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Biased epidemiology practiced for thyroid cancer following the Fukushima nuclear disaster - Fortunately, there's a "Toolkit" for calling out the distortions

The "Toolkit" for assessing the misuse of epidemiology, published in 2021 by C. L. Soskolne and others, is a vitally important tool for calling out the intentionally biased and distorted use of epidemiology to hide the full harm of radiation exposures. [1]

Various governments and international agencies, including the U.S. Department of Energy and the International Atomic Energy Agency (IAEA) who both actively promote nuclear energy, can wield a large and perverse influence over the study of adverse radiation health effects.

The Department of Energy would withhold epidemiological results of increased leukemia in Utah from the nuclear weapons testing conducted at the Nevada Test Site that began in the 1950s. [2] The Department of Energy would also seek to manipulate the epidemiology to lower the cancer rates in radiation workers. [3]

Distorted epidemiology was conducted in the 1979 Three Mile Island accident in the U.S., in the Ukraine, Belarus and Russia due to the 1986 Chernobyl accident and it is happening with the 2011 Fukushima triple-meltdown.

The IAEA would prematurely report in 1991 that they had found no health effects from Chernobyl and, they claimed that the unmonitored and unmeasured radiation doses were too low to predict any but a tiny percentage of future cancers.

The reality was far different. The Chernobyl accident revealed that aggressive and fast-growing thyroid cancers occurred within a few years after the accident. The iodine-131 created during nuclear fission was released by the accident, causing doses from inhalation as well as from milk consumption. The iodine-131 concentrates in milk when cows ingest iodine-131 from fallout on grass.

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[1] C.L. Soskolne, et al. *Environ Health*, "Toolkit for detecting misused epidemiological methods," 2021. https://doi.org/10.1186/s12940-021-00771-6

[2] Philip L. Fradkin, *Fallout – An American Tragedy*, Johnson Books, 2004, 1989. ISBN 1-55566-331-1

[3] Gayle Greene, *The Woman Who Knew Too Much – Alice Stewart and the Secrets of Radiation*, University of Michigan, 1999. ISBN 0-472-08783-5. The Department of Energy support for and subsequent squelching of Hanford radiation worker epidemiology studies are described in Gayle Greene's *The Woman Who Knew Too Much – Alice Stewart and the Secrets of Radiation*.

Thyroid cancers in children before the Chernobyl accident had been extremely rare: Two cases per year, or fewer, in Belarus. But after Chernobyl and by 1991, thyroid cancer cases in children in Belarus were 54 cases. The IAEA ignored this information. The latency period for most cancers is usually expected to be 10 years, but for thyroid cancer in children, these cancers had occurred in just a few years. [4] These thyroid cancers were also extremely aggressive.

There were a small number of thyroid cancers found in children who were fetuses at the time of the Chernobyl accident as well as thyroid cancers in children already born at the time of the accident; however, no thyroid cancers were found in children born after January 1987, due to the decay of the iodine-131. [5]

Only one foreign scientist, Keith Baverstock, would pursue information about the childhood thyroid cancers from the Chernobyl accident. [6] He would investigate and find that the early and unexpected spike in thyroid cancers in children was real and these cases were aggressive. These cancers would have been detected with or without screening and elevated rates were not due to overdiagnosis or increased screening for the cancers. The WHO and others had refused to investigate, and Baverstock was threatened with losing his job, for his raising funding for and conducting the investigation. [7]

By 1996, WHO, UNSCEAR and IAEA had to concede that there was still skyrocketing increases in thyroid cancers in children in the Ukraine and Belarus. The 1996 UNSCEAR Chernobyl report would admit that 6000 childhood thyroid cancers were due to Chernobyl. Still, these agencies would blame the rise in a wide variety of health problems as due to psychological trauma and not radiation. [8]

With the 2011 Fukushima nuclear accident, elevated cases of thyroid cancer in children should have been expected within a few years, based on the study of thyroid cancer in children from the Chernobyl accident. And aggressive thyroid cancers in children should have been expected.

A study by E. Clero and others, "Lessons learned from Chernobyl and Fukushima on thyroid cancer screening and recommendations in case of a future nuclear accident," issued by the

[4] Kate Brown, *MANUAL FOR SURVIVAL – A Chernobyl Guide to the Future*, W. W. Norton & Company, 2019. ISBN 9780393652512. See pages 241, 241, and 249.

[5] Toshihide Tsuda, Yumiko Miyano and Eiji Yamamoto, *Environmental Health*, "Demonstrating the undermining of science and health policy after the Fukushima nuclear accident by applying the Toolkit for detecting misused epidemiological methods," 2022. https://doi.org/10.1186/s12940-022-00884-6.

[6] Keith Baverstock et al., *Nature*, "Thyroid Cancer after Chernobyl," September 3, 1992.

[7] Kate Brown, *MANUAL FOR SURVIVAL – A Chernobyl Guide to the Future*, W. W. Norton & Company, 2019. ISBN 9780393652512. See pages 250 and 251.

[8] Kate Brown, *MANUAL FOR SURVIVAL – A Chernobyl Guide to the Future*, W. W. Norton & Company, 2019. ISBN 9780393652512. See pages 259.

SHAMISEN consortium was reviewed using the "Toolkit." [9] **The study was found to suffer from 20 of 33 items in the Toolkit that demonstrate the misuse of epidemiology.**

The SHAMISEN study was found to suppress data, give biased reporting and fail to generalize health risks. The study claimed the overdiagnosis of childhood thyroid cancers had greatly increased the number of cancers, omitting consideration of the actual screening procedures which limited the reported cases to only those cases with nodules greater than 5 millimeter in diameter. The study would also claim that the cancers were not aggressive, when in fact, they were rapidly growing aggressive cancers. [10]

The large releases of iodine-131 from nuclear reactor (or nuclear weapons tests) are an important cause of thyroid cancer in children (and also adults). This was very clearly documented by doctors in the Ukraine following Chernobyl. (Other radionuclides also contribute to thyroid cancer incidence, including americium-241.)

The usual focus in radiation health studies is in leukemia and cancer. Cases of leukemias arise with shorter latency than most cancers. There are cancers of breast, and other tissues and the latency period is typically expected to be 10 years or more. However, variations occur particularly for differing inhalation or ingestion of radionuclides which are not reflected by the study of survivors of the bombing of Japan. The observations by independent scientists documented in *Chernobyl – Consequences of the Catastrophe for People and the Environment*, and *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident* describe many other adverse health effects including heart disease, poor immune system function, diseases of the nervous system, premature aging, shortened life span, and many others. [11] [12] [13]

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[9] C.L. Soskolne, et al. *Environ Health*, "Toolkit for detecting misused epidemiological methods," 2021. https://doi.org/10.1186/s12940-021-00771-6

[10] Toshihide Tsuda, Yumiko Miyano and Eiji Yamamoto, *Environmental Health*, "Demonstrating the undermining of science and health policy after the Fukushima nuclear accident by applying the Toolkit for detecting misused epidemiological methods," 2022. https://doi.org/10.1186/s12940-022-00884-6.

[11] Editors: C.C. Busby and A.V. Yablokov, *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident, European Committee on Radiation Risk, Documents of the ECRR 2006, No1*, Green Audit, 2006. Dr. Rosalie Bertell, Chapter 14, "First Assessment of the Actual Death Toll Attributable to the Chernobyl Disaster Based Upon Conventional Risk Methodology."

[12] Alexey.V. Yablokov, Vassily B. Nesterenko, and Alexey V. Nesterenko, and Consulting Editor Janette D. Sherman-Nevinger, Annals of the New York Academy of Sciences, Volume 1181, *Chernobyl – Consequences of the Catastrophe for People and the Environment*, 2009.

[13] In reading these studies that use international units of Gray (Gy) and Sievert (Sv), it may be helpful to have conversions to units commonly used in the US of the analogous Rad and rem. Gray and Rad indicate the quantity of energy imparted. Sievert and rem indicate the dose accounting for enhanced biological harm including cancer-causing harm. The rem or Sv can also reflect assumptions of greater biological harm from alpha and neutron exposure.

0.1 rem	=	100 mrem	= 1 mSv
1 rem	=	1000 mrem	= 10 mSv
10 rem	=	10,000 mrem	= 100 mSv
50 rem	=	50,000 mrem	= 500 mSv

Following radiation exposure, in children, there are increased rates of childhood leukemia and cancer, and overall increases in a variety of diseases. There are also increased rates of infant mortality as well as increased rates of birth defects.

Governments tend to seek to avoid liability to the people they harm with radiological releases. Adequate and honest epidemiology that shows more health harm than currently assumed in official government radiation models would mean the need for tighter limits on allowable doses. This would mean more restrictive limits on radioactive effluent releases which would mean higher costs for the polluting nuclear industries from mining, milling, conversion, enrichment, fuel fabrication, nuclear reactors, weapons production, and radioactive waste disposal.

Kate Brown's book *Manual For Survival – A Chernobyl Guide to the Future* – explains the deliberate avoidance of adequate epidemiology by IAEA, WHO and UNSCEAR

Just a few years ago in 2019, Idaho National Laboratory held public meetings to emphasize that the 1986 Chernobyl nuclear disaster had caused very few deaths from acute radiation and had merely caused an increase in thyroid cancers. [14] And that's it — according to the INL which based it views on studies controlled by the International Atomic Energy Agency (IAEA). The IAEA also influenced studies conducted by the World Health Organization (WHO) and UNSCEAR, that downplay the radiological release and the true health harm from Chernobyl.

The studies by IAEA, WHO and UNSCEAR would ignore the internal radiation doses, despite very large inhalation and ingestion doses from radioactivity that permeated vast regions affected by the Chernobyl accident. Their studies would address only the estimated external radiation doses, and only from cesium-137. While vast amounts of highly contaminated crops and animals were disposed of to prevent people from ingesting them, the extensive soil contamination meant that crops and animals continued to be very radioactive and to be consumed for years. Mushrooms, berries, wild boar, and other foods, can remain extremely radioactive even years after the accident.

An in-depth look at the intentional efforts by the IAEA, WHO and UNSCEAR to distort and downplay the adverse health impacts from Chernobyl is provided in Kate Brown's book *Manual for Survival – A Chernobyl Guide to the Future*. [15] While many others, including Rosalie Bertell, [16] have written of the efforts by these official agencies to coverup the true extent of the health harm from Chernobyl, Kate Brown's book is very revealing of the actions and deceptions of

[14] Idaho National Laboratory, Chernobyl Talks – Just the Facts, four public talks held in October 2019.

