

The fukushima nuclear plant



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The Fukushima Daiichi Nuclear Power Plant was built in Okuma, Fukushima, to provide Japan with electricity. The plant consists of six nuclear reactors that were built during different times in the 1970s. The reactors were built close together primarily because finding a new location would make a new reactor very expensive, compared to the addition of a new reactor. The plant was constructed near the sea because nuclear plants consume massive amounts of water just for its cooling needs and also for steam generation which then drives turbines that generate electricity.

The various reactors serviced different companies and suppliers including General Electric, Toshiba, and Hitachi. On March 11th, 2011, an earthquake and subsequent tsunami caused a series of equipment failures, nuclear meltdowns and releases of radioactive materials. According to the International Business Times (Australia) " Fukushima is not the worst nuclear accident ever but it is the most complicated and the most dramatic disaster. " (IBT, 01) On April 2011 The Nuclear Institute rated the disaster a Level 7 " Major Accident" on the International Nuclear Event Scale.

How the reactors were damaged

An earthquake of magnitude 9.0 on a Richter Scale initially damaged the reactors. According to the World Nuclear Association, reactor 4 had been defueled while reactors 5 and 6 were in cold shutdown for planned maintenance. Immediately after the earthquake, the remaining reactors 1-3 shut down automatically and emergency generators came online to power electronics and coolant systems. However, a tsunami rapidly followed the earthquake, flooding the low-lying rooms in which the emergency generators were housed.

The flooded generators failed, cutting power to critical pumps, which must continuously circulate coolant water through a nuclear reactor for several days after being shut down in order to keep the plant from melting down. As the pumps stopped, the high radioactive decay produced in the first few days after the shutdown caused the reactors to overheat. The overheating led to the meltdown of the reactors. General Risks of Nuclear Plants Even without a natural disaster such as an earthquake followed by a tsunami, a Fukushima-like nuclear accident can occur at any nuclear power plant that relies on water for cooling.

Nuclear power reactors today are fueled mostly with uranium, which undergoes a fission chain reaction, releasing heat and creating radioactive fission products, plutonium, and other transuranic elements. After a time, the concentration of chain-reacting isotopes drops to the point where the fuel is considered “spent” and has to be replaced with fresh fuel. The “spent” fuel has to be stored in pool basins allowing the heat and radiation level to decrease. After the fuel has cooled, it may be transferred to massive air-cooled dry casks for storage on-site or in a centralized facility.

Unlike fossil fuels, nuclear power plants do not emit smoke, sodium dioxide, nitrogen oxide, or CO₂ to the atmosphere. However, because of the use of Uranium, all nuclear power plants release radioactive waste, which stays radioactive from thousands of years and is therefore very dangerous. The typical method of storing nuclear waste is to house it in steel-lined concrete basins filled with water. The nuclear power industry’s leading innovators are currently considering alternatives such as moving the nuclear waste to off-

site storage facilities, but this raises the problem of transporting the hazardous material.

The escape of radioactive material from the nuclear reactor is very dangerous. Leakage can occur in the following situations: through small releases during routine plant operation, accidents in nuclear power plants, accidents in transporting radioactive materials, and escape of radioactive material from confinement systems. After the radioactive material escapes it could end up in our ecosystem via the atmosphere, the ground, or even the water. According to America on Radiation Alert: Japan Faces World's Worst Nuclear Accident since Chernobyl as Experts Warn Fallout May Reach U. S. Japan's nuclear disaster in 2011 caused several countries to reconsider their use of nuclear energy. Precautions that could have prevented the Disaster The original site for the Fukushima plant was a bluff 35 meters above sea level, but high costs prevented construction at this altitude. The plant had to be built on a rock to assure stability of land, so Kajima, the plant's constructor, decided to lower the level of the bluff by 25 meters to reduce the cost of extra pipes to reach ground rock. However, Kajima did not take into consideration the possibility that a Tsunami could be higher than 10 meters.

Lowering the height of the cliff was considered one of the main facts associated with the damage according to the International Atomic Energy Agency. The tsunami caused water to flow into the nuclear plant, flooding the lower emergency generators with seawater, and causing the power supply to fail. The plant was built in a geographical location that is vulnerable to earthquakes, volcanoes and tsunamis. An earthquake,

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categorized as 9.0 on a Richter scale, caused a tsunami of magnitude 8.9 Richter Scale.

At the time the plant was built, theories regarding plate tectonics were relatively new. Had geologists and other scientists been more familiar with the causes of earthquakes, especially in that region, the plant might have been built on another, safer site. However, relocating the nuclear plant is the cost effective, time consuming, most locations have similar features because Japan is found on fault lines. The plant's current existing location is conducive in helping cool the nuclear plants (water is taken from seas/ rivers and circulated... that's why it was on the shore).

The damaged reactors cut power to the critical pumps, which failed to circulate coolant water through the nuclear reactors for several days, allowing it to melt down. The high radioactive heat decay produced in the last few days of the disaster had to be cooled. At that point, only the prompt flooding of the reactors with seawater could have cooled the reactors quickly enough to prevent meltdown, but the decision to allow flooding was delayed because it would ruin the costly reactors permanently. Only after a long delay, the Japanese government ordered the reactors to be flooded with seawater.

A meltdown could have been prevented if they had acted sooner.

Alternatively, the disaster could have been prevented if the emergency generators were located in the upper levels of the plant. This would have prevented the flooding and kept the emergency generators in operation. If the generators had not been flooded with seawater the nuclear reactor could

have maintained cooling operations and a nuclear meltdown could have been avoided. Finally, certain safety precautions could have prevented this type of disaster at Fukushima. One, properly trained personnel are, in my opinion the main issue to be addressed.

The American Nuclear Society approved that unlike the United States, “Japan rarely tests the limits of the system and training of personnel” All which lacked training” (ANS, 02). Two, many structural and managerial precautions could have been implemented to protect against natural disasters; “there were serious problems with accident management and with risk communication and crisis communication” (ANS, 04). Most nuclear power plants nowadays practice these basics and have regulation checking’s and visiting taking place.

Conclusion

One could make the argument that the nuclear reactor accidents could have been attributed to at least some level of human error. However, the consensus seems to be that the disaster was caused for the most part by the natural occurrence of the earthquake and tsunami. On October 12th, 2012, a Japanese Nuclear Plant Operator admitted on CNN for the first time that “TEPCO has failed to take stronger measures to prevent disasters.” Tokyo Electric Power Co. said in a statement that paying closer attention to better-trained employees, international standards and recommendations could have prevented the disaster.

TEPCO’s president said to TEPCO’s press release that “these implementations could have saved us from the accident if we turn the clock

back. ” Newly designed reactors For the past few years, nuclear plants have been undergoing an extensive process of redesign. Newly built reactors are designed more safely, so that they do not need electrical power to shut down safely; they are relying less on pumps and valves, and more on natural heat. In addition, advanced digital operation will do away with the requirement of a human controller for 72 hours, and the main core will remain cool because of a containment cooling system.

According to the World Nuclear Association, “ Additional safety measures have been installed at nuclear power plants nationwide since the accident under the government’s instructions. ” Such measures include enhanced seawalls, additional backup power and cooling water sources, the storage of radioactive waste on dry land, and the development of better crisis management training. Nuclear power plants/stations are statistically safe because disasters rarely happen. However, when nuclear disasters happen they cause massive destruction.