality. During the campaigns in the years 2004 and 2005, the majority of test subjects were children and adolescents. In 2004, the total number of test subjects amounted to 171, among them 138 children and adolescents and 33 adults. Among children and adolescents, body activity amounted to a mean value of less than 1 kBq in 2004, the maximum value was 2.12 kBq. In 2005, 210 test subjects came to be measured, 180 of whom were children and adolescents and 30 adults. With the exception of two children, the children's internal radiation burdens were < 1 kBq. The values of the adults varied between a non-detectable burden of < 100 Bq and 1.93 kBq. This result led to the fact that in later years, the internal radiation burden was no longer measured in the municipality of Starograd. Figure 4-5 shows the internal radiation burden in the municipality of Starograd.

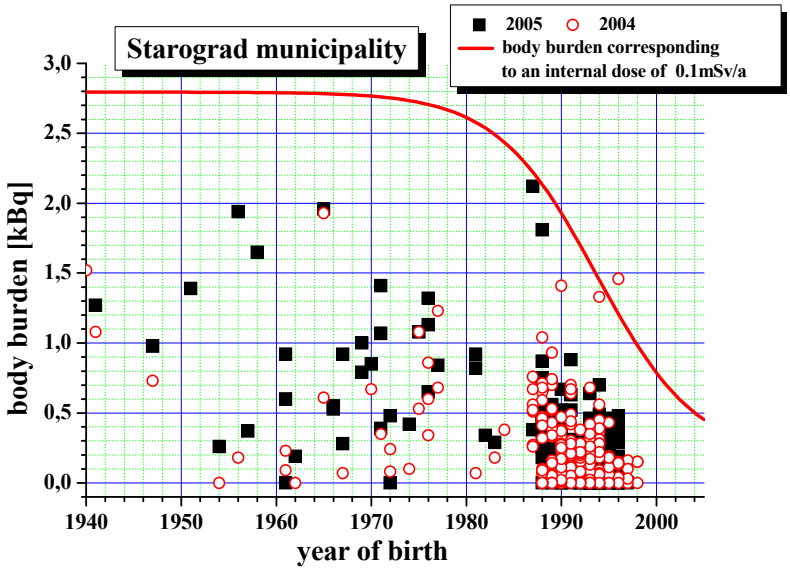


Figure 4-5: Body activity in the population of the Starograd municipality

A direct comparison with the municipality of Volincy can thus only be obtained using the mean values of the internal radiation burden of the entire population (Table 4-1). In 2004, the mean body activity in the municipality of Volincy was higher by a factor of 21 than in the municipality of Starograd. In 2005, the factor was 25.

Even in children and adolescents, the difference in mean body activity is still relevant: in the municipality of Volincy, the body burden was approximately eight times higher.

Based on these results, it was decided not to conduct any further examinations in Starograd. Thus, the subsequent years saw measurement campaigns only in the village of Volincy and its environs.

Table 4-1: Mean body activity values of the populations of Volincy and Starograd

Population	2004		2005	
	Volincy	Starograd	Volincy	Starograd
Entire population	8.13 ±5.74 kBq	0.38 ±0.28 kBq	7.04 ±4.85 kBq	0.28 ±0.23 kBq
Children/adolescents	2.35 ±4.09 kBq	0.27 ±0.18 kBq	1.62 ±2.08 kBq	0.23 ±0.19 kBq

4.3 Internal contamination in the municipality of Volincy

For the calculation of body activity into an internal annual dose, the dose factors set down by ICRP 67 (International Commission on Radiological Protection, Publication 67) were used in conjunction with the tissue weighting factors given in ICRP 60. The values were extrapolated for each year of birth for the ages of 0–18 years. Table 4-2 gives an overview of the ingestion-related mean annual dose values calculated from the measured values in the individual villages of the municipality of Volincy, both for the whole population and for the age groups mentioned above. Table 4-2 also shows that the dose has reduced over the years. This applies to all villages in the municipality of Volincy.

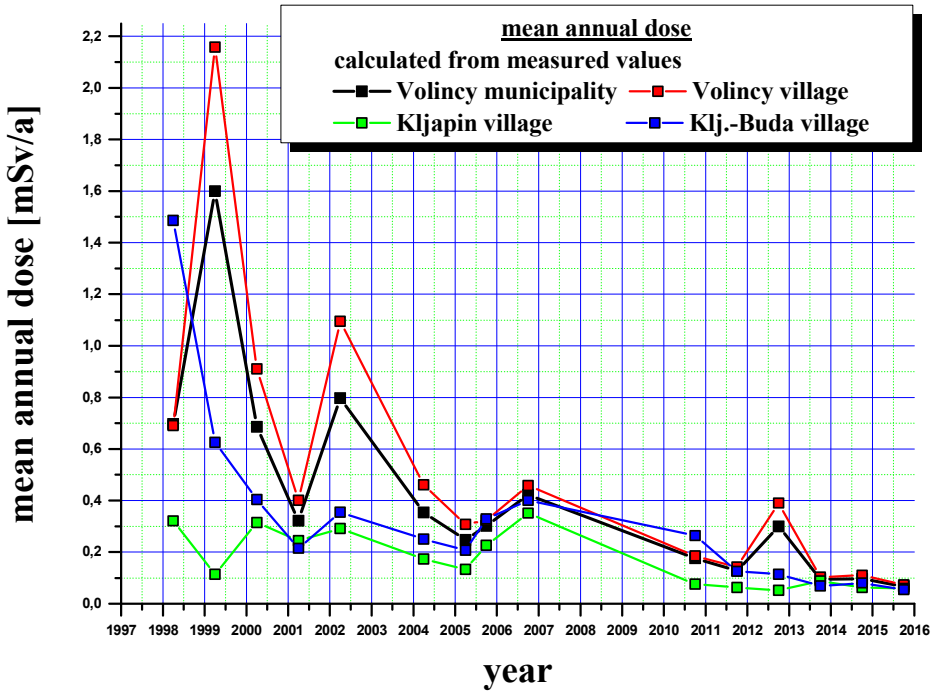


Figure 4-6: Development of the averaged annual dose in the individual villages and the entire municipality of Volincy

Table 4-2: Averaged annual dose in the individual villages of the Volincy municipality

Year (A = autumn) (S = spring)	Mean [mSv/a]	Scatter [mSv/a]	Mean value of age groups		
			< 19 years [mSv/a]	19–35 years [mSv/a]	> 35 years [mSv/a]
Volincy (village)					
1998/S	0.69	0.62	0.63	0.68	0.75
1999/S	2.16	4.88	1.05	5.06	1.25
2000/S	0.91	2.13	0.34	2.26	0.56
2001/S	0.40	0.75	0.12	0.86	0.37
2002/S	1.10	2.74	0.39	2.76	0.93
2004/S	0.46	0.64	0.25	0.84	0.48
2005/S	0.31	0.32	0.19	0.46	0.35
2005/A	0.32	0.28	0.19	0.42	0.39
2006/A	0.46	0.49	0.20	0.56	0.65
2010/S	0.18	0.38	0.09	0.42	0.16
2011/S	0.14	0.23	0.06	0.16	0.29
2012/A	0.39	1.09	0.18	0.06	0.71
2013/A	0.10	0.14	0.06	0.06	0.19
2014/A	0.11	0.16	0.04	0.09	0.21
2015/A	0.07	0.12	0.05	0.15	0.08
Kljapin					
1998/S	0.32	0.18	0.56	0.20	-----
1999/S	0.11	0.10	0.06	0.15	0.20
2000/S	0.31	0.52	0.12	0.39	0.49
2001/S	0.24	0.27	0.07	0.29	0.37
2002/S	0.29	0.25	0.13	0.38	0.41
2004/S	0.17	0.18	0.06	0.28	0.22
2005/S	0.13	0.22	0.04	0.25	0.14
2005/A	0.23	0.28	0.12	0.26	0.29
2006/A	0.35	0.53	0.13	0.80	0.41
2010/S	0.08	0.09	0.08	0.12	0.05
2011/S	0.06	0.07	0.05	0.07	0.10
2012/A	0.05	0.04	0.04	-----	0.09
2013/A	0.09	0.09	0.08	0.07	0.12
2014/A	0.06	0.05	0.05	0.06	0.09
2015/A	0.06	0.07	0.05	0.04	0.09
Kljapinskaja-Buda					
1998/S	1.49	1.18	1.49	-----	-----
1999/S	0.63	1.47	0.22	1.75	0.49
2000/S	0.40	0.86	0.39	0.29	0.44
2001/S	0.22	0.17	0.11	0.25	0.28
2002/S	0.35	0.22	0.21	0.41	0.43
2004/S	0.25	0.26	0.12	0.25	0.32
2005/S	0.21	0.20	0.08	0.17	0.27
2005/A	0.33	0.29	0.11	0.26	0.44
2006/A	0.40	0.45	0.23	0.18	0.50
2010/S	0.26	0.30	0.15	0.45	0.27
2011/S	0.13	0.09	0.09	0.36	0.12
2012/A	0.11	0.06	0.08	0.12	0.12
2013/A	0.07	0.05	0.03	-----	0.08
2014/A	0.08	0.07	0.05	0.10	0.09
2015/A	0.05	0.04	0.03	-----	0.06

Since the year 2004, the differences in the mean annual dose between the villages have been smaller (with the exception of 2012). It seems that the advice given to the population

has had a positive influence. Although the discrepancies between the villages and the age groups were large during the first years, Figure 4-6 shows the mean annual dose values for all test subjects for the individual villages as well as the whole municipality of Volincy. In spite of heavy scatter, the reduction in radiation burden is clear. The strict local hunting ban imposed for the past few years could be another explanation for the reduction of the mean annual dose in the regions' population.

In Figure 4-7 and Figure 4-8, the mean annual internal dose values are plotted separately as a function of sex and age group. Particularly the 19–35 years age group stands out with its high radiation burdens. Their high incorporation was traced back directly to the consumption of game by local investigations into dietary habits. This led to maximum annual dose values of > 20 mSv/a in individual persons (see Appendix A1).

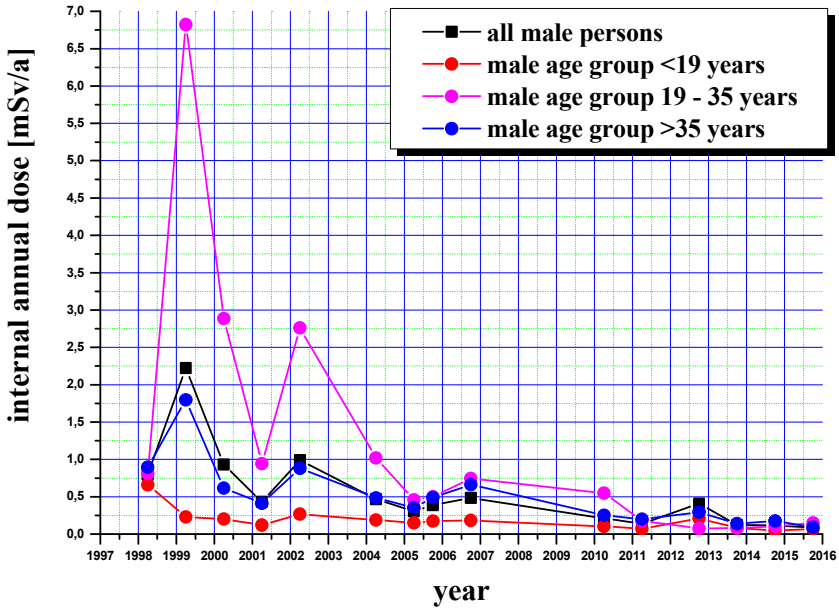


Figure 4-7: Development of the internal annual dose in the male population in the Volincy municipality, broken down into age groups and overall value

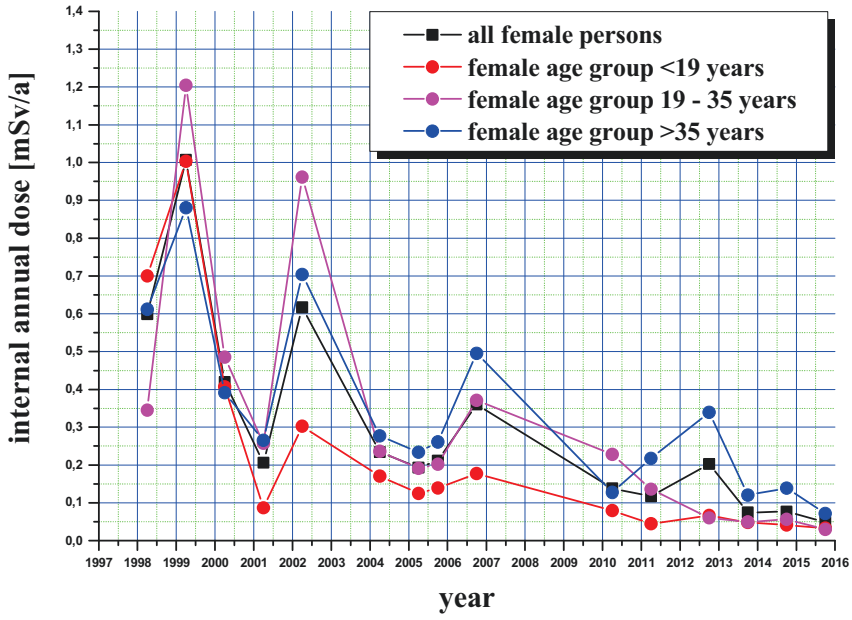


Figure 4-8: Development of the internal annual dose in the female population in the Volincy municipality, broken down into age groups and overall value

The extreme values are to be found almost exclusively among the male sex, particularly in the age group 19–35 years. The high value in the female age group < 19 years in 1999 and 2000 is due to only two adolescents.

The following general conclusions can therefore be drawn:

- Children and adolescents of both sexes have the same low dose burden and are not endangered. The mean value for the internal annual dose is < 0.1 mSv/a.
- For both the age groups 19–35 years and > 35 years, the individually communicated behavioural measures seem to be effective. Even taking the extreme cases into consideration, the mean annual dose does not exceed 0.2 mSv/a.
- The adults seem to adhere to the behavioural rules for their diets.
- Generally, the internal annual dose is higher among the male sex (≥ 19 years) than among the female sex by a factor of two.

4.4 Internal annual dose in the municipality of Starograd

As mentioned before, the municipality of Starograd is to be counted among the uncontaminated municipalities in the Korma district. Figure 4-9 shows the internal annual doses determined from the measured values. In the years 2004 and 2005, they amounted to < 0.1 mSv/a and are therefore comparable to the values occurring in Germany. A radiological comparison with the Volincy municipality can be dispensed with since the mean internal annual dose is lower by a factor of 13–33 than in the Volincy municipality, and the Starograd municipality can therefore be compared with municipalities in Germany. For individual values, the difference may be much greater.

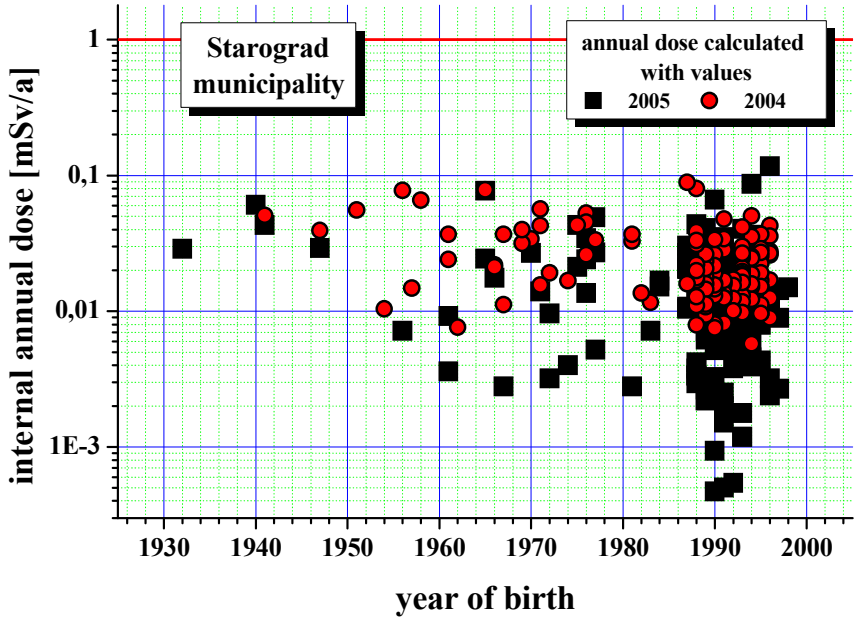


Figure 4-9: Determined annual doses in the municipality of Starograd

Due to the low values, no further measurement campaigns were conducted in Starograd.

4.5 Overall annual dose in the municipalities

The population's overall dose burden is calculated as the sum of the internal and external radiation burdens. The "effective" soil contamination, i.e. the averaged local dose rate, measured in the villages was used to determine the external radiation burden. Figure 4-10 shows the annual dose burden in the municipality of Volincy in the period 1999–2016.

The bottom curves show the development of the mean internal and mean external annual dose, while the top curve represents the sum of external and internal annual dose. In the municipality of Volincy, the external dose is the dominant share of radiation burden. In spring 1999, the measurements revealed that the internal radiation burden was almost equivalent to the external radiation burden. The subsequent years, however, saw a decrease of the mean annual value to around 20 % of the external dose.

The dose reduction during the subsequent years shows that the internal accumulation of the total population has been reduced. In order to achieve values below the limit of 1 mSv/a, further educational efforts and regular local measurements were required in addition to the natural reduction of the external dose caused by migration and decomposition of ^{137}Cs. In our view, a sustainable reduction of internal accumulation was achieved solely due to personal contact, measurements, and educational campaigns at regular intervals. In the year 2013, the mean annual internal dose fell below the value of 0.1 mSv/a. Since 2010, the mean external annual dose has been below 1 mSv/a and since 2012, the mean overall annual dose has also been below 1 mSv/a.

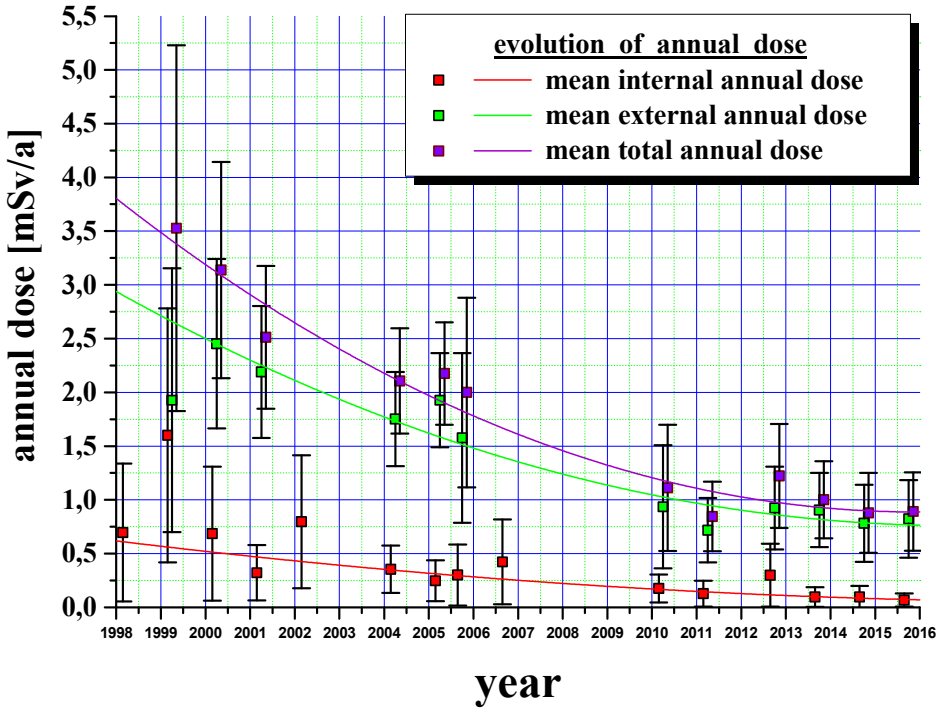


Figure 4-10: Development of the overall annual dose in the municipality of Volincy in the period 1999–2016

In the municipality of Starograd, the external dose burden is exclusively decisive for the radiation burden. Figure 4-9 shows that the internal radiation burden is below 0.1 mSv/a and that the values of the majority of test subjects in Starograd lies below 0.1 mSv/a. The mean value was determined to be 0.02 mSv/a ±0.01 mSv/a. The mean external radiation burden, including the natural component, reached a value of 1.0 ±0.4 mSv/a in 2005. Today, the overall annual dose has fallen below the limit of 1 mSv/a.

5 Medical Situation of the Population

The question arises whether there is any correlation between the population's radiation exposure and their state of health. In the past, a comparison had been conducted between the only slightly contaminated municipality of Vornovka and the relatively severely contaminated municipality of Volincy (Figure 1-2). A statement on the correlation between dose burden and state of health could only be made with reservations due to the general nature of the list of clinical treatments. Nevertheless, a comparison between the municipalities of Starograd and Volincy was conducted with the aid of the Korma district hospital – particularly since the Starograd municipality can be viewed as uncontaminated in comparison. However, it is also advisable to consider the state of health in the contaminated areas as well as the state of Belarus itself.

Due to the tightening of state data protection regulations, detailed patient data are no longer available from the local hospital for the past few years.

5.1 The situation in Belarus and the Gomel area

Numerous studies have been conducted in the past, with conclusions being drawn and published. One main difficulty in establishing an epidemiological result is the shortcomings in the observations of diseases and in dose reconstruction. Furthermore, after the break-up of the Soviet Union, an economic decline occurred which has also contributed to the health and psychological situation for the past three decades. A third issue to be noted is that the health register has been kept with more care since the accident. The number of unrecorded cases of various diseases before 1986 is estimated to be relatively high. In contrast, the cancer register has in recent years been supplemented for the time before 1986.

