

# Effects of the Chernobyl Catastrophe

## -Literature Review-

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### I.) Introduction

#### The Meltdown

On Saturday, April 26th, 1986 at 1:23 am, Block 4 of the nuclear power plant at Chernobyl exploded. The plant was located approximately 100 km north of the Ukrainian capital Kiev, near the border with Belarus. 180,000 kilograms of highly radioactive material is inside the reactor at the time - an amount equal to 1,000 Hiroshima bombs. About  $10^{19}$  Bq of radioactive material – consisting of at least 200 different radioactive isotopes - was set loose into the atmosphere, 50 to 80% of this being <sup>131</sup>Iodine.<sup>12</sup> This nuclear fallout contaminated 23% of the state of Belarus, some parts of Russia and Ukraine, as well as regions of Poland, the Czech Republic, Scandinavia and southern Germany. 36 hours after the meltdown, highly increased doses of atmospheric radioactivity were measured in Germany, Switzerland, the Czech Republic and even as far as Scandinavia. Due to rain and wind currents, 70% of radioactivity came down in Belarus, most of it in the regions of Gomel and Mogilev, 15% in Ukraine and Russia and the other 15% dispersed over the rest of the world. Most of Europe receives additional radiation and even as far as North America, a significant rise in the daily intake of radiation can be noted. A 30% increase in child mortality was registered in May and June of 1986 in New Jersey, while southern Germany measured a 70% rise.<sup>3</sup>

80-90% of the radiation dose received by the inhabitants of the affected areas was and is internal, due to the oral intake of contaminated food, especially home produced milk, wild fruits and mushrooms. The contamination through inhalation was important in early days, when high iodine concentration was present in the air. The highest doses were absorbed by the clean-up workers (liquidators) and the inhabitants of the most contaminated communities.<sup>18</sup>

According to the WHO, up to 800.000 people were used by Soviet authorities to clean up the rubble of Block 4 – exposing them to radiation doses comparable to the victims of Hiroshima and Nagasaki. Up to this day, children in the region eat contaminated food, live in contaminated houses, play in contaminated woods and breathe contaminated dust.

According to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), up to nine million people were and are affected by the devastating results of the Chernobyl catastrophe. (OCHA, Kiev 2001) A significant rise in all types of cancer was established by independent epidemiological studies, as well as thousands of deaths, a sharp increase in the number of spontaneous abortions, stillbirths, and childhood mortality, a growing number of birth defects and genetic abnormalities, disturbance and retardation of mental development, a growing number of neuropsychiatric diseases, blindness, endocrine diseases, diseases of the respiratory, cardiovascular, gastrointestinal, urogenital systems as well as higher depression and suicide rates.

#### The cover-up

The first catastrophe of Chernobyl was the meltdown itself. The second catastrophe of Chernobyl was and still is the subsequent cover-up. Hans Blix, former head of the International Atomic Energy Agency, charged with the promotion of nuclear energy, stated after the Chernobyl meltdown became public that “the atomic industry can take catastrophes like Chernobyl every year”. This cynical slap in the face to the hundreds of thousands of victims of the accident seems to remain the dogma of the IAEA until today. The effects of the accident are still being suppressed, played down and minimized. Even today, the IAEA claims there were only 56 deaths. Meanwhile, hundreds of thousands of people are still being affected: in Ukraine, Belarus, Russia, Poland and other western and northern European countries. Many victims have been neglected and remain without any help at all. Even worse: the IAEA has just recently called for a stop of aid to the victims in order to prevent what it calls victim-mentality. In reality, the organization’s sole aim is to promote nuclear energy and the pictures of tens of thousands of irradiated children with leukaemia don’t really fit into the picture of clean energy.

The IAEA, an organization founded and funded in order to "promote safe, secure and peaceful nuclear technologies" claimed in its report in 1991 that the population of the areas surrounding Chernobyl were "generally" healthy and there was nothing to fear. Another IAEA report in 2000 again took this stand, stating that with only a few cases of treatable, non-lethal thyroid cancer amongst children, no scientific evidence could be found to support

the belief of rising cancer incidence or mortality. Following a recent conference of the Chernobyl Forum, an expert panel staffed with government envoys of the three directly affected countries and some UN agencies including the International Atomic Energy Agency (IAEA), the following excerpts could be read in the world press:

"No evidence or likelihood of decreased fertility among the affected population has been found, nor has there been any evidence of increases in congenital malformations that can be attributed to radiation exposure."

"Poverty, lifestyle diseases now rampant in the former Soviet Union and mental health problems pose a far greater threat to local communities than does radiation exposure."

Dr. Michael Repacholi, Manager of WHO's Radiation Program was quoted as follows: "The sum total of the Chernobyl Forum is a reassuring message." He explains that there have been 4,000 cases of thyroid cancer, mainly in children, but that except for nine deaths, all of them have recovered - a survival rate of almost 99%. Otherwise, the team of international experts found no evidence for any increases in the incidence of leukaemia and cancer among affected residents. (...) The health effects of the accident were potentially horrific, but when you add them up using validated conclusions from good science, the public health effects were not nearly as substantial as had at first been feared. (...) If we do not expect health or environmental effects, we should not waste resources and effort on low priority, low contamination areas," he explains. "We need to focus our efforts and resources on real problems."<sup>2</sup>

IPPNW and many other organizations, states and institutions like the Belarus National Cancer Registry or the Centre for Russian Environmental Policy of the Russian Academy of Sciences have strongly objected to this cynical way of treating the Chernobyl meltdown, including the government of Ukraine. In many cases, the IAEA report is based on studies of more than 10 years of age, without taking into account newer scientific research. Numbers for dosimetry counts of the population are not available and the report thus relies on approximations, without clearly stating this. Mean averages are being created over vast populations in huge territories without knowing any concrete numbers. Health effects outside of the three countries were not even considered and significant amounts of data still remain classified and cannot be reviewed by outside scientists. Therefore, the results of the IAEA studies cannot be formally disproved but have to either be believed or not.<sup>1</sup> Even UN Secretary General Kofi Annan apparently does not really take the IAEA report seriously: "...the exact number of victims may never be known, but 3 million children require treatment and...many will die prematurely...Not until 2016, at the earliest, will be known the full number of those likely to develop serious medical conditions...because of delayed reactions to radiation exposure...many will die prematurely..."

