

The truth about the worst Man-made accidents

Every discussion I have ever had about man-made accidents, it has almost always started with the mention of Chernobyl followed by Fukushima. I wonder whether it is the severity of these accidents that has made them eternal in people's memories or is the Nuclear fear factor to be blamed again!

The Three mile island accident is another one that almost everyone remembers. It was an accident caused by a nuclear meltdown in a reactor of the Three Mile Island Nuclear Generating Station in Pennsylvania in 1979. No direct deaths were claimed.

Fukushima Daiichi has today become synonymous with any and every Nuclear power plant. It was another nuclear accident at the Fukushima Daiichi Nuclear Power Plant in Fukushima, Japan. This accident was initiated by a tsunami following an earthquake on 11 March, 2011. No deaths from short-term radiation exposure occurred. Most people in Fukushima died because of the earthquake and the tsunami that followed.

Yes, these were indeed extremely severe accidents and brought to light some very faulty designs and human errors that claimed human lives. However, some equally bad accidents in thermal power plants and various other industries have long been forgotten and forgiven. I, for one, have always thought of the Bhopal Gas tragedy to be the worst man-made accident to have ever occurred.

Bhopal Gas Tragedy

The Bhopal gas tragedy was a gas leak incident that occurred on the night of 2–3 December 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh. A cloud of gas containing chloroform, dichloromethane, hydrogen chloride, monomethyl amine, dimethylamine, trimethylamine and carbon dioxide was accidentally released in the atmosphere. The toxic gases quickly spread over a large area exposing over 500,000 people and created lingering contamination concerns. The official immediate death toll was a striking 2,259.

Immediate exposure effects involved people complaining of cough, severe eye irritation, suffocation, breathlessness, stomach pains and vomiting. A government affidavit in 2006 stated that the leak caused 558,125 injuries, including 38,478 temporary partial injuries and approximately 3,900 severely and permanently disabling injuries.

The cause of the disaster remains under debate. The Indian government and local activists argue that slack management and deferred maintenance created a situation where routine pipe maintenance caused a backflow of water into a MIC tank, triggering the disaster. Union Carbide India Limited (UCIL) contends water entered the tank through an act of sabotage.

The important point though is that even with this disaster being so extreme in nature, nobody protested against chemical plants. There was no one demanding a complete shut-down of chemical plants. And even after deliberate attempts of Governmental authorities to intervene, chemical plants all over the world keep operating below acceptable safety standards injuring and killing many people every year. And as far as accidents related to power generating plants are considered, dam failures in the United States alone have killed far more people than all the nuclear accidents in the world combined [https://en.wikipedia.org/wiki/Dam_failure].

Chernobyl disaster

The Chernobyl disaster is referred to a catastrophic nuclear accident that occurred on 26 April 1986 in the No.4 light water graphite moderated reactor at the Chernobyl Nuclear Power Plant near Prip'yat, a town in northern Ukrainian Soviet Socialist Republic. In 1995, the Ukrainian Ministry of Health claimed 125,000 deaths however, closer inspections have revealed 31 direct deaths. The Chernobyl Nuclear Power plant had a graphite-moderated reactor. Present day nuclear engineers refer to a graphite-moderated system as the worst possible design for a power plant. The plant was set up to make both electricity and bomb-grade plutonium.

During a mismanaged experimental test to simulate a station blackout power-failure, safety systems were deliberately turned off. Due to the built-in instability of the reactor system, the water supply system that kept the fuel cooled failed. This led to a sudden increase in the power generated and caused an uncontrolled chain reaction which released excessive heat and resulted in a steam explosion sending fuel and fission products flying in the air. A second explosion followed that led to pieces of hot graphite being expelled from the reactor that landed on the roof of the plant, setting it on fire. Also outside air rushed in from the holes in the roof and caused the graphite to catch fire as well.

The worst part of the design at Chernobyl was the absence of a containment building. The reactor was basically just a room filled with graphite blocks. A containment building is one of the most important primary safety features incorporated during the construction of a reactor plant. It is designed as multiple layers of concrete and cement and act as the ultimate barrier to prevent the release of fission products. All nuclear power plants in the United States and most other countries are required by law to construct a robust containment building. An accident like Chernobyl can never occur in the United States. Also, it was the containment building that did not allow the release of any fuel or fission products to the environment at the Three Mile Island reactor site.

After the accident, sandbags were dropped from helicopters onto the reactor site to douse the fire and these firemen received acute radiation doses. Of the 31 direct deaths claimed, 28 were these firemen. This accident motivated safety upgrades on all remaining Soviet-designed reactors, of which eleven continued to power electric grids as of 2013.

The incorporation of a few simple safety features would have largely mitigated the damage and consequences of this accident. The Chernobyl disaster, till date, remains a classic example of the worst design, worst engineering, worst shielding and worst safety practices.

Three Mile Island accident

Often referred to as the first commercial nuclear power plant accident, the Three Mile Island accident occurred on March 28, 1979, in reactor number 2 of Three Mile Island Nuclear Generating Station (TMI-2) in Dauphin County, Pennsylvania, United States. On the night of the accident, some water-purifying resin beads blocked a valve in the TMI-2 reactor. This led to a failure of the main pumps circulating the coolant. The reactors are designed such that if the cooling system fails, the turbine and the reactor are automatically shut down. And so, when the coolant system failed, it was followed by an automatic shut-down of the reactor and the turbine system associated with the TMI-2 immediately. However, decaying fission products continued to release heat and increase the temperature and the system, as per design, automatically shifted to the emergency core-cooling (ECC) pumps to bring the decay heat down to normal. As the pressure reduced, the ECC pumps should have closed but they

stayed open and faulty indicators didn't allow the people in the control room to understand what had happened and a series of faulty assumptions, led them to switch off the flow of water to the core.

For nearly sixteen hours following the accident, no one knew what had exactly happened because there was no way of looking inside the reactor. The temperature of the core kept increasing and before anyone could know, half of the core had already melted. The containment building was flooded with contaminated water and fission products had flown out of the core and stuck to the inner walls of the containment. In spite of the severity of what happened within the reactor core, the containment had worked and prevented the release of any radioactivity or fission products to the outside environment.

Following the accident, scientists at Idaho Lab simulated the conditions inside the TMI-2 reactor and assured that no further damage was going to take place. A closer inspection of radiation levels in and around that area were performed and any evacuation was declared unnecessary. No direct deaths have been claimed to be due to the TMI accident. Worries were however expressed by anti-nuclear movement activists but epidemiological studies analyzing the rate of cancer in and around the area since the accident, determined only a small statistically non-significant increase in the rate and hence no connection linking the accident with cancers has been substantiated.

For a detailed description of the Fukushima accident, see [I will give here a link to my article on Fukushima].

Misrepresentations and use of inflammatory language by media and TV reporters have lodged into the public mind, a fear of devastation that in reality never occurred. Back in 1979, people heard media reports in the aftermath of the nuclear accident describing the emission of “deadly radiation” or “lethal radioactivity” but they failed to account that the so-called hazard that they were describing had caused less than five deaths in American history. People however never heard “lethal electricity” in spite of 1200 Americans dying each year from electrocution; or about “lethal natural gas”, which was killing 500 annually with asphyxiation accidents [With inputs from *‘Power to save the World’* by Gwyneth Cravens].