For Belarus, this is particularly clearly visible in the children's data. In April 2006, IPPNW (International Physicians for the Prevention of Nuclear War) and GSF (Gesellschaft für Strahlenforschung) published a metaanalysis [16] of Chernobyl's consequences on health 20 years after the accident which supports these theories. In the below Figure 5-1, values published in that work are shown for anomalies in the immune system, nerves and sensory organs, and psyche. Figure 5-2 shows the published values concerning anomalies of the digestive tract and of the muscle and skeleton system. In order to better show tendencies, the values were curve-fitted by us. A maximum is revealed between the years 1994 and 1996. As mentioned above, the strain of the political and economic break-up of the former Soviet Union occurred particularly from 1992 onwards. The upheavals were particularly pronounced in 1992 and the subsequent years.

From 1996 onwards, Belarus experienced economic consolidation. How strong this effect's influence was on the health of children in general cannot be determined. The temporal correlation with increases in immune system anomalies is, however, striking.

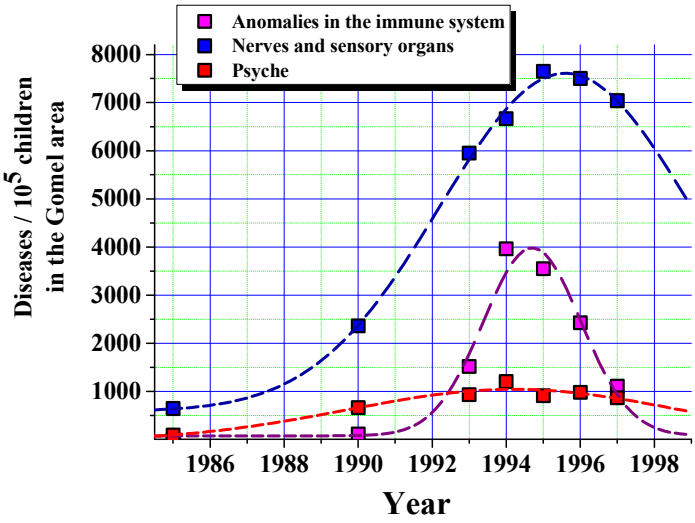


Figure 5-1: Diseases per 100,000 children in the Gomel area: anomalies of the immune system, nerves and sensory organs, and psyche

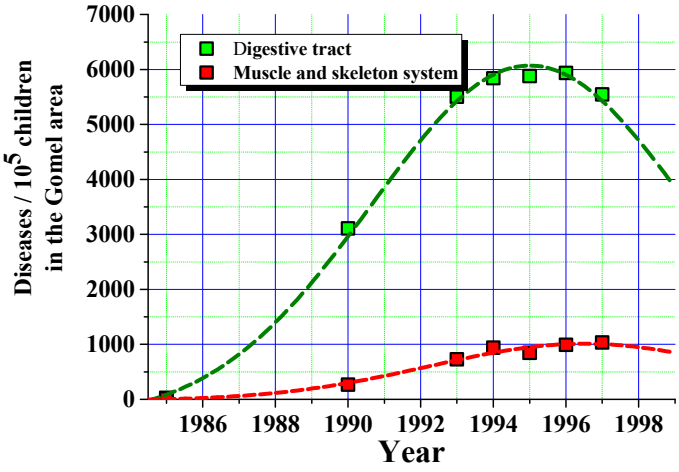


Figure 5-2: Diseases per 100,000 children in the Gomel area: anomalies of the digestive tract and the muscle and skeleton system

In the case of thyroid carcinomas, the incidence is not dependent on the current contamination. In a publication [18], E. Kapitonova shows a map of Gomel province, revealing the incidences of thyroid carcinoma loads per 10,000 inhabitants in the individual districts for the period 1990–2003 (see Figure 5-3).

Figure 5-3: Distribution of the mean thyroid carcinoma load in the Gomel province (blue = low, yellow = medium, brown = high, red = very high loads)

For example, districts with high contamination values, such as Chechersk and Korma, have relatively low loads, while the Rechitza district has a relatively high value. With a population of 25,000 in the Korma district, two cases would have occurred in the period of time mentioned above. Considering the overall development in Belarus provides a better overview. Figure 5-4 shows data given by various authors on the incidence of thyroid carcinomas in Belarus.

The figure shows data from different publications. It differentiates between several age groups. When the relevant data is curve-fitted, a decrease in carcinoma cases can be seen for children younger than 15 since 1996/1997. This point in time seems to be a misinterpretation, however, since the numbers refer only to a diagnosis during childhood and the date refers to the age at which the disease was diagnosed. When considering the data for children and adolescents, a decrease in the number of cases seems to occur in 2002/2003. However, the data are not consistent and differ greatly. In contrast, among adults, the peak seems to have been reached only now.

Studies of the leukaemia rates conducted by Becker [21] show that no increase was recorded among children compared to uncontaminated areas. This is explicable: the organ doses due to radioiodine were a multiple of ^{137}Cs doses. Due to the lower risk for adults, an increase is very unlikely for them. This also applies to the incidences of solid tumours [22, 23].

5.2 The situation in the municipality of Volincy

It would be useful to compare the health situation in the municipality of Volincy with the data of the municipality of Starograd analogously to the Belarusian data. However, due to the population's relatively high fluctuation with regard to their place of residence for economic reasons, it is difficult to make exact statements. Many of the younger inhabitants tend to

move to larger cities due to employment opportunities there or to the remoteness of the municipality.

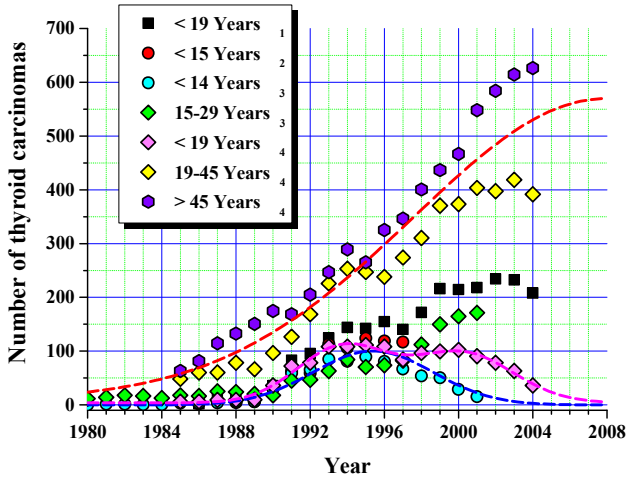


Figure 5-4: Development of thyroid carcinomas in various age groups in Belarus

The footnotes in the legend give the source of the data:
1 = [18] The Republican Research Centre For Radiation Medicine and Human Ecology
2 = [19] Ivanov, VK., Tsyb, AF., Maxyutov, MA., et al.
3 = [19] Belarusian cancer register
4 = [20] Lengfelder, E., Frenzel, Ch., et al.

Detailed data could not be published by the hospital due to state regulations on data protection. These data may only be published by state-run medical centres. Questions concerning individual areas were, however, answered in an adequate and comprehensive – albeit general – manner by the hospital. Thus, only these statements from the doctors can be reported here in a general manner. An analysis was not possible for this region with respect to the incidence of diseases caused by the effects of ^{137}Cs radiation on the human body due to the decrease in the radiation dose during the past few years in the Volincy region and due to the difficulties in obtaining the data on diseases.

Three areas were selected on which general information can be given on the population's treatments during the measurement period:

1. Accident and general disease

   such as burns, wounds, poisoning, skeletal and tissue diseases, and infections

2. Internal diseases

   such as diseases of the cardiovascular system, the respiratory tract, the digestive tract, and urological diseases

3. Diseases that can indirectly be connected to radiological contamination

   such as diseases of the metabolism, immune system, thyroid, and tumours in general

In a comparison between the municipalities, the treatment frequency and the type of disease showed no conspicuous abnormalities. Even comparisons in the individual groups did not

reveal any significant difference. This applies not only to children and adolescents but also to adults. In a comparison between the municipalities of Volincy and Vornovka on the percentage of treatments in the populations in 2000, the same trend was revealed. Broken down into the groups mentioned above, the values are correspondingly shown in Table 5-1.

Table 5-1: Number of medical treatments according to type of disease and age group in the municipalities of Volincy and Vornovka in 2000

Age group	**Volincy**	**Vornovka**
1 Accident and general diseases		
< 15 years	9	75
> 14 years	117	219
2 Internal diseases		
< 15 years	39	159
> 14 years	82	201
3. Diseases that can indirectly be connected to radiological contamination		
< 15 years	15	16
> 14 years	68	137
Number of people treated		
< 15 years	49	116
> 14 years	190	459

Note: Health care is conducted solely by the district hospital.

Since the reactor accident, the latency period for significant radiation damage or diseases (e.g. thyroid carcinomas) has amounted to 20 years. Additionally, the inhabitants of the municipality of Volincy have a relatively high incorporation and local dose rate. It appears remarkable that the effects of radiological contamination in the form of diseases in the population is not significantly higher here than in the population of the Starograd municipality. However, in a comparison with statistical data of diseases in Belarus and the Gomel province, the number of different diseases is not very statistically sensitive since due to the small sample size, these are individual cases. This applies both to the municipality of Volincy and to the municipality of Starograd. Reliable and statistically valid information can only be collected from substantially larger groups (samples).

6 Outlook

In order to evaluate the radiological situation of the population in the municipality of Volincy, external and internal contamination must be strictly distinguished.

The results available show that the population's external dose in the CIS (Commonwealth of Independent States) regions highly contaminated by the Chernobyl accident is not decreasing to the extent expected. Although the external contamination is decreasing due to physical decay and continued vertical migration into deeper soil layers, this decrease is delayed by retransfer into the upper layers. This phenomenon was identified as early as the mid-1990s, when scientists calculated the dose development taking into consideration radioactive decay as well as migration for two areas with different contamination levels [24, 25] (Figure 6-1). The calculations were based on the soil contamination from the year 1992. The figure also shows the mean values of the dose rates measured in various campaigns.

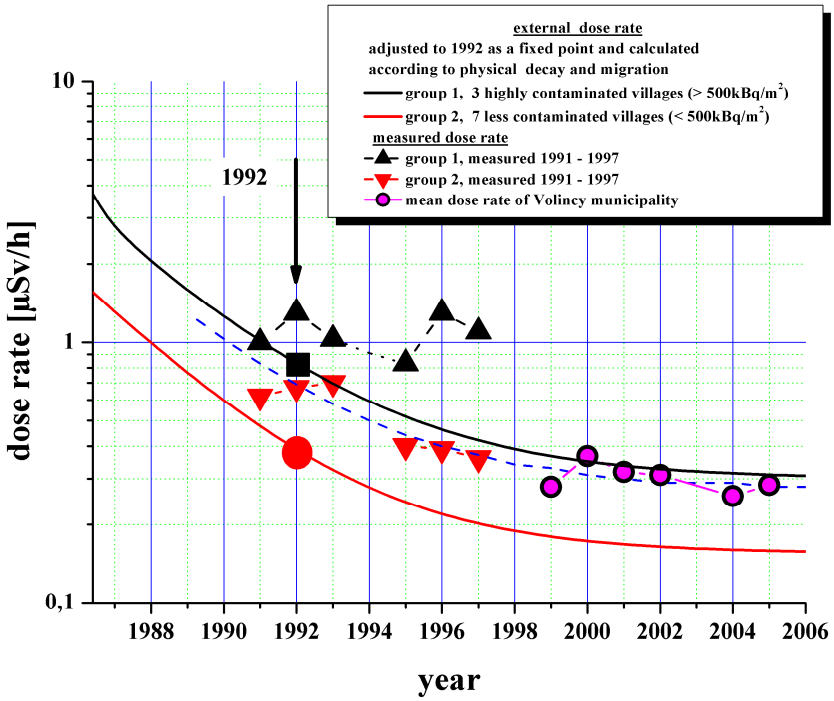


Figure 6-1: External dose rate of two areas with different contamination levels.

The measured values of the areas with low contamination levels are higher by a factor of 1.8 (dotted line) than predicted. The values measured in the municipality of Volincy correspond very well to the temporal progression of these values. The development of the dose rate, which runs in parallel to the areas' contamination levels, shows no great risks for the popula-

tion. However, certain behavioural rules are useful as an alternative. These concern mainly diet. A comparison between the progress of contamination levels in forests and in agriculturally used areas shows this clearly. Figure 6-2 shows the temporal development for the forest in the Strumen closed zone.

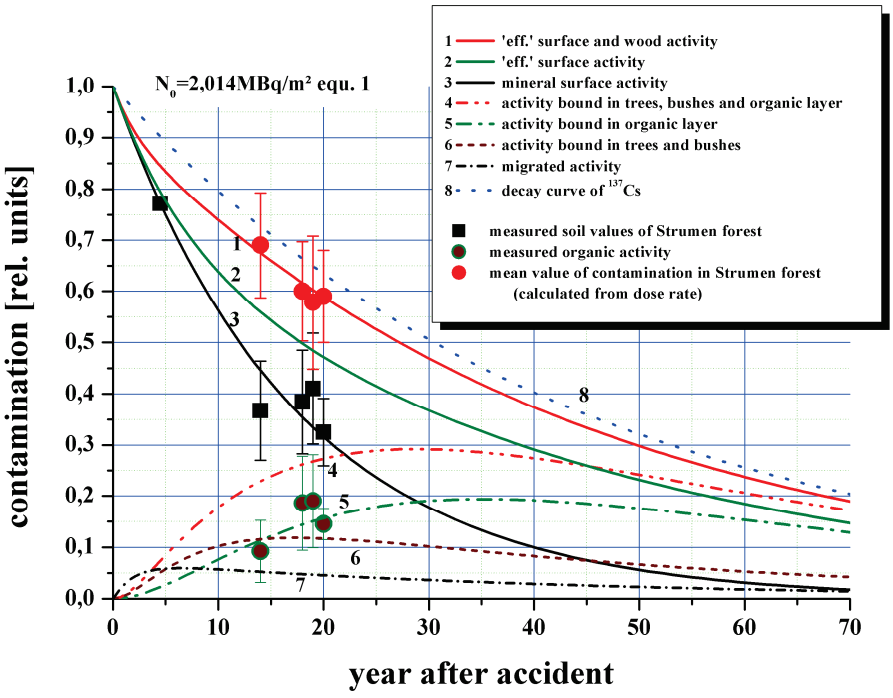


Figure 6-2: Development of the contamination levels in the forest of the Strumen closed zone

The figure demonstrates that the curve representing the overall contamination (curve 1) is almost identical to the decay curve of ^{137}Cs (curve 8). Retransfer from bushes and trees as well as grasses, mosses, and other plants becomes the dominant share (curve 4). The contamination of bushes and trees reaches its maximum at 12 % of initial activity after 15 years (curve 6), while grasses and plants reach theirs at 20 % after 35 years. The smallest share is migrated activity (curve 7). While it reaches 38 % of its initial activity after 17 years in the municipality of Volincy, its maximum is 5 % after 5 years in the forested area of Strumen.

Furthermore, the municipalities' and villages' structure must be taken into consideration when evaluating the external contamination in the population:

- Is the municipality purely agriculturally oriented? I.e., is it surrounded mainly by fields and meadows?
- Or is it an agricultural- as well as forestry-oriented municipality and therefore surrounded by forest?

For the municipality of Volincy, the latter is the case. The municipality of Starograd lends itself for comparison, since it belongs in the first category and had similar initial contamination

levels. A comparison can be made here between the two municipalities and the forested area of Strumen. Figure 6-3 shows the development of the "effective" soil contamination [13] of the municipalities as well as the forested area of Strumen. The progress of the annual dose rate caused by ^{137}Cs is analogous.

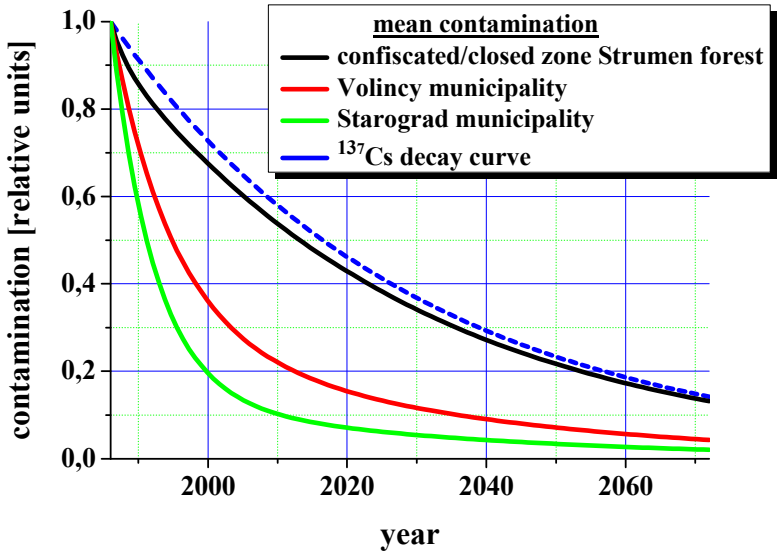


Figure 6-3: Development of the "effective" soil contamination of the municipalities of Volincy and Starograd as well as the forested area of Strumen

The share of ^{137}Cs contamination in the external annual dose is listed in Table 6-1.

Table 6-1: Share of ^{137}Cs contamination in the external annual dose (based on residence for one whole year)

Year	Strumen, forest	Volincy municipality	Starograd municipality
1986	12.6 mSv/a	3.41 mSv/a	1.66 mSv/a
2000	8.1 mSv/a	1.21 mSv/a	0.32 mSv/a
2005	7.3 mSv/a	1.08 mSv/a	0.22 mSv/a
2010	6.8 mSv/a	0.75 mSv/a	0.17 mSv/a
2030	4.2 mSv/a	0.39 mSv/a	0.09 mSv/a
2060	2.1 mSv/a	0.19 mSv/a	0.05 mSv/a

(red: calculated development of values)

On the basis of the curve and the values listed in the table, a decrease in "effective" contamination can be registered in the villages and on the fields, which in later years does not con-

tribute to any considerable external contamination of the population. Solely the forest values of a closed zone show that certain behavioural rules should be adhered to.

When comparing the internal with the external contamination in the municipality of Volincy through the years, it becomes apparent that between 1998 and 1999, the internal contamination is almost equivalent to the external contamination. The internal dose reduction shows that the total population have decreased their internal accumulation. In order to decrease contamination below the 1 mSv/a limit, however, further effort by steadily convincing the population to decrease their internal accumulation was necessary in addition to the natural reduction of the external dose. This was, in our opinion, only possible through personal contact and discussions at regular intervals.

The contamination of children and adolescents is not problematic. It was already below < 0.1 mSv/a, with a downward tendency, during the measurement campaigns, although the contamination of milk gave reason to expect higher values. It appears that the diet of this age group consists only of uncontaminated food products or that the share of milk in their diet is lower than expected. This means that the contamination levels of this age group's diet, which in addition to food provided by the school contains mostly home-produced food, is very low or zero. The age group > 35 years is also viewed as not problematic. Except for a few individuals, the internal contamination is below tolerable limits, with a downward tendency. Relatively viewed, the most critical group is that of the 19–35-year-olds. The development of the internal annual dose, according to sex, is represented once more in Figure 6-4 for further illustration.

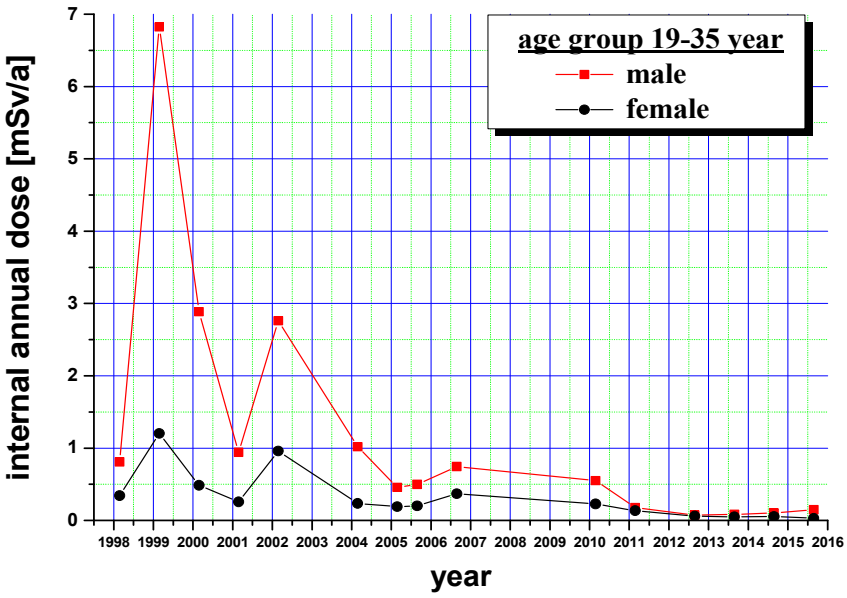


Figure 6-4: Development of the internal annual dose of the age group19–35 years

It can be seen directly that the internal dose of the male population represents the larger share in the group's and the population's contamination levels, although the female population's values are also above those of the > 35 years age group initially. It took some warning and coaxing to convince particularly the young men of the potential consequences of high incorporation levels. But in the end, the measures also appear to be successful in this age group: the measurements of the past few years show annual doses of less than 0.2 mSv/a for all age groups.

However, a certain indifference concerning their situation appeared; it is particularly apparent in the sudden increases in the period of 2001–2002, as well as in 2006 and 2012. Consistent and regular monitoring seems advisable.

The development of the mean internal annual dose can be derived from the personal data and the data on the contamination of home-grown foodstuffs, see Figure 6-5.