[15] Kate Brown, *MANUAL FOR SURVIVAL – A Chernobyl Guide to the Future*, W. W. Norton & Company, 2019. ISBN 9780393652512

[16] Editors: C.C. Busby and A.V. Yablokov, *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident, European Committee on Radiation Risk, Documents of the ECRR 2006, No1*, Green Audit, 2006. Dr. Rosalie Bertell, Chapter 14, "First Assessment of the Actual Death Toll Attributable to the Chernobyl Disaster Based Upon Conventional Risk Methodology."

IAEA, WHO and UNSCEAR, as well as the coverups inside the countries of the former Soviet Union, especially the Ukraine and Belarus.

In addition to the agencies like the IAEA, the governments of countries that have a nuclear accident have clear reasons to avoid liability of the harm from the accidents, both inside and outside their countries. For example, doctors in the Ukraine and other parts of the former Soviet Union were forbidden, for four years, to attribute any death or health harm to the Chernobyl accident, aside from the several dozen early acute radiation deaths of firemen and other accident responders at the Chernobyl plant during accident.

The chronic exposure to radiation from contaminated land, water and food created a health situation quite different than a one-time exposure. The "gold standard" for radiation was considered the study of Japan World War II atomic bombing survivors. That study used as the control case, people who returned to the contaminated cities but had not been exposed to the flash of gamma and neutron radiation from the atomic bombs. Both the exposed citizens and the control citizens lived in the radioactive contamination. While the cancer rates were higher than it had been for citizens in Japan before the bombing, subtracting the control case cancers from those exposed to the bombing, makes the study limited to the study of the effects of the exposure from the radiation directly from the bombing. The study of the Japan bombing survivors also suffers from various problems such as not beginning until 5 years after the bombings, and including manipulations that lowered the estimated cancer and leukemia causing effects of radiation. [17] The study of the bombing survivors underestimates the harm of external radiation doses, and is inappropriate to apply to internal doses, particularly chronic radiation exposures and intakes.

There continue to be nuclear promotors who, like the Idaho National Laboratory, deny the wide range of serious health effects from the Chernobyl accident. The reality is greatly increased disease in the people in the Ukraine from Chernobyl and reduced life expectancy. The reality is that while before Chernobyl, up to 90 percent of children were considered healthy and as of the 2009 report, *Chernobyl – Consequences of the Catastrophe for People and the Environment*, after Chernobyl, only 20 percent (or less) of children are considered healthy.

The huge financial cost of coping with the Chernobyl accident led to the breakup of the Soviet Union. The Chernobyl accident contamination is not limited to the "exclusion zone" near the reactor that required permanent evacuation of thousands of people. The contamination is widespread and variable. Yet, the Idaho National Laboratory continues to downplay the seriousness of the 1986 Chernobyl accident in order to promote nuclear energy.

The Chernobyl disaster required millions of dollars of agricultural products to be destroyed. It affected the use of millions of acres of agricultural land. Reindeer many miles from the accident had to be fed imported food so as to not be so radioactively contaminated as to poison

[17] John W. Gofman, *Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis*, First Edition, Committee for Nuclear Responsibility, Inc., 1990.

people eating them. [18] And the effects of "chronic low-dose contamination has resulted in morphologic, physiologic, and genetic disorders in every animal species that has been studied" according to the 2009 report by Yablokov. The disorders in wildlife are not due to "radiophobia," the excuse for human health problems given by IAEA and other nuclear promotors.

Two radionuclides released by reactor accidents (or nuclear weapons testing) are cesium-137 and strontium-90, with radioactive half-lives of about 30 years, which means about 300 years before these radionuclides decay away. The iodine-131 released has a short half-life of 8 days, but can bioaccumulate in cow or goat milk. Pregnant women drinking the radioactive milk can cause serious harm to their unborn child. The child can die due to failure to thrive, because of malfunctioning thyroid from the high radiation dose. The iodine-131 in the milk decays away within 80 days (assuming 10 half-lives); however, the cesium-137, strontium-90 and other radionuclides can remain in the milk or cheese and also be harmful to adults, children, as well as the unborn developing child in utero.

In addition to these radionuclides, the alpha emitters including uranium, plutonium and americium-241 are also released by nuclear accidents despite often not being adequately monitored. The Chernobyl accident released a large amount of americium-241, and it builds up in the environment from the release of plutonium-241, which decays to Am-241. The Am-241 is water soluble and migrates with water and is taken up by plants and animals eat the plants. People eat the contaminated plants and animals, and drink contaminated water and breath contaminated air. **The half-life of americium-241 of 430 years is misleading because the buildup of americium-241 increases for the first 70 years.** The half-life of plutonium-239 is 24,000 years, and yet it, as well as other radionuclides like Am-241 must decay through a series of radioactive decays before becoming a non-radioactive stable isotope of lead. (Read more about the estimates of the radiological release from the Chernobyl accident in the December 2019 Environmental Defense Institute newsletter, that was probably a few billion curies, far higher than 80 million curies that is frequently stated.)

Ionizing radiation causes oxidative stress as the radiation strips electrons off atoms or molecules in the body at energies far exceeding normal biological energy levels. Ingestion or inhaling radioactive particles causes chronic internal radiation doses. The health harm of internal radiation doses is recognized by many experts as currently underestimated by official radiation models.

The internal radiation cancer rates used in the nuclear industry are not based on solid epidemiological evidence and there are experts from Karl Z. Morgan to Chris Busby to Jack Valentin that understand that the accepted models may understate the cancer harm by a factor of 10, 100 or more. The nuclear industry continues to ignore the epidemiological evidence that implies tighter restrictions are needed. Chris Busby has witnessed and written about the fact that

[18] Zhores A. Medvedev, The Legacy of Chernobyl, 1990, W. W. Norton and Company, ISBN 0-393-30814-6.

Jack Valentin, former chair of the International Commission on Radiological Protection (ICRP) has admitted, before resigning from the ICRP, that the ICRP's radiation model underpredicts the harm of internal radiation by over a factor 100.

The official agencies, IAEA, WHO and UNSCEAR would focus on the cesium-137 but ignore a variety of other radionuclides released by the Chernobyl accident: the strontium-90, the plutonium, americium, the ruthenium and other radionuclides. **And these agencies assessed only external dose, ignoring the chronic and continuing intakes of radioactivity from food and water.** While monitoring of radioactivity in food was performed, and there were cases that required food to be destroyed, the accepted or unmonitored radioactivity in food remained a serious problem.

Jay M. Gould's study of breast cancer rates near nuclear reactors is still relevant and it points out the elevated rates of breast cancer near the Idaho National Laboratory

A study of breast cancer in women in the U.S. has consistently shown increases in breast cancer near commercial nuclear power plants or Department of Energy nuclear reactors. [19] The study by Jay M. Gould compared the rate of breast cancer mortality for counties within 50 miles of 51 nuclear reactors from 1950 to 1954 to the rates from 1980 to 1984 and also to 1985 to 1989.

At the Idaho National Laboratory, the breast cancer mortality increase was the highest in the country, an increase of 333 percent for counties within 50 miles of the INL for 1980-84 compared to 1950-54. For three counties near the INL, the increase was 433 percent for these years. The INL had higher breast cancer, using age-adjusted mortality rates, than Hanford or Oak Ridge. Also, near the INL, according to the Idaho Cancer Registry, men also get breast cancer.

Gould found that in the U.S., the risk of dying of breast cancer is significantly greater for women living within 50 miles of a nuclear reactor.

When the industry depicts what it considers a "safe dose" it usually is not pointed out that public radiation standards do not protect women, children or the unborn developing child. It is long known that women are more vulnerable to radiation health harm than men. And female children are more vulnerable than male children. The studies of the developing child in utero show harm, a doubling of leukemia or cancer rates, from medical radiation doses less than about 500 millirem.

Before the late 1990s, radiation risks to females were generally treated as roughly equal to the radiation risks to males. But by the late 1990s, studies of the survivors of the atomic bombing

[19] Jay M. Gould with members of the Radiation and Public Health Project, Ernest J. Sternglass, Joseph U. Mangano, and William McDonnell, *The Enemy Within – The High Cost of Living Near Nuclear Reactors – Breast Cancer, Aids, Low Birthweights, and Other Radiation-Induced Immune Deficiency Effects*, Four Walls Eight Windows, 1996. ISBN 1-56858-066-5. See pages 131 and 281.

of Japan in 1945 by the International Commission on Radiation Protection (ICRP) had higher radiation risk harm to women than men, for the same dose. And the studies showed higher cancer risk to children, especially female children, than to adults for the same dose. The National Research Council BEIR VII report issued in 2006 found even higher risks to women and children. [20] (See the Institute for Energy and Environmental Research (IEER.org) report, *Science for the Vulnerable*, for additional insight. [21] See also the August 2020 Environmental Defense Newsletter at Environmental-Defense-Institute.org.)

The higher risk to females than males is treated as acceptable by using a radiation cancer death (mortality) coefficient not protective of adult females. And the high risk to children, especially to female children and to the unborn, is not addressed in National Environmental Policy Act (NEPA) environmental impact statements.

The nuclear industry likes to hide abnormally high organ doses by expressing doses in whole-body dose. The fact is that one must consider not only the whole-body dose but also each organ dose. Very low whole-body doses can be stated, despite very high organ doses, such as the thyroid dose. The thyroid dose determines the thyroid cancer incidence and failure to state the organ dose is deceptive. The Idaho National Laboratory continues to claim its annual radiological releases remain below whole-body dose of 1 millirem, just a fraction of a millirem. And yet, they do not disclose that the thyroid organ dose is far greater than would result from naturally occurring radiation. In Idaho and elsewhere, thyroid cancer incidence has been rapidly climbing. But curiously, all of the counties surrounding the INL have experienced more than a decade of roughly double the thyroid cancer incidence than the rest of Idaho and the rest of the country. [22] [23] [24] [25]

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[20] "Health Risks from Exposure to Low Levels of Ionizing Radiation BEIR VII – Phase 2, The National Academies Press, 2006, http://www.nap.edu/catalog.php?record_id=11340 The BEIR VII report reaffirmed the conclusion of the prior report that every exposure to radiation produces a corresponding increase in cancer risk. The BEIR VII report found increased sensitivity to radiation in children and women. Cancer risk incidence figures for solid tumors for women are about double those for men. And the same radiation in the first year of life for boys produces three to four times the cancer risk as exposure between the ages of 20 and 50. Female infants have almost double the risk as male infants.

[21] Arjun Makhijani, Ph.D., Brice Smith, Ph.D., Michael C. Thorne, Ph.D., Institute for Energy and Environmental Research, *Science for the Vulnerable Setting Radiation and Multiple Exposure Environmental Health Standards to Protect Those Most at Risk*, October 19, 2006.

