

The Severity of the Fukushima Daiichi Nuclear Disaster: Comparing Chernobyl and Fukushima

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On April 12, 2011 the Japanese government officially announced that the severity of the Fukushima Daiichi nuclear disaster had reached level 7, the highest on the International Nuclear Event Scale. Before Fukushima, the only level 7 case was the 1986 Chernobyl disaster, whose 25th anniversary was marked on April 26. Two and a half months after the 3.11 catastrophe, the first to affect multiple reactors, TEPCO and the Japanese government continue to struggle to bring the reactors at Fukushima Daiichi under control. TEPCO estimates that the problems could be solved in six to nine months now appearing extraordinarily optimistic and plans have been announced to close nuclear power plants deemed of particularly high risk such as the Hamaoka facility.

Fukushima explosion

Following the upgrade to level 7, Japan's Prime Minister's Office released a statement comparing Fukushima and Chernobyl. ([Source](#))

The Japanese government argues that apart from children who contracted thyroid cancer from drinking contaminated milk, there have been no health effects among ordinary citizens as a result of Chernobyl radiation. Is this really the case? Given the Japanese government's precautions against thyroid cancer in children, is there reason to believe that the Fukushima accident will take no lives except those exposed to the highest dangers in the plant clean-up? ([Source](#))

On April 15, Kyodo, Japan's major news service, ran an English language piece by Russian scientist Alexey V. Yablokov ([source](#)). Yablokov's stern warnings about the threat of even low levels of radiation had been ignored by the major media but was reported in Japanese in the *Nishi Nippon Shimbun*. ([Source](#))

The English only Kyodo piece, however, ties Yablokov's extensive Chernobyl research with the unfolding Fukushima crisis. Under the headline "How to minimize consequences of the Fukushima catastrophe," Yablokov observed that

The analysis of the health impact of radioactive land contamination by the accident at the Fukushima Daiichi nuclear power plant, made by Professor Chris Busby (the European Committee of Radiation Risk) based on official Japanese Ministry of Education, Culture, Sports, Science and Technology data, has shown that over the next 50 years it would be possible to have around

400,000 additional cancer patients within a 200-kilometer radius of the plant.

This number can be lower and can be even higher, depending on strategies to minimize the consequences. Underestimation is more dangerous for the people and for the country than overestimation.

Based on the Chernobyl experience, he made the following recommendations:

1. Enlarge the exclusion zone [from 20 kilometers] to at least about a 50-km radius of the plant;
2. Distribute detailed instructions on effective ways to protect the health of individuals while avoiding the additional contamination of food. Organize regular measurements of all people by individual dose counters (for overall radionuclides) at least once a week. Distribute radioprotectors and decontaminants (substances which provide the body protection against harmful effects of radiation) of radionuclides. . .
3. Develop recommendations for safe agriculture on the contaminated territories: reprocessing of milk, decontamination of meat, turning agriculture into production of technical cultures (e.g. biofuels etc.). Such "radionuclide-resistant" agriculture will be costly (it may be up to 30-40 percent compared with conventional agriculture) and needs to be subsidized;
4. It is necessary to urgently improve existing medical centers — and possibly create new ones — to deal with the immediate and long-term consequences of the irradiated peoples (including medical-genetic consultations on the basis of chromosome analysis etc.);
5. The most effective way to help organize post-Fukushima life in the contaminated territories (from Chernobyl lessons) is to create a special powerful interagency state body (ministry or committee) to handle the problems of contaminated territories during the first most complicated years.

Yablokov is one of the primary architects of the 2006 Greenpeace [report](#) "The Chernobyl Catastrophe: Consequences on Human Health" and an extensive 2010 follow-up study *Chernobyl: Consequences of the Catastrophe for People and the Environment* published by the New York Academy of Sciences, which makes the startling claim that 985,000 deaths can be attributed to the 1986 disaster.

This claim is startling because it differs so dramatically from a 600 page 2005 study by the International Atomic Energy Agency, the WHO, and the UN Development Programme, which claimed that fewer than 50 deaths can be attributed directly to Chernobyl and fewer than 4000 likely from Chernobyl-related cancers in the future. Indeed, the two works continue to frame much of the public controversy, with little progress toward resolution. Attempts to assess the consequences of the 1986 Chernobyl disaster remain the subject of fierce debate over widely different estimates in both the scientific and policy communities. In the months since the Fukushima disaster, scores of reports have uncritically passed on the results of the IAEA/WHO or the Yablokov study published by the New York Academy of Sciences without seriously engaging the conflicting conclusions or moving the debate forward. Here we present the major findings of major studies across the divide that may help to clarify the likely outcomes of the Fukushima disaster. ([1](#), [2](#))

Yablokov and colleagues assessed thousands of studies of the localities and people affected

by the Chernobyl disaster in Russian and other Eastern European languages. They argue that these studies have been ignored by the Anglophone scientific community.