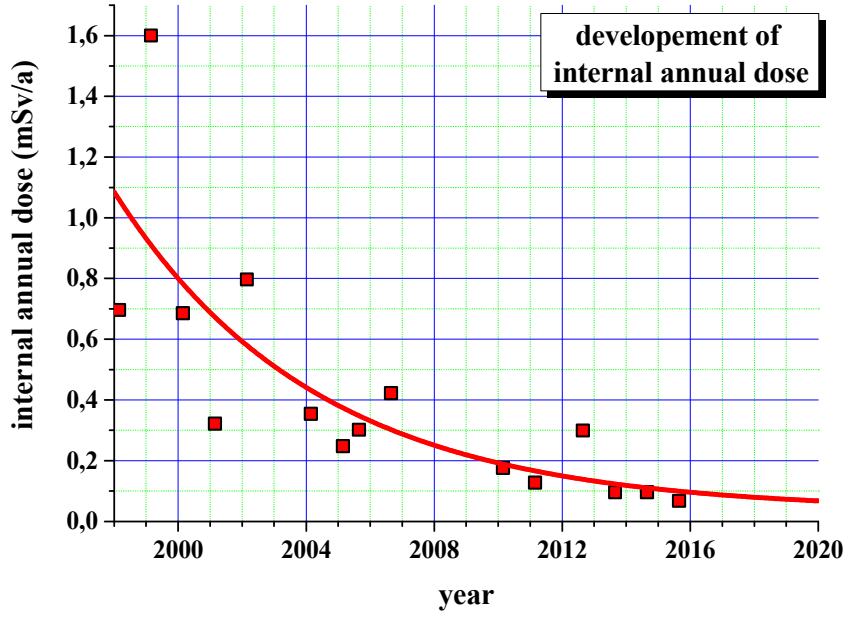


Figure 6-5: Development of the mean internal annual dose in the Volincy municipality

The internal dose fell below 0.1 mSV/a from 2015 onwards. However, due to the external dose, the overall dose will continue to be above "normal" values for some time. Figure 6-6 shows an estimate.

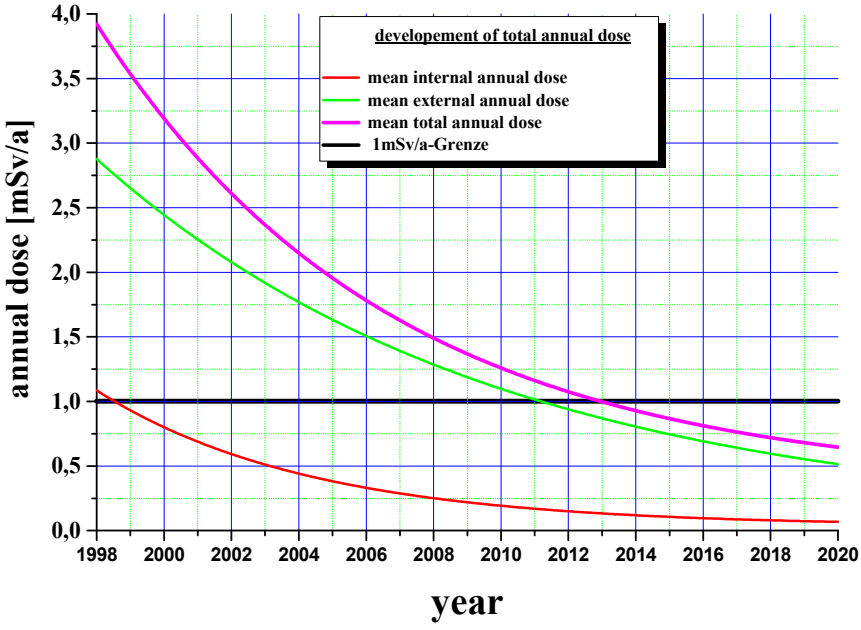


Figure 6-6: Estimate of the annual dose for the coming years

7 Summary

The radiological situation of the heavily contaminated area of the Volincy municipality in Belarus was observed over a period of 18 years (1998–2015), for which purpose both whole-body and environmental measurements were conducted at regular intervals. Initially, these displayed differences between the external and the internal dose burden that could not be explained.

Compared with the external dose, the internal dose was initially very high. The geographical location, the economic situation, the decreasing caution in dietary habits, and the passage of time since the accident itself were identified as possible causes. A major proportion of the population no longer accepted further constraints caused by the Chernobyl accident, and they returned to their previous habits.

The reason is the new generation: the group of people who were children and adolescents at the time of the Chernobyl accident, are now themselves mothers and fathers of school children. They are barely aware of the consequences of the accident since it seems endlessly long ago to young people's sense of time, while to older people it seems like yesterday. General behavioural rules are thus of no use: personal contact is required.

It was thus important to give the population behavioural rules to reduce the internal contamination in addition to whole-body measurements. For this purpose, mutual trust between the population and the measurement team had to be established. As the results of the measurements show, dose-reducing measures are successful if regular control and individual advice is provided, so that currently internal radiation exposure is low and can be viewed as irrelevant to the population's health.

In contrast to the internal radiation exposure, no substantial direct influence can be exerted on external exposure. The development of dose values varies between the individual villages, depending on the structure of the surroundings and their economic orientation. Generally speaking, life is possible in these areas today, even in former closed zones, if appropriate behavioural rules are observed.

Regrettably, it is not possible to make any conclusive statement on the connection between radiation exposure and the health situation of the population of the Volincy municipality. While in the years 1999 and 2000 a comparison was conducted between the less contaminated municipality of Vornovka and the heavily contaminated municipality of Volincy, a comparison was also drawn with the municipality of Starograd by the Korma district hospital. In both cases, there have so far been no significant indications of diseases caused by high radiation exposure.

Due to the tightening of state data protection regulations, detailed patient data from the past few years are no longer available from the local hospital.

Based on the results obtained, it can be summarized that so far there are some differences in internal annual dose between different age groups as well as between men and women. There are also small differences in the internal annual doses between the inhabitants of the different villages that were studied. However, these differences have now become negligible.

The internal annual doses are also heavily dependent on the foodstuffs consumed, particularly when these originate from contaminated forests.

The declining number of inhabitants in Volincy reduced the number of incorporation measurements, causing the measuring accuracy of the mean internal dose burden to also decline. This is partly compensated, however, by the small number of people with extremely high ^{137}Cs incorporation.

In conclusion, it can be said from the results that in the near future, there is no special danger for the population of the Volincy municipality if regular controls of their internal contamination are conducted and individual advice is given.

The work carried out and the results obtained during the past 18 years emphasize the importance and the uniqueness of our investigations. They could prove to be extremely useful for understanding and predicting radiation dangers caused by nuclear accidents. Furthermore, advice for people living in contaminated areas can be derived and given to the population.

8 References

[1] N. Beresford, S. Fesenko, A. Konoplev, L. Skuterud, J.T. Smith, G. Voigt. (2016): Thirty years after the Chernobyl accident: What lessons have we learnt? Journal of Environmental Radioactivity, Vol. 157, June 2016, P. 77–89

[2] V. Moiseenko, I. Khvostunov, J. Hattangadi-Gluth, L. Muren, D. Lloyd. (2016): Biological dosimetry to assess risks of health effects in victims of radiation accidents: Thirty years after Chernobyl. Radiotherapy and Oncology. In Press, Corrected Proof

[3] A. Moller, T. Mousseau. (2016): Are Organisms Adapting to Ionizing Radiation at Chernobyl? Trends in Ecology & Evolution. Vol. 31, Iss. 4, April 2016, P. 281–289

[4] H. Dederichs, J. Pillath, B. Heuel-Fadianek, P.Hill, R. Lennartz. (2009): Langzeitbeobachtung der Dosisbelastung der Bevölkerung in radioaktiv kontaminierten Gebieten Weißrusslands – Korma Studie. Schriften des Forschungszentrum Jülich, Reihe Energie and Umwelt, ISSN 1866-1793

[5] IAEA. (2006): Environmental Consequences of the Chernobyl Accident and Their Remediation: Twenty Years of Experience. Radiological Assessment Reports Series. Report of the Chernobyl Forum Expert Group “Environment”IAEA, Vienna (2006) http://www-pub.iaea.org/mtcd/publications/pdf/pub1239_web.pdf

[6] R. Hille, P. Hill, K. Heinemann, M. Heinzelmann.(1996): The Impact of the Chernobyl Accident – an Evaluation from the German Perspective. Berichte des Forschungszentrum Jülich, Jül-3186, February 1996; ISSN 0944-2952.

[7] I. Uray, R. Hille. (1993): Messprogramm der Bundesrepublik Deutschland. Externe Strahlenbelastung der Bevölkerung in den Bezirken Brjansk und Gomel der Republiken Russland und Weißrussland im Sommer 1992. Berichte des Forschungszentrum Jülich, Jül-2729, Februar 1993; ISSN 0336-0885.

[8] K. Heinemann, R. Hille. (1994): Messprogramm der Bundesrepublik Deutschland. Ergebnisse der Umweltmessungen in Russland, Weißrussland und der Ukraine in der Zeit vom 17. Mai bis 2. September 1993 und vom 8. Oktober bis 1. November 1993. Berichte des Forschungszentrum Jülich, Jül-2925, Juni1994; ISSN 0944-2952.

[9] H. Dederichs, E.Konoplya, P. Hill, R. Hille. (2002): Systematische Differenzierung kontaminierter und nicht kontaminierter Nutzflächen in der Region Korma. Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. BMU-2002-613; ISSN 0724-3316.

[10] P. Hill, H. Dederichs, R. Hille. (2001): Mobile in-Vivo-Monitoring – Ameans of Post-Accident Mass Screenings. IRPA Vth Regional Congress on Radiation Protection and Safety, Recife, Brazil, April 29 –May 04, 2001.

[11] H. Dederichs, P. Hill, J. Höbig. (1998): Ein Ganzkörpermeßfahrzeug für kontaminierte Gebiete.“Radioaktivität in Mensch und Umwelt”, 30. Jahrestagung des Fachverbandes für Strahlenschutz, Lindau, 28.9 – 2.10.1998 (M. Winter, K. Henrichs, H. Dörfel Hrsg.); TüV-Verlag Köln, Publikationsreihe ‚Fortschritte im Strahlenschutz’, FS-98-98-T, 1998, S.245 – 250. ISSN 1013-4056; ISBN 3-8249-0494-2.

[12] A.N. Kovtun, V.B. Firsanov, V.I. Fominykh, G.A. Isaakyan, (2000): Metrological parameters of the unified calibration whole-body phantom with gamma-emitting radionuclides, Rad. Prot. Dosim. 89, 239 242 (2000).

[13] H. Dederichs, J. Pillath, R. Lennartz, P. Hill, R. Hille. (2004): The time-dependent effect of the biological component of ^{137}Cs soil contamination. Kerntechnik, Vol. 69, No 1-2, February 2004, P. 58 -65.

[14] Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit: Richtlinie zur Emissions- und Immissionsüberwachung kerntechnischer Anlagen. GMBI No. 29, 502, 1993

[15] E. Konoplya, R. Hille, R. Neth. (2000) Forschungsprogramm “Kinder und Zukunft Kormas” (Meßprogramm) Bericht für das Jahr 2000. Исследовательский проект “Дети и будущее Кормы” (измерительная программа), Отчет за 2000 год.

[16] IPPNW, Deutsche Sektion der Internationalen Ärzte zur Verhütung des Atomkrieges, Ärzte in sozialer Verantwortung e.V.; GSF, Gesellschaft für Strahlenschutz e.V.; Metaanalyse; Stand: April 2006.

[17] The French-German Initiative for Chernobyl; GRS; IRSN; Programme 3 Study of the Health Effects; March 2006; GRS/IRSN-5 ISBN 3-931995-85-2.

[18] E. Kapitonova. (2006): Medical Consequences of the Chernobyl Catastrophe: Problems and Prospects.CPR/KSR Radiation Protection Seminar; Berlin, 03.02.2006 http://www.bag.admin.ch/ksr-cpr/04320/04359/04801/index.html.

[19] V.K. Ivanov, A.F. Tsyb, M.A Maxyutov,et al. (1999): United registry of Russia and Belorussia on thyroid cancer. Radiatio and risk; Special Issue 2; 1999.

[20] E. Lengfelder, C. Frenzel, et al.(2002): 16 Jahre nach Tschernobyl. Weiterhin dramatisches Ansteigen der Schilddrüsenkarzinome in Belarus. Der Heilungserfolg ist bei zahllosen Patienten weiter von intensiver westlicher Hilfe abhängig. Otto Hug Strahleninstitut HMH, Sept. 2002.

[21] S. Becker. (2003): Entwicklung der Leukämieraten bei Kindern in den durch Tschernobyl radioaktiv belasteten Gebieten der ehemaligen Sowjetunion; BMU-2003-615.

[22] D. Preston, S. Kusumi, et al. (1994): Cancer incidence in atomic bomb survivors. Part III. Leukemia, lymphoma and multiple myeloma, 1950-1987. Radiat Res 137 (Suppl): S68-S97.

[23] D. Thompson, K. Mabuchi, et al. (1994): Cancer incidence in atomic bomb survivors. Part II: Solid Tumors, 1958-1987. Radiat Res 137 (Suppl): S17-S67.

[24] R. Hille, P. Hiil, V. Ramzaev, A. Barkovski, V. Konoplia, R. Neth. (2000) Current development of the human and environmental contamination in the Briansk-Gomel spot after the Chernobyl accident; Radiat. Environ. Biophys. (2000) 99 – 109.

[25] R. Hille, P. Hill, H. Dederichs. (2006) Langzeitmessungen im Brjansk-Gomelgebiet, FS/GAST ‘20 Jahre Tschernobyl’, Deutsche Physikalische Gesellschaft, Heidelberg: 15./16.03.2006

9 Acknowledgements

This work was only made possible thanks to funding provided by the

Walter Gastreich Foundation,

which is part of the organization Stifterverband für die Deutsche Wissenschaft e.V.

We would like to once again express our gratitude for this support.

We would also like to thank the Korma district hospital, in the Gomel province of Belarus, represented by the heads of the hospital,

Dr. Valerie Majewski and Tamara Bisiukova,

for providing us with accommodation during our stay as well as for their help with the authorities.

In order to achieve the desired results, the extraordinary performance of each participating colleague was crucial during the data collection in Belarus. These colleagues were:

Jürgen Höbig,

Wolfgang Marquardt,

Frank Bast,

Edith Preuß-Offermann,

Markus Gorgels,

Hans Mertens, and

Heinz Preiß.

10 Appendixes

Appendix 1: Tables: Internal radiation burden, annual dose

Appendix 2: Photographic documentation

1. Tables: Internal radiation burden, annual dose

Explanatory notes:
F/M: Sex (ж = female, м = male)
A/S = autumn/spring
Волынцы = Volincy
Кляпино = Kljapin
Кляпинская Буда = Kljapinskaja-Buda

1.1. Body activity in the municipality of Volincy

Table 1-1 Body activity in the municipality of Volincy

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
Волынцы (Volincy)																
м	2013															0.6
м	13.09.2012														0	0.1
м	04.10.2012													0.1		
ж	29.11.2011														0	0.1
ж	2010													0.3		
ж	14.08.2010											0	0.3			
м	03.07.2010											0.2	0.1		0.1	
ж	28.04.2010											0.1				
ж	07.05.2009											0.5		0.6		
ж	15.01.2009											0.1		0.6		0.2
ж	05.06.2008											0.1	0	0.2		0
ж	06.04.2008											0.7		0.9	0.6	0.5
м	30.10.2007										0.12					
м	04.05.2007										0.01					
м	07.04.2007										0.2	0	0.1	0	0	0
ж	08.03.2007											0.9	0.4		0.1	0.9
м	16.02.2007											0		0.3	0.2	0
ж	14.06.2006									0.6	0.8	0.5	1.5	0	0.2	0.2
м	02.06.2006									0.3		0				
ж	29.03.2006											0.2	0.3	0.1	0	0.2
ж	23.11.2005											0.3	0.2	1.1	0	0
м	21.09.2005									1.2		0.3				
м	03.09.2005									0.5	0.01	0.1	0.2	0	0.1	0
ж	05.08.2005									0.7	0.1		0.9	1.1	0.2	0.9
ж	03.06.2005									1.1		0.2	0.3	0.2	0.3	0
ж	14.05.2005								0.2			0.3	0.5	0	0.3	0
м	12.05.2005								0.0			0.4		0.3	0.6	0.2
ж	01.02.2004										0.2	0.1	0.04	0.2	0.4	0
ж	01.01.2004						0.6									
м	21.11.2003						0.9			1.6	0.3		0.5	1.2	0	0.2
м	13.08.2003										0					
м	17.07.2003							3.6	3.0	0.7	7.2	3.2	15.3	2.2	1	
ж	03.06.2003						0.3	0.5	0.2	0.6	0.1	0.1	0.8	0.2	0.4	
м	12.01.2003						0.3	1.1	1.2		0.5					
ж	01.01.2003						0.9									
ж	01.01.2003						0.5		1.8							
м	01.01.2003						0.4									
м	14.07.2002							0.5		0.6	0.1	0.7	12.7		0.1	1.2

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	29.03.2002					0.6	8.2	1.4	1.4	2.5	1.9	1.2		1.7	0.5	0.6
м	10.02.2002					0.5	0.6	0.8	0.9	1.0	0.3	0.9		0.9	1.2	1.1
м	19.10.2001						0.7	0.1	0.1	0.3		0.2		0	0	0
ж	21.04.2001					0.8	0.9	1.6	1.3	3.2	2.3	1.4		0.8	1.4	0.7
м	29.01.2001					1.7	1.0	0.5		0.7	0.1	0.2	0.1	0	0.2	0.5
м	23.12.2000											0.3			3.1	14.4
ж	03.12.2000							1.1		1.6	0.3	0.7	1.7	0.3	1.2	0.5
м	20.08.2000										0.7	0.5	0.4	0.9		0
ж	03.07.2000				0.3	7.5		1.5	1.5	0.1	3.7	1.9	8.2	1.2	1.5	1.6
м	21.05.2000			0.5	0.4	1.7	1.4	0.7	4.1						1.2	
ж	25.12.1999					0.6	0.7	0.3	0.5	1.1	0.1	0.3	0.8	1.2	0.7	0.6
м	13.11.1999					5.3										
ж	19.10.1999					0.1										
ж	21.07.1999					0.0										
ж	03.09.1999											0.06	0.7		1.6	0.5
м	06.08.1999				0.4	0.5	1.0	0.4	1.2			0.3	1.2	3.2	1.5	0
ж	23.04.1999											0.5			2	0.4
ж	26.03.1999				0.4		0.4		0.5	1.4		1.1	1.8	1.2	0.1	1.2
м	16.10.1998										2.1		0.6	1.6	2.9	
м	10.08.1998		2.1	1.4	0.4	1.6	3.9	1.4	0.9	0.4	0.8		0.6	2.5		2.3
м	08.05.1998			7.1	5.4	12.9	16.3	4.3	3.3	4.2	8.1	5.9	3.8	4.5		
м	01.08.1998			0.5	0.7		1.4	0.5	2.3	1.7	0.4	1		3.5	1.2	
ж	25.12.1997						0.8	0.2	0.1	0.4				0	0.2	
ж	15.12.1997	5.7	1.1	1.7	0.4	1.4	1.6	0.7	3.6		0.5	0.6	0.6	0.6	0.5	
м	11.11.1997		0.5			0.1										
ж	19.06.1997			0.4	0.7									0		
м	09.04.1997		2.3			1.9						1.9	3.3			
ж	01.01.1997						8.9									
ж	01.01.1997						0.5	0.1								
м	04.07.1996	1.6														
ж	02.06.1996	15.3	13.2	2.0	0.1	0.5	1.7	3.4	1.6	9.6		2.7	0.8			
м	01.06.1996			0.4	0.4	0.6	0.7	0.4	1.8	0.8	0.4	1.4	3.2	4.7		
м	23.04.1996					3.3										
ж	08.02.1996	1.8														
ж	06.10.1995	4.7	2.1	2.3	0.6	3.8	1.3	1.3	2.6	2.1		0.3	0.4			0.8
м	30.08.1995	5.0	0.9	1.2	0.7	3.4	2.2	1.1	1.4		0.7	1.9	36.2			
ж	01.01.1995				0.5	4.8	0.5	0.8	0.7							
м	27.12.1994			1.6	2.7		1.0					0.2				
м	13.11.1994			0.5	0.4	1.0	1.8	0.4	3.1	3.4						
м	11.11.1994		19.9	12.9	1.8	20.3			0.5		3.4	4				
м	04.11.1994					0.4										
м	20.09.1994					1.0										
ж	10.04.1994													0		
ж	01.02.1994		2.9	1.4	0.3	1.6	2.2	2.0	2.3	1.6	1.2					
м	24.01.1994			2.0	1.7											
ж	01.01.1994						1.6	1.2	2.7		0					
м	24.08.1993		1.1													
м	15.03.1993										5				4.7	9.7
м	28.12.1992	5.4	3.2		0.5	4.8	1.4	1.7	2.6	2.3	2			0.3		
ж	17.11.1992	6.0														
м	24.08.1992		1.0	3.6	0.6	2.3	2.6	1.7								
ж	30.05.1992	3.3	1.0	3.1	0.3	0.6	0.9	0.8	1.8	2.4						
м	23.02.1992		8.4	0.5	0.3	0.9	1.0	3.1	4.1	8.6				0.8		
ж	16.09.1991		0.7	1.7	0.5	1.5	4.3	6.4	6.0	5.0		1.5				
м	25.07.1990											3.2				
ж	10.11.1990		1.1	1.3	1.3				1.7	1.8	11.9			2.5	3.1	