[22] National Cancer Institute, Surveillance, Epidemiology, and End Results Program, Cancer Query System. https://seer.cancer.gov/canques/incidence.html

[23] Hyeyeun Lim et al., JAMA, "Trends in Thyroid Cancer Incidence and Mortality in the United States, 1974-2013," April 4, 2017. https://pubmed.ncbi.nlm.nih.gov/28362912/ or https://jamanetwork.com/journals/jama/fullarticle/2613728

[24] C. J. Johnson, B. M. Morawski, R. K., Rycroft, Cancer Data Registry of Idaho (CDRI), Boise Idaho, Annual Report of the Cancer Data Registry of Idaho, *Cancer in Idaho – 2017*, December 2019. https://www.idcancer.org/ContentFiles/AnnualReports/Cancer%20in%20Idaho%202017.pdf.

[25] Environmental Defense Institute February/March 2020 and July 2020 newsletter articles. "Rate of cancer in Idaho continues to increase, according to Cancer Data Registry of Idaho." As the SEER 9 region thyroid incidence peaked at 15.7 per 100,000, and the State of Idaho thyroid incidence average was 14.2 per 100,000, Bonneville County reached thyroid cancer rates of 30.9 per 100,000. [25] But other counties near the Idaho National Laboratory also have elevated thyroid cancer incidence rates: Madison (29.3 per 100,000), Fremont (27.9 per 100,000),

Similarly, a low whole-body dose can be claimed for a mammogram; but it is the breast dose that matters to the risk of developing breast cancer. The whole-body dose sounds smaller than the actual breast dose from a mammogram. The medical industry low-balls the stated breast dose from mammography because it provides only "average" breast doses and ignores the higher doses commonly needed for large breasted women who require more films to be taken.

Even when honest epidemiology is conducted, government and international agencies tend to ignore it. They tend to dispute the honest epidemiology if the findings are showing more health harm than the industry wants to admit.

Honest epidemiology of radiation workers by Richardson remains ignored by the Idaho National Laboratory and the Department of Energy. Epidemiology of thousands of nuclear workers in general would find that annual radiation doses for workers averaging about 400 millirem per year showed increased rates of cancer. [26] Excuses have been given for ignoring this study of a large population of radiation workers since this study came out in 2015. Epidemiology that was conducted of INL workers found unexplained elevated levels of certain radiogenic cancers in both radiation and non-radiation workers. The INL-specific study found radiation and nonradiation workers at the Idaho National Laboratory site had higher risk of certain cancers. [27]

Epidemiology for the public was avoided by the underestimate of the radiological releases from the Idaho National Laboratory from 1952 to 1989. Records destruction combined with inadequate environmental monitoring and low-balled release estimates were all used to argue that epidemiology was not needed in the communities surrounding the Idaho National Laboratory. [28] The historical dose assessment ignored many very important radionuclides like plutonium and americium. The decision to not study the epidemiology around the Idaho lab from

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Jefferson (28.9 per 100,000), and Bingham (28.6 per 100,000). But let's not forget Butte county. Butte county's thyroid cancer rate of 45.9 per 100,000 puts it in a class by itself. Much of Butte county is within 20 miles of the INL and nothing says radiation exposure like Butte's leukemia rate at 3 times the state rate and myeloma at 5 times the state average rate.

[26] Richardson, David B., et al., "Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS), BMJ, v. 351 (October 15, 2015), at http://www.bmj.com/content/351/bmj.h5359 Richardson et al 2015] (This cohort study included 308,297 workers in the nuclear industry. Also, please note that studies of high leukemia risk in radiation workers and of ongoing studies to assess health effects of high and low-linear energy transfer internal radiation must also be studied in addition to this one on external radiation.)

[27] "An Epidemiology Study of Mortality and Radiation-Related Risk of Cancer Among Workers at the Idaho National Engineering and Environmental Laboratory, a U.S. Department of Energy Facility, January 2005. http://www.cdc.gov/niosh/docs/2005-131/pdfs/2005-131.pdf and http://www.cdc.gov/niosh/oerp/ineel.htm and Savannah River Site Mortality Study, 2007. http: /www.cdc.gov/niosh/oerp/savannah-mortality/

[28] US Department of Energy Idaho Operations Office, "Idaho National Engineering Laboratory Historical Dose Evaluation," DOE-ID-12119, August 1991. See Table E-5 on p. E-36 for mystery milk and see Table C-21 for the public annual dose summary. Volumes 1 and 2 can be found at https://www.iaea.org/inis/inis-collection/index.html

1950s through 1980s fallout was based on indefensibly low-balled radiological release estimates and also by inadequate radiation health models.

The true harm to radiation workers is not reflected in Department of Energy or U.S. Nuclear Regulatory Commission Environmental Impact Statements. The annual radiation limit remains 5 rem per year (or 5000 millirem per year) in the U.S. and radiation worker training has not included mention of the elevated cancer risk at permissible doses. Workers are also not told of fertility risks and not told the truth about the increased risk of birth defects.

In summary, the radiation dose limits for routine operations in the U.S. are not protective of radiation workers (5,000 millirem per year) or the public (100 millirem per year). The specific organ doses matter for determining cancer incidence and yet are often not disclosed. Accident radiation doses can far exceed these operational dose guidelines. And ultimately, the storage and disposal of spent nuclear fuel and other radioactive waste are poised to render this planet unlivable for humans.

Another health impact found in Chernobyl liquidators – brain deterioration and poor mental health

Brain structural and functional health problems, termed encephalopathy, have been noted in Chernobyl liquidators. [29] Brain health issues were studied in a limited number of male liquidators in their 40s and their brain deterioration had occurred at a much younger age than is typical. Poor memory and brain atrophy and widening of the ventricles had occurred among liquidators.

The irreversible damage to the structures of the brain causes reduced function of the central nervous system. A high level of psychiatric disorders has been observed among Ukrainian liquidators, up to 5 times higher than in the general population. This was being observed in 1990 to 1993, only four to eight years after the 1986 accident.

An almost twofold increase in the incidence of all mental disorders was observed in the liquidators, compared to the general Ukrainian population. It was noted that alcohol dependence among liquidators was not much higher than that in the total population, ruling out a major contribution resulting from higher alcohol consumption. From 93 to 100 percent of the

[29] Editors: C.C. Busby and A.V. Yablokov, *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident, European Committee on Radiation Risk, Documents of the ECRR 2006, No1*, Green Audit, 2006. Alexey V. Yablokov, Chapter 9, "Liquidators Health: a Meta-Analysis." Hundreds of thousands of people, "740,000 people between 1986 and 1990 (250,000 from Russia, [about] 360,000 from Ukraine, 130,000 from Belarus)" took part in operations pertaining to attempts to address the Chernobyl contamination. Many were military, military reserves, and of draftees. Some worked within the exclusion zone of the Chernobyl power plant. Liquidator status was not automatic and required application for the possible benefits associated with liquidator status. Reliable data on their external and their internal radiation doses is not available. Data on the true number of liquidators is uncertain. (Also, see Kate Brown's book for additional information, such as wool workers subjected to high levels of radiation who were given liquidator status.)

liquidators were found to have neuropsychiatric disorders, with predominantly organic symptomatic mental disorders. [30]

The actual radiation dose received by the liquidators is not known. One radiation badge to evaluate only the external dose would be used for a group of men. That badge might have stayed at the camp area and not even gone with the men as they performed work in more highly radiologically contaminated areas. Official dose estimates were basically fiction and not representative of the men's total external dose. The internal dose from breathing contaminated air and from ingestion of contaminated food and water were not considered.

Radiation doses from external radiation to the liquidators would likely been stated as not exceeding 25 rem; however, the actual doses may not have been recorded. The internal doses from unmonitored air, water and food that occur for months would add significantly to the dose and the harm, because internal radiation actually causes more health harm than indicated by rem or Sievert measures of dose.

Despite the repeated refrain that the harm from doses below 10 rem cannot be discerned, multiple and diverse studies from human epidemiology continue to find elevated cancer risks below 10 rem and from low-dose-rate exposure. [31]

The intake of alpha emitters, such as americium-241, which accumulates in the bones of the body, including the cranial bones, and in the bone marrow, is unknown. The americium-241, along with its alpha particle, also gives off a significant gamma ray that causes additional harm to nearby tissues. The amerium-241 is highly retained and is recycled by the body. It is difficult to detect and urine excretion rates are now known to be quite low. A low amount detected in urine, long after the intake, would not mean the accumulation in the body is low.

The usual focus in radiation health studies is in leukemia and cancer. The observations by independent scientists documented in *Chernobyl – Consequences of the Catastrophe for People and the Environment*, and *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident* describe many other adverse health effects including heart disease, compromised immune systems, diseases of the nervous system, and many others, and also increases on deterioration of brain structure and function, with associated increases in mental health problems.

Increased rates of infant mortality, birth defects and genetic damage from ionizing radiation

[30] Alexey.V. Yablokov, Vassily B. Nesterenko, and Alexey V. Nesterenko, and Consulting Editor Janette D. Sherman-Nevinger, Annals of the New York Academy of Sciences, Volume 1181, *Chernobyl – Consequences of the Catastrophe for People and the Environment*, 2009.

[31] US EPA 2015 http://www.regulations.gov/#!documentDetail;D=NRC-2015-0057-0436 . For important low-dose radiation epidemiology see also John W. Gofman M.D., Ph.D. book and online summary of low dose human epidemiology in "Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis," Committee for Nuclear Responsibility, Inc., 1990, http://www.ratical.org/radiation/CNR/RIC/chp21.txt And see EDI's April 2016 newsletter for Ian Goddard's summary and listing of important human epidemiology concerning low dose radiation exposure.

Low Doses of Ionizing Radiation Cause Increased Infant Mortality

Jay M. Gould and Benjamin A. Goldman would write in their book *Deadly Deceit – Low Level Radiation High Level Cover-Up* of excess infant deaths near the Department of Energy's Savannah River Site and near the 1979 Three Mile Island nuclear accident. [32]

Elevated rates of infant mortality and birth defects were found in communities near the Department of Energy's Hanford site, but workers were not told of these epidemiology results and newspapers did not report the findings. [33]

Following the 1986 Chernobyl nuclear disaster, a comprehensive study also found a spike in perinatal mortality (still-births plus early neonatal deaths) in several countries that received airborne radioactivity from Chernobyl. The amount of airborne radioactivity to cause this was far smaller than generally assumed. [34]

Robin Whyte wrote in the *British Medical Journal* in 1992 about the effect in neonatal (1 month) mortality and stillbirths in the United States and also in the United Kingdom. The rise in strontium-90 from nuclear weapons testing from 1950 to 1964 has been closely correlated, geographically, with excess fetal and infant deaths. The doses from strontium-90 due to atmospheric nuclear weapons testing were less than 50 millirem (or 0.5 millisievert), according the Chris Busby. Radioactive fallout from atmospheric nuclear weapons testing would not only include strontium-90, it would include iodine-131, tritium, cesium-137, and other radionuclides, including plutonium. [35] The extent of the nuclear weapons testing immorality continues to astound me and I applaud the work being done to reduce the risk of human extinction from nuclear weapons. [36]

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[32] Jay M. Gould and Benjamin A. Goldman, *Deadly Deceit – Low Level Radiation High Level Cover-Up*, Four Walls Eight Windows New York, 1990. ISBN 0-941423-35-2. The finding of excess infant deaths near the Department of Energy Savannah River site around the 1970s and near the 1979 Three Mile Island nuclear accident are described in Jay Gould's book *Deadly Deceit*.