Critics, such as the British science journalist George Monbiot, have criticized Yablokov and his colleagues for attributing any increase in cancer occurrence in regions affected by Chernobyl to the radiation released in the disaster. Emphasizing the multiplicity of factors that may affect cancer rates, Monbiot states, for example, that none of the hardest hit areas subjected to Chernobyl radiation, show as dramatic a cancer increase in the 1986-2000 period as does Japan. The impact of Chernobyl radiation in Japan was negligible, yet the cancer rate there has nearly doubled since the disaster. In the wake of the Fukushima disaster, at a time when many have moved to reject the nuclear power option, Monbiot announced that he had abandoned his former criticism to embrace nuclear power as a responsible component of a green energy policy.

Japanese government statistics in fact show large increases in screening rates for cancer during this period and this is one possible explanation for the increase in the number of cases reported. ([1](#), [2](#), [3](#), [4](#))

Monty Charles of the School of Physics and Astronomy, University of Birmingham, reviewed Yablokov's work in the journal *Radiation Protection Dosimetry* (Volume 141, Issue 1, 2010, pp. 101-104) and found the statistical conclusions far from clear and even contradictory:

Numerous facts and figures are given with a range of references but with little explanation and little critical evaluation. Apparently related tables, figures and statements, which refer to particular publications often disagree with one another. The section on oncological diseases (cancer) was of most interest to me. A section abstract indicated that on the basis of doses from ^{131}I and ^{137}Cs ; a comparison of cancer mortality in the heavily and less contaminated territories; and pre- and post-Chernobyl cancer levels, the predicted radiation-related cancer deaths in Europe would be 212 000-245 000 and 19 000 in the remainder of the world. I could not however find any specific discussion within the section to support these numbers. The section ends with an endorsement of the work of Malko who has estimated 10 000-40 000 additional deaths from thyroid cancer, 40 000-120 000 deaths from the other malignant tumours and 5000-14 000 deaths from leukaemia—a total of 55 000-174 000 deaths from 1986 to 2056 in the whole of Europe, including Belarus, Ukraine and Russia. These numbers confusingly, do not agree with a table (6.21) from the same author. The final section on overall mortality contains a table (7.11), which includes an estimate of 212 000 additional deaths in highly contaminated regions of Russia, Belarus and Ukraine. This figure is for the period of 1990-2004, and is based on an assumption that 3.8-4.0% of all deaths in the contaminated territories being due to the Chernobyl accident. One is left unsure about the meaning of many of these numbers and which is preferred.

If his work has been subject to trenchant critiques, Yablokov has offered a few of his own concerning the WHO/IAEA study discussed above. Yablokov's work forms a major part of a document, "Health Effects of Chernobyl: 25 Years after the Reactor Catastrophe", released by the German Affiliate of International Physicians for the Prevention of Nuclear War on the occasion of an international conference on Chernobyl held in Berlin between April 8 - 10, 2011. ([Source](#))

The report contains a devastating critique of the low WHO and IAEA Chernobyl death toll

estimates:

Note on the unreliability of official data published by WHO and IAEA

At the “Chernobyl Forum of the United Nations” organised in September 2005 by the International Atomic Energy Agency and the World Health Organisation, the presentation of the results of work on the effects of Chernobyl showed serious inconsistencies. For example: the press release of the WHO and IAEA stated that in the future, at most, 4000 surplus fatalities due to cancer and leukaemia amongst the most severely affected groups of people might be expected. In the WHO report on which this was based however, the actual number of deaths is given as 8,930. These deaths were not mentioned in any newspaper articles. When one examines the source quoted in the WHO report, one arrives at a number between 10,000 and 25,000 additional fatalities due to cancer and leukaemia.

Given this it can be rationally concluded that the official statements of the IAEA and the WHO have manipulated their own data. Their representation of the effects of Chernobyl has little to do with reality.

The report continues:

S. Pflugbeil pointed out already in 2005 that there were discrepancies between press releases, the WHO report and the source quoted in it (Cardis et al.). Up until now neither the Chernobyl Forum, IAEA nor the WHO have deemed it necessary to let the public know that, on the basis of their own analysis, a two to five-fold higher number of deaths due to cancer and leukaemia are to be expected as the figures they have published.