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	22.10.1990	7.1	4.3	2.8	0.7	7.1	1.8	2.6	4.0	3.2						
ж	07.04.1990			41.9	1.2	4.3	9.1	9.9	4.8	2.9						
м	07.09.1989		1.1	1.9	2.8	4.9	5.2	7.4	12.9							
м	05.09.1989		3.2	1.8	0.3	1.9	3.0	6.0	3.8							
ж	14.05.1989	3.7	0.5	0.8	0.3	6.7	1.8	1.0	2.0			0.6				
ж	27.11.1988		2.6													
м	23.11.1988								8.8	18.9	2.9					
ж	16.08.1988	7.9	1.1	4.7	0.6	2.9		0.7								
м	07.08.1988	4.1	2.2	1.8	1.0	2.6	3.3	2.1								
ж	31.07.1988	6.4	1.4	14.9	1.1	6.1		4.7	2.9	4.9						
ж	28.05.1988	9.1	37.2	11.1	9.9	68.3		10.5	4.8							
ж	09.05.1988	7.5	26.7	4.0	4.0	3.6	7.0	4.4	5.3	8.3		0.5	1.3			0.8
м	19.04.1988					0.3										
ж	20.02.1988		2.1	2.0	1.3	7.6	4.0	0.9	3.7							
м	28.03.1987				3.5	4.0	5.7	8.9		8.7	5.9					
м	26.01.1987	10.3	2.1	1.9	1.2	9.9	29.2	33.0		14.5						
ж	07.01.1987	9.7	1.4	4.8	0.9	3.0	2.8									
ж	17.03.1986	3.8	1.5	1.6	1.5	7.6	7.7	0.9			0.5					
ж	13.11.1985										0.15					
м	17.07.1985	7.9	3.0	3.0	4.5	19.9		17.7		22.8						2.3
ж	07.06.1985	5.4	3.4													
ж	04.04.1985	3.8	3.9	2.9	4.6	2.7	1.3	2.7								
ж	24.01.1985		2.0	4.4	7.8	20.4	3.8	5.2	5.2	7.5	2.8					
м	28.07.1984		1.1													
ж	11.05.1984		2.1	3.6	0.9											
ж	01.01.1984			11.8												
м	14.12.1982	14.1		7.7	6.2	26.5										
ж	09.12.1982			1.8				10.3		7.1	1.9	3.8				
ж	20.07.1982	39.3	453.5													
ж	05.02.1982					4.6	4.3			7.6					0.4	
ж	05.02.1982		1.7													
ж	01.01.1982			17.2	3.1											
ж	30.11.1981		3.7	4.0	9.0	3.2										
ж	13.11.1981	13.3	17.6	8.9				10.9	6.3	13.9						
м	27.08.1981					4.9	5.0	9.3		30.3						
м	19.08.1981	5.6	2.3		6.0	7.5	14.6	7.6	10.7	7.8			2.6	5.5		4.4
ж	16.08.1981									10.2	8.8	11.6				
ж	13.07.1981		99.5	10.1												
м	07.05.1981	7.8	3.2		3.8	5.8	2.9				0.7					
ж	26.04.1981		47.8	31.3	13.9	66.5	10.0									
м	19.02.1981					0.2										
ж	27.01.1981										7.6					
ж	16.05.1980		4.3	2.2												
м	01.01.1979												1.7			
ж	12.11.1979		6.3	1.6	4.7											
ж	27.06.1979					166.8										
м	26.01.1979		3.8	5.9	8.8	6.9	7.5	7.9	7.9	7.4	1.8	3.5	1.4	1.8	0.8	0.3
ж	24.08.1978	3.2														
ж	14.07.1978													1.3		
м	20.05.1978		66.6	98.2	49.7	235.1	32.5	34.2	12.2							
м	11.02.1978				7.2					9.5				2.2		1.7
ж	26.01.1978									6.4		0.2	0.2	0	0.5	0
ж	01.01.1978						5.3	5.1	3.7							
м	15.11.1977			10.8	1.1											
м	14.08.1977		483.1	295.0	113.1											
ж	11.08.1976		21.7			9.9										

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	30.05.1976			1.6	1.6	3.1	6.1									
м	20.05.1976	21.2	110.3	34.6	19.6	42.5	10.9	15.6	11.9	18.1	8	10.6				
м	09.03.1976						10.7	16.4	10.5		2.4				2.7	1.5
ж	05.01.1976	1.5														
ж	01.01.1976				2.3		1.2									
ж	01.01.1976		197.5			62.5	6.2	3.1	0.9							
м	01.01.1976			18.8												
ж	20.12.1975		2.3			0.0										
ж	18.10.1975			4.9	8.0											
м	27.09.1975			7.1				9.6	4.4	6.5				3.2		
ж	17.07.1975					4.6										
м	19.06.1975	37.0	436.7													
м	21.02.1975								14.3							
м	09.02.1975		17.3		22.5			2.8	14.1		32					
м	24.01.1975	46.1	660.3	386.3	153.6	642.8										
м	16.01.1975					5.5										
м	02.01.1975	7.5	173.0	122.5		375.2	28.9		22.5		68.3		22.6			
м	15.11.1974			10.8												
м	04.08.1974							5.1	13.6	9.6		2.5		5.3	11.5	4
м	26.06.1974	18.1	12.0	9.5	6.2		19.1			32.8		27.3	9.3	11.4	3.3	2.8
м	21.03.1974	52.8	89.1	316.4		215.3	70.8	26.3	29.3	36.5			192	20	7.9	3.7
ж	07.03.1974	8.5	29.6	10.6	2.5	20.7	3.6	2.8	5.0							1.7
ж	01.01.1974		118.8	49.1	47.2	64.9	41.4		12.1							
ж	26.06.1973					45.3										
м	22.06.1973			59.0	39.1											
м	19.01.1973		107.6													
ж	31.07.1972					6.0										
м	29.06.1972						41.6	43.4	15.8	8.6		5.1	3.6		16.4	6.4
м	15.06.1972						88.0									
м	21.02.1972	6.7														
м	01.01.1972	18.8		37.2	12.9	13.3										
м	01.01.1971			114.0	97.0		102.7									
ж	30.07.1970		12.2	6.5		3.7	3.5		1.3		1.3					1.4
м	07.07.1970													0.8	1.6	
ж	03.07.1970	11.3	3.4	3.0	2.2	8.0	4.7	2.8	9.6			3.9		2.5	1.6	0.8
м	22.02.1970															0.6
м	18.01.1970	6.6	339.9	230.1												
ж	01.01.1970				1.2											
ж	10.04.1969					0.0										
м	20.12.1968		6.7	5.3	5.2	8.8	13.4		11.3	12.2						
м	11.12.1968		11.8	7.4	5.7	11.2	18.9	23.2	13.2							
ж	16.07.1968				14.0	7.0		2.3				0.6		1.6	2.4	0
м	14.06.1968		51.0													
ж	08.06.1968	19.6	52.9	66.9		130.7	6.5		8.0	9.1			109			
м	16.07.1966												3.8			2.9
м	03.06.1966	10.7	6.8	4.1	2.1	19.3	21.4	5.8	5.8		1.9	3.2			4.4	2.6
ж	15.03.1966	6.5	2.5	2.6	1.0	6.3	9.5	1.9	1.3	3.5	0		29.4	1.98		0.8
ж	24.10.1965			2.7	1.7	7.8		17.0		10.8					5.9	1.3
м	10.05.1965		59.0			16.5										
м	01.01.1965			1.2												
м	22.10.1964			82.9	17.7	12.9	18.1		11.1	16.6						5.4
м	23.07.1964			45.0		273.5										
ж	31.05.1964	11.9		53.5	11.2	14.4	28.5	34.3	12.3	9.5		4	3.5	13	13.9	3.3
м	23.05.1964	7.7														
м	19.03.1964		580.5		28.0		12.0		41.1	36.3	15.2	28.6			2.3	3.2
ж	01.01.1964				7.4											

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	21.10.1963		3.8				5.3									
м	21.08.1963	26.2	4.3	7.2												
м	14.04.1963					2.3										
м	10.03.1963		30.2	7.5	3.1	8.3										
ж	01.12.1962				8.8	20.3	10.7	11.0	6.7	38.1			7.2		7.7	
м	12.08.1962			23.1	27.6	22.5	20.9			7.7						
ж	08.06.1962	8.1					7.1	2.3	2.2		1.3		0.5			2.5
м	29.05.1962			1.0												
м	01.01.1962							30.0						6.9		2.3
ж	10.04.1961		6.5	5.7	12.9		6.0									
ж	10.04.1961				12.1	71.2		10.1	9.4				7.1			
м	24.04.1960														0.1	
ж	27.12.1960	17.3	65.1	6.4	1.9	2.9		12.1	11.5	16.8		7.1	0.3	1	1.3	0.6
ж	29.11.1960			7.5		8.2	5.5	5.2								
ж	23.05.1959		2.6				7.8									
м	02.01.1959		15.5	23.3	9.0					16.5						
м	06.04.1958		5.2	6.3	14.2	78.7	15.6	7.5	9.8							
ж	10.05.1958				7.4	6.2		5.5	3.0	4.0	5.4					
м	22.03.1958					21.9	6.1	6.8	8.8	7.8						
м	21.02.1958	11.3														
м	01.01.1958				3.4											
м	13.04.1957		6.3	6.4	7.3	5.8	8.3	2.7	3.4	5.7						
м	15.01.1956		37.4	5.2		4.1										
м	12.11.1956						8.3					1.7		2.5		0.5
ж	03.01.1956															1.7
ж	12.12.1955			10.7	14.1	27.4	11.1		10.5			9.3			15.3	
м	23.10.1955			2.3	19.6	45.0	26.9	25.7	12.8	59.7			8.8		14	
м	01.01.1955				18.2											
м	1955													1.9		
м	27.10.1954			7.3	5.3	19.1	16.2	5.2	8.2	10.2		5.4		3.2		1.3
м	25.08.1954			6.8					33.9							
ж	25.06.1954			9.8	4.8	16.5	15.7	7.1	15.6	16.6		8.8	5.3	8.1	2	12.8
м	14.04.1954	28.4														
м	01.01.1954						2.2									
м	07.12.1953									15.8		9.9	13.1	5.1	7.9	2.8
ж	29.11.1953			18.0	13.6	10.2		17.9		31.7						
ж	05.04.1953	3.9	14.9	2.8		4.7	2.8	1.6	2.8	3.6	0.2					
м	01.03.1953		17.2			42.4	55.9		10.2							
м	25.08.1952	5.9														
ж	13.04.1952		5.4			7.5										
ж	23.03.1952							5.2		7.6						0.1
м	27.02.1952		203.2	43.0	25.7	14.6	10.4		13.1		3.9					1.7
м	15.01.1951	107.0	24.8	10.8	27.3	22.1										
ж	10.01.1951		95.1	40.7	18.9	88.5	13.6	12.1	4.3			5.4	2.7	1.2		0
м	05.03.1950				13.8	13.3	7.0	23.3		6.4	7.4					
м	10.12.1950					16.3										
м	26.01.1949														9.2	
м	07.01.1949	18.6	10.5	11.4	7.5	23.6										
м	01.01.1948						19.4	9.8								
м	01.01.1948			3.6	8.4											
ж	09.11.1947					29.6		6.8	7.9	14.8	3.3					
м	10.09.1947	26.7	6.5			26.1	9.0	22.6			12.8	8.6	6.2		11.8	
ж	22.08.1946	9.0		8.8		8.9	9.7	7.7	11.3							
ж	20.07.1946						14.6	16.4	25.5	60.3		31.2	8.2	12.5		3.6
м	21.11.1944					35.2	9.5									
ж	24.04.1944					6.8										

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	07.04.1944			11.3	19.6	25.2		8.2	9.1	10.1						
ж	14.01.1944					145.6		1.0	0.4	3.2		1		1	0	0.2
м	03.01.1944					5.9	8.2	13.8	7.8			1.4				
м	26.06.1943														2.3	0
ж	25.03.1943	28.1		3.5	3.8	5.3		4.6								
ж	01.01.1943				4.0											
ж	17.06.1942	9.1		3.6	4.1	7.2		3.4	3.6	4.3			0.7			0
м	02.06.1942		4.0		1.8											
м	13.03.1942					7.2										
м	28.12.1941														0.8	
ж	05.07.1941		187.1	16.2	23.7	19.6	12.4	7.4	7.4	35.3	3.8	4.9	8.7			2.9
м	03.06.1941	19.8														
ж	08.05.1941			18.6		21.0	29.3	9.9								
м	28.08.1940	15.6														
ж	24.08.1940		11.0	13.2	20.1	18.1										
ж	02.08.1940											1.8		0	0.3	
ж	20.03.1940	12.0				0.8		1.8								
ж	23.01.1940			2.4	3.1	4.0	0.8	1.9								
м	01.01.1940			7.1					34.8							
м	28.10.1939					19.1	9.3			43.1						
м	19.03.1939		4.0													
м	05.03.1939			12.3	8.4	10.9	5.7	10.5	9.8							
м	23.02.1939		6.0	3.8				5.1	11.9							
м	12.10.1938					14.8	11.6		6.9							
м	15.07.1938	16.3		16.0	11.6	15.2	78.7	12.0	8.7							
ж	05.04.1938	25.1	31.6													
ж	16.02.1938			17.6	4.4	17.4	4.8	6.0	7.8	10.9						
м	15.02.1938		290.1	80.2	14.6	307.4	17.3	2.1								
ж	21.01.1938					4.6	5.6		7.4				0.8			
ж	02.01.1938			20.5	21.6	110.7	7.4		4.4							
ж	25.10.1937	8.7	5.3	3.4	4.5	7.9	7.5									
м	01.08.1937					9.7			24.9							
м	15.07.1937					13.3	19.1	8.3	15.9	6.1	4.2					
ж	25.06.1937							4.7	7.6							
ж	15.06.1937			4.5		16.4	5.0	4.7								
ж	30.05.1937				5.8	9.6	3.1	8.1				1.6	1.2			
м	15.05.1937	28.1	5.9	4.6	5.3	6.9	1.7	3.6								
ж	22.03.1937					2.9										
ж	01.03.1937			1.3	1.1	3.6	2.0		1.2							
ж	02.01.1937				1.4	6.9		5.9								
м	26.10.1936								11.0							
м	14.08.1936		10.5		5.6	28.3	19.8	18.5	24.9	55.0						
м	01.07.1936								0.2			1.4	24.7	2.1		0.5
м	04.04.1936		8.9													
ж	01.01.1936				0.3	1.6								1.6		
м	01.01.1936					5.6										
м	01.11.1935				1.4	5.1										
ж	22.03.1935			1.0	0.5	2.0	1.2		2.3		0.6					
ж	19.03.1935	11.4	15.7	2.7	5.2	4.7	6.0	4.4	10.0	7.7	2.7		1.9		1.4	
ж	01.01.1935				4.6											
м	11.09.1934		5.8		5.2											
ж	03.05.1934	13.8	5.3			5.1		5.8	6.7	11.8	1.6	2.1				
ж	06.02.1934					4.9	2.8	4.7	6.0	7.2			6.5	1.5	1.1	
ж	22.11.1933				6.8	22.1			10.8	12.1		9.9	3.2	2		
ж	10.11.1933			15.0	16.5	46.0			11.7		2.5					
м	28.02.1932	9.9	4.3	1.5	1.5	4.2	2.9		0.6							

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	20.02.1932			4.1		16.3	6.3			6.6						
м	01.01.1932			8.3												
м	03.12.1931		9.8	5.0	7.7	11.9	10.7	4.4	3.5	5.2		1	2.8	1.6	0.9	0
ж	12.10.1931					2.1	2.3		3.1							
м	07.01.1931				3.7	8.1										
м	30.12.1930		10.5	23.0	4.9	11.4										
м	19.11.1930			2.7		5.1		1.7								
ж	18.08.1930	24.9		53.7	19.5	14.1	12.0	11.9	10.7	16.7						
м	15.07.1930	13.4	5.4		6.9	11.1	11.8		7.7							
ж	06.04.1930					3.3		4.5	4.5	6.2						
ж	15.03.1930	9.6				3.9			5.3							
ж	30.01.1930	45.2			12.7	23.6										
м	04.05.1929	21.8		10.4												
м	14.03.1929				3.4	1.7										
ж	01.01.1929					3.8										
ж	14.10.1928	9.7														
м	01.01.1928	11.5		3.5												
м	15.06.1927		10.1													
ж	01.06.1927					5.9	8.4	5.5	6.4							
м	05.01.1927	11.8	23.3	3.1		3.8	5.3	4.2	8.2							
м	01.01.1927			4.7												
ж	01.01.1927					5.2										
ж	01.01.1926			7.7												
м	01.01.1926			61.2	7.4	38.5										
ж	29.04.1925					5.3	2.3									
ж	01.03.1925				1.9	2.0										
ж	10.01.1925			5.7		6.5		2.6	2.5							
ж	01.01.1925					5.3		4.1								
ж	19.11.1924			3.7												
ж	16.08.1924	8.8		7.4		5.0										
ж	24.02.1924			23.3	5.4	28.1										
м	01.01.1924	9.0		9.4		7.2		3.7	6.5	8.5						
м	01.01.1924			2.2												
ж	01.01.1924				3.1	2.0										
ж	14.01.1923					0.5										
м	15.04.1921					0.7										
ж	22.03.1921					1.9										
ж	04.11.1920		13.6													
ж	01.01.1920			3.4	2.0	12.2										
ж	01.12.1911					225.9										
Кляпино (Kljapin)																
ж	18.11.2007											0		0.1	0	0.5
ж	17.11.2007											0		0	0.8	0.5
ж	08.03.2007													0.1		
м	17.02.2006												0.4			
м	26.08.2006											0.05	0.4	0.4	0.5	
м	22.11.2004									0.1		0.2	0.2		0	0
м	06.05.2003							0.1	0.9				0.1	2.7	0.3	
м	01.09.2001									0.3	0.1	0.4	0.4	0.4	0	0
м	29.06.2001					0.5	1.0									
м	10.04.2001								0.2		1.5	2	1.7			
м	12.11.2000													0	0.1	0.6
ж	12.10.2000				0.4	0.4	0.3	0.5	0.9	0.8			0.3	4.8	2.2	2
м	03.07.2000													0.8	1.6	
м	24.03.2000					0.4	0.3	0.1	0.7	1.2	1.1	0.3	1.9	2.7	2.7	1.9
м	09.03.1999			1.2		1.7	0.4	1.4	1.8	1.9	1.6		0.7		1.2	0.5

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	26.01.1999		0.0	0.1	0.5	0.4	0.4		0.0	0.2	0.4	0.8	0.4	0.6	0	0.7
ж	24.06.1998					0.4	0.4	0.2	0.9	0.8						
ж	21.05.1997			0.2	0.5	0.6	0.3	0.0	0.8	2.3	0.6	0.3	0			
м	19.02.1997					0.5	0.4	0.2	1.4	1.1						
м	25.04.1994		0.7	2.5	0.5	2.4	0.8	1.1	2.5	2.0	1.9					
м	04.11.1994			0.3	0.3		0.3	0.3	2.6	1.4	0.8	2.9		2		
м	17.08.1993		0.2	0.2	0.1	0.8	0.4	0.3	4.9	3.5	2					
м	05.05.1993			0.4	0.5	1.2	0.6	0.5	3.0	2.2	3					
м	04.05.1993		0.5	0.5		0.8	0.5	0.3	1.7	6.1	1.5					
ж	17.06.1991		0.4	0.3	0.5	1.6		0.8	2.9	6.4						
м	01.01.1991						0.9	1.3	1.0	0.2						
ж	10.07.1990		0.7	0.6	0.2	0.5	0.3	0.4	1.5	1.0	0					
м	01.07.1990		0.6	0.5	0.8	2.0	3.3	0.5								
ж	09.04.1990		0.4	0.4	0.3	1.0	0.4	0.7	1.7	3.9					0.2	0.6
м	31.12.1988	7.8	1.1			1.4										
ж	06.09.1988		0.8	0.8	0.9	1.1	0.8	0.9			0.4	0				
м	25.03.1987		1.3	11.7	4.6	10.9	3.8									
ж	08.09.1986							24.1	18.0	45.2	11.3	6.1		2.8	2.1	1
М	18.05.1986														2.3	2
ж	17.04.1985		1.4	7.9	2.0	2.3										
м	19.02.1985		1.7	2.2		5.3										
м	23.01.1985		1.1	1.0	0.8	1.9		0.8			1.8	0.52				0.3
ж	14.01.1985		1.8	1.7	0.8	3.1	1.7		1.4	3.8						0.5
м	22.12.1984				6.1	4.9										
ж	01.12.1984		2.3			3.5		0.7	4.0						1.2	
ж	04.09.1984				1.2	2.4										
м	01.01.1982			3.5												
ж	08.10.1980				5.8	3.6	3.8	3.5	6.3							
ж	18.02.1980				0.0											
ж	06.07.1979			1.8	3.0	3.8	4.0		0.5	4.3	1	0.8		0.8		
м	01.01.1979			6.4	20.3			2.6								
м	08.12.1978					17.5		1.1		10.2						
ж	14.04.1978							0.3								
ж	07.01.1978			47.6		12.8	10.6		1.9						2.1	
м	01.01.1978						19.6									
м	11.12.1976				8.9											
м	10.06.1976					8.0	3.8	2.5								
ж	21.08.1975			15.5		9.9	1.2	1.5	2.0	3.0						
м	14.04.1975	3.6														
ж	12.04.1974		2.5	1.6	5.1	6.6	3.5	4.4		4.8						1.4
м	31.05.1973				7.8	10.0		5.1	5.1							1.9
м	01.05.1973							31.3	23.6	68.1						1.9
м	28.01.1973					6.7										
м	22.12.1970			2.0	3.1	9.4	14.1	1.8	2.5	6.3					1.4	0
ж	01.11.1968			1.5	2.6	8.4	2.4		5.0	12.4	1.5					
ж	13.05.1968					0.4										
м	01.01.1968				16.2	24.9	4.5	5.5	6.0	8.7						
ж	25.03.1966		4.9	2.0	1.1	5.8	4.4	2.2	8.8	15.5	2.1	4.3		1.9	2	
ж	01.01.1966				7.1											
ж	09.04.1965			10.0	4.5	5.0	1.3	2.3	2.0	3.1						
м	18.08.1964				6.7	18.7	5.0	4.8								
м	01.12.1963					5.5										
ж	08.09.1963	6.5	3.8	2.2	2.4	3.8	2.0	1.3	1.3	2.1	1.8			2.4	1.9	1.8
м	29.01.1963			3.5	7.4		13.2		0.7							
м	06.12.1962		10.3	7.1	7.6	10.4	7.7	4.2	3.3							2.6
м	10.09.1962			2.7	6.7	4.2	2.0	2.1	5.7		1			4.2	4.2	