[33] Kate Brown, *Plutopia – Nuclear Families, Atomic cities, and the Great Soviet and American Plutonium Disasters,* Oxford University Press, 2013. ISBN 978-0-19-985576-6. Note that many publications use spelling variation Mayak instead of Maiak. *Plutopia* documents the elevated percentage of deaths among infants in the Richland population in the 1950s. Elevated fetal deaths and birth defects in Richland were documented by the state health reports, yet Hanford's General Electric doctors and the Atomic Energy Commission that later became the Department of Energy failed to point these statistics out. The local newspapers failed to write of it. The Department of Energy has continued to fail to tell radiation workers and the public of the known risk of increased infant mortality and increased risk of birth defects that result from radiation exposure.

[34] Alfred Korblein, "Studies of Pregnancy Outcome Following the Chernobyl Accident," from *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident*, Editors C.C. Busby and A. V. Yablokov, 2006.

[35] R. K. Whyte, *British Medical Journal*, "First day neonatal mortality since 1935: re-examination of the Cross hypothesis," Volume 304, February 8, 1992. https://www.bmj.com/content/bmj/304/6823/343.full.pdf

[36] Jackie Abramian, ForbesWomen, "After Her Nuclear Disaster Dress Rehearsal, Cynthia Lazaroff Has A Wake-Up Call For Our World As We Sleepwalk Into Nuclear Extinction," September 21, 2021. https://www.forbes.com/sites/jackieabramian/2021/09/21/after-her-own-nuclear-disaster-dress-rehearsal-cynthia-lazaroff-has-a-wake-up-call-as-our-world-sleepwalks-into-nuclear-extinction/?sh=6a22151d62e2 Lazaroff has founded NuclearWakeupCall.Earth due to her concern over nuclear weapons. "There are nearly 13,500 nuclear warheads in current arsenals of nine nuclear-armed states. That the U.S. has more nuclear warheads than hospitals should be a wake-up call," says Lazaroff.

The U.S. Nuclear Regulatory Commission Cancelled Meaningful Epidemiology

The US NRC cancelled what would have been the first meaningful epidemiology study of health effects near US nuclear reactors, [37] despite the German epidemiology study of children living near nuclear plants have roughly double the incidence of cancer and leukemia and similar findings resulted from the study of clusters of childhood leukemia near nuclear sites including Sellafield, Dounreay and La Hague where an excess of 300-fold infant leukemia were found. [38] [39] [40]

Birth Defects Ignored or Not Reported by U.S. Agencies

Birth defects were omitted from studies of the Marshallese people that the U.S. exposed in nuclear weapons tests in the Marshall Islands. [41]

While the Department of Energy ignores its releases of uranium and thorium radionuclides in its environmental monitoring programs, despite the ever-increasing amounts of these radionuclides in our environment, honest epidemiology that finds elevated birth defects in regions that have higher levels of natural uranium is also ignored. [42]

Gulf War veterans who inhaled depleted uranium have children with birth defects at much higher-than-normal rate. The same kinds of birth defects also became prevalent in the countries where citizens were exposed to depleted uranium. There are accounts to suggest that the actual number of birth defects resulting from the World War II atomic bombs dropped on Japan and by weapons testing over the Marshall Islands have been underreported. The Department of Energy early on made the decision not to track birth defects resulting from its workers or exposed populations. But people living near Hanford and near Oak Ridge know of increased birth defects in those communities.

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[37] NRC (Nuclear Regulatory Commission) 2010. NRC Asks National Academy of Sciences to Study Cancer Risk in Populations Living near Nuclear Power Facilities. NRC News No. 10-060, 7 April 2010. Washington, DC: NRC. The framework for the study was reported in "Analysis of Cancer Risks in Populations Near Nuclear Facilities; Phase I (2012). See cancer risk study at nap.edu.

[38] P Kaatsch et al., Int J Cancer, "Leukaemia in young children living in the vicinity of German nuclear power plants," 2008 Feb 15;122(4):721-6. http://www.ncbi.nlm.nih.gov/pubmed/18067131

[39] Spix C, Schmiedel S., Kaatsch P, Schulze-Rath R, Blettner M., Eur J Cancer, "Case-control study on childhood cancer in the vicinity of nuclear power plants in Germany 1980-2003." 2008 Jan;44(2):275-84.Epub 2007 Dec 21. http://www.ncbi.nlm.nih.gov/pubmed/18082395

[40] Chris Busby, "Infant Leukaemia in Europe after Chernobyl and its Significance for Radioprotection; a Meta-Analysis of Three Countries Including New Data from the UK," Chapter 8 of *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident*, Editors C.C. Busby and A. V. Yablokov, 2006.

[41] Giff Johnson, *Don't Ever Whisper – Pacific Health Pioneer, Darlene Keju, Champion for Nuclear Survivors*, 2013. ISBN-10: 1489509062. For more information about the health effects and after math from the U.S. bomb tests over the Pacific islands and the repeated deceptions about the consequences, read Giff Johnson, *Don't Ever Whisper —Darlene Keju, Pacific Health Pioneer, Champion for Nuclear Survivors*. *Time* magazine (around 2017) mentioned Julian Aguon's book *What We Bury At Night*, a chronicle of how irradiated Marshallese mothers had borne "jellyfish babies" with translucent skin and no bones. From 1946 to 1958, the U.S. tested 67 nuclear weapons in the Marshall Islands near Guam. Official reports deliberately omitted the truth of the birth defects.

[42] Kendall et al (2013). A record-based case–control study of natural background radiation and the incidence of childhood leukaemia and other cancers in Great Britain during 1980–2006. Leukemia. 27(1):3-9. http://pubmed.gov/22766784

The nuclear industry, including the Department of Energy, is wrong to use the International Commission on Radiological Protection (ICRP) treatment of heritable disease. While the ICRP continues to say that "Radiation induced heritable disease has not been demonstrated in human populations," Chis Busby writes that evidence of genetic effects *has* been found in humans and at very low radiation doses. [43] [44]

The ICRP maintains that human evidence of genetic effects due to radiation does not exist. The ICRP then uses the study of external radiation on mice to estimate the heritable risks for humans. One study was conducted using internal radionuclides on mice and the study noted that "detailed research on internal radiation exposure has hardly ever been reported in the past." [45] **This limited study of microcephaly in mice found that far lower doses of internal radiation caused the same effect as higher doses of external radiation.**

It has been known now for a few decades that radiation exposure to the developing embryo and fetus "can cause growth retardation; embryonic, neonatal, or fetal death; congenital malformations; and functional impairment such as mental retardation." [46]

In 2007, the International Commission of Radiological Protection (ICRP) lowered its estimate of the risk of genetic harm of congenital malformations by 6-fold, from 1.3E-4 per rem to 0.2E-4 per rem. Based on the belief that the study of the Japanese bomb survivors did not detect genetic effects, **the ICRP genetic effect estimate for humans is based on studies of external radiation of mice.**

The ICRP estimate of risk of congenital malformations is a fraction of its predicted cancer risk for cancer mortality (or latent cancer fatality). The ICRP latent cancer fatality risk was 5.0E-4 LCF per rem (1991 estimate), close to the cancer mortality rate used in the Department of Energy's Versatile Test Reactor EIS of 6.0E-4 LCF per rem. [47]

While the studies of genetic injury to the Japan bombing survivors declared that they found no evidence of genetic damage, other researchers have found those studies to have been highly

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[43] Chris Busby, *The Ecologist*, "It's not just cancer! Radiation, genomic instability and heritable genetic damage," March 17, 2016. https://theecologist.org/2016/mar/17/its-not-just-cancer-radiation-genomic-instability-and-heritable-genetic-damage

[44] Chris Busby, Scientific Secretary, European Committee on Radiation Risk, Presentation, *Radioactive discharges from the proposed Forsmark nuclear waste disposal project in Sweden and European Law*, September 8, 2017. Online pdf 646_Nacka_TR_M1333-11_Aktbil_646_Christopher_Busby_presentation_170908

[45] Yukihisa Miyachi, J-STAGE, "Microcephaly Due to Low-dose Intrauterine Radiation Exposure Caused by 33P Beta Administration to Pregnant Mice," 2019 Volume 68 Issue 3 Pages 105-113. https://www.jstage.jst.go.jp/article/radioisotopes/68/3/68_680303/_article/-char/en

[46] Eric J. Hall, *Radiobiology for the Radiologist*, 5th ed., 2000, p. 190.

[47] U.S. Department of Energy's Versatile Test Reactor Draft Environmental Impact Statement (VTR EIS) (DOE/EIS-0542) (Announced December 21, 2020). A copy of the Draft VTR EIS can be downloaded at https://www.energy.gov/nepa or https://www.energy.gov/ne/nuclear-reactor-technologies/versatile-test-reactor. (See discussion in VTR EIS Appendix C, page C-4).

flawed. A report published in 2016 by Schmitz-Feuerhake, Busby and Pfugbeil summarizes numerous human epidemiology studies of congenital malformations due to radiation exposure. [48]

The 2016 report disputes the ICRP genetic risk estimate and finds that diverse human epidemiological evidence supports a far higher genetic risk for congenital malformations. **Nearly all types of hereditary defects were found at doses as low as 100 mrem.** The pregnancies are less viable at higher doses and so the rate of birth defects appears to stay steady or falls off at doses above 1000 mrem or 1 rem. The 2016 report found the excess relative risk for congenital malformations of 0.5 per 100 mrem at 100 mrem falling to 0.1 per 100 mrem at 1000 mrem.

The 2016 report's result for excess relative risk of congenital malformations of 5.0 per rem is 250,000-fold higher than the ICRP estimate of 0.2E-4 per rem which ICRP appears to assume has a linear dose response. (See the August 2021 Environmental Defense Institute newsletter.)