Even in 2011 – some 5 years on – no official UN organisation has as yet corrected these figures. The latest UNSCEAR publication on the health effects of Chernobyl does not take into account any of the numerous results of research into the effects of Chernobyl from the three countries affected. Only one figure – that of 6,000 cases of thyroid cancer among children and juveniles, and leukaemia and cataracts in liquidators – was included in their recent information to the media. Thus, in 2011 the UNSCEAR committee declared: On the basis of studies carried out during the last 20 years, as well as of previous UNSCEAR reports, UNSCEAR has come to the conclusion that the large majority of the population has no reason to fear that serious health risks will arise from the Chernobyl accident. The only exception applies to those exposed to radioiodine during childhood or youth and to liquidators who were exposed to a high dose of radiation and therefore had to reckon with a higher radiation induced risk.

Even if Yablokov’s estimates for Chernobyl deaths are high, the WHO and IAEA numbers are almost certainly too low.

One area of continuing debate is the fate of the “liquidators” at Chernobyl. A major difference between Fukushima and Chernobyl is government handling of the aftermath. While the Japanese government can be criticized for the speed of evacuation and the limited evacuation radius, the seriousness of the issues was immediately recognized and efforts made to send people away from the stricken plant. In the case of Chernobyl, even as the state suppressed information about the catastrophe, between 600,000 and 1,000,000 people termed “liquidators” were sent to the most heavily irradiated zone to work to contain the effects of the meltdown, many with limited protection and unaware of the risks.

Some research, such as the article “Thyroid Cancer among ‘Liquidators’ of the Chernobyl Accident” published in the *British Journal of Radiology* (70, 1997, pp. 937-941), suggests relatively limited health effects (fewer than 50 cases of thyroid cancer in a group of over 150,000 liquidators followed in the study). ([Source](#))

The article “Chernobyl Liquidators – The People and the Doses”, published by the International Radiation Protection Association, likewise concludes that across the majority of the liquidator group, “The health consequences from these radiation doses are too small to be identifiable in any epidemiological study, which does not target specific sub-groups with potentially higher exposure.” ([Source](#))

Support groups for liquidators, however, claim that 25,000 have died and over 70,000 are disabled. ([Source](#))

The issue cannot be limited to fatalities. The German Affiliate of International Physicians for the Prevention of Nuclear War “Health Effects of Chernobyl” [report](#) presents extensive evidence of widespread crippling disability among liquidators. As in the case of the Chernobyl death toll, the plight of liquidators is a hotly contested topic with radically different figures emerging from different quarters.

Some commentators have presented data that suggests a way out of the deadlock over the health and death consequences of Chernobyl. [Peter Karamoskos](#), a Nuclear Radiologist and public representative on the Radiation Health Committee of the Australian Radiation Protection and Nuclear Safety Agency argues in “Do we know the Chernobyl death toll?” that despite uncertainties about the numbers, “The weight of scientific opinion holds that there is no threshold below which ionising radiation poses no risk and that the risk is proportional to the dose: the “linear no-threshold” (LNT) model.”

Drawing on the 2006 report of the Committee on the Biological Effects of Ionising Radiation (BEIR) of the US National Academy of Sciences. Karamoskos points out: “The ... view that low-level radiation is harmless, is restricted to a small number of scientists whose voice is greatly amplified by the nuclear industry (in much the same way as corporate greenhouse polluters amplify the voices of climate science sceptics).”

He continues:

There is general agreement that about 50 people died in the immediate aftermath of the Chernobyl accident. Beyond that, studies generally don't indicate a significant increase in cancer incidence in populations exposed to Chernobyl fallout. Nor would anyone expect them to because of the data gaps and methodological problems mentioned above, and because the main part of the problem concerns the exposure of millions of people to very low doses of radiation from Chernobyl fallout.

For a few marginal scientists and nuclear industry spruikers, that's the end of the matter – the statistical evidence is lacking and thus the death toll from Chernobyl was just 50. Full stop. But for those of us who prefer mainstream science, we can still arrive at a scientifically defensible estimate of the Chernobyl death toll by using estimates of the total radiation exposure, and multiplying by a standard risk estimate.

The International Atomic Energy Agency estimates a total collective dose of 600,000 Sieverts over 50 years from Chernobyl fallout. A standard risk estimate from the International Commission on Radiological Protection is 0.05 fatal cancers per Sievert. Multiply those figures and we get an estimated 30,000 fatal cancers.