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	20.04.1961			48.2	19.1	19.7	6.3									
ж	02.04.1961		3.0	3.0		3.3	1.4	0.6	1.0	1.3	0.1	1.8	1.3	0.9	1.1	0.7
м	01.01.1959				9.9		10.6	6.3	11.5	22.8						8.5
м	03.02.1959				25.2	8.9	2.8	1.9	15.1						1.6	
м	19.11.1958		3.8							0.6	1.2	2.1		1.2		0.7
м	01.01.1956				8.3											
ж	12.12.1955					28.0										
ж	27.04.1952		1.6	4.3		10.4	9.5	1.5								
ж	01.01.1952			12.9		11.5	7.8	8.1	3.1				3.4			
м	20.09.1951				8.4	8.0	3.6		2.6	1.0	1.6	2.1		8.1	3.2	
м	30.05.1951			5.8		10.5		2.6	4.0	6.7						
м	26.07.1949		8.8	61.7					28.4							
м	01.01.1949				15.6			11.4	35.5	32.9						
ж	01.01.1949				3.2		2.3		3.5							
ж	10.10.1946		6.5	10.7	2.1	3.6		0.7	3.4	13.3	0.6		2.3			
м	18.09.1946			2.0	3.2	11.0	2.6	1.6	2.3							
м	10.01.1939			23.7	29.1	22.1	6.1	6.6	11.6							
м	04.08.1938					1.9										
ж	01.01.1938		1.6													
м	06.08.1936			4.8	5.8	7.7	3.8	4.5	6.5	6.7						
м	25.12.1935					19.3	19.1		7.9	21.1						
м	15.07.1935					8.4	8.6									
ж	16.05.1935					8.0		2.5	3.8							
ж	12.03.1935		5.2	5.0	3.3	12.5	4.2	3.7	2.8							
ж	01.02.1934				5.2	5.7	3.9	1.5								
ж	12.01.1929							0.6								
ж	01.01.1927			1.7	2.3											
м	01.01.1927			7.1	23.9	14.6										
м	01.01.1922				4.6		4.2									
Кляпинская Буда (Kljapinskaja-Buda)																
ж	22.03.2011													0.3	0.5	
ж	12.12.2007										0.87			0	0.3	0.1
м	31.03.2006										0.86	0.3	1.1	0.5	0.4	0.4
ж	04.02.2002					0.5	0.9	0.4	0.9	1.7	2.5	0.2		0.4	1.1	0
м	10.04.2001					0.3	0.48		0.6							
м	07.12.2000				0.0											
м	28.08.2000					0.2										
м	03.07.2000				0.4	0.8	0.9	0.7	1.6	2.3	4.1					1.6
м	23.05.1999			1.1	0.3											
ж	26.03.1999							0.2								
м	01.01.1999				0.4											
м	03.11.1998			0.6	2.2	0.6	0.6	0.3	1.2		2.1	3.8	0.8			
м	28.08.1998			0.5	0.8	0.3	0.3	0.5	0.8	0.6	0.8	1.5	1.7			
м	21.08.1998		0.7	0.7	0.8											
м	01.03.1997				2.6	3.8	1.2	2.2								
м	11.11.1995	18.8						0.3	0.1							
ж	01.07.1993				0.8											
ж	01.07.1993			1.2		3.9	1.9	2.9								
м	15.03.1993			1.0	1.0	0.8	1.2		2.2	1.7						
ж	10.06.1992		10.5		0.4											
м	27.11.1991				1.7											
м	12.03.1991		3.0	0.8	0.4	1.7	1.4	1.8	3.5	9.3						
м	01.01.1991			1.32												
ж	01.01.1991						0.8									
ж	10.11.1990		1.1	1.3	1.3		2.3		1.7	1.8	11.9					
ж	01.01.1990				1.4											

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	22.05.1989		2.5	1.1	0.5	3.6	3.1	2.7	2.8							
м	08.09.1988			1.37	3.2					8.4						
ж	12.08.1988		2.6	0.8	1.3	5.1	1.2	0.6								
ж	20.03.1988			1.7	1.4	1.3		1.9	1.9	3.6						
м	26.04.1987		1.9	3.1		9.2										
ж	17.08.1986		3.8	2.2	1.1	4.1										
ж	27.04.1986		2.3	102.0												
ж	04.04.1986		2.5	2.1	2.5	2.7										
м	05.03.1986		1.4	3.1	3.2	10.0	8.0	2.1								
м	15.05.1984	5.4		2.8	2.5	11.7	9.1	7.6	7.5						2.5	
ж	02.11.1983					4.1	5.6	3.1								
ж	10.10.1982		3.5	1.8	3.8	9.2										
м	01.01.1982			9.2	17.6	14.4										
м	05.03.1980									7.0						
ж	28.07.1979					5.2	3.0	3.8	5.6		3.2					
ж	07.03.1979		7.2	5.4	5.6											
ж	09.04.1978		1.5		3.4					0.0						
ж	25.12.1977		14.3	4.0	4.3	8.6	4.4		5.3		18.5		3	3.4	6.6	1.5
м	29.10.1976			13.8	7.9	12.5	7.6	8.7	12.4				6.4	4.2		
м	29.06.1976							4.4	6.4					1.5		
м	29.06.1976			2.6	4.5	12.0	3.8									
ж	28.06.1976						1.3	0.7	1.7	6.7		8.9				
м	23.05.1976		10.4		5.2											
ж	01.01.1972				1.4											
ж	01.03.1971			4.9	6.7	17.0	5.2									
м	01.09.1970										7.1					
м	11.04.1969					9.1	16.6			5.0						
м	01.01.1968			5.3	9.0			9.0	17.7							
м	07.01.1967								6.3							
м	03.04.1966		185.6													
ж	18.03.1965			15.2	1.6					5.2	6.3					
м	01.04.1964							8.5								
м	12.10.1959			21.9			44.1	20.5		13.2	2.8	1.8				
м	01.01.1959						4.04	24.8	11.3							
ж	16.08.1958		4.0	5.4	5.5	14.1	8.1	2.0	2.8	10.6						
м	01.01.1958			70.3	13.8											
ж	16.11.1954		17.5	3.7	16.0		6.9	15.8	8.9	19.6						
ж	10.08.1954															1.8
м	01.01.1954			2.9												
м	19.08.1953				14.7	15.6	12.5	11.1	8.4	14.7						
м	16.05.1953			5.9	12.0	20.2	7.0	9.7	25.0				4.3			
м	01.01.1952															0.8
ж	14.04.1951		15.7		3.2	13.0	8.3	5.1	5.1			2.8	2.7	1	2.8	2.1
ж	10.10.1949			3.4	4.2	12.7	3.6	2.3	5.9	10.3	2	4.1		2		0.6
м	30.10.1947		20.1	11.0	4.4		10.2					5.1	3.9		4.8	2.1
м	20.01.1946			14.3	2.0	5.0		2.7	5.4	7.6	25.3	3.6	4		1.4	3.2
м	04.04.1943			23.4	12.9	16.2	6.6	10.2	19.6							
ж	06.05.1942			7.2	4.0	6.4	8.7	4.8	6.4	6.9	2.4					
ж	12.01.1942			8.15	7.4	15.6	5.8	2.9	8.5	9.5	2.2		2.2	2.5	1.8	0.5
ж	20.08.1940			8.34	1.2	6.0	2.3	1.1	3.4	5.6	27.4	2.9	2.9	2.8	1	2.8
ж	24.02.1940					17.4										
м	07.10.1939			3.26	12.3	17.7	9.0	4.8	11.1	10.4	2.7	1.3	2.9	2.9	1.5	1.6
ж	10.02.1938			4.5	6.5	4.3	3.3	4.5		10.5	1.7					
ж	15.01.1938			9.8	5.7	17.0	5.8	3.4	5.8	10.1	0.6	3.9	0.9	0.9	0.8	1
м	02.08.1936			2.38	5.8	21.3	5.6	4.8	7.7	9.1	1.6	2.5				
ж	01.06.1936							0.9								

F/M	Date of Birth	Body activity in the municipality of Volincy [kBq]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	01.01.1934			59.6	13.8	14.8	12.0	7.8	22.0							
ж	20.02.1932			9.5	3.6	4.19										
м	15.12.1930			3.1	6.5	6.0		3.1	5.5							
м	10.04.1930			8.2	8.9	6.1	4.9	3.4	8.0							
ж	30.03.1930				3.4	3.3	3.3									
ж	01.01.1930				4.3											
ж	15.02.1928		6.5	1.7	7.1	8.7	9.0	7.3	8.3	11.2						
ж	01.01.1928				4.1		2.4									
ж	01.01.1928				3.8											
ж	07.10.1927			2.7	8.9	5.2	11.7	1.9	9.3	12.4		1.2	0.4	0	0	0.4
м	10.09.1927			5.0		11.8	6.9		16.8	9.3						
м	15.03.1926			2.25	2.6	5.9	1.8	3.5	1.8	3.5						
ж	10.01.1926					7.0										
ж	11.12.1925					4.5										
ж	01.01.1925			4.9												
м	01.01.1925			1.0	2.0											
м	22.04.1922		9.9		14.9		12.4	7.8	38.7	66.9						
м	01.01.1922			4.49	8.5		2.4									
м	01.01.1922				2.9											
ж	14.09.1917				6.3	11.0	3.2		14.4							
м	01.01.1915				6.3											

1.2. Summary of the body activity in the municipality of Volincy

Table 1-2: Summary of the body activity in the municipality of Volincy [kBq]

Year	1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
	A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
Volincy municipality															
Number	83	162	246	264	310	243	228	224	169	120	135	94	127	132	148
							[kBq]								
Max. value	107.0	660.3	386.3	153.6	642.8	102.7	43.4	41.1	68.1	68.3	31.2	191.6	20.0	16.4	14.4
Mean	14.2	37.5	16.1	7.7	18.9	8.1	5.7	7.0	9.8	3.9	2.9	6.8	2.1	2.2	1.5
Mean deviation	14.7	101.3	42.7	14.6	54.7	12.9	7.2	7.4	12.7	8.2	5.0	22.9	3.0	3.4	2.3
Qan-95	39.1	196.9	61.6	23.5	65.8	28.3	23.0	23.4	36.4	14.1	9.9	23.3	7.7	10.5	4.6
Qan-05	3.3	0.7	0.5	0.3	0.4	0.4	0.3	0.5	0.4	0.1	0.0	0.1	0.0	0.0	0.0
Mean < 19	8.3	11.7	4.5	1.4	4.0	2.4	2.1	2.2	2.6	1.4	0.9	2.3	1.0	0.7	0.8
Mean 19–35	15.8	108.1	41.6	15.2	44.1	15.0	8.5	8.8	14.4	8.9	3.7	1.7	1.7	1.9	2.2
Mean > 35	19.0	34.9	12.9	8.5	19.6	9.6	7.2	9.4	14.3	4.4	5.2	8.1	3.1	3.9	2.0
Volincy village															
Number	78	112	145	143	191	139	129	129	98	65	82	66	73	72	78
							[kBq]								
Max. value	107.0	660.3	386.3	153.6	642.8	102.7	43.4	41.1	60.3	68.3	31.2	191.6	20.0	16.4	14.4
Mean	14.6	50.7	21.6	9.6	26.1	10.5	7.1	7.4	10.6	4.1	3.2	8.9	2.3	2.6	1.6
Mean deviation	14.9	117.9	53.3	18.8	68.4	15.8	8.0	7.3	12.7	9.4	5.8	26.9	3.4	4.0	2.6
Qan-95	40.2	312.5	82.4	27.5	120.7	33.4	24.7	24.0	36.7	12.6	10.6	28.2	9.4	12.7	5.5
Qan-05	3.3	1.0	1.0	0.3	0.5	0.6	0.4	0.4	0.5	0.0	0.1	0.1	0.0	0.0	0.0
Mean < 19	8.0	18.0	4.6	1.6	5.3	3.2	3.0	2.6	2.7	1.3	0.8	2.9	1.0	0.7	0.8
Mean 19–35	16.9	126.4	56.6	21.6	66.9	21.1	11.4	10.6	14.0	10.4	3.9	1.4	1.6	2.3	3.8
Mean > 35	18.7	31.3	14.1	9.3	23.4	11.9	8.7	9.6	16.4	4.0	7.2	17.9	4.5	5.2	2.1
Kljapin village															
Number	3	27	45	52	65	53	53	52	40	24	18	14	20	24	23
							[kBq]								
Max. value	7.8	10.3	61.7	29.1	28.0	19.6	31.3	35.5	68.1	11.3	6.1	3.4	8.1	4.2	8.5
Mean	6.0	2.5	7.3	5.9	6.8	4.1	3.1	5.2	8.2	1.6	1.4	1.0	1.8	1.4	1.3
Mean deviation	1.8	2.6	13.1	6.9	6.4	4.5	5.4	7.0	13.3	2.1	1.6	1.0	2.0	1.1	1.7
Qan-95	7.7	8.1	42.8	21.9	19.6	13.6	9.4	20.5	33.5	2.9	4.6	2.7	5.0	3.1	2.5
Qan-05	3.9	0.3	0.2	0.3	0.4	0.3	0.2	0.6	0.2	0.1	0.0	0.1	0.0	0.0	0.0
Mean < 19	7.8	0.9	1.9	1.2	2.0	0.8	0.5	1.6	2.0	1.3	0.8	0.6	1.3	0.9	0.8
Mean 19–35	5.1	3.7	9.8	6.7	9.4	6.9	6.1	6.5	19.9	2.9	1.9	-----	1.9	1.5	0.9
Mean > 35	-----	5.0	12.1	9.3	10.3	5.6	3.5	7.3	10.3	1.2	2.6	2.3	3.1	2.2	2.2
Kljapinskaja-Buda village															
Number	2	23	56	69	54	51	46	43	31	21	15	14	14	14	16
							[kBq]								
Max. value	18.8	185.6	102.0	17.6	21.3	44.1	24.8	38.7	66.9	27.4	8.9	6.4	4.2	6.6	3.2
Mean	12.1	14.3	8.9	4.9	8.2	5.9	5.0	7.9	9.5	6.0	2.9	2.7	1.6	1.8	1.3
Mean deviation	6.7	36.9	17.5	4.3	5.8	6.6	5.1	7.6	11.4	7.8	2.1	1.6	1.3	1.8	0.9
Qan-95	18.1	19.8	32.5	14.3	17.5	12.4	14.6	21.8	17.2	25.3	6.2	5.0	3.7	5.5	2.9
Qan-05	6.1	1.2	0.8	0.4	0.4	0.7	0.3	0.8	1.2	0.8	0.3	0.7	0.0	0.2	0.1
Mean < 19	12.1	3.0	6.7	1.3	3.4	1.7	1.2	1.6	3.7	1.9	1.5	1.2	0.3	0.6	0.5
Mean 19–35	-----	43.8	7.3	6.3	10.2	6.3	4.3	6.5	4.6	11.2	8.9	3.0	-----	2.5	-----
Mean > 35	-----	12.3	11.0	7.0	10.8	7.9	6.8	10.9	12.6	6.8	2.9	3.1	2.1	2.3	1.5

1.3. Internal annual dose in the Volincy municipality

Table 1-3: Internal annual dose in the Volincy municipality, derived from the values of the internal radiation burden

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
Волынцы (Volincy)																
м	2013															0.10
м	13.09.2012														0.00	0.01
м	04.10.2012													0.02		
ж	29.11.2011														0.00	0.01
ж	2010													0.04		
ж	14.08.2010											0.00	0.05			
м	03.07.2010											0.04	0.02		0.01	
ж	28.04.2010											0.02				
ж	07.05.2009											0.08		0.08		
ж	15.01.2009											0.02		0.08		0.02
ж	05.06.2008											0.01	0.00	0.02		0.00
ж	06.04.2008											0.10		0.10	0.06	0.05
м	30.10.2007										0.02					
м	04.05.2007										0.00					
м	07.04.2007										0.03	0.00	0.01	0.00	0.00	0.00
ж	08.03.2007											0.12	0.05		0.01	0.08
м	16.02.2007											0.00		0.03	0.02	0.00
ж	14.06.2006									0.12	0.10	0.06	0.16	0.00	0.02	0.02
м	02.06.2006									0.06		0.00				
ж	29.03.2006											0.02	0.03	0.01	0.00	0.02
ж	23.11.2005											0.03	0.02	0.09	0.00	0.00
м	21.09.2005									0.21		0.03				
м	03.09.2005									0.09	0.00	0.01	0.02	0.00	0.01	0.00
ж	05.08.2005									0.12	0.01		0.08	0.09	0.02	0.07
ж	03.06.2005									0.19		0.02	0.03	0.02	0.02	0.00
ж	14.05.2005								0.03			0.03	0.05	0.00	0.02	0.00
м	12.05.2005								0.00			0.04		0.03	0.05	0.02
ж	01.02.2004										0.02	0.01	0.00	0.02	0.03	0.00
ж	01.01.2004						0.11									
м	21.11.2003						0.16			0.23	0.03		0.04	0.09	0.00	0.01
м	13.08.2003										0.00					
м	17.07.2003							0.57	0.48	0.10	0.68	0.27	1.19	0.16	0.07	
ж	03.06.2003						0.06	0.08	0.03	0.09	0.01	0.01	0.06	0.01	0.03	
м	12.01.2003						0.05	0.17	0.20		0.05					
ж	01.01.2003						0.16									
ж	01.01.2003						0.09		0.29							
м	01.01.2003						0.07									
м	14.07.2002							0.07		0.07	0.01	0.05	0.91		0.01	0.07
ж	29.03.2002					0.12	1.30	0.20	0.20	0.32	0.16	0.09		0.11	0.03	0.04
м	10.02.2002					0.10	0.10	0.11	0.12	0.13	0.03	0.07		0.06	0.07	0.07
м	19.10.2001					0.00	0.10	0.01	0.02	0.03		0.01		0.00	0.00	0.00
ж	21.04.2001					0.14	0.13	0.20	0.17	0.37	0.18	0.10		0.05	0.08	0.04
м	29.01.2001					0.30	0.14	0.06		0.09	0.01	0.01	0.01	0.00	0.01	0.03
м	23.12.2000							0.00				0.02			0.17	0.80
ж	03.12.2000							0.13		0.16	0.02	0.05	0.11	0.02	0.07	0.03
м	20.08.2000										0.05	0.03	0.02	0.05		0.00
ж	03.07.2000				0.05	1.18		0.17	0.17	0.01	0.27	0.13	0.51	0.07	0.08	0.09
м	21.05.2000			0.10	0.07	0.27	0.18	0.08	0.47						0.07	
ж	25.12.1999					0.09	0.08	0.03	0.06	0.10	0.01	0.02	0.05	0.07	0.04	0.03

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	13.11.1999					0.75										
ж	19.10.1999					0.01										
ж	21.07.1999															
ж	03.09.1999											0.00	0.04		0.09	0.03
м	06.08.1999				0.06	0.07	0.11	0.04	0.13			0.02	0.07	0.18	0.08	0.00
ж	23.04.1999											0.03			0.11	0.02
ж	26.03.1999				0.07		0.05		0.05	0.13		0.07	0.11	0.07	0.01	0.06
м	16.10.1998										0.13		0.03	0.09	0.15	
м	10.08.1998		0.37	0.21	0.06	0.20	0.40	0.13	0.08	0.03	0.05		0.03	0.13		0.12
м	08.05.1998			1.12	0.76	1.65	1.69	0.40	0.31	0.36	0.50	0.35	0.21	0.24		
м	01.08.1998			0.08	0.10		0.14	0.05	0.22	0.15	0.02	0.06		0.19	0.06	
ж	25.12.1997						0.08	0.02	0.01	0.03				0.00	0.01	
ж	15.12.1997	1.00	0.17	0.25	0.05	0.16	0.15	0.06	0.31		0.03	0.03	0.03	0.03	0.03	
м	11.11.1997		0.07			0.01										
ж	19.06.1997			0.06	0.09									0.00		
м	09.04.1997		0.36			0.22						0.11	0.18	0.00		
ж	01.01.1997						0.83									
ж	01.01.1997						0.04	0.01								
м	04.07.1996	0.25														
ж	02.06.1996	2.42	1.87	0.26	0.02	0.05	0.15	0.27	0.13	0.69		0.15	0.04			
м	01.06.1996			0.05	0.04	0.06	0.06	0.03	0.14	0.06	0.02	0.08	0.17	0.24		
м	23.04.1996					0.34										
ж	08.02.1996	0.28														
ж	06.10.1995	0.67	0.27	0.26	0.07	0.36	0.10	0.09	0.19	0.14		0.02	0.02			0.03
м	30.08.1995	0.71	0.12	0.14	0.07	0.32	0.17	0.08	0.10		0.04	0.10	1.85			
ж	01.01.1995				0.06	0.45	0.04	0.06	0.05							
м	27.12.1994			0.16	0.25		0.07					0.01				
м	13.11.1994			0.05	0.04	0.08	0.13	0.03	0.20	0.21						
м	11.11.1994		2.29	1.34	0.16	1.73			0.03		0.18	0.20				
м	04.11.1994					0.03										
м	20.09.1994					0.09										
ж	10.04.1994													0.00		
ж	01.02.1994		0.33	0.15	0.03	0.13	0.16	0.13	0.15	0.10	0.06					
м	24.01.1994			0.21	0.16											
ж	01.01.1994						0.11	0.08	0.18		0.00					
м	24.08.1993		0.11													
м	15.03.1993										0.26				0.19	0.39
м	28.12.1992	0.56	0.30		0.04	0.34	0.09	0.10	0.15	0.13	0.10			0.01		
ж	17.11.1992	0.62														
м	24.08.1992		0.09	0.31	0.05	0.17	0.16	0.10								
ж	30.05.1992	0.34	0.09	0.26	0.03	0.05	0.05	0.05	0.11	0.13						
м	23.02.1992		0.79	0.04	0.02	0.06	0.06	0.18	0.24	0.48				0.03		
ж	16.09.1991		0.06	0.13	0.04	0.10	0.25	0.36	0.34	0.27		0.06				
м	25.07.1990											0.13				
ж	10.11.1990		0.09	0.09	0.09				0.09	0.09	0.48			0.10	0.12	
ж	22.10.1990	0.61	0.34	0.20	0.05	0.44	0.10	0.14	0.21	0.17						
ж	07.04.1990			3.00	0.08	0.27	0.51	0.53	0.26	0.15						
м	07.09.1989		0.08	0.13	0.18	0.29	0.28	0.39	0.67							
м	05.09.1989		0.23	0.12	0.02	0.11	0.16	0.31	0.20							
ж	14.05.1989	0.29	0.04	0.05	0.02	0.39	0.10	0.05	0.10			0.02				
ж	27.11.1988		0.17													
м	23.11.1988								0.45	0.95	0.12					
ж	16.08.1988	0.57	0.08	0.29	0.03	0.16		0.04								
м	07.08.1988	0.29	0.14	0.11	0.06	0.14	0.17	0.11								
ж	31.07.1988	0.46	0.09	0.93	0.06	0.34		0.24	0.15	0.25						
ж	28.05.1988	0.65	2.47	0.69	0.58	3.82		0.54	0.24							