Despite frequently cited statistics about the rate of cancer screenings and other medical follow up, few official attempts were undertaken to truly assess the results of radiation and many NGOs in the area, as well as the institutes cited in this paper criticize the publication of IAEA statistics, which are not based on any real facts. Fact is that a vast majority of the population is not being screened for cancer, is not receiving regular check ups, ultrasound exams or other types of secondary preventive measures. What's worse, the IAEA is going public these days with statements ridiculing the so called "radiophobia" of the population and calling for an end of aid programs, which, according to the IAEA report of 2005, only serve to instil a victim mentality in a totally healthy population – a claim not only cynical, but potentially dangerous for the health of the affected population.

## II.) The effects of radiation

The claims over the amount of fatalities caused by Chernobyl could not be more different: While the WHO and the IAEA talk about 56 casualties resulting from the meltdown, their opponents cite scientific studies amounting tens of thousands of additional deaths. Who is to be believed?

The question of casualties can be tackled from two directions: The first one would be to ask the following question: How many casualties would be expected by a meltdown like the one in Chernobyl? Secondly, the actual number of victims could be accounted for.

### Calculations of expected casualties

How many casualties would be expected by a meltdown like the one in Chernobyl, freeing radioactive isotopes like <sup>137</sup>Cesium, <sup>131</sup>Iodine or <sup>90</sup>Strontium and spreading them over an area of more than 43,000 square kilometres in Belarus alone?

In order to answer this question, let's take the official Soviet statistics and analyze them according to the calculations of the International Commission on Radiological Protection (ICRP). This institute, which is not under the suspicion of being partial in this matter, calculated in 1977 that 125 additional cancer deaths would be caused by each 1,000,000 man rem radiation. Man rem is a product of the amount of people irradiated and the doses received. This means that 1 million man rem could be 1 million people each receiving a single rem radiation or, for example, 100,000 people each receiving 10 rem radiation.

The measurement rem is equivalent to 0.01 Sievert (Sv) or 10 mSv, which is a more modern unit used for accurately assessing the relative biological effect of radiation. The natural background radiation received by every human on this planet is about 0.0024 Sv (2,4 mSv) or 0.24 rem per year. Radiation Protection laws prohibit occupational exposure to more than 5 rem per year.

Just to compare: according to the Belarus National Cancer Registry, the average dose of radiation per person in Ukraine was: 17 rem (with liquidators receiving up to 100 rem) in 1986, 13 rem in 1987, 3 rem in 1988 and 1.5 rem in 1989. Not citing specific sources, the IAEA report of 2005 cites rem counts of the general population five times lower for 1986.

Taking the official statistics quoted in Appendix 7 of the report of the USSR to the IAEA in 1986, it can be said that 240,600,000 million man rem have to be calculated for the Chernobyl meltdown. The report breaks it down to the following:

- 1.6 million man rem for the 135,000 people that had to be evacuated from the 30 km security perimeter around the destroyed power plant, who received an average of 11.85 rem each
- 29 million man rem for the 74.5 Million people who were affected by radioactive fallout and external Gamma ray irradiation immediately following the meltdown in Chernobyl (an average of 2.6 rem per person)
- 210 million man rem for the entire population of the former Soviet Union in a period of seventy years due to consumption of radiocesium in the daily diet

Combining the statistics offered by the USSR (which no doubt sought to downplay the problems caused by the meltdown and could not take into account modern day finding concerning the effects of low level radiation, but only concentrated on the effects of radiocesium and direct gamma ray irradiation) with the calculations of the ICRP, one comes to the conclusion that the IAEA would have come to as well in 1986: even with the drastically underplayed Soviet figures and the relatively low risk factor of 125, the expected cases of additional cancer deaths due to the Chernobyl meltdown would be 240.6 Million man rem x 125 cases per 1 Million man rem = 30,075 cases!

And this was in 1986. In 1990, the ICRP corrected its original risk factor due to new findings and published the new figure of 500 additional cancer deaths per 1 million man rem in its 60th report. This would bring the number of expected additional cases of cancer deaths due to Chernobyl to 120,300.

In the year 2000, after reviewing statistical evidence and new scientific research, the UN Scientific Committee on the Effects of Atomic Radiation UNSCEAR, again an institution not readily associated with left-winged ecological activism, corrected this number again and published the figure of 11,000 additional cancer deaths per every 1 Million man rem, bringing the figure of additional expected cancer deaths due to Chernobyl to a staggering 264,660 cases.<sup>1</sup>

## Low level radiation

Let's not forget, however that these numbers are only theoretical, but do not count in the effects of low level radiation, the non-cancer causes of death, the casualties outside the Soviet Union (Sweden, Southern Germany and the Czech Republic received vast amounts of radiation as well) and many other aspects of the disaster.

One such aspect is the evidence suggesting the detrimental effects of low level radiation as opposed to high level radiation. The bombs over Hiroshima and Nagasaki caused high-level radiation in form of gamma rays, which hit people like rays of light and caused damage to their cells. Low level radiation however is the type of radiation emanating from radioactive particles in the air, the soil, the food or the buildings of the regions around Chernobyl.