Fraudulent lung count results by the Department of Energy's Idaho National Laboratory

On May 17, an Office of Workers Compensation Programs meeting of the Energy Advisory Board at the Department of Labor held a meeting in Idaho Falls. This is the Board on Toxic Substances and Worker Health under the Energy Employee Occupational Illness Compensation Program Act (EEOICPA).

Public comment was given by workers and their families and others concerned about fraudulent exposure records provided by Department of Energy contractors, such as Battelle Energy Alliance.

I gave public comment on the issue of radiation exposure dose fraud at the Idaho National Laboratory which can be seen on Youtube (posted by Jack Stanton via JStanton1968). My statement pertained to the 2011 plutonium inhalation event at the Idaho National Laboratory's Materials and Fuels Complex, at the Zero Power Research Reactor (ZPPR).

I remember when the accident [the November 8, 2011 accident at the Idaho National Laboratory operated by Battelle Energy Alliance] happened. I wasn't working there, but I was very interested to follow what the doses for the workers were and so forth, and I waited for the reports to come out and started studying and yeah, it's been a long time of studying. And I became acquainted with Ralph and his family.

I continued to study and there were such strange things, because there were lung counts taken and because INL did not have a procedure for translating the lung counts into a dose, the lung count reported results were then given to Oak Ridge because they had a procedure for

[48] Inge Schmitz-Feurerhake, Christopher Busby, and Sebastian Pflugbeil, *Environmental Health and Toxicology, Genetic radiation risks: a neglected topic in the low dose debate*, January 20, 2016. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4870760/ The 2016 report found the "excess relative risk for congenital malformations of 0.5 per mSv at 1 mSv falling to 0.1 per mSv at 10 mSv exposure and thereafter remaining roughly constant."

translating the lung counts into a dose, which they did. And yet that report — which the workers were never supposed to see — but did get emailed to them, quite by accident.

His first day's lung count wasn't in that report. That first day's lung count would have shown a 6-rem whole body dose — over the annual limit. So, it simply was excluded from what was sent to Oak Ridge. That was interesting.

Ralph's lung count, his first day lung count was the highest of the group. Brian's was the second. Ralph was the closest to the material.

Each lung count INL would give, the dose would get lower and lower, and intake would get lower and lower with each lung count they gave. As I studied those lung counts, there were actually error messages in the reports, "Peak Search" errors and other error messages. This then BEA would claim this [accident] was no contamination — there was no intake. "There was no contamination" and [yet] you had these error messages.

And you have, if you start looking at it, all kinds of irregularities in the lung counts and the reason for it was they were so contaminated, their [BEA's] normal way of manipulating the lung counts didn't get rid of the doses.

The fact is the software for the lung counts allow the operator to input gain factors, peak delete functions — that are not documented in the lung counts. And the irregularities in the lung counts and the tweaking that went on are criminal and basically NIOSH [National Institute of Occupational Safety and Health] should never accept results from any [Department of Energy] site as being honest for the lung counts.

The 6-rem dose was an underestimate based on the actual nasal swabs which were over 4000 dpm [disintegrations per minute] in a single nostril — for just plutonium-239, not the americium.

The fact is they [BEA] expected the lung counts would cheat successfully and it wasn't happening smoothly because they [the workers] were so contaminated.

The lung count process used by Department of Energy allows the operator to tweak it, manipulate it and lower the doses.

That's why Ralph's whole-body dose is far greater than 6 rem. It's far higher than the lung count showed [on the first day] and BEA's final dose for Ralph was 102 millirem. That's a hundred times too low. You just ought to be aware of more of the dose fraud. It's real. Thank you.

Please note that Ralph Stanton's first day lung count, would have yielded a dose estimate exceeding the 5-rem annual whole-body dose and the 50-rem bone dose. It would have predicted about 6 rem whole-body dose. Battelle Energy Alliance's final estimate dose for Stanton was 100 millirem (or 0.1 rem) whole-body dose.

While Battelle Energy Alliance claimed that there was essentially no intake, Stanton's urine and fecal bioassay yielded positive detections 226 days after the accident, and no further

bioassay was conducted. Stanton should not have been allowed to return to radiation work at that point, but was released for radiation work and also not told that his bioassay was still high.

More information about the 2011 plutonium inhalation event, including a detailed slide presentation on Ralph Stanton's lung counts, can be found on the Environmental Defense Institute website, including the INL accidents page at https:// http://www.environmental-defense-institute.org/inlrisk.html

Three Mile Island, a Look at the Increased Cancer Deaths and Infant Deaths Caused by the 1979 Accident

This is Part 3 of a series about the 1979 Three Mile Island Accident. See Part 1 in the May 2023 Environmental Defense Institute newsletter and see Part 2 in the June newsletter.

Highly Uncertain Official Estimates of Maximum Radiation Doses to the Public from Three Mile Island

Federal and state government officials continue to stand by the story that maximum doses from the 1979 accident at the Three Mile Island nuclear plant did not exceed 100 mrem to any member of the offsite public. [49] [50] [51] The U.S. Nuclear Regulatory Commission would continue to promote the idea that the radioactive gases were held within the reactor confinement building, that extensive monitoring "disclosed no evidence of large releases to the environment," and would conclude that the worst-case maximum individual dose from 100 millirem or less, within a fifty-mile radius of the plant, would amount to less than one additional cancer death. [52]

The most important radiation monitors at the Three Mile Island reactor site went off scale. By 7 am on March 28, airborne releases occurred from the main vent stack as well as many other unmonitored or unreliably monitored buildings. Evidence of steam generator tube breaks from the "B" loop are evident but rarely, if ever, mentioned in NRC reports or other technical reports from industry supportors. Steam generator tube breaks release reactor core radioactivity to the environment. There are clear differences in the pressure response to the March 28 hydrogen

[49] John G. Kemeny, Chairman, *Report of The President's Commission on the Accident at Three Mile Island*, October 1979.

[50] Nuclear Regulatory Commission Special Inquiry Group, Mitchell Rogovin and George T. Frampton, Jr., *Three Mile Island – A Report to the Commissioners and to the Public*, NUREG/CR-1250V1, August 1979.

[51] Nuclear Regulatory Commission, L. Battist, J. Buchanan, F. Congel, C. Nelson, M. Nelson, H. Peterson and M. Rosenstein, *Population Dose and Health Impact of the Accident at the Three Mile Island Nuclear Station*, NUREG-0558. 1979.

[52] J. Samuel Walker, *A Nuclear Crisis in Historical Perspective – Three Mile Island*, University of California Press, ISBN 0-520-24683-7, 2004. This book was sponsored by the U.S. Nuclear Regulatory Commission and although containing important dates and reference material, it uncritically promotes the misinformation provided by the NRC. See pages 205-206.

explosion, the hydrogen from zirconium cladding oxidation, and yet the different response to the pressure pulse in steam generator A compared to steam generator B is not addressed. [53]

The monitoring of the radioactive releases was spotty and poorly documented. Furthermore, without knowing the composition of the radionuclides in the plumes, instruments could not be properly calibrated. The monitoring by the utility that owned and operated TMI was inadequate and various records lost or never written down.

The Department of Energy sent a helicopter on the second and third day of the accident, reporting 3000 millirem (beta, gamma) 15 feet above the main vent on March 29 and 1500 millirem (beta gamma) at 130 feet about the reactor building on March 30. [54] But no helicopter monitoring occurred on March 28 when the releases were the highest.

But it is acknowledged that about 70 percent of the airborne releases that week came from the first 36 hours of the accident that began the morning of March 28. [55] There are extremely high uncertainties in the estimates of the curie amounts of radionuclides released from the TMI accident. [56] Jan Beyea stated: "The principal finding of the review is that the present scientific record does not support as final the published estimates for doses to the whole body and to the thyroid. The following factors enter into this finding: 1) The monitoring network in place, both inside and outside the plant, did not perform adequately, 2) Environmental sampling, instituted after the accident, was insufficiently coordinated, with problems in labeling and calibration. 3) The selective use of data collected and inferences as to missing data do not appear to have been fully justified. 4) Additional data, new and old, remain to be analyzed. Greater uncertainty than heretofore acknowledged should be assigned to the doses delivered to the population and, as a result, to the estimated health effects projected for the accident."

The original highly optimistic estimates of low radiological releases issued in the summer of 1979 were never modified. At that time, the extent of the fuel damage, about 50 percent of the

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[53] Electric Power Research Institute (EPRI), *Analysis of Three Mile Island – Unit 2 Accident*, SAC-80-1, NSAC-1, EPRI-NSAC—80-1, March 1980. Note that "This report was prepared by the Nuclear Safety Analysis Center (NSAC) operated by the Electric Power Research Institute, Inc. (EPRI). Neither the NSAC, EPRI, members of EPRI, other persons contributing to or assisting in the preparation of the report, nor any person acting on the behalf of any of these parties (a) makes any warranty or representation, express or implied with respect to the accuracy, completeness or usefulness of the information contained in this report, or that the use of any information, apparatus, method or process disclosed in this report may not infringe privately owned rights; or (b) assumed any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method or process disclosed in this report." In other words, this report is as unreliable to the safety of human health and the environment as U.S. Department of Energy or U.S. Nuclear Regulatory Commission reports.

[54] U.S. Nuclear Regulatory Commission, Office of Inspection and Enforcement, *Investigation into the March 28, 1979 Three Mile Island Accident by Office of Inspection and Enforcement*, NUREG-0600, Date Completed: July 1979, Published: August 1979. Findings of the investigation are signed by Victor Stello, Jr.

[55] Nuclear Regulatory Commission, Office of Standards Development, Lewis Battist and Harold T. Peterson, Jr., *Radiological Consequences of the Three Mile Island Accident Special Inquiry Group*, TMI collection, 12575453, (1979).

[56] Jan Beyea, Prepared for the TMI Public Health Fund, *A Review of Dose Assessments at Three Mile Island and Recommendations for Future Research*, August 1984.

fuel had melted, was not known. The public was told and continues to be told that the only health concern from the Three Mile Accident in 1979 was of an imperceptibly low increase in the number of fatal cancers. The focus on cancer (and leukemia) as though these are the only adverse health effects of radiation continues. The cancer rate assumed for the 1979 Three Mile Island accident was 0.0001 fatal cancers per rem. [57]

Changing Estimates of Radiation Exposure Cancer Fatality Rates

The Department of Energy's Environmental Impact Statements continue to focus on the latent cancer effects when assessing the impact of radiological releases. The cancer fatality rate has increased over the years. The Department of Energy has in recent years assumed the cancer fatality rate of 0.0006 fatal cancers per rem. [58] [59]

It is relevant to note that this 6-fold increase in the estimated rate of fatal cancers per rem since the 1970s appears to be too low, even for external penetrating ionizing radiation. A studies of radiation workers and the Techa River cohort indicate that the rate of cancer increase is higher still, of 0.01 fatal cancers per rem. [60] This would mean that the rate of fatal cancer per rem is 100 times higher than assumed in 1979. See Table 1 for a comparison of cancer fatality rate per rem.

