



The Chernobyl Disaster : A Lesson to Learn

Dr. S. K. Ujlambkar

H. O. D. Dept. of Chemistry

P. E. Society's, Modern College of Arts, Science and Commerce, Shivajinagar, Pune -411005.

The Chernobyl disaster, also referred to as the Chernobyl accident, was a catastrophic nuclear accident. It occurred on 26th April 1986, in the No. 4, Light water graphite moderated reactor, at the Chernobyl nuclear power plant, near pripyat, in what was then part of the Ukrainian Soviet Socialist Republic of the Soviet Union (USSR)

The power station is located nine miles northwest of the town of Chernobyl, with a population 12, 500 and less than two miles from the town of Pripyat, which contains 45, 000 inhabitants. The explosion and its aftermath, including the manner, in which the accident was handled, have raised questions, about the safety and future of Nuclear Power.

The Chernobyl accident resulted from several factors : Flaws in the engineering design, which were compensated by a strict set of procedures, failure of the plant management to enforce these procedures, and finally the decision of the engineers to conduct a risky experiment. They wanted to test, whether the plants turbine generator, from its rotating inertia, could provide enough power to the reactor, in case of a power shutdown. This experiment required disconnecting the reactors emergency core cooling pump and other safety devices.

The series of critical events occurred as follows. At 1. 00 A. M. on April 25, power reduction was started in preparation for the experiment. At 1. 40 a. m. the reactors emergency core cooling system was tuned off. At 11. 10 P. M. power was further reduced, resulting in a nearly unmanageable situation. At 1. 00 A. M. on April 26, power was increased, in an attempt to stabilise the reactor, however, cooling pumps were operating well beyond their rated capacity, causing a reducing in steam generation and a fall in steam pressure. By 1. 19 A. M. , the water in the cooling circuit, had approached the boiling point. At 1. 23 A. M. the operators tried to control the reaction, by manually pushing control rods into

the core, however, the rods did not descend their full length into the reactor, Since destruction of graphite core was started already occurring. In 4. 5 seconds, the power level rose thousand fold. At 1. 24 A. M. , there was an explosion, when the hot reactor fuel elements, lacking enough liquid for cooling, decomposed the water into hydrogen and oxygen. The generated pressure blew off the 1000 ton concrete roof of the reactor and the burning graphite, molten uranium and radioactive ashes spilled out to the atmosphere.

The explosion that occurred was not a nuclear explosion such as would occur with an atomic bomb, but its effect were just as devastating. In order to put the explosion of the radioactive material from the reactor into perspective, almost 50 tons, of fuel went into the atmosphere, plus an additional 70 tons of fuel and 700 tons of radioactive reactor graphite, settled, in the vicinity of the damaged unit. Some 50 tons of nuclear fuel and 800 tons of reactor graphite remained in the reactor vault, with the graphite burning up completely, in the next several days after the accident. The amount of radioactive material, which went into the atmosphere was equivalent to 10 Hiroshima bombs. Officials at first denied that there had been a serious accident, at the power plant. The government in Moscow was led to believe, for several hours, after the explosion and fire at Chernobyl that the reactor core was still intact. This delayed the evacuation for a critical period, during which the local citizens, were exposed to a very high radiation levels. The evacuation of Chernobyl and local villages was spread out, over eight days. A total of 1, 35, 000 persons were evacuated from the area, with the major evacuation at Pripyat, starting at 2. 00 p. m. , the day after the explosion.

Tests showed that air, water and soil, around the plant, had significant contamination. Children, in particular, were a matter of concern and were evacuated to the southern Ukraine, the



Crimea, and the black sea coast.

At the time of the accident, and for several days, thereafter, the winds carried the radioactive waste, to the north. The radioactive cloud split into two Lobes, one spreading west and then north through Poland, Germany, Belgium and Holland and the other through Sweden and Finland. By the first of May, the wind direction changed and the radioactive fallout, at a diminished rate went south over the Balkans and then west, through Italy. Large areas of Europe were affected and many farmers destroyed their crops for fear of contamination forests have been cleared and large amounts of earth were removed in order to clean up the radioactivity, plastic films have been laid in some area in an effort to contain radioactive dust. Officially 31 persons were reported to have been killed at the reactor site by a combination of explosion and radiation exposure another 174 were exposed to high dose of radiation, which resulted in radiation sickness and long term illnesses.