Pierce and Preston used Life Span Study (LSS) solid cancer incidence data for the period from 1958 through 1994 in an assessment of low-dose risks to show that there is statistically significant evidence of risk in the dose range of approximately 0-0.1 Sv.<sup>17</sup> Even the conservative National Academy recently conceded the fact that low-dose radiation can significantly alter genetic information, cause cancer and that no threshold dose can be established. This finding contradicts IAEA statements, which claimed that a clear threshold dose exists for harmful radiation, under which no damage occurs. 2003, the European Commission for Radiation Risk (ECRR) established a model explaining the increase in leukaemia and cancer incidence around nuclear power plants and the region around Chernobyl. This model takes into account epidemiological and biophysical factors and differentiates between low dose radiation causing damage over a long period of time and short external high dose radiation. This model clearly expands the former ICRP model, which completely disregarded damage cause by low-dose radiation and was not able to explain the damage caused by isotope ingestion and other aspects of the Chernobyl meltdown.

The interesting findings of Abraham Petkau of the Canadian Atomic Research Unit in Manitoba showed that low level radiation actually does more harm to cells and DNA than high dose radiation. This so-called Petkau effect was established in the paper "Internal Exposure to Low Level Radiation" in 1975 and showed that the amount of radiation necessary to damage cell membranes was significantly lower when his radiation was applied to the cells in a very slow way, while high radiation that hit the membrane very quickly and then stopped did considerably less damage to the cell:

- High-dose radiation of 25 rad/min needed 3,500 rads to destroy a cell membrane
- Low-dose radiation of 0.001 rad/min needed 0.7 rad to destroy a cell membrane

The rationale for this is the lipid peroxidation in the membranes and the creation of free oxygen radicals, which then in turn destroy the membrane and the genetic material in the cell's nucleus. Thus, it becomes apparent that the low dose radiation still emanating from Ukrainian soil, or the wood of the forests around Chernobyl, mushrooms in Russia, milk of Ukrainian cows or the bricks of the houses in and around Gomel actually do more harm to the body's cells when ingested, inhaled or inoculated than the gamma rays which were emitted in the beginning of the meltdown. Over the course of 20 years, radioactive <sup>137</sup>Cesium, <sup>131</sup>Iodine and <sup>90</sup>Strontium have polluted the region around Chernobyl and vast strips of land in Belarus and are still irradiating the population today. By the way, the rad is a unit of absorbed radiation dose defined in terms of the energy actually deposited in the tissue. One rad is an absorbed dose of 0.01 joules of energy per kilogram of tissue. The more recent SI unit is the gray, which is defined as 1 joule of deposited energy per kilogram of tissue. Thus one gray is equal to 100 rad.

Taking into account these findings and the potential results on the calculations of Chernobyl victims, the WHO estimate of more than 9 million affected people does not sound all too far fetched anymore – despite the fact that this number is one not appearing in any IAEA or UNSCEAR reports for reasons which would become obvious at the end of this paper.

## Identifying the victims

But now to the second method of looking at casualties – actually counting them. For this, we need to know how many people were actually affected by the irradiation.

The main group affected by the radiation were the so-called liquidators – clean-up workers drawn from all over the USSR in order to extinguish the fire belching out radioactive isotopes into the atmosphere for 10 days, carry away heavy pieces of radioactive material, clean the roof of Block 4, decontaminate the villages around Chernobyl, construct the sarcophagus and seal off all radioactive material. Instead of using robots or heavy machinery, these "human drones" as they were also called provided the Soviet authorities with a cheap, effective and virtually unlimited resource. From September 20<sup>th</sup> to October 1<sup>st</sup> 1986, more than 3000 soldiers-partisans worked on the roof, the most heavily radiated area of the entire region, with a radiation dose of about 1000 Roentgen/hour.<sup>19</sup>

The average age of the liquidators was 33. They were soldiers serving in the Red arms, civilians drawn to civil service or construction workers. They were not given protective gear, were told to run in, count to 90 and return immediately – so much for primary prevention. Upon termination of their work, they received phony medals and certificates, stating that their country was grateful for their sacrifice. When it came to measuring their dosage, it was oftentimes not possible to measure real exposure doses due to unavailability of equipment. If it was available, the people in charge were ordered to note false measurements, as doses of 50 or 100 rem were simply not permitted so that they had to be noted down in official record as 7.5 or 17 rem – as a result falsifying the official reports and preventing the liquidators from receiving recognition as radiation victims later on.

The estimates on how many liquidators were involved in the clean up vary. Until 1996, the governments of Belarus, Ukraine and Russia registered 200,000 liquidators. At the same time, the number given by Russian authorities today on how many Russian citizens were involved is 120,000. Add to that 363,000 Ukrainians officially registered as liquidators and another 120,000 liquidators from Belarus and a fairly large number of unregistered people and you end up with a total number somewhere between 800,000 and 1 Million, a number frequently appearing in WHO reports as well – including soldiers and young men from Kazakhstan, Estonia, Siberia and other parts of the former Soviet Union. In Uzbekistan alone, the number of liquidators is estimated to be 100,000.<sup>26</sup> In the IAEA report, there is talk of 600,000 clean-up workers, while the number used for calculations is 200,000. No explanation given.<sup>25</sup>

About half of these liquidators were never officially registered but rather moved to Chernobyl for the cleanup and later returned home without knowing their received dosage or being supplied with proper medical follow up. But even for the registered liquidators, there is no sound data. Only 63% of all registered Russian liquidators have documented dosage levels – and only 56% of the Ukrainians and 9% of the liquidators from Belarus.<sup>1</sup> At the same time, the liquidators themselves report of false readings, broken instruments and orders to state dosage levels much lower than actually measured so that even these registered values cannot be trusted. The WHO itself cites the calculated error of some of the dosage readings as 50%, 300% or 500%, depending on the source.<sup>31</sup> Surely these readings cannot be seriously taken as the basis for scientific calculations. However, the IAEA does just that. These liquidators were the ones to bear the greatest burden of the meltdown and were mostly left alone with their problems arising from the work in Chernobyl. Taking into account reliable sources from Russia, the Ukraine and Belarus, it can be estimated that around 50,000 of the liquidators have already died before the year 2000. The vast majority of the rest is invalid and suffers from cancer, cardiovascular diseases and other ailments.<sup>11</sup>