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	09.05.1988	0.54	1.78	0.25	0.23	0.20	0.37	0.22	0.27	0.42		0.02	0.05			0.03
м	19.04.1988					0.02										
ж	20.02.1988		0.14	0.12	0.08	0.43	0.21	0.05	0.19							
м	28.03.1987				0.20	0.21	0.29	0.45		0.35	0.24					
м	26.01.1987	0.68	0.13	0.11	0.07	0.53	1.49	1.66		0.58						
ж	07.01.1987	0.64	0.09	0.28	0.05	0.16	0.14									
ж	17.03.1986	0.24	0.09	0.09	0.08	0.40	0.39	0.04			0.02					
ж	13.11.1985										0.01					
м	17.07.1985	0.46	0.17	0.16	0.23	1.02		0.71		0.91						0.09
ж	07.06.1985	0.32	0.19													
ж	04.04.1985	0.22	0.22	0.15	0.24	0.14	0.05	0.11								
ж	24.01.1985		0.11	0.24	0.41	1.04	0.15	0.21	0.21	0.30	0.11					
м	28.07.1984		0.06													
ж	11.05.1984		0.11	0.19	0.04											
ж	01.01.1984			0.62												
м	14.12.1982	0.74		0.39	0.25	1.06										
ж	09.12.1982			0.09				0.41		0.28	0.08	0.15				
ж	20.07.1982	2.05	23.18													
ж	05.02.1982					0.18	0.17			0.30					0.02	
ж	05.02.1982		0.09													
ж	01.01.1982			0.87	0.13											
ж	30.11.1981		0.19	0.16	0.36	0.13										
ж	13.11.1981	0.68	0.89	0.36				0.44	0.25	0.56						
м	27.08.1981					0.20	0.20	0.37		1.21						
м	19.08.1981	0.29	0.12		0.24	0.30	0.58	0.30	0.43	0.31			0.10	0.22		0.18
ж	16.08.1981									0.41	0.35	0.46				
ж	13.07.1981		5.02	0.40												
м	07.05.1981	0.40	0.16		0.15	0.23	0.12				0.03					
ж	26.04.1981		2.41	1.25	0.56	2.66	0.40									
м	19.02.1981					0.01										
ж	27.01.1981										0.30					
ж	16.05.1980		0.17	0.09												
м	01.01.1979												0.07			
ж	12.11.1979		0.25	0.06	0.19											
ж	27.06.1979					6.67										
м	26.01.1979		0.15	0.24	0.35	0.28	0.30	0.32	0.32	0.30	0.07	0.14	0.06	0.07	0.03	0.01
ж	24.08.1978	0.13														
ж	14.07.1978													0.05		
м	20.05.1978		2.66	3.93	1.99	9.40	1.30	1.37	0.49							
м	11.02.1978				0.29					0.38				0.09		0.07
ж	26.01.1978									0.26		0.01	0.01	0.00	0.02	0.00
ж	01.01.1978						0.21	0.20	0.15							
м	15.11.1977			0.43	0.04											
м	14.08.1977		19.33	11.80	4.52											
ж	11.08.1976		0.87			0.40										
ж	30.05.1976			0.06	0.06	0.12	0.24									
м	20.05.1976	0.85	4.41	1.38	0.78	1.70	0.44	0.62	0.47	0.72	0.32	0.42				
м	09.03.1976						0.43	0.66	0.42		0.10				0.11	0.06
ж	05.01.1976	0.06														
ж	01.01.1976				0.09		0.05									
ж	01.01.1976		7.90			2.50	0.25	0.12	0.04							
м	01.01.1976			0.75												
ж	20.12.1975		0.09			0.00										
ж	18.10.1975			0.20	0.32											
м	27.09.1975			0.28				0.38	0.18	0.26				0.13		
ж	17.07.1975					0.18										

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	19.06.1975	1.48	17.47													
м	21.02.1975								0.57							
м	09.02.1975		0.69		0.90			0.11	0.56		1.28					
м	24.01.1975	1.84	26.41	15.45	6.14	25.71										
м	16.01.1975					0.22										
м	02.01.1975	0.30	6.92	4.90		15.01	1.16		0.90		2.73		0.90			
м	15.11.1974			0.43												
м	04.08.1974							0.20	0.54	0.38		0.10		0.21	0.46	0.16
м	26.06.1974	0.72	0.48	0.38	0.25		0.76			1.31		1.09	0.37	0.46	0.13	0.11
м	21.03.1974	2.11	3.56	12.66		8.61	2.83	1.05	1.17	1.46			7.66	0.80	0.32	0.15
ж	07.03.1974	0.34	1.19	0.42	0.10	0.83	0.14	0.11	0.20							0.07
ж	01.01.1974		4.75	1.96	1.89	2.60	1.66		0.49							
ж	26.06.1973					1.81										
м	22.06.1973			2.36	1.56											
м	19.01.1973		4.31													
ж	31.07.1972					0.24										
м	29.06.1972						1.66	1.74	0.63	0.34		0.20	0.14		0.66	0.26
м	15.06.1972						3.52									
м	21.02.1972	0.27														
м	01.01.1972	0.75		1.49	0.51	0.53										
м	01.01.1971			4.56	3.88		4.11									
ж	30.07.1970		0.49	0.26		0.15	0.14		0.05		0.05					0.06
м	07.07.1970													0.03	0.06	
ж	03.07.1970	0.45	0.14	0.12	0.09	0.32	0.19	0.11	0.38			0.16		0.10	0.06	0.03
м	22.02.1970															0.02
м	18.01.1970	0.26	13.60	9.20												
ж	01.01.1970				0.05											
ж	10.04.1969															
м	20.12.1968		0.27	0.21	0.21	0.35	0.53		0.45	0.49						
м	11.12.1968		0.47	0.30	0.23	0.45	0.76	0.93	0.53							
ж	16.07.1968				0.56	0.28		0.09				0.02		0.06	0.10	0.00
м	14.06.1968		2.04													
ж	08.06.1968	0.78	2.12	2.68		5.23	0.26		0.32	0.36			4.36			
м	16.07.1966												0.15			0.12
м	03.06.1966	0.43	0.27	0.16	0.08	0.77	0.86	0.23	0.23		0.08	0.13			0.18	0.10
ж	15.03.1966	0.26	0.10	0.10	0.04	0.25	0.38	0.08	0.05	0.14	0.00		1.18	0.08		0.03
ж	24.10.1965			0.11	0.07	0.31		0.68		0.43					0.24	0.05
м	10.05.1965		2.36			0.66										
м	01.01.1965			0.05												
м	22.10.1964			3.32	0.71	0.52	0.72		0.44	0.66						0.22
м	23.07.1964			1.80		10.94										
ж	31.05.1964	0.48		2.14	0.45	0.58	1.14	1.37	0.49	0.38		0.16	0.14	0.52	0.56	0.13
м	23.05.1964	0.31														
м	19.03.1964		23.22		1.12		0.48		1.64	1.45	0.61	1.14			0.09	0.13
ж	01.01.1964				0.30											
ж	21.10.1963		0.15				0.21									
м	21.08.1963	1.05	0.17	0.29												
м	14.04.1963					0.09										
м	10.03.1963		1.21	0.30	0.12	0.33										
ж	01.12.1962				0.35	0.81	0.43	0.44	0.27	1.52			0.29		0.31	
м	12.08.1962			0.92	1.10	0.90	0.83			0.31						
ж	08.06.1962	0.32					0.28	0.09	0.09		0.05		0.02			0.10
м	29.05.1962			0.04												
м	01.01.1962							1.20						0.28		0.09
ж	10.04.1961		0.26	0.23	0.51		0.24									
ж	10.04.1961				0.48	2.85		0.40	0.37				0.28			

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	24.04.1960														0.00	
ж	27.12.1960	0.69	2.60	0.26	0.08	0.12		0.48	0.46	0.67		0.28	0.01	0.04	0.05	0.02
ж	29.11.1960			0.30		0.33	0.22	0.21								
ж	23.05.1959		0.10				0.31									
м	02.01.1959		0.62	0.93	0.36					0.66						
м	06.04.1958		0.21	0.25	0.57	3.15	0.62	0.30	0.39							
ж	10.05.1958				0.29	0.25		0.22	0.12	0.16	0.22					
м	22.03.1958					0.88	0.24	0.27	0.35	0.31						
м	21.02.1958	0.45														
м	01.01.1958				0.14											
м	13.04.1957		0.25	0.26	0.29	0.23	0.33	0.11	0.14	0.23						
м	15.01.1956		1.49	0.21		0.16										
м	12.11.1956						0.33					0.07		0.10		0.02
ж	03.01.1956															0.07
ж	12.12.1955			0.43	0.56	1.10	0.45		0.42			0.37			0.61	
м	23.10.1955			0.09	0.78	1.80	1.08	1.03	0.51	2.39			0.35		0.56	
м	01.01.1955				0.73											
м	1955													0.08		
м	27.10.1954			0.29	0.21	0.76	0.65	0.21	0.33	0.41		0.22		0.13		0.05
м	25.08.1954			0.27					1.35							
ж	25.06.1954			0.39	0.19	0.66	0.63	0.28	0.62	0.66		0.35	0.21	0.32	0.08	0.51
м	14.04.1954	1.14														
м	01.01.1954						0.09									
м	07.12.1953									0.63		0.40	0.52	0.20	0.32	0.11
ж	29.11.1953			0.72	0.54	0.41		0.72		1.27						
ж	05.04.1953	0.16	0.60	0.11		0.19	0.11	0.06	0.11	0.14	0.01					
м	01.03.1953		0.69			1.70	2.24		0.41							
м	25.08.1952	0.24														
ж	13.04.1952		0.22			0.30										
ж	23.03.1952							0.21		0.30						0.00
м	27.02.1952		8.13	1.72	1.03	0.58	0.42		0.52		0.16					0.07
м	15.01.1951	4.28	0.99	0.43	1.09	0.88										
ж	10.01.1951		3.80	1.63	0.76	3.54	0.54	0.48	0.17			0.22	0.11	0.05		0.00
м	05.03.1950				0.55	0.53	0.28	0.93		0.26	0.30					
м	10.12.1950					0.65										
м	26.01.1949														0.37	
м	07.01.1949	0.74	0.42	0.46	0.30	0.94										
м	01.01.1948						0.78	0.39								
м	01.01.1948			0.14	0.34											
ж	09.11.1947					1.18		0.27	0.32	0.59	0.13					
м	10.09.1947	1.07	0.26			1.04	0.36	0.90			0.51	0.34	0.25		0.47	
ж	22.08.1946	0.36		0.35		0.36	0.39	0.31	0.45							
ж	20.07.1946						0.58	0.66	1.02	2.41		1.25	0.33	0.50		0.14
м	21.11.1944					1.41	0.38									
ж	24.04.1944					0.27										
м	07.04.1944			0.45	0.79	1.01		0.33	0.36	0.40						
ж	14.01.1944					5.82		0.04	0.02	0.13		0.04		0.04	0.00	0.01
м	03.01.1944					0.24	0.33	0.55	0.31			0.06				
м	26.06.1943														0.09	0.00
ж	25.03.1943	1.12		0.14	0.15	0.21		0.18								
ж	01.01.1943				0.16											
ж	17.06.1942	0.36		0.14	0.16	0.29		0.14	0.15	0.17			0.03			0.00
м	02.06.1942		0.16		0.07											
м	13.03.1942					0.29										
м	28.12.1941														0.03	
ж	05.07.1941		7.48	0.65	0.95	0.78	0.49	0.30	0.30	1.41	0.15	0.20	0.35			0.12

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	03.06.1941	0.79														
ж	08.05.1941			0.74		0.84	1.17	0.40								
м	28.08.1940	0.62														
ж	24.08.1940		0.44	0.53	0.80	0.72										
ж	02.08.1940											0.07			0.01	
ж	20.03.1940	0.48				0.03		0.07								
ж	23.01.1940			0.10	0.12	0.16	0.03	0.08								
м	01.01.1940			0.28					1.39							
м	28.10.1939					0.76	0.37			1.72						
м	19.03.1939		0.16													
м	05.03.1939			0.49	0.34	0.44	0.23	0.42	0.39							
м	23.02.1939		0.24	0.15				0.20	0.48							
м	12.10.1938					0.59	0.47		0.28							
м	15.07.1938	0.65		0.64	0.46	0.61	3.15	0.48	0.35							
ж	05.04.1938	1.00	1.26													
ж	16.02.1938			0.70	0.18	0.70	0.19	0.24	0.31	0.44						
м	15.02.1938		11.60	3.21	0.58	12.30	0.69	0.08								
ж	21.01.1938					0.18	0.22		0.30				0.03			
ж	02.01.1938			0.82	0.86	4.43	0.29		0.18							
ж	25.10.1937	0.35	0.21	0.14	0.18	0.32	0.30									
м	01.08.1937					0.39			1.00							
м	15.07.1937					0.53	0.77	0.33	0.63	0.24	0.17					
ж	25.06.1937							0.19	0.30							
ж	15.06.1937			0.18		0.66	0.20	0.19								
ж	30.05.1937				0.23	0.38	0.13	0.32				0.06	0.05			
м	15.05.1937	1.12	0.24	0.18	0.21	0.28	0.07	0.14								
ж	22.03.1937					0.12										
ж	01.03.1937			0.05	0.04	0.14	0.08		0.05							
ж	02.01.1937				0.06	0.28		0.24								
м	26.10.1936								0.44							
м	14.08.1936		0.42		0.22	1.13	0.79	0.74	1.00	2.20						
м	01.07.1936								0.01			0.06	0.99	0.08		0.02
м	04.04.1936		0.36													
ж	01.01.1936				0.01	0.06								0.06		
м	01.01.1936					0.22										
м	01.11.1935				0.06	0.20										
ж	22.03.1935			0.04	0.02	0.08	0.05		0.09		0.02					
ж	19.03.1935	0.46	0.63	0.11	0.21	0.19	0.24	0.18	0.40	0.31	0.11		0.08		0.06	
ж	01.01.1935				0.18											
м	11.09.1934		0.23		0.21											
ж	03.05.1934	0.55	0.21			0.20		0.23	0.27	0.47	0.06	0.08				
ж	06.02.1934					0.19	0.11	0.19	0.24	0.29			0.26	0.06	0.04	
ж	22.11.1933				0.27	0.88			0.43	0.48		0.40	0.13	0.08		
ж	10.11.1933			0.60	0.66	1.84			0.47		0.10					
м	28.02.1932	0.40	0.17	0.06	0.06	0.17	0.12		0.02							
ж	20.02.1932			0.16		0.65	0.25			0.26						
м	01.01.1932			0.33												
м	03.12.1931		0.39	0.20	0.31	0.48	0.43	0.18	0.14	0.21		0.04	0.11	0.06	0.04	0.00
ж	12.10.1931					0.08	0.09		0.12							
м	07.01.1931				0.15	0.32										
м	30.12.1930		0.42	0.92	0.19	0.46										
м	19.11.1930			0.11		0.20		0.07								
ж	18.08.1930	1.00		2.15	0.78	0.56	0.48	0.48	0.43	0.67						
м	15.07.1930	0.54	0.21		0.28	0.44	0.47		0.31							
ж	06.04.1930					0.13		0.18	0.18	0.25						
ж	15.03.1930	0.38				0.16			0.21							

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	30.01.1930	1.81			0.51	0.94										
м	04.05.1929	0.87		0.42												
м	14.03.1929				0.14	0.07										
ж	01.01.1929					0.15										
ж	14.10.1928	0.39														
м	01.01.1928	0.46		0.14												
м	15.06.1927		0.41													
ж	01.06.1927					0.23	0.33	0.22	0.26							
м	05.01.1927	0.47	0.93	0.12		0.15	0.21	0.17	0.33							
м	01.01.1927			0.19												
ж	01.01.1927					0.21										
ж	01.01.1926			0.31												
м	01.01.1926			2.45	0.30	1.54										
ж	29.04.1925					0.21	0.09									
ж	01.03.1925				0.07	0.08										
ж	10.01.1925			0.23		0.26		0.10	0.10							
ж	01.01.1925					0.21		0.16								
ж	19.11.1924			0.15												
ж	16.08.1924	0.35		0.30		0.20										
ж	24.02.1924			0.93	0.22	1.12										
м	01.01.1924	0.36		0.38		0.29		0.15	0.26	0.34						
м	01.01.1924			0.09												
ж	01.01.1924				0.12	0.08										
ж	14.01.1923					0.02										
м	15.04.1921					0.03										
ж	22.03.1921					0.08										
ж	04.11.1920		0.54													
ж	01.01.1920			0.13	0.08	0.49										
ж	01.12.1911					9.04										
Кляпино (Kljapin)																
ж	18.11.2007											0.00		0.01	0.00	0.05
ж	17.11.2007											0.00		0.00	0.08	0.05
ж	08.03.2007													0.01		
м	17.02.2006												0.04			
м	26.08.2006											0.01	0.04	0.04	0.04	
м	22.11.2004									0.02		0.02	0.02		0.00	0.00
м	06.05.2003							0.02	0.13				0.01	0.19	0.02	
м	01.09.2001									0.03	0.01	0.03	0.03	0.02	0.00	0.00
м	29.06.2001					0.08	0.13									
м	10.04.2001								0.02		0.12	0.14	0.11			
м	12.11.2000													0.00	0.01	0.03
ж	12.10.2000				0.06	0.06	0.04	0.06	0.10	0.08			0.02	0.28	0.12	0.11
м	03.07.2000													0.05	0.09	
м	24.03.2000					0.07	0.03	0.01	0.07	0.12	0.08	0.02	0.12	0.16	0.15	0.11
м	09.03.1999			0.22		0.24	0.05	0.15	0.18	0.18	0.11		0.04		0.06	0.03
ж	26.01.1999		0.00	0.01	0.08	0.05	0.04		0.00	0.02	0.03	0.05	0.02	0.03	0.00	0.04
ж	24.06.1998					0.05	0.05	0.02	0.09	0.07						
ж	21.05.1997			0.03	0.07	0.07	0.03		0.07	0.18	0.04	0.02	0.00			
м	19.02.1997					0.06	0.04	0.02	0.12	0.09						
м	25.04.1994		0.09	0.26	0.05	0.20	0.06	0.07	0.17	0.12	0.10					
м	04.11.1994			0.03	0.03		0.02	0.02	0.17	0.09	0.04	0.15		0.08		
м	17.08.1993		0.02	0.02	0.01	0.06	0.02	0.02	0.30	0.21	0.10					
м	05.05.1993			0.03	0.04	0.09	0.04	0.03	0.18	0.13	0.15					
м	04.05.1993		0.06	0.05		0.07	0.03	0.02	0.11	0.36	0.08					
ж	17.06.1991		0.04	0.02	0.04	0.11		0.04	0.16	0.34						
м	01.01.1991						0.06	0.07	0.06	0.01						

