

# sounding board



## The Chernobyl Nuclear Disaster: Medical Effects 23 Years Later

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April 26, 2009, is exactly 23 years after the explosion of Reactor 4 at Chernobyl nuclear reactor site in the Ukraine. March 30 was the thirtieth anniversary of the meltdown of the reactor at Three Mile Island. Because of these incidents, no further nuclear power plants have been constructed in the United States since then. The time has come to reevaluate the possible dangers of such power plants.

The mass hysteria has subsided, and now enough time has elapsed to evaluate the medical effects of the explosion at Chernobyl, which released 50 tons of radioactive material (Iodine, Cesium, Krypton and Strontium) into the atmosphere, much more than, the amount of radioactive contamination from the early “atomic bombs” at Hiroshima and Nagasaki. The release of radioactive gases (mainly Krypton-85 with a half life of 11 years) from Three Mile Island was negligible.

I visited Chernobyl last year, when my brother and I traveled to the Ukraine to find out where our family came from over 100 years ago, when our parents immigrated to the United States. We eventually found the village, Stryanka, so small it is not even on any map, and located a second cousin. But that is another story.

It is difficult to get to Chernobyl, since you have to be part of an organized tour, prearranged, and paid for (US \$225). You cannot go to the exclusion zones alone (there are two security checkpoints, one at 30 km from Reactor 4 and one at 10 km) (Figure 1), and, while there, you are under strict supervision of the guides and guards. You are forbidden to remove anything from the exclusion zones.

A woman biker, Elena Fortinova (aka Kidd of Speed) claims to have ridden on her motorcycle alone across the exclusion zone, kilometer after kilometer of deserted roads. I recommend her web site, which has remarkable photos.<sup>1</sup>

Our companions on the trip were three physicians from the University of Colorado who were in the Ukraine studying the AIDS



**Figure 1:** 30 km checkpoint - Note the armed guard in the background.

epidemic. The Ukraine has ten times the number of cases of any country in the European Union. About 1.4% of the population has AIDS, and probably another 1% is HIV positive. Although the majority (70+ %) are IV drug users, heterosexual transmission is rapidly rising. The problem is that Ukrainian women are very beautiful and very poor. (Average income in the Ukraine is about US \$100 per month, perhaps US \$200 in Kiev, which is not enough to live on.) There are numerous “dating services” and “marriage services,” which are actually brothels without walls, run by criminals exploiting desperate young women whose main desire is to get out of the Ukraine. Actually, this is a much worse problem than the aftereffects of the Chernobyl nuclear explosion. The incidence of HIV/AIDS is rapidly increasing, while the effects of radiation sickness have long since disappeared.

What did happen and what are the long-term results as to health care? Getting the facts is difficult since the truth has been obscured by individuals who have a political ax to grind, either to

condemn nuclear power (Greenpeace)<sup>2</sup> or extol its safety. In 1980 Styrikovich of the Soviet Union and Strauss of the United States claimed that nuclear plants were perfectly safe.<sup>2a</sup>

What did happen? It started out as a test of the dynamics of the turbines and the diesel generators in case electrical power was interrupted. The reactor was of Russian design, natural uranium fueled (the Ukraine mines its own uranium), "light" water cooled, graphite moderated. If it loses its coolant, it will run faster and hotter and will not shut down but will melt down very rapidly. The reactor was out of control 40 seconds after the start of the test. They were not covered by adequate containment structures, such as used in the United States. They were built cheap and run by inexperienced personnel, whose experience was with conventional power plants and who had no idea of the potential for disaster. For instance, they did not know that at low power levels, the reactor becomes unstable, which could result in a very rapid increase in output.<sup>3,4</sup>

On the 25<sup>th</sup> of April, 1986, an experiment was planned to determine, when the reactor output was reduced to low levels, whether the turbines that generate the power would continue to run. However, demands for increased power during the day resulted in the experiment being put off until that night.

On the 26<sup>th</sup> of April, 1986, at about 0100 hours, the reactor was powered down to test the dynamics of the turbines with limited electrical power flow. At 0118 hours one of the operators apparently neglected to reset the safety devices, which allowed the power level to fall to 1%, which was too low for the test. His supervisor decided to continue the test anyway, and at 0120 hours he also disabled the emergency shutdown procedures, such as indication of low water level, which would have shut down the turbines, in order to avoid aborting the test and having to start over. The usual way to increase power is to pull out the control rods which regulate the speed of the chain reaction by absorbing neutrons. Such an attempt was made by pulling more and more of the control rods until only six were left. It was not realized by the operators that no less than a minimum of 30 of 205 rods were necessary to avoid loss of control.

At 0122 hours the test was started, and at 0123 hours the remaining turbine was shut down.

At 0123 hours and 40 seconds, there was a marked rise in power output, partly due to a reduction in coolant water flow, since the turbines were off line. The operator pressed the emergency SCRAM (Safety Control Rod Axe Man\*) button to reinsert all control rods, which takes about 20 seconds.