But of course, these liquidators are not the only ones affected by the fallout. According to the Belarus National Cancer Registry, about 2.1 million inhabitants (23%) of Belarus lived in the territory with Cs level of more than 40 kBq/m<sup>2</sup>.<sup>3</sup> The extent of the health problems of the Ukrainian population was made public by the Ukrainian embassy in April of 2005. In a press-release, the government published findings stating that of the 2,646,000 inhabitants of the contaminated region (23% of the state of Belarus received more than 1 Curie of 137Cs per km<sup>2</sup>), 85% are affected by radiation-induced diseases. Amongst the affected population live 500,000 children. Every year brings with it a worsening of their health situation. 94% of the liquidators are also sick, one third of them being invalids according to a study released by the Ukrainian Congress in June of 2001. Long lived isotopes remain in the upper part of the soils; they are recycled in plants and animals, especially wood used for building and agricultural products, becoming the main source of the radioactive contamination of humans.<sup>7</sup>

According to aid relief agencies, cancer registries and researchers like Dr. Okeanov of Belarus, 20,000 deaths and roughly 200,000 invalids can be attributed to the radiation, although these numbers are extremely hard to accurately verify. What's clear though is that the numbers presented by the IAEA are a cynical slap in the face to the more than 5 million people living in the contaminated regions: 50 workers of the power plant who died of acute radiation sickness, 9 children who died from thyroid cancer and 3940 people who died from radiation-induced leukaemia and solid cancers! Another thing that should be very clear is that anyone claiming to provide exact numbers in this region should not be trusted, as means of acquiring valid data are extremely limited and the effects of political unrest and migration, especially since the fall of the Iron Curtain are making it hard to extract exact numbers.

Another disturbing fact is that the estimated number of victims outside of the former Soviet Union may have to be reevaluated following UNSCEAR's 1993 study, which showed that the collective radiation dose in the former Soviet Union only contributes to 36% of the total collective dose. 53% of this total dose went down over Europe, 8% over Asia, 2% over Africa and 0,3% over the Americas. This might lead to a drastic reassessment of the total number of expected casualties in connection with the Chernobyl disaster in years to come.<sup>30</sup>

## Radiation sickness

The immediate effects of radiation sickness to the liquidators closely resemble those described by survivors of Hiroshima and Nagasaki: nausea, hair loss, fatigue, loss of consciousness, disorientation, internal bleeding, delirium, etc. The countless stories of the liquidators and their families are moving testimonies of a horrible crime committed against these people by their own government. While IAEA claims that the total amount of casualties due to Acute Radiation Sickness (ARS) do not exceed 28, this number cannot be trusted due to the secrecy and top-level cover up of the immediate effects of the accident. While we may have no way of proving the exact number of deaths caused by ARS, we should certainly look upon this number very critically in light of what we know about the political situation, the obvious self-interest of the people promoting these low statistics and the eye-witness reports of liquidators which suggest much higher numbers of ARS victims. A movie recently produced brings their stories to life and shows the horror of their work in short, black-and-white scenes of 1986 as well as their suffering and dying in the subsequent years. Today, 94% of the surviving liquidators are sick and dying – many people in their fifties look like they have already reached their 80's or 90's, premature aging being another effect of radiation.

## Cancer statistics

Besides the accounts of survivors, another important source of information about the effects of Chernobyl is the research of Dr. Okeanov. Dr. Okeanov is considered the father of the Belarus National Cancer Registry and a scientist at the Clinical Institute of Radiation Medicine and Endocrinology Research of the International Sakharov University, Minsk. This Institute first established reliable statistics on the true amount of radiation received by the liquidators, of which 71,840 are registered at the Institute: According to their measurements, 40% of the liquidators received a dose of up to 50 mSv (keeping in mind that natural radiation is about 2.4 mSv, this would be 20 times the normal annual dose), while 37% received 50-100 mSv, 20% received 100-200 mSv and 3% received the maximum dose of 200-300 mSv – 120 times the mean annual dose!

The Belarus National Cancer Registry, which was founded in 1973 and has been continuing its work on a high quality and process standard, has found that “the overall cancer morbidity rate in all organs including colon, urinary bladder and thyroid, was significantly higher in all regions of Belarus, but that it was the most pronounced in the Gomel region, where it increased by more than 50% - from 147.5 to 224.6. The regions of Mogilev and Gomel had received a vast amount of radiation due to a rainfall shortly after the Chernobyl meltdown in the southwest of Gomel. In Gomel the relative incidence of cancer cases rose from 240.0 per 100,000 in 1989 (the lowest incidence rate in all of Belarus at the time) to 346.0 per 100,000 in 1999 (by far the highest in all of Belarus).<sup>3</sup>

Average annual excess rates of cancers in all sites in liquidators was 5.5%, which is significantly higher than in the adult population of Vitebsk, a region of Belarus receiving less amount of radiation. There, it is a mere 1.5%. Among liquidators living in areas with the levels of contamination of <sup>137</sup>Cs higher than 555 kBq/m<sup>2</sup>, the mean incidence of respiratory tract cancer was 80.1 per 100,000 in 1993-2002, compared to 44.7 per 100,000 for liquidators living in regions with a lower contamination level.<sup>3</sup>

From 1976-1985, the morbidity rate in the Gomel region had been lower than the republican average. In 1990-2000 it far exceeded the republican average. These findings speak for a dosage effect – regions receiving more radiation also have higher incidences of cancer, while regions receiving less radiation still have rising incidences, but far lower ones than the regions with lots of radiation. This is a simple fact, but one which the IAEA reputedly doesn't exist.<sup>3</sup> In fact, the IAEA only states that “a possible increase in cancer mortality due to this radiation exposure might be up to a few per cent.”<sup>25</sup>

## Thyroid cancer

One of the best documented types of cancers which resulted from the Chernobyl meltdown are cancers of the thyroid glands, which are extremely frequent due to the high amount of radioactive iodine isotopes, which accumulate in thyroid glands and cause low-level radiation. The increase in the incidence of thyroid cancer among children is indisputable. The unparalleled increase by more than 100-fold is considered to be due to radioactive iodine in the first weeks following Chernobyl.<sup>5</sup>

E. Lengfelder published a 58-fold increase in thyroid cancer in children aged 0-18 in the first 13 years after the meltdown. In the age group 19-64, the risk is 5-6 times higher now than before the meltdown. The highest rate of thyroid cancer was found in children living in the heavily contaminated region of Gomel and within this group, the highest increase was found amongst children aged 0-18. While this age group had had 7 cases of thyroid cancer per 100,000 in the period of 1973-1985, the years 1986-1998 saw 407 cases - a 58-fold increase! A highly aggressive growth, early metastazation and a predominantly papillary histology were the common attributes of these cancer cases.