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	10.07.1990		0.05	0.04	0.02	0.03	0.02	0.02	0.08	0.05	0.00					
м	01.07.1990		0.05	0.03	0.05	0.12	0.18	0.03								
ж	09.04.1990		0.03	0.03	0.02	0.06	0.02	0.04	0.09	0.20					0.01	0.02
м	31.12.1988	0.56	0.07			0.08										
ж	06.09.1988		0.05	0.05	0.05	0.06	0.04	0.05			0.02	0.00				
м	25.03.1987		0.08	0.68	0.26	0.58	0.19									
ж	08.09.1986							0.96	0.72	1.81	0.45	0.24		0.11	0.08	0.04
М	18.05.1986														0.09	0.08
ж	17.04.1985		0.08	0.42	0.10	0.12										
м	19.02.1985		0.09	0.12	0.00	0.27										
м	23.01.1985		0.06	0.06	0.04	0.09		0.03			0.07	0.02				0.01
ж	14.01.1985		0.10	0.09	0.04	0.16	0.07		0.06	0.15						0.02
м	22.12.1984				0.31	0.24										
ж	01.12.1984		0.12			0.17		0.03	0.16						0.05	
ж	04.09.1984				0.06	0.12										
м	01.01.1982			0.17												
ж	08.10.1980				0.23	0.14	0.15	0.14	0.25							
ж	18.02.1980															
ж	06.07.1979			0.07	0.12	0.15	0.16		0.02	0.17	0.04	0.03		0.03		
м	01.01.1979			0.25	0.81			0.10								
м	08.12.1978					0.70		0.04		0.41						
ж	14.04.1978							0.01								
ж	07.01.1978			1.90		0.51	0.42		0.08						0.08	
м	01.01.1978						0.79									
м	11.12.1976				0.36											
м	10.06.1976					0.32	0.15	0.10								
ж	21.08.1975			0.62		0.39	0.05	0.06	0.08	0.12						
м	14.04.1975	0.14														
ж	12.04.1974		0.10	0.06	0.20	0.26	0.14	0.18		0.19						0.06
м	31.05.1973				0.31	0.40		0.20	0.20							0.08
м	01.05.1973							1.25	0.94	2.72						0.08
м	28.01.1973					0.27										
м	22.12.1970			0.08	0.12	0.38	0.56	0.07	0.10	0.25					0.06	0.00
ж	01.11.1968			0.06	0.10	0.34	0.10		0.20	0.50	0.06					
ж	13.05.1968					0.02										
м	01.01.1968				0.65	1.00	0.18	0.22	0.24	0.35						
ж	25.03.1966		0.20	0.08	0.04	0.23	0.18	0.09	0.35	0.62	0.08	0.17		0.08	0.08	
ж	01.01.1966				0.28											
ж	09.04.1965			0.40	0.18	0.20	0.05	0.09	0.08	0.12						
м	18.08.1964				0.27	0.75	0.20	0.19								
м	01.12.1963					0.22										
ж	08.09.1963	0.26	0.15	0.09	0.10	0.15	0.08	0.05	0.05	0.09	0.07			0.10	0.08	0.07
м	29.01.1963			0.14	0.30		0.53		0.03							
м	06.12.1962		0.41	0.28	0.30	0.42	0.31	0.17	0.13							0.10
м	10.09.1962			0.11	0.27	0.17	0.08	0.08	0.23		0.04			0.17	0.17	
м	20.04.1961			1.93	0.76	0.79	0.25									
ж	02.04.1961		0.12	0.12		0.13	0.06	0.02	0.04	0.05	0.00	0.07	0.05	0.04	0.04	0.03
м	01.01.1959				0.39		0.43	0.25	0.46	0.91						0.34
м	03.02.1959				1.01	0.36	0.11	0.08	0.60						0.06	
м	19.11.1958		0.15							0.02	0.05	0.08		0.05		0.03
м	01.01.1956				0.33											
ж	12.12.1955					1.12										
ж	27.04.1952		0.06	0.17		0.42	0.38	0.06								
ж	01.01.1952			0.52		0.46	0.31	0.32	0.12				0.14			
м	20.09.1951				0.34	0.32	0.14		0.10	0.04	0.06	0.08		0.32	0.13	
м	30.05.1951			0.23		0.42		0.10	0.16	0.27						

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	26.07.1949		0.35	2.47					1.14							
м	01.01.1949				0.62			0.46	1.42	1.32						
ж	01.01.1949				0.13		0.09		0.14							
ж	10.10.1946		0.26	0.43	0.08	0.14		0.03	0.13	0.53	0.02		0.09			
м	18.09.1946			0.08	0.13	0.44	0.10	0.06	0.09							
м	10.01.1939			0.95	1.16	0.88	0.25	0.26	0.46							
м	04.08.1938					0.08										
ж	01.01.1938		0.06													
м	06.08.1936			0.19	0.23	0.31	0.15	0.18	0.26	0.27						
м	25.12.1935					0.77	0.76		0.32	0.84						
м	15.07.1935					0.34	0.34									
ж	16.05.1935					0.32		0.10	0.15							
ж	12.03.1935		0.21	0.20	0.13	0.50	0.17	0.15	0.11							
ж	01.02.1934				0.21	0.23	0.16	0.06								
ж	12.01.1929							0.02								
ж	01.01.1927			0.07	0.09											
м	01.01.1927			0.29	0.96	0.58										
м	01.01.1922				0.18		0.17									
Кляпинская Буда (Kljapinskaja-Buda)																
ж	22.03.2011													0.05	0.07	
ж	12.12.2007										0.12			0.00	0.03	0.01
м	31.03.2006										0.11	0.03	0.11	0.05	0.03	0.03
ж	04.02.2002					0.09	0.14	0.06	0.12	0.22	0.21	0.02		0.03	0.07	0.00
м	10.04.2001					0.04	0.07		0.08							
м	07.12.2000				0.00											
м	28.08.2000					0.03										
м	03.07.2000				0.06	0.13	0.11	0.08	0.18	0.24	0.29					0.09
м	23.05.1999			0.19	0.05											
ж	26.03.1999							0.02								
м	01.01.1999				0.06											
м	03.11.1998			0.09	0.31	0.07	0.06	0.03	0.11		0.13	0.22	0.04			
м	28.08.1998			0.08	0.11	0.04	0.03	0.05	0.07	0.05	0.05	0.09	0.09			
м	21.08.1998		0.13	0.10	0.12											
м	01.03.1997				0.33	0.44	0.11	0.19								
м	11.11.1995	2.67						0.02	0.01							
ж	01.07.1993				0.07											
ж	01.07.1993			0.11		0.30	0.12	0.18								
м	15.03.1993			0.09	0.08	0.06	0.08		0.14	0.10						
ж	10.06.1992		0.99		0.03											
м	27.11.1991				0.12											
м	12.03.1991		0.25	0.06	0.03	0.11	0.08	0.10	0.20	0.50						
м	01.01.1991			0.10												
ж	01.01.1991						0.04									
ж	10.11.1990		0.09	0.09	0.09		0.13		0.09	0.09	0.48					
ж	01.01.1990				0.09											
ж	22.05.1989		0.18	0.07	0.03	0.21	0.17	0.14	0.15							
м	08.09.1988			0.09	0.19					0.42						
ж	12.08.1988		0.17	0.05	0.08	0.28	0.06	0.03								
ж	20.03.1988			0.11	0.08	0.07		0.10	0.10	0.18						
м	26.04.1987		0.12	0.18		0.49										
ж	17.08.1986		0.23	0.12	0.06	0.21										
ж	27.04.1986		0.13	5.70												
ж	04.04.1986		0.15	0.12	0.13	0.14										
м	05.03.1986		0.08	0.17	0.17	0.52	0.40	0.08								
м	15.05.1984	0.30		0.15	0.13	0.59	0.36	0.30	0.30						0.10	
ж	02.11.1983					0.16	0.22	0.12								

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
ж	10.10.1982		0.18	0.09	0.15	0.37										
м	01.01.1982			0.46	0.70	0.58										
м	05.03.1980									0.28						
ж	28.07.1979					0.21	0.12	0.15	0.22		0.13					
ж	07.03.1979		0.29	0.22	0.22											
ж	09.04.1978		0.06		0.14					0.00						
ж	25.12.1977		0.57	0.16	0.17	0.34	0.18		0.21		0.74		0.12	0.14	0.26	0.06
м	29.10.1976			0.55	0.32	0.50	0.30	0.35	0.50				0.26	0.17		
м	29.06.1976							0.18	0.26					0.06		
м	29.06.1976			0.10	0.18	0.48	0.15									
ж	28.06.1976						0.05	0.03	0.07	0.27		0.36				
м	23.05.1976		0.42		0.21											
ж	01.01.1972				0.06											
ж	01.03.1971			0.20	0.27	0.68	0.21									
м	01.09.1970										0.28					
м	11.04.1969					0.36	0.66			0.20						
м	01.01.1968			0.21	0.36			0.36	0.71							
м	07.01.1967								0.25							
м	03.04.1966		7.42													
ж	18.03.1965			0.61	0.06					0.21	0.25					
м	01.04.1964							0.34								
м	12.10.1959			0.88			1.76	0.82		0.53	0.11	0.07				
м	01.01.1959						0.16	0.99	0.45							
ж	16.08.1958		0.16	0.22	0.22	0.56	0.33	0.08	0.11	0.42						
м	01.01.1958			2.81	0.55											
ж	16.11.1954		0.70	0.15	0.64		0.27	0.63	0.35	0.78						
ж	10.08.1954															0.07
м	01.01.1954			0.12												
м	19.08.1953				0.59	0.62	0.50	0.44	0.34	0.59						
м	16.05.1953			0.24	0.48	0.81	0.28	0.39	1.00				0.17			
м	01.01.1952															0.03
ж	14.04.1951		0.63		0.13	0.52	0.33	0.20	0.20			0.11	0.11	0.04	0.11	0.08
ж	10.10.1949			0.14	0.17	0.51	0.14	0.09	0.24	0.41	0.08	0.16		0.08		0.02
м	30.10.1947		0.80	0.44	0.18		0.41					0.20	0.16		0.19	0.08
м	20.01.1946			0.57	0.08	0.20		0.11	0.22	0.30	1.01	0.14	0.16		0.06	0.13
м	04.04.1943			0.94	0.52	0.65	0.26	0.41	0.78							
ж	06.05.1942			0.29	0.16	0.26	0.35	0.19	0.25	0.28	0.10					
ж	12.01.1942			0.33	0.30	0.63	0.23	0.12	0.34	0.38	0.09		0.09	0.10	0.07	0.02
ж	20.08.1940			0.33	0.05	0.24	0.09	0.04	0.14	0.22	1.10	0.12	0.12	0.11	0.04	0.11
ж	24.02.1940					0.69										
м	07.10.1939			0.13	0.49	0.71	0.36	0.19	0.44	0.42	0.11	0.05	0.12	0.12	0.06	0.06
ж	10.02.1938			0.18	0.26	0.17	0.13	0.18		0.42	0.07					
ж	15.01.1938			0.39	0.23	0.68	0.23	0.14	0.23	0.40	0.02	0.16	0.04	0.04	0.03	0.04
м	02.08.1936			0.10	0.23	0.85	0.22	0.19	0.31	0.36	0.06	0.10				
ж	01.06.1936							0.04								
м	01.01.1934			2.38	0.55	0.59	0.48	0.31	0.88							
ж	20.02.1932			0.38	0.14	0.17										
м	15.12.1930			0.12	0.26	0.24		0.12	0.22							
м	10.04.1930			0.33	0.36	0.24	0.20	0.14	0.32							
ж	30.03.1930				0.14	0.13	0.13									
ж	01.01.1930				0.17											
ж	15.02.1928		0.26	0.07	0.28	0.35	0.36	0.29	0.33	0.45						
ж	01.01.1928				0.16		0.09									
ж	01.01.1928				0.15											
ж	07.10.1927			0.11	0.35	0.21	0.47	0.08	0.37	0.50		0.05	0.02	0.00	0.00	0.02
м	10.09.1927			0.20		0.47	0.28		0.67	0.37						

F/M	Date of Birth	Internal annual dose [mSv/a]														
		1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
		A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
м	15.03.1926			0.09	0.10	0.23	0.07	0.14	0.07	0.14						
ж	10.01.1926					0.28										
ж	11.12.1925					0.18										
ж	01.01.1925			0.20												
м	01.01.1925			0.04	0.08											
м	22.04.1922		0.40		0.60		0.50	0.31	1.55	2.68						
м	01.01.1922			0.18	0.34		0.10									
м	01.01.1922				0.12											
ж	14.09.1917				0.25	0.44	0.13		0.57							
м	01.01.1915				0.25											

1.4. Summary of the internal annual dose in the Volincy municipality

Table 1-4: Summary of the internal annual dose in the Volincy municipality

Year	1998	1999	2000	2001	2002	2004	2005	2005	2006	2010	2011	2012	2013	2014	2015
	A	S	S	S	S	S	S	A	A	A	A	A	A	A	A
Volincy municipality															
Number	83	162	246	264	310	243	228	224	169	120	135	94	127	132	148
							[mSv/a]								
Max. value	4.28	26.41	15.45	6.14	25.71	4.11	1.74	1.64	2.72	2.73	1.25	7.66	0.80	0.66	0.80
Mean	0.70	1.60	0.69	0.32	0.80	0.35	0.25	0.30	0.42	0.18	0.13	0.30	0.10	0.10	0.07
Mean deviation	0.64	4.18	1.72	0.58	2.19	0.52	0.29	0.28	0.50	0.33	0.20	0.92	0.12	0.13	0.10
Qan-95	2.03	7.88	2.62	0.94	2.63	1.17	0.92	0.94	1.46	0.65	0.40	1.05	0.31	0.42	0.18
Qan-05	0.22	0.06	0.04	0.03	0.05	0.04	0.02	0.03	0.03	0.00	0.00	0.01	0.00	0.00	0.00
Mean < 19	0.68	0.69	0.30	0.10	0.28	0.18	0.14	0.16	0.18	0.10	0.06	0.14	0.06	0.04	0.05
Mean 19–35	0.63	4.33	1.66	0.62	1.79	0.60	0.34	0.35	0.58	0.35	0.15	0.07	0.07	0.08	0.09
Mean > 35	0.76	1.40	0.51	0.34	0.78	0.39	0.29	0.38	0.57	0.18	0.21	0.33	0.13	0.16	0.08
Volincy village															
Number	78	112	145	143	191	139	129	129	98	65	82	66	73	72	78
							[mSv/a]								
Max. value	4.28	26.41	15.45	6.14	25.71	4.11	1.74	1.64	2.41	2.73	1.25	7.66	0.80	0.66	0.80
Mean	0.69	2.16	0.91	0.40	1.10	0.46	0.31	0.32	0.46	0.18	0.14	0.39	0.10	0.11	0.07
Mean deviation	0.62	4.88	2.13	0.75	2.74	0.64	0.32	0.28	0.49	0.38	0.23	1.09	0.14	0.16	0.12
Qan-95	1.88	12.50	3.29	1.10	4.87	1.66	0.98	0.96	1.47	0.59	0.42	1.19	0.38	0.51	0.22
Qan-05	0.23	0.08	0.05	0.03	0.04	0.05	0.03	0.03	0.06	0.00	0.00	0.01	0.00	0.00	0.00
Mean < 19	0.63	1.05	0.34	0.12	0.39	0.25	0.19	0.19	0.20	0.09	0.06	0.18	0.06	0.04	0.05
Mean 19–35	0.68	5.06	2.26	0.86	2.76	0.84	0.46	0.42	0.56	0.42	0.16	0.06	0.06	0.09	0.15
Mean > 35	0.75	1.25	0.56	0.37	0.93	0.48	0.35	0.39	0.65	0.16	0.29	0.71	0.19	0.21	0.08
Kljapin village															
Number	3	27	45	52	65	53	53	52	40	24	18	14	20	24	23
							[mSv/a]								
Max. value	0.56	0.41	2.47	1.16	1.12	0.79	1.25	1.42	2.72	0.45	0.24	0.14	0.32	0.17	0.34
Mean	0.32	0.11	0.31	0.24	0.29	0.17	0.13	0.23	0.35	0.08	0.06	0.05	0.09	0.06	0.06
Mean deviation	0.18	0.10	0.52	0.27	0.25	0.18	0.22	0.28	0.53	0.09	0.07	0.04	0.09	0.05	0.07
Qan-95	0.53	0.33	1.71	0.88	0.78	0.54	0.38	0.82	1.34	0.15	0.18	0.12	0.28	0.15	0.11
Qan-05	0.16	0.02	0.02	0.02	0.05	0.02	0.02	0.03	0.02	0.00	0.00	0.01	0.00	0.00	0.00
Mean < 19	0.56	0.06	0.12	0.07	0.13	0.06	0.04	0.12	0.13	0.08	0.05	0.04	0.08	0.05	0.05
Mean 19–35	0.20	0.15	0.39	0.29	0.38	0.28	0.25	0.26	0.80	0.12	0.07	-----	0.07	0.06	0.04
Mean > 35	-----	0.20	0.49	0.37	0.41	0.22	0.14	0.29	0.41	0.05	0.10	0.09	0.12	0.09	0.09
Kljapinskaja-Buda village															
Number	2	23	56	69	54	51	46	43	31	21	15	14	14	14	16
							[mSv/a]								
Max. value	2.67	7.42	5.70	0.70	0.85	1.76	0.99	1.55	2.68	1.10	0.36	0.26	0.17	0.26	0.13
Mean	1.49	0.63	0.40	0.22	0.35	0.25	0.21	0.33	0.40	0.26	0.13	0.11	0.07	0.08	0.05
Mean deviation	1.18	1.47	0.86	0.17	0.22	0.26	0.20	0.29	0.45	0.30	0.09	0.06	0.05	0.07	0.04
Qan-95	2.55	0.97	1.30	0.57	0.70	0.50	0.59	0.87	0.69	1.01	0.26	0.20	0.15	0.22	0.12
Qan-05	0.42	0.08	0.07	0.04	0.06	0.06	0.03	0.07	0.07	0.05	0.03	0.03	0.00	0.02	0.01
Mean < 19	1.49	0.22	0.39	0.11	0.21	0.12	0.08	0.11	0.23	0.15	0.09	0.08	0.03	0.05	0.03
Mean 19–35	-----	1.75	0.29	0.25	0.41	0.25	0.17	0.26	0.18	0.45	0.36	0.12	-----	0.10	-----
Mean > 35	-----	0.49	0.44	0.28	0.43	0.32	0.27	0.44	0.50	0.27	0.12	0.12	0.08	0.09	0.06

1.5. Internal annual dose in the Starograd municipality

Names of villages:

Берестовец = Berestowec
Барсук = Barsuki
Богдановичи = Bordanowichi
Задубье = Sadubje
Рогачев = Rogachew
Любянка = Lubjanka
Петравичи = Petrawich
Староград = Starograd
Хисов = Chisow

Table 1-5: Body activity and internal annual dose (derived from the values of body activity) in the municipality of Starograd

Sex	Year of birth	Place of residence	2004		2005		2004	2005
			Weight	Activity	Weight	Activity	Dose	Dose
			[kg]	[kBq]	[kg]	[kBq]	[mSv/a]	[mSv/a]
ж	1998	Берестовец			50	0.15		0.01
м	1993	Берестовец			32	0.10		0.01
м	1993	Берестовец	47	0.32			0.02	
м	1993	Берестовец	32	0.64			0.04	
ж	1993	Берестовец			45	0.42		0.03
ж	1993	Берестовец	32	0.29	33	0.35	0.02	0.02
м	1991	Берестовец			36	0.03		0.00
ж	1991	Берестовец	50	0.88			0.05	
м	1991	Берестовец			48	0.44		0.02
ж	1989	Берестовец	55	0.44	50	0.43	0.02	0.02
ж	1988	Берестовец	56	0.75	52	1.04	0.04	0.05
ж	1974	Барсук	64	0.42	62	0.10	0.02	0.00
ж	1996	Богдановичи	31	0.29			0.02	
ж	1996	Богдановичи	32	0.30			0.03	
ж	1994	Богдановичи			30	0.31		0.02
ж	1993	Богдановичи	30	0.28	32	0.00	0.02	0.00
ж	1992	Богдановичи	35	0.29	35	0.28	0.02	0.02
ж	1992	Богдановичи			40	0.25		0.01
ж	1991	Богдановичи	36	0.29	38	0.30	0.02	0.02
ж	1990	Богдановичи			43	0.16		0.01
м	1988	Богдановичи			68	0.44		0.02
ж	1988	Богдановичи			50	0.59		0.03
ж	1987	Богдановичи			71	0.27		0.01
ж	1987	Богдановичи			45	0.67		0.03
ж	1976	Богдановичи	84	1.32	79	0.34	0.05	0.01
м	1965	Богдановичи	121	1.96	118	1.93	0.08	0.08
ж	1956	Богдановичи			74	0.18		0.01
ж	1998	Задубье			18	0.00		0.00
ж	1998	Задубье			23	0.00		0.00
ж	1998	Задубье			22	0.15		0.01
м	1997	Задубье	25	0.00	26	0.00	0.00	0.00
м	1997	Задубье	22	0.00	23	0.16	0.00	0.01
м	1997	Задубье	25	0.00			0.00	
ж	1997	Задубье			25	0.10		0.01
ж	1997	Задубье			20	0.03		0.00
м	1996	Задубье	32	0.00			0.00	
м	1996	Задубье	23	0.30	25	0.00	0.03	0.00
м	1995	Задубье	26	0.12			0.01	