A number of studies apply that basic method – based on collective radiation doses and risk estimates – and come up with estimates of the death toll varying from 9000 (in the most contaminated parts of the former Soviet Union) to 93,000 deaths (across Europe). Those are the credible estimates of the likely eventual death toll from Chernobyl. Claims that the death toll was just 50 should be rejected as dishonest spin from the nuclear industry and some of its most strident and scientifically-illiterate supporters.

Karamaskos then turns to Fukushima, observing that

Nuclear industry spruikers will insist that no-one is at risk from low-level radiation exposure from Fukushima. The rest of us will need to wait some months or years before we have a plausible estimate of total human radiation exposure upon which to base an estimate of the death toll. To date, radiation releases from Fukushima are estimated by the Japanese government to be 10 per cent of the total Chernobyl release.

Needless to say, the view that low-level radiation is harmless is completely at odds with the current situation in Japan – the 20 km evacuation zone around the Fukushima nuclear plant, restrictions on food and water consumption in Japan and restrictions on the importation of food from Japan. ([Source](#))



A [joint survey](#) conducted by the Japanese and U.S. governments has produced a detailed map of ground surface radioactive contamination within an 80-kilometer radius of the Fukushima Daiichi nuclear power plant.

Yablokov's Chernobyl research and the dire prediction of as many as 400,000 radiation-related cancers in the Fukushima region if wider evacuation is not considered, deserves consideration, scrutiny, and debate as the Japanese government deals with radiation releases from Fukushima Daiichi. The same is true of alternative methodologies, particularly as the "linear no-threshold model" described by [Peter Karamaskos](#). Despite recent efforts to evacuate people from high radiation areas outside of the 20 km evacuation zone, however, Japanese newspapers reported on April 20 that at the same time, the Japanese government had increased the permissible hourly radiation dose at schools in Fukushima Prefecture to 3.8 microsieverts. The *Mainichi* describes this as "a level that would see students absorb the internationally recognized maximum of 20 millisieverts per year." See "Save the Children: Radiation Exposure of Fukushima Students," [link](#).

What are the risks of such doses? Thomas L. Slovis of the Society for Pediatric Radiology writes in *Pediatr Radiol* (2002:32:225-227)

... the risk of cancer from radiation is 5% per sievert... That's an average number; but an average is almost meaningless. If you are a mature, late middle-aged individual, it is maybe 1% per sievert. But if you are a child, it is maybe 15% per sievert, with a clear gender difference too at these early ages. So children are very, very sensitive compared to adults." For an adult the acceptable risk for any activity for emergency workers is 50 mSv. For a child the equivalent risk is $(50 \text{ mSv} / 250 \text{ mSv}) * 66 \text{ mSv} = 13 \text{ mSv}$. The standard suggested by Japan for children is twice this value. The change in standard to 20 mSv corresponds to a change to 0.3% risk in cancer later on in life.

Uncertainty about the long-term health effects of even low levels of radiation was further highlighted by David J. Brenner in the April 5 issue of Nature. ([Source](#))

In recent weeks, the issue of radiation and the 300,000 children of Fukushima has moved to the center of debate in assessing Japanese government handling of the Fukushima meltdown, even as the seriousness of radiation issues has grown with the belated disclosure by TEPCO of the multiple disasters experienced at the outset, and still far from under control, in Fukushima Daiichi.

On April 28, Kosako Toshiso, a radiation specialist at Tokyo University, resigned his position as Special Advisor to the Cabinet. Kosako had earlier gained notoriety for his role in helping to deny the extension of benefits to some radiation victims of the atomic bombs in a 2003 court case. After Fukushima, however, Kosako made an impassioned and courageous stand against what he saw as a government taking the potential health effects of long-term radiation exposure too lightly. In a press conference, Kosako castigated the Kan cabinet for its decision to increase permissible radiation exposure for Fukushima children:

At times of emergency, we cannot do without exceptions to standard rules and we are indeed capable of setting them up, but in any case, international common sense ought to be respected. It is wrong to forcibly push through conclusions that happen to be convenient only for the administrative authorities but which are utterly unacceptable by international standards. Such conclusions are bound to draw criticism from the international community.