\*SCRAM is the way a reactor can be shut down in an emergency. It stands for Safety Control Rod Axe Man. When Enrico Fermi built the first nuclear reactor, he realized that the reaction could go out of control. Therefore, he placed a large graphite rod above the reactor and tied a rope to it, which ran down to a pulley to the floor. A technician was given a fireman's axe and told, in case of emergency, to cut the rope, which would drop the rod into the atomic pile and abort the chain reaction.

Due to faulty design of the control rods, which accelerated the chain reaction, power increased to over 100 times in four seconds and meltdown commenced. A steam (2500+ degrees C at 3000 psi pressure) explosion blew off the 1000 ton reactor cover, followed by a second explosion. This was a chemical, not a nuclear, explosion, although no one has ever determined what exactly occurred. No commercial reactor contains enough Uranium 235 or plutonium to cause a nuclear fission explosion, and, even if it did, the conditions are not suitable for a rapid chain reaction. However, about 50 tons of nuclear fuel was



**Figure 2:** Chernobyl Reactor #4 - This is probably taken from a helicopter several days after the explosion. The reactor was in the center of the photo and apparently has stopped burning. The photographer is unknown. It is published under the fair use rationale.

vaporized and blown straight up into the air and carried off by the prevailing winds northward to Belarus, Russia, Finland, and Sweden. Another 25 tons was projected sideways by the second explosion.

Figure 2 shows the aftermath of the explosion. This was taken by an unknown person, possibly a helicopter pilot. The graphite core had been burning at over 2000 degrees Celsius, and the situation was totally out of control.

Two people were killed by the blast, and one died of a "heart attack." About 30 fires were started by the second explosion. The firefighters were not told of the radiation hazard, and six died



**Figure 3:** “They saved the world,” a monument to the plant workers and fire fighters.

of acute radiation sickness along with 22 power plant workers within three weeks. Initial symptoms are vomiting and general malaise, followed by leucopenia, loss of bone marrow, hair loss, sepsis, and GI hemorrhage.

There is a monument to these workers on site (Figure 3), which states, “They saved the world.” Those on duty, who bravely fought the fires and tried to control the damage, were all accused of dereliction of duty and failure to follow safety procedures (which were written *ex post facto*) and were sentenced to prison, which made no difference since they all died anyway.

No one in authority said anything to anyone, and life went on as usual on that Saturday, with several weddings being celebrated in the town of Priyapat, where the workers lived. Finally, on Sunday afternoon evacuation procedures were started. About 135,000 people were evacuated including 39,000 from Priyapat. To simplify transport they were told not to bring any possessions and that they would be returning in three days. Those in charge knew that they would never be returned and would be “resettled” elsewhere. The Soviets had had considerable experience in resettling the Ukrainians.

However, a number of people have returned illegally, estimates being from 300 to 1000, living by hunting and fishing and living in abandoned houses.

In fact, there were nothing but lies told by the authorities. The first people to discover that there was a problem were the Swedes, who noted a marked increase in background radiation at their reactors. After determining that their facilities were not at fault, they contacted the Soviets and demanded to know if there had been a nuclear accident. The Soviets denied any problems until the evidence became overwhelming, such as a US satellite photo, which, on April 29 noted the effects of the fire and explosion. On the evening of the 29<sup>th</sup> the Soviets issued a terse communiqué that there had been “an accident at the Chernobyl nuclear power plant” and that “Measures are being taken to eliminate the consequences of the accident.”<sup>5</sup> Actually, no one knew what to do, since this was the first time a nuclear reactor had exploded. The graphite core was burning at over 2500 degrees Celsius, totally out of control. Those in charge were terrified that there would be a “China syndrome,” and the core would burn its way into the cellars, which were full of water and would have caused another steam explosion, blowing the remains of the reactor up to the stratosphere or continuing down and contaminating the water table for the whole western Ukraine. Fortunately, neither occurred, and the fire burned out by itself after several days.

Figure 2 may have been taken from a helicopter dropping material to cover the fire in the graphite core, which apparently accomplished nothing, since most of the material missed the reactor core. Liquid nitrogen was tried and accomplished nothing. Finally, a huge “sarcophagus” of concrete and steel was erected to enclose the reactor (Figure 4).

In addition to the above 28 fatalities, two were killed in the explosion and 17 subsequently died of radiation sickness or “other causes,” and there were nine documented deaths from thyroid cancer in children. There were about 4000 cases of thyroid cancer due to uptake of radioactive iodine, primarily in children, which could have been prevented. All exposed should have been given iodide tablets, which would block further uptake of radioactive iodine by the thyroid gland. Most of the ingested iodine came from milk from cows eating contaminated grass. Fortunately, radioactive iodine has a half life of eight days. Since the Soviets did not admit to the accident until it was too late to give iodide tablets or perhaps did not have them available, this step was not done.