While the incidence of thyroid cancer in children rose in the early nineties, it peaked in 1995 and then started to decline again. The IAEA uses this fact to claim that the number of thyroid cancer cases is not exceedingly high and that the worse is already over.<sup>11</sup>

However, a closer look at the statistics reveal that the reason for the numbers to go down is that the persons who were children in 1986 are now, twenty years after the meltdown, counted as adults and their cases of thyroid cancer no longer appear in the childrens' statistics.

Correspondingly a steady and sharp increase of thyroid cancer can be noted in young and middle aged adults in Belarus, as was shown by Lengfelder of the Otto Hug Institute for radiation in Munich. His research shows the number of thyroid cancers reaching an incredible 980 cases per 100,000 people a year by the end of 2000.<sup>11</sup> This is reflected again in the statistics of the Belarus National Cancer Registry, which finds a 5-fold increase of incidence of thyroid cancer: In 1980 the standardised index of thyroid cancer incidence among the adult population older than 30 years of age was 1.24 per 100,000. In 1990 this index was 1.96 and in 2000 it was 5.67. Among the liquidators the standardised index of incidence for the period of 1993-2000 was 24.4 per 100,000.<sup>3</sup>

This fact has not yet been reflected in documents of the IAEA and the UNSCEAR. These pro-nuclear organizations claim that since the rate of thyroid cancer in children is decreasing, this disproves the connection to Chernobyl-irradiation. However, they fail to mention their own practice of gerrymandering with official statistics and that in fact, the relative risk of thyroid cancer is increasing every year.<sup>15</sup> The WHO developed a prognosis study out of the numbers and scientific evidence to date, which showed that the young children of 1986 who lived in the affected regions have a 33% probability of developing thyroid cancer in their lifetime – that's another 50,000 people!<sup>15</sup>

Taking into account all people living in the affected areas and not just the children, the WHO concludes that more than 100,000 people would potentially develop thyroid cancer – a study, which was disregarded by the joint WHO/IAEA symposium this year for the obvious reason of painting too bleak a picture about the effects of the Chernobyl disaster.<sup>11</sup>

## Other types of cancer

And we must also not forget that although a great number of publications after Chernobyl deal with thyroid cancer in children, this well recognised malignant solid tumour does not represent more than 0.4% of the total of cancers described as results of Chernobyl. There are numerous studies on other solid cancers, such as the research by Burlakova, who found a 3.7-fold increase in the incidence of GIT tumours amongst the affected population.<sup>14</sup>

Since 1997 a significant increase of relative risk for malignant tumours of colon and urinary tract has been observed in the Gomel region when compared with the incidence in the Vitebsk region – a region which received the least amount of radiation in all of Belarus. The data showed a stable trend towards increase of relative risk for tumours of the stomach and the lung. This data is extremely important as they give a statistically significant evidence of an increase of the incidence of cancer among clean-up workers already after a 10-15 year latent period following their exposition.<sup>10</sup>

The relative risk in the incidence of colon, stomach, rectal, skin, breast, bladder, kidney and lung cancer in a group of 120,000 liquidators twelve years after the Chernobyl disaster was also found to be 20% higher than in a control group living in the fairly uncontaminated region of Vitebsk. For some isolated types of cancers like gastrointestinal tumours (35%) or lung cancer (64%), this incidence rate is even higher. The incidence rate for this group of liquidators has increased by a staggering 56% in the period of time after the Chernobyl disaster - by far higher than the normal increase in cancer incidence. The long latency period of 10 to 40 years strongly supports the probability of an even greater rise in incidence rates in the years to come.<sup>3</sup>

Additionally, the age in which these cancers first appeared was extremely lowered in the regions of Gomel and Mogilev. "In populations living in two areas with high <sup>137</sup>Cesium contamination (Gomel and Mogilev), the peak incidence rates of breast cancer were already reached between the ages of 45-49 years, 15 years earlier than in the Vitebsk region."<sup>3</sup>

Finally there are the non-solid cancers, namely leukaemia. Ivanov found a dose-related increase of Non-CLL-leukaemia in a group of 70,000 Russian liquidators. With a dose of 150.300 mGy, the relative Risk for developing such a leukaemia doubled.<sup>7</sup> The rise of leukaemia incidences amongst liquidators yielded a difference between male and female statistics, but showed a consistent rise in both sexes:

	Normal	Liquidators	Increase by
Females	9.4 +-1,2	19.6 +- 4.4	108 %
Males	17.7 +-1.3	21.2 +-3.5	20 %

## The effects on children

The effects of radiation did not stop with the generation directly exposed to it. In 1997, a study by the Belarus Medical Academy of 58 children of liquidators born 1987 in Minsk and 57 children of non-liquidators born in Minsk that same year showed that the children of liquidators had an average 79% activity of antioxidant enzymes, a sign of destructive processes going on in their bodies, potentially harming their genetic material, whereas the children born in the same city, the same year, with a similar male to female ratio and no significant difference in weight and height had an average antioxidant activity of just 29% - less than half.