The underlying studies arrived at a cancer rate twice as high as indicated in Table 1, except for Gofman's and Beyea's estimates. Studies largely based on the survivors of the 1945 bombing of Nagasaki and Hiroshima found the cancer rate to be twice as high, but assumed that at lower doses (below 10 rem or below 25 rem) were half that of the higher doses.

In other words, the advertised cancer fatality rates for low doses are low, and about half what the studies indicated. (The convention the Department of Energy and others use is to then double the cancer rates for doses above 10 or 25 rem, depending on the choice made as to what a low dose is.)

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[57] Nuclear Regulatory Commission, Office of Standards Development, Lewis Battist and Harold T. Peterson, Jr., *Radiological Consequences of the Three Mile Island Accident Special Inquiry Group*, TMI collection, 12575453, (1979).

[58] Department of Energy, Draft Environmental Assessment on the proposed Molten Chloride Reactor Experiment (MCRE) proposed for the Idaho National Laboratory, DOE/EA-2209, March 2023.

[59] U.S. Department of Energy's Versatile Test Reactor Draft Environmental Impact Statement (VTR EIS) (DOE/EIS-0542) (Announced December 21, 2020). A copy of the Draft VTR EIS can be downloaded at https://www.energy.gov/nepa or https://www.energy.gov/ne/nuclear-reactor-technologies/versatile-test-reactor. (See discussion in VTR EIS Appendix C, page C-4).

[60] Declaration of Dr. Jan Beyea in Support of Massachusetts Attorney General's Contention and Petition for Backfit Order, In the Matter of Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), Docket No. 50-293, U.S. Nuclear Regulatory Commission Before the Commission, May 2006. See NRC Adams ML111220356.pdf. "In addition, there has been a marked increase in the value of the cancer mortality risk per unit of radiation at low doses (2-to-3 rem average) as a result of recent studies published on a) radiation workers (Cardis et al. 2005) and b) the Techa River cohort (Kristinina et al. 2005). Both studies give similar values for low dose, protracted exposure, namely about 1 cancer death per Sievert (100 rem)." Note that 1 cancer death per 100 rem equates to 0.01 fatal cancers per rem.

Table 1. Comparison of various radiation-induced cancer fatality risk per rem levels.

Study	Radiation-induced cancer mortality (death) risk per rem
1985 Chupadera Mesa and Near-by Areas Summary Review to Support the DOE Designation/Elimination Decision (in regard to the 1945 Trinity atomic bomb test), November 1985	1.2E-4 fatal cancers per rem
2005 Type B Accident Investigation of the Americium Contamination Accident at the Sigma Facility, Los Alamos National Laboratory https://www.energy.gov/sites/prod/files/2014/04/f15/LANL_Am_Type_B.pdf	3.0E-4 fatal cancers per rem
2015 Department of Energy, Naval Nuclear Propulsion Program, Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling, DOE/EIS-0453D, June 2015	5.5E-4 fatal cancers per rem
2006 National Academy of Sciences BEIR VII, 2006 4.8E-4 fatal cancers per rem for adult men; 6.6E-4 fatal cancers per rem for adult women	5.7E-4 fatal cancers per rem
2023 Department of Energy Environmental Assessment for the Molten Chloride reactor and 2020 EIS for the Versatile Test Reactor	6.0E-4 fatal cancers per rem
1990 John W. Gofman's review of the atomic bomb study, both the original 1965 estimated doses and the 1986 modified doses and includes neutron dose corrections	26E-4 fatal cancers per rem
2006 observation by Jan Beyea that the study of radiation workers and the Techa River cohort indicate higher cancer rates	1.0E-2 fatal cancers per rem

Table 1 notes: All the estimates of radiation-induced cancer mortality risk are largely based on the study of World War II atomic bombing survivors except the 2006 observation by Beyea. All the studies except Beyea's and Gofman's [61] have applied a dose reduction factor for slow dose or low dose, known as the "DREF" effectively cutting the mortality risk in half. The DREF is 2.0 except for the BEIR VII study, [62] which used a DREF of 1.5. The lifetime dose in rem is used with the cancer mortality risk. For 1.2 radiation-induced cancer deaths in 10,000 people per rem, 1.2E-4 fatal cancers per rem is indicated. In many cases, the Department of Energy report does not identify the source of the estimated radiation-induced cancer rate.

[61] John W. Gofman, M.D., Ph.D., Committee for Nuclear Responsibility, Inc., "Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis," 1990.

[62] "Health Risks from Exposure to Low Levels of Ionizing Radiation BEIR VII – Phase 2, The National Academies Press, 2006, http://www.nap.edu/catalog.php?record_id=11340 The BEIR VII report reaffirmed the conclusion of the prior report that every exposure to radiation produces a corresponding increase in cancer risk. The BEIR VII report found increased sensitivity to radiation in children and women. Cancer risk incidence figures for solid tumors for women are about double those for men. And the same radiation in the first year of life for boys produces three to four times the cancer risk as exposure between the ages of 20 and 50. Female infants have almost double the risk as male infants.

Strong and diverse human epidemiology continues to show that no reduction in the risk should be applied for doses below 10 rem or obtained slowly over time. The 2015 nuclear-industry funded study of radiation workers by Richardson included low doses and doses obtained slowly over time and indicated no risk reduction factor should be applied. [63] Again, this means that most of the cancer fatality rates per rem are half of what their underlying studies supported.

John W. Gofman's higher estimate of cancer mortality risk per rem in the table was based on his independent analysis of atomic bomb survivors. [64] But all of the studies of the atomic bomb survivors are based on external radiation and may underestimate internal exposure from inhalation and ingestion of radionuclides and were limited to cancer risk.

Great Harm to the Unborn from Low Doses of Radiation Ignored by NRC

Furthermore, it is very important to understand that the age of the person exposed to ionizing radiation is very important. The fetus or embryo exposed in utero is the most vulnerable to radiation exposure. This fact was discovered by Dr. Alice Stewart in the 1950s, even though it was disputed for many years. As few as one or two medical x-ray exposures of pregnant women resulted in doubling the rate of childhood cancer and leukemia. [65] The vulnerability was later found to be greatest in the first trimester of pregnancy, with as little as little as 100 to 300 millirads producing a doubling of stillbirths and genetic defects. [66]

In 1979, the genetically related ill-health was considered to be smaller than that of a radiation dose causing a fatal or non-fatal cancer, and much smaller than currently occurring cases of genetically related ill health. While the radiation protection models have increased the rate of fatal cancers per rem, the rate of genetic damage has been deemed to have decreased and is no longer addressed in Environmental Impact Statements.

In 2007, the International Commission of Radiological Protection (ICRP) lowered its estimate of the risk of genetic harm of congenital malformations by 6-fold, from 1.3E-4 per rem to 0.2E-4 per rem. Based on the belief that the study of the Japanese bomb survivors did not detect genetic effects, **the ICRP genetic effect estimate for humans is based on studies of external radiation of mice.**

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[63] Richardson, David B., et al., "Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS), BMJ, v. 351 (October 15, 2015), at http://www.bmj.com/content/351/bmj.h5359 Richardson et al 2015 . This epidemiology study that included a cohort of over 300,000 nuclear industry workers has found clear evidence of solid cancer risk increases despite the average exposure to workers being about 2 rem and the median exposure was just 410 millirem. Also see December 2015 EDI newsletter.

[64] John W. Gofman, M.D., Ph.D., Committee for Nuclear Responsibility, Inc., "Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis," 1990.

[65] Gayle Greene, *The Woman Who Knew Too Much – Alice Stewart and the Secrets of Radiation*, The University of Michigan Press, 1999. ISBM 0-472-11107-8

[66] Ernest J. Sternglass, *Secret Fallout – Low level Radiation from Hiroshima to Three Mile Island*, McGraw-Hill, 1981, expanded from the version first published in 1972 by Ballantine Books. ISBN 0-07-061242-0. See page 106 in the 1981 version and page 141 in the 1972 version. This information pertaining to the vulnerability of the unborn to very low doses of ionizing radiation was readily available prior to the 1979 Three Mile Island accident.

However, the reality is that neither the U.S. Nuclear Regulatory Commission nor the Department of Energy adequately address the harm to the unborn from low doses of radiation.

Increases in Rates of Childhood Cancer and Leukemia from Radioactive Fallout

It was the nuclear weapons fallout, from use in World War II in Japan and from weapons testing in the U.S. and outside the U.S. that had repeatedly caused radioactive fallout. Experts within the Atomic Energy Commission, later to become the Department of Energy, working closely with state health departments, sought to cover up the adverse health effects from weapons testing. The knowledge of increased childhood leukemia cases in Utah, after receiving fallout from the Nevada Test Site, was suppressed by the AEC. Later, an independent study by Dr. Joseph Lyon detected the increased childhood leukemia cases in Utah. [67]

The rate of thyroid cancers from radioactive iodine-131 from nuclear weapons testing increased, thought to be largely from the ingestion of milk. The radioactive fallout covered grass consumed by cows and concentrated in milk. Testing of radioactivity levels in milk for iodine-131 and other radionuclides was conducted in the U.S. during the 1950s until 1974. While the association with increased thyroid cancer is well known, less known is the serious affect the radioactive iodine-131 has on the developing child in utero.

Any radionuclide consumed in food or water will disproportionately affect the unborn child's newly forming body. When the unborn child's tiny thyroid contains radioactive iodine-131, the child's development is impeded. This leads to underweight babies, babies who are not ready to breath air when born and require incubators, and increased rates of stillbirths and increased rates of neonatal death (within a month of birth). If the baby survives, the development of the brain was also impeded in utero, and lower intelligence occurs as was notable by low SAT test scores by those kids exposed in utero. (See Sternglass's book *Secret Fallout*.)

So, while official radiation protection guidelines still ignore the extreme vulnerability of the unborn, it was known in 1979 that pregnant women and their unborn child, were particularly vulnerable to airborne releases of radioactivity and to radioactivity in food, including milk or water. And this was why Ernest Sternglass spoke up on March 29, the day after the TMI accident began, to urge pregnant women to leave the vicinity of the damaged reactor.

The Evacuation of Pregnant Women and Children came too late

Ultimately, the Governor of Pennsylvania would reluctantly call for the evacuation of women living within 5 miles of the TMI reactor. But he only did so about noon on March 30 even though the largest radiological releases began by 7 am March 28. Criteria for evacuating people did not exist and currently do not exist and do not address the vulnerability of the unborn and young children.