Inspired by the hysteria generated by the accident and the large numbers of people exposed from the Ukraine to Belarus, Russia to Sweden, the UNSCENR (United Nations Scientific Committee on the Effects of Nuclear Radiation) reported in 2000 and again in 2005 that there was no scientific evidence of any significant health effects from radiation to the people exposed.<sup>6</sup> The Swedes have stated that there is no evidence of an increase in childhood leukemia in their population.<sup>7</sup>

At best, there are apparently about 56 documented deaths that can be attributed to the disaster, 47 in plant workers, and nine children who died of thyroid cancer.<sup>6</sup>



**Figure 4:** The sarcophagus which covers the remains of the reactor, taken from the back of the view in Figure 2.

What about Chernobyl today? It is an eerie place – the town, deserted and in ruins, windows smashed, a child's stuffed toy lays in the ruins near a ticket booth of a theme park, which was set to open on May 1. There are plenty of workers still there. The sarcophagus of concrete and steel that encases Reactor 4 is deteriorating and requires daily maintenance (Figure 4). The workers are supposed to spend ten minutes working on the structure at any one time, but are able to do their tasks in about four minutes. Nobody bothers with dosimeters. There are elaborate plans for a new structure, but no money is available. Actually, nobody seems to care; the political situation is in chaos, the government has been at a standstill for the past three years, while the President and Prime Minister fight for power, and the hopes of the orange revolution (which was supposed to restore democracy) are gone.

And what about the remaining reactors? Supposedly, #2 was closed after a turbine fire in 1991; #1 was closed in 1996, and #3 was closed after coercion from the EU in either 2000 or 2004, which promised to provide supplementary money and electric power; of course, they did neither.

However, I was told that Reactors #1 and #2 were still online; nobody will talk about Reactor #3. After all, a reactor is not like a car engine; you cannot just turn it off and walk away. Remember what happens to reactors at very low power levels. Supposedly, there are crews manning the reactors 24 hours a day. Apparently, they are using SAFSTOR (SAFtey STORAge protocol), allowing the reactor to decay until it is safe, the cheapest way to decommission, or they may still be producing power for use and sale, which nobody will admit. The whole country is like the women of Kiev, beautiful and desperately poor.

Could it happen here? Yes and it did.

The other major nuclear disaster was in the US at Three Mile Island on March 30, 1979. It was due to loss of coolant, due to a valve being stuck open, draining out the water, which was

not appreciated. There was no way to measure the coolant level in the reactor or the functions of the valves. Coolant flow was measured by the temperature of the reactor. The temperature kept rising, and the technicians increased the coolant flow, which they did not realize was rapidly draining out of the open valve. The temperature kept rising until meltdown. Due to much superior containment construction and good control rod design, the amount of radiation released was about 1 millirem (a chest x-ray delivers about 6 millirems). The subsequent media hysteria was totally unsupported by facts. There is no evidence of any medical problems, during or after, the incident.<sup>8</sup>

Is nuclear power safe? No. Are coal-fired plants safe? No. More people are ill and dying of the effects of coal mining than from radiation sickness. According to the CDC there were 104,503 coal miners who were beneficiaries of the Federal Black Lung Act in 2005, at a total cost of USD \$675,339,000. In 2002 there were about 900 deaths from Black Lung Disease.<sup>9</sup> In 2006 there were 33 deaths of coal miners due to mine accidents in the United States. Even worse, in the People's Republic of China there were almost 100 times as many deaths from coal mining, which the government has tried to cover up.<sup>10</sup>

Hans Bethe, who was called to evaluate the incident, stated that the Chernobyl incident was due more to Soviet governmental and bureaucratic managerial incompetence rather than the design of the reactor.<sup>11</sup> I believe that both are to blame.

And now the Russians have built a nuclear power station at Bushehr in Iran for USD \$100,000,000, which will soon be on-line. I am not sure of the reactor design, but for that price it is most probably a uranium fueled, "light water", graphite-moderated reactor, such as those in Chernobyl. It does not present any hazard to us, since weapons grade uranium or plutonium is not used or produced in a commercial reactor in any significant degree. It presents more of a hazard to the Iranians.

The Chernobyl nuclear accident was the result of a poorly designed and poorly built reactor, run by technicians who had no appreciation of the potential for disaster. In spite of the large amount of radiation released by the accident, most of the fatalities (47) were due to the workers on site who were exposed to massive amounts of radiation. There have been about 4000 cases of thyroid cancer in children with about nine fatalities, which could have been prevented by early administration of sodium iodide tablets. There has been no evidence of increase in childhood leukemia or any other tumors. There has been no evidence of reproductive problems.<sup>7</sup>

The only other meltdown of a nuclear reactor occurred in the US at Three Mile Island in 1979 and was due to a mechanical valve failure in the cooling system. Because of superior design, the containment cover remained intact, preventing any significant amount of radiation to be released. As in Chernobyl, there is no evidence of any effects on health or reproduction, either animal or human.<sup>8</sup> The resulting hysteria fanned by antinuclear activists succeeded in paralyzing the nuclear power industry.

No plants have been built since, and only 20% of the US output of electricity comes from nuclear power in contrast to France, where 75% of the electric power comes from nuclear reactors. Our reactors are aging and need replacement.

The time has come for a serious reevaluation of the use of nuclear reactors to produce electricity. Our appetite for electrical power is increasing. Fossil fuel supplies are disappearing. Deaths caused by nuclear power station accidents are far below that of coal mining, fossil fuel-fired plants, and air pollution.

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