Another sign of destructive processes on the cell level and protein aberration, the UV-luminescence of erythrocyte membranes also showed a three-fold difference between the two groups, with the liquidator children having a 60% activity and the non-liquidator children having only 20% (Gres, 1997) Scientists at the University of Haifa found a seven-fold increase in genetic mutations amongst children of liquidators born after the Chernobyl accident – seven times higher than in their siblings born before the accident. Their fathers had taken in a dose of 50-200 MSv.<sup>29</sup>

Why did the cancer incidence amongst children increase so drastically? The research by Dubrova and others could yield some answers. The results of her study showed that radiation-induced instability can be transmitted for at least two generations after initial paternal exposure to either high-LET fission neutrons or low-LET X-rays. She used mini-satellite instabilities to demonstrate the destructive and dose-related effects of radiation on genetic material. In one of her studies, the children of liquidators were tested for mutations of mini-satellites. Dubrova published research in 1996, showing that children born of local parents between February and September of 1994 in the heavily contaminated Mogilev region of Belarus showed a 200% increase in mutations of the mini-satellite genome. Jeffreys later published a study analyzing 41 children of liquidators born after the Chernobyl accident and 22 children of liquidators born before the event. He compared these children with 28 children born to non-liquidator parents in Belarus. The children of liquidators born after the accident had a seven-fold increase in mutations of the mini-satellite genome.<sup>6</sup>

Goncharava, the head of Genetic Safety Laboratory of National Academy of Sciences of Belarus showed in a study that genomes of animals from distant generations are more sensitive to the impact of very low radiation doses in comparison with those of animals of prior generations. Taking these findings and applying them to humans, it could well mean that the worse is still to come regarding the effects of radiation induced instability on the genome of Chernobyl victims and their children.<sup>17</sup>

Despite this research, the IAEA denies the potential teratogenic effect of low-level radiation and refers to the official statement of the International Commission on Radiological Protection (ICRP). The ICRP defined a threshold dose of 100 mSv for irradiation-induced mutations in its publication No. 90 in 2003. However, clinical experience has shown this level, which represents 100x the recommended annual total exposure limit for the general public or roughly 50 abdominal X-rays, to be much too high. No doctor would permit a pregnant woman to have 50 abdominal x-rays and presume that “no teratogenic effects are to be expected”. But that’s exactly what’s being said about the supposed risk of the Chernobyl irradiation. Furthermore, the damage done by radiation to the human genome, especially during the most vulnerable period of the blastogenesis and fetal period has been shown to be a stochastic effect, meaning that there is no threshold, but rather a dose-related effect. Even at 10 mSv, Swiss studies have been able to show teratogenic effects of radiation in mice and rats and similar results can be deduced from the studies of children born after Chernobyl. The following list shows a few of the most valuable studies done in the three most affected regions in this respect:

Region	Type of effect	References
Belarus – Central Registry	Anencephaly, spina bifida, polydactyly, Down Syndrome, cleft palate, congenital malformation, perinatal mortality, anaemia	Lazjuk et al, 1997
Belarus – Selected Regions	Anencephaly, spina bifida, polydactyly, Down Syndrome, cleft palate, congenital malformation, perinatal mortality, anaemia	Petrova et al, 1997
Belarus	Mental Retardation	Kondrashenko et al, 1996, Kolominsky et al, 1999
Belarus, Gomel	Congenital malformation	Bogdanovich, 1999 Savchenko, 1995
Belarus, Chechersky	Congenital Malformation, perinatal mortality	Kulakov et al, 1993
Belarus, Brest	Congenital Malformation, perinatal mortality	Körblein, 2003 Shidlovskii, 1992
Belarus, Ukraine, Russia	Mental retardation	Kozlova et al, 1999
Ukraine, Polessky	Congenital malformation, perinatal mortality,	Kulakov et al, 1993
Ukraine, Lygyny	Perinatal mortality, congenital malformation	Godlevsky, Nasvit 1998
Ukraine, Zhitomir	Perinatal mortality, low birth rate	Körblein, 2003

And here’s a selection of studies on the teratogenic effect of radiation on children outside of the three most affected regions, showing, for example, that heavily irradiated regions in countries like Turkey also showed a significant rise

in mutations amongst new born children connected to a temporal event in 1986. This suggests a direct link to the radiation caused by Chernobyl.

Region	Type of effect	References
Turkey	Anencephaly, spina bifida	Akar et al,1988/89 Caglayan et al, 1990 Güvenc et al, 1993 Mocan et al, 1990
Germany, Greece, Hungary, Poland, Sweden	Stillbirths	Scherb et al, 1999, 2000, 2003
Croatia	Mutations in miscarriages and neonatal deaths	Kruslin et al, 1998
Western Europe	Down syndrome	Dolk et al, 1999
Poland	Neonatal mortality	Körblein, 2003
Norway	Spontane Aborte	Ulstein et al, 1990
Sweden	Down Syndrome	Ericson, Kallen, 1994
Scotland	Down Syndrome	Ramsay et al, 1991
Finland	Stillbirths	Scherb, Weigelt, 2003
Bulgaria,Pleven	Multiple anomalies of the heart and the CNS	Moumdjiev et al, 1992
Germany	Perinatal mortality	Körblein, Küchenhoff, 1997 Scherb et al, 2000, 2003
Southern Germany	Down Syndrome, Perinatal mortality	Sperling et al, 1987, 1991 Lüning et al, 1989
Bavaria	Perinatal mortality, stillbirths, congenital malformation	Grosche et al, 1997 Scherb et al, 1999, 2000, 2003 Körblein 2003, 2004 Scherb, Weigelt, 2003 Körblein, 2003
GDR, Central Register	Cleft palate	Zieglowski, Hemprich, 1999
West-Berlin	Down Syndrome	Sperling et al, 1991, 1994