The maximum permissible dose of a radiation for a nuclear power operator is 5 Rontgens per year and for rest of population, it is 0.5 Rontgon per year. At the Chernobyl plant, the levels of radiation ranged from 1000 to 20,000 Rontgens Per hour. One British report estimates the worldwide, the number of persons afflicted with Cancer, which can be attributed to the Chernobyl accident will be about 23,000. In Minsk, the rate of Leukemia Cancer, has been increased, many times.

Many heroic deeds were reported during this emergency. Fire fighters exposed themselves to deadly radiation, while trying to stop the inferno. Everyone eventually died from radiation exposure. Bus drivers risked further exposure by making trips into contaminated areas in order to evacuate villages. Over 60,000 people were involved in the decontamination and clean up of Chernobyl.

Three design drawbacks were noted of the Chernobyl nuclear power plant.

- 1) The reactor was intrinsically unstable below 20% power and never should have been operated in that mode

- 2) The shut down operating systems was inadequate and contributed to the accident rather than terminating it.
- 3) There were no controls to prevent the staff from operating the reactor in the unstable region or preventing the disabling of existing safeguards.

Environmental effects :

- 1) National and International spread of radioactive substances. Four hundred times more radioactive material was released from Chernobyl, than by the atomic bombing of Hiroshima. The disaster released 01% of the total amount of radioactivity releases by nuclear weapons testing during 1950 and 1960. Mutations in both humans and other animals increased in large percentages. Cancer percentage is increased.
- 2) Rivers, Lakes and Reservoirs : The radioactive contamination of aquatic system is increased,
- 3) After the disaster, four square kilometers of pine forest died. Animals in that areas also died.
- 4) Many people suffered from acute radiation sickness. Many workers, died from acute radiation syndrome. Death due to cancer increased to a very large percentage.
- 5) The thyroid Cancer, among children, is one of the health impact from the Chernobyl accident.
- 6) More than one lakhs, elective abortions may have been performed.
- 7) Physiological increase, in the rate of pregnancy anomalies
- 8) The total economic cost of the disaster is about 20 Billion dollar, at that time.
- 9) Complete destruction of large acres of agricultural land and forest.

Following the accident, questions arose about the future of the plant and its eventual fate. All works on the unfinished reactors 5 and 6 was halted, three years after. The damaged reactor was sealed off. The Ukrainian government continued to let three remaining reactor operate because of an energy shortage in the country.

Most of the nuclear reactors, uses fuel, as



enriched Uranium, Plutonium or Thorium, which are radioactive substances. Nuclear fission processes are carried out in most of the nuclear reactors; where a very large amount of heat energy is released. By use of this energy and it can be supplied throughout the country, through grid. Developed countries like U. S. A. , Russia, France Japan, China are using nuclear energy from the reactors, which is the main source of power. The Electrical energy, obtained will be a clean source, less polluting source, as compare to carbon source and it will be available, throughout, indefinite life time.

In India, we have more than 10, nuclear reactor, from which, the country is getting electrical energy. Some of the names of the nuclear reactors in India, are Apsara, Ciraes,

Zerlina, Pornima, Dhruva etc. The electrical energy obtained from there nuclear reactors, is only upto 5% where as France, Russia are producing electrical energy, more than 70%

The only problem is, what will happen, if accidents, occur at reactor site? These may man made or natural phenomenon like earthquake or Sunami where there is no control of men or suppose any powerful country, attacks on Indias Nuclear Reactor, what will happen to the population of 130 crore?

Answer to these questions, are very difficult. If accidents occur at nuclear reactors, the % of immediate death will be very less, but in the indefinite time span, large number of deaths, will occur, due to cancer, which is a slow poisoning death.