This time, upon discussing the acceptable level of radiation exposure for playgrounds in primary schools in Fukushima, they have calculated, guided and determined a level of “3.8 μ Sv per hour” on the basis of “20mSv per year”. It is completely wrong to use such a standard for schools that are going to run a normal school curriculum, in which case a standard similar to usual radiation protection measurement (1mSv per year, or even in exceptional cases, 5mSv) ought to be applied, and not the one used in cases of exceptional or urgent circumstances (for two to three days, or at the most, one to two weeks). It is not impossible to use a standard, perhaps for a few months, of 10mSv per year at the maximum, if the public is rightly notified of the necessity of taking caution, and also if special measures are to be taken. But normally it is better to avoid such a thing. We have to note that it is very rare even among occupationally exposed persons (84,000 in total) to be exposed to radiation of 20mSv per year. I cannot possibly accept such a level to be applied to babies, infants and primary school students, not only from my scholarly viewpoint but also from my humanistic beliefs.

You rarely come across a level of 10mSv per year on the covering soil if you measure the leftover soil at a disposal site in any uranium mine (it would be about a few mSv per year at the most), so one needs to have utmost caution when using such a level. Therefore, I strongly protest the decision to use the standard of 20mSv per year for school playgrounds, and ask for revision.

(Translation by Tanaka Izumi) Complete translation available [here](#).



On April 29, the International Physicians for the Prevention of Nuclear War appealed to the Japanese government to recognize the risk that students of Fukushima would be exposed to, citing widely accepted scientific principles for radiation effects:

The U.S. National Academy of Sciences BEIR VII report estimates that each 1 mSv of radiation is associated with an increased risk of solid cancer (cancers other than leukemia) of about 1 in 10,000; an increased risk of leukemia of about 1 in 100,000; and a 1 in 17,500 increased risk of dying from cancer. But a critical factor is that not everyone faces the same level of risk. For infants (under 1 year of age) the radiation-related cancer risk is 3 to 4 times higher than for adults; and female infants are twice as susceptible as male infants.

Text [available online](#).

On May 12, the Japan Medical Association, in the wake of the Kosako resignation, criticized government indifference to the exposure of Fukushima children to radiation. ([Source](#))

The [Mainichi](#) also reports protests from various corners.

Indeed, coverage has spread to corners of the mass media hardly known for political critique. Journalist Hirokawa Ryuichi, known for his coverage of the plight of Palestinian children, Unit 731, and Chernobyl, takes on the 20mSv issue in the May 26 issue of *Josei Seven* (Women's Seven), a weekly known mostly for paparazzi-style star stalking, but now including more political criticism as mothers nationwide consider the implications of the government's 20mSv for children decision. ([Source](#))

Hirokawa argues that while the Soviet government may have been irresponsible in its initial approach to the Chernobyl radiation release, it undertook a massive effort to evacuate children from Kiev, 120 kilometers away from the crisis zone, between May and September 1986. Fukushima City is just over 50 kilometers away from Fukushima Daiichi. At the currently approved 20mSv, Hirokawa points out, Japanese children could be exposed to four times the radiation of children in Ukraine in 1986. He writes, "... an hourly rate of 3.8 microsieverts is a number not all that different from readings at the dead ruins of Pripjat. I don't want to imagine Japanese children running and playing in this ruined shell of a city." Pripjat, built originally to house Chernobyl workers, is the abandoned city at the heart of Ukraine's "Zone of Alienation".

While comparisons between Chernobyl and Fukushima abound, there are many who point to the contrasts. In the latest issue of the *Journal of Radiological Protection*, radiation, Professor Richard Wakeford of the University of Manchester's Dalton Nuclear Institute points out flaws in the International Nuclear Event Scale, "Since Level 7 is the highest rating on INES there can be no distinction between the Fukushima and Chernobyl accidents, leading many to proclaim the Fukushima accident as 'another Chernobyl', which it is not..." He asserts that as of early April, Fukushima had released but one tenth of the amount of radiation expelled in the Chernobyl disaster and praises Japan's official response,

"Given the difficult background circumstances pertaining in Fukushima Prefecture as problems mounted at the Fukushima Dai-ichi NPS, the organisational abilities of the Japanese authorities in dealing with the evacuation, monitoring and protection of the public has to be admired. In particular, the heroic efforts of the emergency workers, battling under conditions that were often atrocious, should not pass without respect and praise. I for one bow to their courage." ([Source](#))

We have, likewise, noted important differences in the handling of the disasters at Chernobyl and Fukushima. Yet it is important to note that Wakeford's praise ignores the most

important revelations of TEPCO's and the Japanese governments cover-ups and recklessness, as in its decisions to expose Fukushima children to 20 mSv of radiation on a long-term basis.

As the nature of the Fukushima crisis relative to Chernobyl continues to be contested, the important issue of radiation exposure of Fukushima school children remains at the center of public debate. To date, the Japanese government has failed to respond effectively to critics of policies that pose long-term risks to the nation's children.

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