### Non-cancer diseases related to radiation

Apart from the heavily publicized findings on cancer caused by radiation, there are many illnesses and problems faced by the affected populations, which have not reached high media circulation. Among the pathological conditions due to radiation, excluded from official reports, Professor Alexey Yablokov from the Centre for Russian Environmental Policy of the Russian Academy of Sciences notes:

#### A growing number of still-births, birth defects and genetic abnormalities

In Ukraine, the number of genetic mutation and chromosomal aberration increased by 15-fold when comparing the numbers of 1986-1990 with the numbers of 1982-1985. The same study also found a 1.5-fold increase of stillbirths. The number of stillbirths rose significantly in 1986 and 1987 compared to the years before – an additional 1,639 dead babies in Eastern European countries. Taking the babies of Western European countries as a control group, no significant rise in the incidence of still-births was found, except in regions like Southeastern Bavaria, which received significant doses of radiation. Here, the number of still-births in 1987 rose by 45% and in 1988 by another 35%. Owing to the large amount of cases evaluated in this study, the significance of the results is extremely high.<sup>11</sup>

#### A disturbance and retardation of mental development

Burlakova found that the rate of mental disease rose by the factor of 9.6 in the affected areas.<sup>14</sup>

#### A growing number of neuropsychiatric diseases, depression and suicides

20% to 35% of all liquidators have mental disorders, most of all depression, compared to the normal population of Ukraine, where the incidence according to the Ministry of Public Health of Ukraine is 20.5% according to critical WHO findings.

A dramatic increase of the prevalence of depression (24.5%) in liquidators in comparison to the general Ukrainian public (9.1%) was also established.<sup>21</sup>

600-800 suicides for every 100,000 liquidators have been recorded by Estonian researchers. In people who have received doses of 0.25 Sv, the incidence of mental disease is 80.5%. These findings help to establish a dose-effect-relationship for cerebral damage after radiation.

## Blindness and other eye-diseases

Fedirko found that the effect of ionizing radiation was the cause of deterioration of the visual function even before the appearance of clinical pathology symptoms and influenced negatively on the electrobiological activity of retina and optic nerve. A dose-dependent deterioration of the accommodative capability of eyes in irradiated person has been established.<sup>22</sup>

## Diseases of the respiratory, gastrointestinal, endocrine and urogenital systems

### Cardiovascular disease

- According to forensic pathologists, 48 percent of the deceased liquidators in Ukraine died of cardiovascular diseases. Cancer is the second most prominent cause of death with 28%<sup>27</sup>

Significantly higher rates of cardiovascular disease in liquidators were found in a study by D.

Lazyuk: 76% of all liquidators suffered from ischemic heart disease and 72% suffered from arterial hypertension. Liquidators showed an annual increase of death from CVD of 22.1% in the period between 1992 and 1997, while in the rest of the country it was only a 2.5% increase. This not only shows that the group of liquidators was originally a healthier subgroup than the rest of the population, but also that their risk suddenly increased<sup>13</sup>

- Even a WHO-study confirmed the significant rise in cardiovascular diseases amongst former liquidators in the Russian federation.<sup>28</sup>

Kusunoki also confirmed that increases in both mortality from and incidence of cardiovascular disease have been found to be associated with radiation dose.<sup>20</sup>

Burlakova found an increase of cardiovascular disease by the factor of 4.3.<sup>14</sup>

Romanenko from the French-German Research Initiative found a dose-effect relationship for cerebrovascular disorders in liquidators.<sup>21</sup>

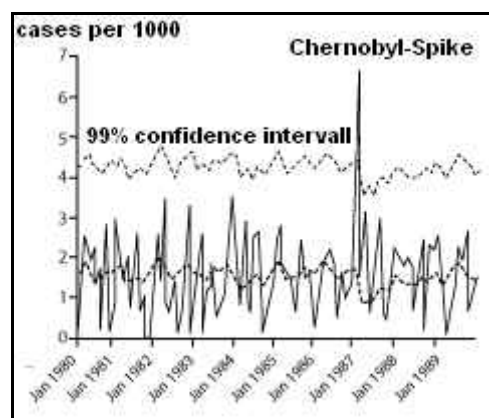
There's also a decent number of sound research devoted to radiation effects on reproduction. A study from Ukraine comparing the numbers of 1986-1990 with the numbers of 1982-1985 found a 3-fold increase in male infertility.

### Cerebrovascular disease

Cerebrovascular diseases correlate significantly with the amount of radiation received (Buzunov et al, 2003). Cortical Atrophy was found in MRI scans in 57 of 98 Liquidators (Bomko, 2005). A significant increase in vestibular vertigo was found by Trinus and Zabolotny in 1997 (Kiev). Their studies allow the conclusion that vestibular symptoms that occur in liquidators seem to be due to central nervous system lesions which might well be caused by irradiation.<sup>23</sup>

Delayed recovery after trauma or diseases and premature aging.

A highly significant study performed by Sperling in the hermetically sealed city of West-Berlin before the fall of the Iron Curtain shows a sharp rise in the cases of Down Syndrome – exactly 9 months after the radioactive cloud passed over the city<sup>32</sup>:



## **Social effects of the disaster**

When talking about medical effects of a disaster like the one in Chernobyl, the psychosocial impact on the affected population must not be forgotten. Ridiculed by the IAEA as radiophobia, the helplessness of the population living in a radiation-contaminated environment without proper health-care follow up, information about the true dangers of radiation or respect for their suffering is harrowing. Migration of 842,600 people in the first 10 years after the disaster and another 700,000 since have added to the already great burden of living in a contaminated areas with little hope for economic, medical or social improvement in the next decades. But not only in the directly affected regions have social effects been noticeable. According to an article in the Journal of Nuclear Medicine in 1987, 100.000-200.000 abortions took place in Europe as a result of the Chernobyl accident. It cannot be reconstructed how many of these were undertaken due to malformations and how many for pure fear of the radioactive cloud. Little research exists as to the psychodynamic processes behind the sharp rise of schizophrenia, depression and suicide amongst survivors of Chernobyl and recent studies by Flor-Henry of the University of Alberta showed that the commonly associated effects of post-traumatic stress disorder (PTSD) are simply not sufficient to explain the structural changes found in EEGs and MRI studies of Chernobyl survivors, although one component of the psychological changes found in these patients could be assumed to be PTSD-related.<sup>7</sup>