Sex	Year of birth	Place of residence	2004		2005		2004	2005
			Weight	Activity	Weight	Activity	Dose	Dose
			[kg]	[kBq]	[kg]	[kBq]	[mSv/a]	[mSv/a]
ж	1995	Задубье	32	0.19	32	0.43	0.01	0.03
ж	1995	Задубье	30	0.14	31	0.06	0.01	0.00
ж	1995	Задубье	31	0.19	31	0.11	0.01	0.01
м	1995	Задубье	24	0.12	25	0.11	0.01	0.01
ж	1995	Задубье	32	0.34	32	0.00	0.03	0.00
м	1994	Задубье	35	0.21	38	0.28	0.02	0.02
ж	1994	Задубье	33	0.00	35	0.00	0.00	0.00
м	1994	Задубье	23	0.00	32	0.00	0.00	0.00
м	1994	Задубье	32	0.17			0.01	0.00
м	1994	Задубье	35	0.26	37	0.00	0.02	0.00
м	1994	Задубье	32	0.00	31	0.28	0.00	0.02
м	1994	Задубье	41	0.22	42	0.28	0.02	0.02
м	1993	Задубье	37	0.00			0.00	
м	1993	Задубье	37	0.15	47	0.68	0.01	0.04
м	1993	Задубье	34	0.00	35	0.08	0.00	0.00
м	1993	Задубье	40	0.00	40	0.17	0.00	0.01
м	1993	Задубье	39	0.00	42	0.00	0.00	0.00
м	1992	Задубье			45	0.07		0.00
ж	1992	Задубье	29	0.00	30	0.28	0.00	0.02
м	1991	Задубье	45	0.52			0.03	
м	1991	Задубье	49	0.15			0.01	
м	1991	Задубье	35	0.00	36	0.22	0.00	0.01
м	1991	Задубье	42	0.31	40	0.20	0.02	0.01
ж	1991	Задубье	50	0.23	55	0.28	0.01	0.02
ж	1990	Задубье	39	0.16	40	0.00	0.01	0.00
ж	1990	Задубье			56	0.16		0.01
ж	1990	Задубье	56	0.38			0.02	
м	1990	Задубье	66	0.31	69	0.38	0.02	0.02
ж	1990	Задубье			52	0.01		0.00
ж	1990	Задубье	51	0.43	50	0.02	0.02	0.00
м	1989	Задубье			42	0.05		0.00
ж	1989	Задубье			55	0.00		0.00
м	1989	Задубье	44	0.34	48	0.53	0.02	0.03
м	1989	Задубье	59	0.23	61	0.00	0.01	0.00
ж	1989	Задубье			51	0.14		0.01
м	1988	Задубье	64	0.50	65	0.10	0.03	0.01
ж	1988	Задубье	56	0.40			0.02	
м	1988	Задубье			62	0.41		0.02
ж	1987	Задубье			71	0.26		0.01
м	1976	Задубье	84	0.65	95	0.86	0.03	0.03
м	1975	Задубье	67	1.08	63	1.08	0.04	0.04
ж	1972	Задубье	82	0.00	80	0.24	0.00	0.01
ж	1971	Задубье	68	0.39			0.02	
ж	1970	Задубье	86	0.85			0.03	
м	1969	Задубье	115	0.79			0.03	
ж	1969	Задубье	86	1.00			0.04	
ж	1967	Задубье			66	0.07		0.00
м	1967	Задубье	71	0.92			0.04	
ж	1966	Задубье	49	0.53			0.02	
ж	1962	Задубье	76	0.19	72	0.00	0.01	0.00
м	1961	Задубье	77	0.92			0.04	
ж	1954	Задубье	106	0.26	101	0.00	0.01	0.00
ж	1951	Задубье	87	1.39			0.06	
м	1947	Задубье	104	0.98	103	0.73	0.04	0.03
ж	1941	Задубье	99	1.27	93	1.08	0.05	0.04
ж	1940	Задубье			59	1.52		0.06

Sex	Year of birth	Place of residence	2004		2005		2004	2005
			Weight	Activity	Weight	Activity	Dose	Dose
			[kg]	[kBq]	[kg]	[kBq]	[mSv/a]	[mSv/a]
м	1932	Задубье			82	0.72		0.03
м	1966	Рогачев	67	0.55			0.02	
ж	1992	Любянка	42	0.17	45	0.38	0.01	0.02
м	1990	Любянка	42	0.67	48	0.23	0.04	0.01
ж	1987	Любянка	69	2.12	73	0.76	0.11	0.04
ж	1997	Петравичи	22	0.00			0.00	
ж	1996	Петравичи	33	0.48	35	1.46	0.04	0.11
м	1996	Петравичи	27	0.19	29	0.15	0.02	0.01
ж	1994	Петравичи	34	0.70	33	1.33	0.05	0.09
ж	1994	Петравичи			27	0.07		0.00
ж	1993	Петравичи			51	0.11		0.01
ж	1992	Петравичи	38	0.21	39	0.11	0.01	0.01
м	1991	Петравичи	57	0.25	57	0.13	0.01	0.01
ж	1991	Петравичи	89	0.63	93	0.00	0.04	0.00
ж	1990	Петравичи	49	0.45	49	0.33	0.03	0.02
ж	1990	Петравичи			45	0.28	0.00	0.02
м	1989	Петравичи	69	0.50			0.03	
ж	1988	Петравичи	66	0.18	59	0.00	0.01	0.00
м	1988	Петравичи	62	1.81	65	0.68	0.09	0.03
ж	1988	Петравичи	56	0.45			0.02	
ж	1977	Петравичи			93	0.68		0.03
ж	1971	Петравичи	88	1.41			0.06	
ж	1996	Староград			37	0.14		0.01
ж	1996	Староград	25	0.10	26	0.03	0.01	0.00
ж	1996	Староград	25	0.00			0.00	
ж	1996	Староград	32	0.00	34	0.13	0.00	0.01
ж	1996	Староград	28	0.00			0.00	
ж	1996	Староград	26	0.00	27	0.04	0.00	0.00
ж	1996	Староград	28	0.14	29	0.14	0.01	0.01
м	1995	Староград	27	0.00			0.00	
м	1995	Староград	29	0.21	30	0.19	0.02	0.01
м	1995	Староград	26	0.00	28	0.00	0.00	0.00
ж	1995	Староград			30	0.18		0.01
м	1994	Староград	30	0.00	29	0.09	0.00	0.01
м	1994	Староград	30	0.00	31	0.00	0.00	0.00
м	1994	Староград	36	0.08			0.01	
м	1994	Староград	28	0.00			0.00	
ж	1994	Староград			35	0.45		0.03
ж	1994	Староград	45	0.00	52	0.22	0.00	0.01
м	1994	Староград			32	0.00		0.00
ж	1994	Староград	32	0.49	36	0.39	0.04	0.03
ж	1993	Староград	56	0.20	56	0.02	0.01	0.00
ж	1993	Староград	36	0.00	39	0.00	0.00	0.00
м	1993	Староград	34	0.18	35	0.09	0.01	0.01
ж	1993	Староград	43	0.00	50	0.00	0.00	0.00
ж	1993	Староград	32	0.15	33	0.26	0.01	0.02
м	1993	Староград	32	0.25	33	0.17	0.02	0.01
ж	1992	Староград			41	0.20		0.01
м	1992	Староград	43	0.26	47	0.01	0.02	0.00
ж	1992	Староград	48	0.00	49	0.00	0.00	0.00
м	1992	Староград	61	0.00	65	0.21	0.00	0.01
ж	1992	Староград	37	0.00	38	0.00	0.00	0.00
м	1991	Староград			52	0.49		0.03
м	1991	Староград	44	0.25			0.01	
м	1991	Староград			47	0.22		0.01
м	1991	Староград	49	0.23	54	0.67	0.01	0.04

Sex	Year of birth	Place of residence	2004		2005		2004	2005
			Weight	Activity	Weight	Activity	Dose	Dose
			[kg]	[kBq]	[kg]	[kBq]	[mSv/a]	[mSv/a]
м	1991	Старо град	46	0.00	50	0.05	0.00	0.00
ж	1991	Старо град	56	0.23	61	0.21	0.01	0.01
м	1990	Старо град	57	0.42			0.02	0.00
м	1990	Старо град	48	0.32	56	0.27	0.02	0.01
м	1990	Старо град	60	0.26	62	0.14	0.01	0.01
ж	1990	Старо град	58	0.29	60	0.07	0.02	0.00
м	1990	Старо град	56	0.00	62	0.11	0.00	0.01
м	1990	Старо град	49	0.15			0.01	
м	1990	Старо град			57	0.25		0.01
м	1989	Старо град			82	0.72		0.04
ж	1989	Старо град			98	0.06		0.00
ж	1989	Старо град	70	0.21	66	0.05	0.01	0.00
м	1989	Старо град			71	0.52		0.03
ж	1989	Старо град	61	0.00	56	0.00	0.00	0.00
ж	1989	Старо град	87	0.31	94	0.00	0.02	0.00
ж	1989	Старо град	58	0.24	55	0.34	0.01	0.02
м	1988	Старо град			65	0.47		0.02
ж	1988	Старо град			55	0.08		0.00
м	1988	Старо град			55	0.00		0.00
ж	1988	Старо град	52	0.00	51	0.07	0.00	0.00
ж	1988	Старо град			44	0.00		0.00
ж	1988	Старо град			50	0.00		0.00
м	1987	Старо град	68	0.38	70	0.52	0.02	0.03
ж	1981	Старо град	89	0.82			0.03	
ж	1971	Старо град			65	0.35		0.01
ж	1970	Старо град			85	0.67		0.03
м	1965	Старо град			72	0.61		0.02
ж	1961	Старо град	60	0.60	56	0.23	0.02	0.01
ж	1961	Старо град	84	0.00	82	0.09	0.00	0.00
ж	1957	Старо град	99	0.37			0.01	
ж	1996	Хисов	23	0.40			0.03	
м	1996	Хисов	28	0.31			0.03	
м	1995	Хисов	29	0.32			0.02	
м	1995	Хисов	34	0.46			0.04	
м	1995	Хисов	29	0.28			0.02	
м	1995	Хисов	27	0.36			0.03	
ж	1995	Хисов	24	0.24			0.02	
ж	1994	Хисов			39	0.20		0.01
ж	1994	Хисов			44	0.36		0.02
ж	1994	Хисов			46	0.00		0.00
ж	1994	Хисов	32	0.35	33	0.56	0.03	0.04
м	1994	Хисов	31	0.34	33	0.06	0.02	0.00
м	1993	Хисов	32	0.30	31	0.09	0.02	0.01
м	1993	Хисов	44	0.38	46	0.32	0.03	0.02
ж	1993	Хисов			33	0.18		0.01
м	1993	Хисов			26	0.03		0.00
м	1993	Хисов	35	0.39	35	0.41	0.03	0.03
ж	1993	Хисов			40	0.22		0.01
ж	1993	Хисов	40	0.32	42	0.00	0.02	0.00
ж	1993	Хисов	36	0.29	36	0.38	0.02	0.02
ж	1993	Хисов	31	0.30	33	0.13	0.02	0.01
ж	1993	Хисов			40	0.02		0.00
ж	1993	Хисов	40	0.46	41	0.24	0.03	0.01
м	1993	Хисов	39	0.41	41	0.20	0.03	0.01
ж	1993	Хисов	30	0.27	31	0.00	0.02	0.00
ж	1993	Хисов	55	0.25			0.02	

Sex	Year of birth	Place of residence	2004		2005		2004	2005
			Weight	Activity	Weight	Activity	Dose	Dose
			[kg]	[kBq]	[kg]	[kBq]	[mSv/a]	[mSv/a]
м	1992	Хисов			45	0.15		0.01
ж	1992	Хисов			57	0.18		0.01
м	1992	Хисов			50	0.20		0.01
м	1992	Хисов	35	0.00	37	0.07	0.00	0.00
м	1992	Хисов			45	0.22		0.01
ж	1992	Хисов			52	0.08		0.00
ж	1991	Хисов			45	0.04		0.00
ж	1991	Хисов			45	0.64		0.04
м	1991	Хисов			56	0.42		0.02
ж	1991	Хисов	33	0.30	35	0.12	0.02	0.01
ж	1991	Хисов			52	0.70		0.04
ж	1991	Хисов			60	0.01		0.00
ж	1991	Хисов			43	0.11		0.01
ж	1990	Хисов			52	0.18		0.01
м	1990	Хисов			54	0.39		0.02
ж	1990	Хисов	38	0.38			0.02	
м	1990	Хисов	44	0.52	49	0.15	0.03	0.01
ж	1990	Хисов			58	1.41		0.08
ж	1990	Хисов			46	0.17		0.01
м	1990	Хисов	50	0.00	52	0.47	0.00	0.03
м	1990	Хисов			73	0.37		0.02
м	1989	Хисов			35	0.33		0.02
м	1989	Хисов			62	0.16		0.01
ж	1989	Хисов	59	0.38	60	0.00	0.02	0.00
ж	1989	Хисов	59	0.20			0.01	
м	1989	Хисов			76	0.39		0.02
м	1989	Хисов			75	0.70		0.04
м	1989	Хисов			55	0.74		0.04
м	1989	Хисов	58	0.56	64	0.93	0.03	0.05
м	1988	Хисов	61	0.70	65	0.71	0.04	0.04
м	1988	Хисов	68	0.87	69	0.65	0.05	0.03
ж	1988	Хисов	65	0.38	59	0.00	0.02	0.00
м	1988	Хисов			35	0.35		0.02
ж	1988	Хисов			50	0.08		0.00
ж	1988	Хисов	66	0.50			0.03	
м	1988	Хисов			62	0.46		0.02
м	1988	Хисов			71	0.09		0.00
ж	1988	Хисов	41	0.25			0.01	
м	1988	Хисов	52	0.29	55	0.32	0.02	0.02
м	1987	Хисов			64	0.56		0.03
м	1987	Хисов			67	0.51		0.03
м	1987	Хисов			105	0.00		0.00
ж	1984	Хисов			65	0.42		0.02
ж	1984	Хисов			58	0.38		0.02
ж	1983	Хисов	67	0.29	68	0.18	0.01	0.01
ж	1982	Хисов	55	0.34			0.01	
м	1981	Хисов			75	0.07		0.00
м	1981	Хисов	90	0.92			0.04	
ж	1977	Хисов			60	0.13		0.01
м	1977	Хисов	64	0.84	63	1.23	0.03	0.05
м	1976	Хисов	74	1.13	72	0.60	0.05	0.02
ж	1975	Хисов			60	0.53		0.02
ж	1972	Хисов	67	0.48	66	0.08	0.02	0.00
м	1971	Хисов	68	1.07			0.04	
ж	1966	Хисов			105	0.44		0.02
ж	1958	Хисов	84	1.65			0.07	

Sex	Year of birth	Place of residence	2004		2005		2004	2005
			Weight	Activity	Weight	Activity	Dose	Dose
			[kg]	[kBq]	[kg]	[kBq]	[mSv/a]	[mSv/a]
м	1956	Хисов	93	1.94			0.08	
м	1954	Хисов			30	0.18		0.01

Table 1-6: Summary of the measurement data in the Starograd municipality

Year	2004	2005	2004	2005
Number	170	210		
	Body activity		Internal annual dose	
	[kBq]	[kBq]	[mSv/a]	[mSv/a]
Mean	0.38	0.28	0.01	0.01
Mean deviation	0.40	0.32	0.02	0.02
< 18 years	0.27	0.24	0.01	0.01
> 18 years	0.83	0.51	0.02	0.01

Photo 1 : Measuring vehicle (whole-body counter) and support vehicle before departure to Belarus (2013)

Photo 2 : Forschungszentrum Jülich's measuring vehicle with whole-body counter and analysis unit

Photo 3 : New pontoon bridge crossing the Sozh river, on the road from Korma to Volincy (2013)

Photo 4 : The old pontoon bridge across the Sozh river (before 2003)

Photo 5 : Strumen closed zone between Korma and Volincy (2004)

Photo 6 : The road through the village of Volincy

Photo 7 : Measurement campaign in Kljapinskaja-Buda (2013)

Photo 8 : Measurement campaign in Kljapinskaja-Buda (2015)

Photo 9 : Traditional means of transportation in Volincy (2004)

Photo 10 : “Home-made” tractor in Volincy (2002)

Photo 11 : Forschungszentrum Jülich's measuring vehicle in action in Volincy (2014)

Photo 12 : Children waiting in front of the measuring vehicle in Kljapin (2013)

Photo 13 : One of the youngest test subjects

Photo 14 : Measuring vehicle at a school in the municipality of Starograd (2005)

Photo 15 : Children in front of Forschungszentrum Jülich's measuring vehicle at the school in Kljapin (2013)

Photo 16 : Taking soil samples in Volincy (2015)

Photo 17 : Measuring local dose rates and taking soil samples in the forest of Koljut (2013)

Photo 18 : Sample location, covered with firewood (2015)

Photo 19 : Food samples at the local market

Photo 20 : Collecting mushrooms is forbidden in the closed zone

Photo 21 : Personal contact is necessary

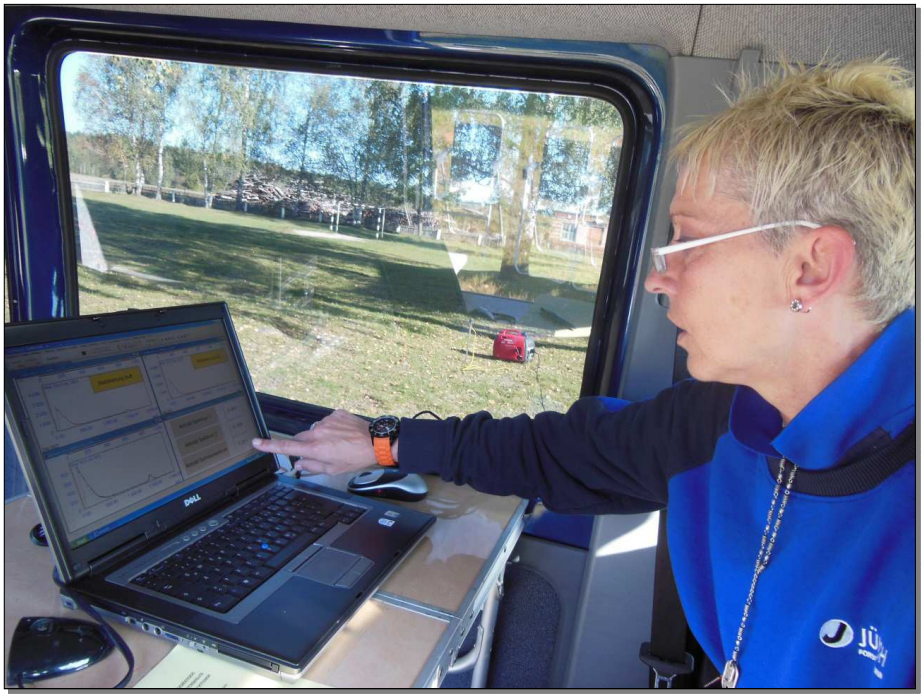


Photo 22 : Final measurements in the year 2015 in Kljapin

Photo 23 : Keeping children happy is part of our job

Photo 24 : Unfortunately, we were not able to offer whole-body measurements for animals

Photo 25 : The new measurement team in Korma (2013)

Photo 26 : Measurement team with contacts in the Korma district hospital

Photo 27 : Belarus is a fabulous country for mushrooms

Photo 28 : ... as well as a nature reserve

Band / Volume 328
Conductivity and Structure of Sputtered ZnO:Al on Flat and Textured Substrates for Thin-Film Solar Cells
N. Sommer (2016), vii, 195, XIV pp
ISBN: 978-3-95806-156-9

Band / Volume 329
Glaslotfügen von Festoxid-Brennstoffzellen durch Laseraufschmelzung
M. Willberg (2016), 99 pp
ISBN: 978-3-95806-157-6

Band / Volume 330
The Role of Natural Nanoparticles and Colloids for Phosphorus Binding in Forested Headwater Catchments
N. Gottselig (2016), VIII, 116 pp
ISBN: 978-3-95806-160-6

Band / Volume 331
Numerische Modellierung der thermomechanischen Fluid-Struktur-Interaktion im SOFC-Stack
A. Al-Masri (2016), iii, 165 pp
ISBN: 978-3-95806-161-3

Band / Volume 332
Analysis of biomixtures to determine the fate of pesticides
S. Mukherjee (2016), xix, 136 pp
ISBN: 978-3-95806-163-7

Band / Volume 333
Temperature Dependence of Carbon Kinetic Isotope Effect for The Oxidation Reaction of Ethane by Hydroxyl Radicals Under Atmospherically Relevant Conditions: Experimental and Theoretical Studies
T. Piansawan (2016), 196 pp
ISBN: 978-3-95806-166-8

Band / Volume 334
Konzeption von Membranmodulen zur effizienten Abtrennung von Kohlendioxid aus Gasgemischen
S. Luhr (2016)
ISBN: 978-3-95806-170-5

Band / Volume 335
Einfluss fehlpassungsinduzierter Spannungsfelder auf den Transportprozess bei ionischer Leitung
J. Keppner (2016), viii, 171 pp
ISBN: 978-3-95806-171-2

Band / Volume 336
Production and Characterization of Monodisperse Uranium Particles for Nuclear Safeguards Applications
A. Knott (2016), A-H, 123, xxviii, xiii pp
ISBN: 978-3-95806-172-9

Band / Volume 337
3D hydrological simulation of a forested headwater catchment: Spatio-temporal validation and scale dependent parameterization
Z. Fang (2016), XVII, 119 pp
ISBN: 978-3-95806-174-3

Band / Volume 338
Influence of Thermomechanical Treatment on High Temperature Properties of Laves Phase Strengthened Ferritic Steels
M. Talík (2016), xxiii, 130 pp
ISBN: 978-3-95806-175-0

Band / Volume 339
Groundwater recharge in Slovenia
Results of a bilateral German-Slovenian Research project
Mišo Andjelov, Zlatko Mikulič, Björn Tetzlaff, Jože Uhan & Frank Wendland (2016)
ISBN: 978-3-95806-177-4

Band / Volume 340
Atomic oxygen derived from SCIAMACHY O(1S) and OH airglow measurements in the Mesopause region
Y. Zhu (2016), 206 pp
ISBN: 978-3-95806-178-1

Band / Volume 341
Diagnostic Mirror Concept Development for Use in the Complex Environment of a Fusion Reactor
A. Krimmer (2016), x, 123 pp
ISBN: 978-3-95806-180-4

Band / Volume 342
Long-Term Measurements of the Radiation Exposure of the Inhabitants of Radioactively Contaminated Regions of Belarus – The Korma Report II (1998 – 2015)
P. Zoriy, H. Dederichs, J. Pillath, B. Heuel-Fabianek, P. Hill, R. Lennartz (2016), ca 105 pp
ISBN: 978-3-95806-181-1

Weitere ***Schriften des Verlags im Forschungszentrum Jülich*** unter
http://wwwzb1.fz-juelich.de/verlagextern1/index.asp

Energie & Umwelt /
Energy & Environment
Band / Volume 342
ISBN 978-3-95806-181-1