[67] Ernest J. Sternglass, *Secret Fallout – Low level Radiation from Hiroshima to Three Mile Island*, McGraw-Hill, 1981. See page 211.

Studies have shown that females are more vulnerable to ionizing radiation than men, and children are more vulnerable than adults. Furthermore, female children are more vulnerable than male children for certain cancer. Radiation protection standards commonly focused on cancer rates are simply not protective of children and the unborn, not even for cancer (and leukemia). The radiation protection standards are also not protective in regard to increased infant and neonatal deaths as well as weakened infant health.

Cancer mortality (or fatal cancers) had once been the main focus in radiation protection, but by the late 1990s, there was growing awareness of increasing **cancer incidence risk** per unit dose of radiation documented in various studies. [68] [69] [70] In the early 1990s, International Commission on Radiation Protection report ICRP 60 estimated the rate of non-fatal cancer incidence to be roughly one fifth of the rate of fatal cancers.

By 1999 and further amplified in 2006, the radiation-induced cancer incidence risk from radiation would be recognized to be far higher. The 2006 National Academy of Sciences report known as BEIR VII estimated that the average fatal cancer risk was 5.7E-4 per rem and the cancer incidence risk from radiation for males was estimated at 9.0E-4 per rem and for women was 13.7E-4 per rem lifetime exposure for solid cancers and leukemia combined. Table 2 shows cancer incidence and cancer mortality from the 2006 BEIR VII report. [71]

Before the late 1990s, radiation risk to females was generally treated as roughly equal to the radiation risks to males. But by the late 1990s, studies of the survivors of the atomic bombing of Japan in 1945 by the International Commission on Radiation Protection (ICRP) had higher radiation risk harm to women than men, for the same dose. And the studies showed higher cancer risk to children, especially female children, than to adults for the same dose. The National Research Council BEIR VII report issued in 2006 found even higher risks to women and children, see Table 3. See also the Institute for Energy and Environmental Research (IEER.org) report, *Science for the Vulnerable*, for additional insight. [72]

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[68] Keith F. Eckerman, Richard W. Leggett, Christopher B. Nelson, Jerome S. Puskin, Allan C. B. Richardson, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides: Radionuclides-Specific Lifetime Radiogenic Cancer Risk Coefficients for the U.S. Population, Based on Age-Dependent Intake, Dosimetry, and Risk Models*, Federal Guidance Report No. 13. EPA-402-R-99-001. Oak Ridge, TN, Oak Ridge National Laboratory, U.S. Environmental Protection Agency, September 1999. Known as "FGR 13."

[69] U.S. Environmental Protection Agency, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides: CD Supplement*. Federal Guidance Report 13. EPA-402-C-99-001, Rev. 1 2002. Known as "FGR 13 CD."

[70] U.S. Environmental Protection Agency, *EPA Radiogenic Cancer Risk Models and Projections for the U.S. Population*, EPA 402-R-11-001, April 2011. Known as the "Blue Book."

[71] Richard R. Monson (Chair) et al., *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII – Phase 2*, Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, National Research Council of the National Academies, Washington, DC: National Academies Press, 2006. Known as "BEIR VII."

[72] Arjun Makhijani, Ph.D., Brice Smith, Ph.D., Michael C. Thorne, Ph.D., Institute for Energy and Environmental Research, *Science for the Vulnerable Setting Radiation and Multiple Exposure Environmental Health Standards to Protect Those Most at Risk*, October 19, 2006.

Table 2. Radiation-induced cancer incidence and fatality estimates per rem, lifetime dose, BEIR VII report.

	Males, solid cancers	Females, solid cancers	Males, leukemia	Females, leukemia	Males, all cancers	Females, all cancers
Cancer incidence (fatal and non-fatal)	8E-4	13E-4	1.0E-4	0.7E-4	9E-4	13.7E-4
Fatal cancer only	4.1E-4	6.1E-4	0.7E-4	0.5E-4	4.8E-4	6.6E-4
Average fatal cancer only					5.7E-4	

Table notes: National Research Council, National Academy of Sciences, BEIR VII report, 2006. The average fatal cancer rate per rem, of 5.7 per 10,000 persons per rem is equivalent to 5.7E-4 fatal cancers per rem. The cancer estimates include a dose reduction factor of 1.5.

Table 3. Radiation-induced cancer (incidence) per rem, by age at exposure and gender, for some cancer types, 2006 BEIR VII report.

	Infant		Age 5 years		Age 30 years	
	Male	Female	Male	Female	Male	Female
Colon	3.36E-4	2.2E-4	2.85E-4	1.87E-4	1.25E-4	0.82E-4
Lung	3.14E-4	7.33E-4	2.61E-4	6.08E-4	1.05E-4	2.42E-4
Breast	N/A	11.71E-4	N/A	9.14E-4	N/A	2.53E-4
Thyroid	1.15E-4	6.34E-4	0.76E-4	4.19E-4	0.09E-4	0.41E-4
Leukemia	2.37E-4	1.85E-4	1.49E-4	1.12E-4	0.84E-4	0.63E-4
All solid cancers	23.26E-4	45.92E-4	16.67E-4	32.65E-4	6.02E-4	10.02E-4
All cancers	25.63E-4	47.77E-4	18.16E-4	22.77E-4	6.86E-4	10.65E-4

Source: BEIR VII, 2006.

The American Cancer Society website states that in the U.S. the annual cancer incidence (all causes) for 2012 to 2016 for males is 48.9 in 10,000 people (48.9E-4) and for women is 42.1 in 10,000 (42.1E-4) people, but there was no trend information on cancer incidence overall. [73]

Studies by the International Commission on Radiation Protection (ICRP) have been adapted into U.S. Environmental Protection Agency reports including Federal Guidance Report 13. The incorporation of the higher radiation-induced risks to women and children for cleanup standards for radioactively contaminated sites sounds beneficial. But in reality, the high costs of cleanup mean that EPA cleanup standards are not feasible to meet and are not met.

The ICRP, EPA's reports and BEIR VII are not independent of each other. And there is good reason to believe that external radiation cancer risk is still underestimated a few-fold and that internal radiation risk from breathing radiatively contaminated air and from ingesting radioactively contaminated food and water is still underestimated by a far larger amount.

People Living Near (and not so near) from TMI Were Harmed

People living near Three Mile Island noticed a variety of unusual acute symptoms beginning the day the accident began on March 28. Some people noticed a metallic taste in their mouths and reddened skin that was exposed, vomiting, diarrhea and/or other symptoms. Some people experienced hair loss. Unusual pet deaths and an absence of song birds was also noted.

Subsequent FISH DNA damage testing conducted 15 years after the accident for 29 people who were vomiting the day of the accident showed radiation doses far higher: 50 to 90 rem. [74]

The official story from the Nuclear Regulatory Commission and others state that the maximum radiation dose to the public did not exceed 100 millirem. DNA testing indicated damage to blood lymphocytes corresponding to doses over 500 times higher.

In April 1980, the Pennsylvania health department would declare that neither fetal nor infant mortality had risen in the six months following the accident within a ten-mile radius of Three Mile Island and four years later, declared that within a 20-mile radius of the plant, cancer deaths were no higher after the accident. [75] The Three Mile Island Public Heath Fund, created by court order, [76] provided financial support for studies and subsequent epidemiology was conducted in accordance with the court order which stipulated that the radiation doses were low and that no health effects above [one percent increase] were allowed to be found. See Wing's 1997

[73] American Cancer Society website, accessed July 27, 2020. https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2020/cancer-facts-and-figures-2020.pdf

[74] Steve Wing, David Richardson, Donna Armstrong, and Douglas Crawford - Brown, A Reevaluation of Cancer Incidence Near the Three Mile Island Nuclear Plant: The Collision of Evidence and Assumptions, Volume 105, Number 1, January 1997, Environmental Health Perspectives.

[75] J. Samuel Walker, *A Nuclear Crisis in Historical Perspective – Three Mile Island*, University of California Press, ISBN 0-520-24683-7, 2004. This book was sponsored by the U.S. Nuclear Regulatory Commission and although containing important dates and reference material, it uncritically promotes the misinformation provided by the NRC. See pages 234 and 235.

[76] Karl Z. Morgan and Ken M. Peterson, *The Angry Genie – One Man's Walk through the Nuclear Age*, University of Oklahoma Press, 1998. ISBM: 0-8061-3122-5. See page 185.

description of the court constraints on the epidemiology funded by the Three Mile Island Public Health Fund.

The epidemiology conducted with the Three Mile Island Public Health Fund did in fact find elevated levels of cancer, and attributed the elevated cancers to some unknown cause, stating that perhaps the elevated cancer rates were due to stress or stress-related behaviors. [77] A 10-mile radius from the plant was subdivided into 69 study tracts, based on wind dispersion of radioactive emissions. [78] A population of 160,000 people within the 10-mile radius was studied, the population within each study tract was an average of 2,300 persons. This the 69 study tracts were associated according to lowest to highest fallout, despite the amount of fallout of largely gaseous radionuclides, being unknown.

Steven Wing was asked to review the epidemiology conducted by Hatch and others, that had been funded by the Three Mile Island Public Health Fund. Wing's study utilized the 69 study tracts that were based on lowest to highest exposures that had already been developed by Beyea. He noted several errors in the study by Hatch and he found a very strong association of increased cancers in accordance with the tracts having the highest (although unknown) radiation exposure. [79] Basically, the airborne radioactive xenon-133 and krypton-85 and iodine-131 that were inhaled in the most affected hilltop areas would allow inhalation of radioactivity. This is distinctly different from high external radiation that occurred in the case of the World War II bombings of Hiroshima and Nagasaki, which could affect the latency period for cancer. He found elevated rates of lung cancer, of leukemia, and of the grouping of "all cancers."

An author of the Three Mile Island Public Health Fund's epidemiology, Marvin Susser, provided scathing rebuttal to the Wing study. But if you take the time to read the studies, you will see that Wing's observations are absolutely solid. The epidemiology study by Hatch, Susser and others, had refused to acknowledge radiation as even a possible cause of elevated cancers, had used undercounted cancers prior to the accident in 1975 to inflate the cancer rise before the accident and thus minimized the impact of the accident, and had counted children who were not exposed to the accident. Rudeness by Susser in his rebuttal does not make him right. [80]

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[77] Maureen C. Hatch, PhD, Sylvan Wallenstein, PhD, Jan Beyea, PhD, Jeri W. Nieves, MS, and Mervyn Susser, MB, BCh, American Journal of Public Health, "Cancer Rates after the Three Mile Island Nuclear Accident and Proximity of Residence to the Plant," June 1991.