## **III.) Conclusion**

### **The politics behind the cover-up**

Why, you might ask, would the World Health Organization, the institution responsible for promoting world health, knowingly play into the hands of a group of businessmen out to make a quick buck with nuclear power, completely disregarding the health effects of this industry? Well, for once, there is an easy explanation to this: they have to! Article III.1 of the IAEA-WHO treaty clearly states that the WHO is not allowed to publish any research not approved of by the IAEA and that whenever the interests of IAEA are touched, the WHO must first confer with it and ask for its approval (see Article I.3 of the same agreement). Thus, the radiation research department of the WHO has long been taken over by the IAEA and there is virtually no research done by the WHO on radiation effects on health – all of it is being carried out by the IAEA, the very organization who states in its charter that its central objective is: “The worldwide promotion of the peaceful use of nuclear technology.”<sup>9</sup> Keith Baverstock, former head of the Radiation and Health Section of the WHO states that the WHO does not have many experts on, nor much interest in radiological issues, so that the staff is passed on to the IAEA.

But what about UNSCEAR – the UN body founded to assess the health risks of radiation on humans and the environment? Actually, its job is actually to research and publish its findings in an “adequate and useful form”. Then who decides what adequate and useful should mean? Well, its scientists are not elected by international expert groups, but are rather placed in this committee by the group of 21 countries running nuclear energy research and power plants – parties, which of course are not very interested to devote time to the possible health effects of radiation. The scientists are not neutral, independent researchers, but delegates of their home countries, working for a strictly pro-nuclear agenda. (Founding Resolution for UNSCEAR, United Nations, Resolution 913 (X), 3 December 1955) The public thinks that because UNSCEAR and IAEA are official bodies, their research carries an air of legitimacy. Few people are aware of the true intention of these bodies and of the treaties and politics binding them in their statements. In questions regarding national safety levels of radiation, the ICRP is consulted. This is also not a neutral committee but is directly under the influence of pro-nuclear governments. Many members of the ICRP and also members in UNSCEAR, which explains the similar stance on the presumed safety of nuclear energy and the impacts of the Chernobyl catastrophe. The WHO meanwhile did not correct the false statements made in the IAEA or ICRP report, even when they directly contradicted WHO studies. This again can be explained by the treaty between the WHO and IAEA, binding WHO not to work against IAEA in any way.<sup>11</sup>

One more criticism directed at the IAEA report is that of selecting only certain scientific research and negating all contrary research. Even the studies cited in the IAEA report are only partially quoted, leaving out many of the most important pieces of information. One of the main sources of the IAEA report is the scientific study done by E. Cardis, which states that 10.593-26.598 of additional cancer deaths are to be expected due to the Chernobyl meltdown. However uncertain Cardis' numbers are (the number of liquidators is given at 200,000 and in one part of the report, she calculates with an approximate number of inhabitants ranging from 35,000 to 100,000, who received a dose of somewhere between 6-20 mSv), these expected casualties by far exceed what the IAEA would like to admit. Careful readers will note that the dose calculation restricts itself to the years from 1986 to 1995, as if all radiation exposure would cease afterwards. Owing to the remaining irradiation, especially due to contaminated foodstuffs, the actual radiation dose should be calculated much higher. In its report of September 2005, the IAEA cites the study by Cardis, but speaks of only 8,930 expected additional cancer deaths. In the press releases of the 2005 conference of the Chernobyl Forum, even these 8,930 additional cancer deaths are not mentioned. Instead, the number of about 4,000 additional deaths is mentioned, but with the addition that this number would not significantly differ from the normal amount of cancer deaths and would not be noticeable.<sup>8</sup>

## Lessons not learned

The IAEA claims that the expected mortality from radiation cancer would not significantly differ from deaths caused by other origin. According to the IAEA report, not radiation but poverty and immoral life style are the main causes for the diseases striking the residents of the former USSR, especially those in the Chernobyl region and the regions of Gomel and Mogilev, where the nuclear fallout came down with the rain a few days after the meltdown. It is also mentioned in the report that the radiation situation would be worse in regions where sufferers of Chernobyl receive financial support due to a syndrome called radiophobia.

Pseudoscientific arguments of the IAEA are built on the methods of radiation risk estimates developed by the nuclear industry itself. The report openly ignores tendentiously interprets and even falsifies the results of the research of thousands of specialists from Ukraine Belarus and Russia. Moreover, the report dissembles the data on the impact of Chernobyl to the countries beyond former USSR borders.

Building upon their conclusions, the authors propose to significantly reduce the programs of support for Chernobyl victims<sup>25</sup> - a slap in the face for hundreds of state and private initiatives, struggling to provide the suffering population with some form of aid.

These initiatives include IPPNW doctors offering ultrasound-exams of thyroid glands, a service not rendered to a vast majority of the population in the affected areas, or help with relocation. The living situation in some areas of Belarus is so dire that people depend on stealing the contaminated bricks of the buildings within the closed off 30 km perimeter around Chernobyl and build new houses with them. Experts believe that the worst of the radiation effects are still to come, owing to the long latency period of some types of cancer and to the rising incidences in adult cancers. Okeanov of the Belarus National Cancer Registry concludes: "We've only just seen the top of the iceberg."

Chernobyl should have been the beginning of the end of nuclear energy. The Chernobyl catastrophe should be synonymous with the understanding that nuclear energy is neither technically under our control, neither can it prevail politically. The civilian use of nuclear energy is inextricably linked with severe health, security, ecological, political, economic and social risks. Let us hope that mankind will learn from this disaster and will not allow another Chernobyl to occur before it stops and thinks about the health dangers it surrounds itself with.

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