[78] Maureen C. Hatch, PhD, Jan Beyea, Jeri W. Neives and Mervyn Susser, MB, BCh, American Journal of Epidemiology, "Cancer Rates after the Three Mile Island Nuclear Accident: Radiation Emissions," September 1990.

[79] Steve Wing, David Richardson, Donna Armstrong, and Douglas Crawford - Brown, A Reevaluation of Cancer Incidence Near the Three Mile Island Nuclear Plant: The Collision of Evidence and Assumptions, Volume 105, Number 1, January 1997, Environmental Health Perspectives.

[80] Mervyn Susser, "Consequences of the 1979 Three Mile Island Accident Continued: Further Comment," Volume 105, Number 6, June 1997, Environmental Health Perspectives.

Wing responded to Susser's comments and also wrote another article "Objectivity and Ethics in Environmental Health Science" in 2003. [81] [82] The highly speculative and biased estimates that asserted that the radiation doses were low had caused the epidemiologists of the Hatch study, to discard radiation as even a possible cause of the increased rates of cancer.

The court, however, would accept without scrutiny the tremendously uncertain radiation dose estimate of 100 millirem or less, yet would refuse to acknowledge the findings of elevated cancers by Wing or of the biologic markers of very high radiation exposure from the FISH tests.

In the most highly exposed study tracts, the lung cancer rates for 1984 to 1985 were 2.66 to 3.24 times expected. The leukemia cases for 1984 to 1985 were 6 to 8 times higher than expected. The "all cancers" grouping was in 1984 to 1985, 1.4 to 1.68 higher than expected. (See Wing, 1997 for more detail.)

Despite the call for evacuation of pregnant women and young children within 5 miles on the plant, the evacuation order came over two days after the accident began. This was after over 70 percent of the accident's releases had already occurred. No restriction was placed on the drinking of milk. (Later venting of the reactor containment building would release another wave of radionuclides on the nearby public.)

Iodine-131 Releases from Three Mile Island

The NRC's official estimate of the iodine-131 release was 15 curies, of the 65 million curies of it in the reactor fuel at the time of the accident. [83] An estimate by Dr. Karl Morgan that a far higher number, 64,000 curies of iodine-131 had been released. [84] Another analyst was noted in the report by Beyea to have also estimated the radioiodine releases at 64,000 curies. [85] The radioactive iodine would be inhaled and would also be concentrated in cow's milk. Milk tested April 4, 1979 by the Food and Drug Administration showed elevated iodine-131 and cesium-137. (See Caldicot, *Nuclear Power is not the Answer*, page 69.) Officially declared iodine-131 levels in milk ranged from non-detect to 15-36 picocuries per liter. (See Battist, NRC.) However, far higher levels of iodine-131 in milk were detected March 30, 1979, by Pennsylvania State University, which found levels exceeding 4000 pCi/L, and as high as 21,500 pCi/L. (See Caldicot, page 70.)

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[81] Steven Wing and David Richardson, "Response: Science, Public Health, and Objectivity: Research into the Accident at Three Mile Island," Volume 105, Number 6, June 1997, Environmental Health Perspectives.

[82] Steven Wing, "Objectivity and Ethics in Environmental Health Science," Volume 111, Number 14, November 2003.

[83] Nuclear Regulatory Commission, Office of Standards Development, Lewis Battist and Harold T. Peterson, Jr., *Radiological Consequences of the Three Mile Island Accident Special Inquiry Group*, TMI collection, 12575453, (1979).

[84] Helen Caldicott, *Nuclear Power is not the Answer*, The New Press New York and London, 2006. ISBM 13-978-1-59558-067-02. See page 67.

[85] Jan Beyea, Prepared for the TMI Public Health Fund, *A Review of Dose Assessments at Three Mile Island and Recommendations for Future Research*, August 1984.

Jay Gould, in his book, *Deadly Deceit*, noted that increased deaths are associated with levels of iodine-131 in milk that exceed 20 pCi/L. Of course, the radioactive fallout that increased the iodine-131 in milk was accompanied by other radionuclides as well, including strontium-90 and cesium-137. (The allowable federal level for iodine-131 in milk (in 1986) was 15,000 pCi/L and monitoring of radiation in milk in the U.S. ceased in 1990.)

Harm to the Public from Three Mile Island Accident Releases was Notable by 1983

Gould also evaluated the health changes around Three Mile Island, comparing 1968 though 1973 to 1979 through 1983. In ten counties around TMI, he noted large increases in infant diseases (15.5 percent), infant birth defects (20.7 percent), breast cancer (7.0 percent) and child cancers (35.7 percent.) [86]

As you can see, the Nuclear Regulatory Commission, the Food and Drug Administration, the Environmental Protection Agency and not even the Pennsylvania State Health Department were not protecting human health during the Three Mile Island accident. The elevated cancer rates were tragic but there's more. The concerns expressed by Ernst Sternglass pertaining to infant deaths were well founded. Sternglass and later Jay M. Gould would find elevated infant deaths and health problems such as low birthweight, hypothyroidism, decreased intelligence, and compromised immune systems. U.S mortality rates also spiked in 1979 and mortality rates from all causes spiked after Three Mile Island. [87]

Elevated rates of infant deaths were noted during the atomic bomb testing years, and degree of radioactive fallout could be correlated to the levels of radioactivity in milk. Low birthweight for live babies accompanied the higher radioactive fallout levels as well. Despite efforts by the Pennsylvania State Health Department to manipulate vital health statistics and lower or remove the increases, there remained evidence of the harmful effects of the Three Mile Island accident that spanned far beyond the 5- and 10-mile radius of the plant. (See Sternglass, *Secret Fallout* and Gould, *Enemy Within*.) Infant mortality peaked in the 3 or 4 months after the accident, when highly active fetal thyroids would have taken in radioactive iodine-131, and could explain the large increase in immature and underweight babies who died of respiratory distress. (See Gould, *Enemy Within*, page 52.) Infant deaths are typically lower in the summer months than in the winter. Sharp increases occurred during the summer of 1979. [88]

During the highest releases from the accident at Three Mile Island, the fallout was said to predominantly blow north, northwest and west of the plant. (Sternglass, *Secret Fallout*, page 231.) **For May through December of 1979, in Pennsylvania, whereas Pennsylvania infant**

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[86] Jay M. Gould and Benjamin A. Goldman, *Deadly Deceit – Low Level Radiation High Level Cover-Up,* Four Walls Eight Windows New York, 1990. ISBN 0-941423-35-2. See pages 69, 83 and 84.

[87] Jay M. Gould with members of the Radiation and Public Health Project, Ernest J. Sternglass, Joseph U. Mangano, and William McDonnell, *The Enemy Within – The High Cost of Living Near Nuclear Reactors – Breast Cancer, Aids, Low Birthweights, and Other Radiation-Induced Immune Deficiency Effects*, Four Walls Eight Windows, 1996. ISBN 1-56858-066-5

[88] Jay M. Gould and Benjamin A. Goldman, *Deadly Deceit – Low Level Radiation High Level Cover-Up,* Four Walls Eight Windows New York, 1990. ISBN 0-941423-35-2.

mortality had been below the U.S. rate, for each of these months after the accident, Pennsylvania's infant mortality exceeded the U.S. rate. North of TMI, upstate New York also had increases in infant mortality. (See Sternglass, *Secret Fallout*.)

Summary

The key points concerning the continuing claim by the nuclear industry that no one was harmed by the Three Mile Island accident are these:

- It is true that no one was sent to the hospital for acute radiation, either at the plant or to members of the public. It is true that the releases from TMI were less than those of the 1986 Chernobyl accident. However, members of the public receiving the highest fallout from TMI did experience symptoms of acute radiation poisoning. The blood tests, 15 years later, indicated very high radiation doses, from 50 to 90 rem, over 500 times higher than estimated by the NRC.
- While the Nuclear Regulatory Commission and others, maintain that the maximum dose to the public was less than 100 millirem (or 0.1 rem), this estimate is highly uncertain and based on very selective information, while actively ignoring reasons why the doses were much higher. An excellent description for many reasons to not believe the maximum 100 mrem dose is given by Beyea in 1984, cited above. The U.S. government is the insurer for damages from a nuclear accident. The promotors of nuclear energy and nuclear weapons actively sought to coverup and downplay the severity of the Three Mile Island accident. The radiation doses to the public were far higher than have been acknowledged.
- It is revealing, the extent to which the Pennsylvania Health Department aggressively sought to withhold and to manipulate infant mortality rates and engaged in ridiculing members of the public who were seeking answers as to why they had experienced strange symptoms immediately following the commencement of the accident, and why elevated infant mortality and cancer deaths were occurring, which in fact, were occurring. State health departments also provided cover in Utah for the Nevada weapons testing.
- The nuclear-industry influenced and constrained epidemiology study by Hatch would find elevated cancer rates and yet would refuse, based on the highly biased and speculative dose estimates, to acknowledge that the Three Mile Island radiological releases could have possibly been the cause.
- The epidemiology for people living within 10 miles conducted by Steven Wing yielded increased cancer rates. The highest cancer rates spiked far above previous levels in those study tracts receiving the highest amount of radioactive fallout. The large amount of fallout in a period of days along with precise wind and topography allowed this to be shown. (For other historical releases over longer periods, the lack of a clear trend based on weather patterns should not be used to argue radiation exposure did not occur. Contamination by milk and food can be highly variable in people living within a similar region.)
- The number of infant deaths, low birthweight babies, and birth defects also spiked upward following the Three Mile Island accident, above the normal increases for people living near operating nuclear power plants. See studies by Sternglass and Gould.

- Current Nuclear Regulatory Commission standards, Environmental Protection Agency standards and Department of Energy standards and their evaluation of the health impacts of nuclear reactors and other nuclear facilities continue to neglect the true health harm to the public of the airborne emissions from these operations. Also neglected are the true health risks to workers at these facilities.

The importance of the adverse health findings by Ernst Sternglass, Jay M. Gould and others, from several decades of weapons testing and nuclear power plants in the U.S. is more relevant today than ever, as the current push is being made for building a large number of new nuclear reactor power plants.

The pressure is increasing to reduce licensing reviews, loosen reactor siting criteria, reduce the already ridiculously ineffective emergency preparedness, do not bode well for public health. The increased number of nuclear reactors mean increasing mortality rates for young and old, increasing infant mortality rates and rates of birth defects, and increases in a variety of illnesses.

Either the nuclear industry will survive, or the human race. But not both.

Articles by Tami Thatcher for July 2023. Minor editorial edits made late June 29 evening. On June 30, I added more descriptive information on Chernobyl liquidators and on the absence of mention by NRC and others of the apparent steam generator "B" tube ruptures at Three Mile Island.