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Fukushima Disaster

Over the years society has understood more about atoms and atomic power than ever believed possible. This newfound knowledge has led to the invention and implication of nuclear powered power plants. People believed that with this new more efficient power source electricity could be created on a much greater scale, thus nuclear power plants began to be built all over the world. With a nuclear power plants great need for water, it is no surprise that the island of Japan decided to construct many plants within its country. With Japan's need for so many power plants it is no surprise that eventually disaster struck on March 11th 2011. This disaster left many people wondering, what exactly happened, what is still happening today, how it could be fixed, what precautionary solutions' could be, and what would be different in the United States.

On Friday, March 11th, at 2:46pm Japan Standard Time (JST), the Tohoku earthquake occurred in the Pacific Ocean just off the coast of Honshu, the main island of Japan. This resulted in a loss of electricity to the Fukushima Daiichi power plant on the coastline of Japan. These events lead to the start up of backup generators to continue cooling the nuclear reactors. On this particular date, only three of the six reactors were currently active, and only two backup generators were allotted to each reactor. At approximately 3:41pm JST, the impending tsunami swept passed the nineteen foot tall sea wall. After flowing past the wall, the water proceeded to flood the turbines, disabling the active generators, thus, the reactors began to overheat.

It has now been more than two years since this Fukushima disaster occurred, and problems are still occurring from the site. After attempting to control the initial March 2011 disaster the Tokyo Electric Power Company (TEPCO) has been designing systems to minimize radiation leaks from within the plant. The number one concern for TEPCO is Caesium-137 contamination; Cesium-137 is a highly radioactive isotope of Cesium. This isotope is dangerous because of its ability to easily spread in nature, in part due to its high solubility in water. TEPCO is dealing with solid wastes such as the building materials from the plant itself as well as soil and vegetation from the immediate area, all of which are heavily contaminated with Cesium-137. However, the biggest risk of contamination comes from the contaminated water being used to keep the reactors cool. It is known that from the initial flooding and subsequent use of sea water to cool the reactors that the water pooling in the reactor rooms is leaking out to other parts of the plant. The water is then seeping into the ground and reaching the groundwater. Besides that water leak there is a leak from all the water storage tanks used to store contaminated water after it is used to cool the reactors. All of these leaks are further contaminating the soil and leaching into the groundwater supply which leads directly to the ocean. As for the solid waste the plans are to break up the waste and filter out Cesium-137. The water problem is much more intensive as it involves containment of the existing water and has to provide containment of new water that is to be used to cool the reactors. The plans have been to design systems which run the water to cool the reactors then filter out contaminants. But in the mean time the water on the premises has to be contained which is being accomplished by making walls extending down below the surface to stop the movement of water to the ocean. This fix is a temporary one whose main goal is to stop further contamination until systems can be designed to decontaminate all water in the facility.

While people began to suffer from radiation burns three months after the disaster, precautionary solutions needed to be discussed among the people of Honshu. People began building fabric covers in order to protect their homes from tsunami's and heavy rain falls. Filters and detectors were installed to reduce the amounts of emissions leaving the power plants. In addition, more generators needed to be installed at the power plants to help cool the reactors. These reactors had a hard time cooling themselves because plant workers were in a position of trying to cope simultaneously with core meltdown at three reactors. The solution that we came up with as a team would be to install generators at a higher level to prevent generators from getting disabled. Increase the height of seawalls to prevent flooding in areas and finally create better filtration systems in homes. Thus, adapting to more safety measures in power plants, this disaster could have been prevented by planning solutions ahead of time in order to protect the people of Honshu.

The Fukushima Daiichi nuclear disaster began soon after the 2011 Tohoku earthquake and tsunami. After the earthquake, the facility automatically shut down and stopped generating electricity. To prevent a meltdown, emergency generators, located in the facility’s basement, began to power the cooling system. Soon thereafter, the tsunami struck and flooded the generators, resulting in their failure, leaving no way to power the cooling system. Although the Tohoku earthquake and tsunami initiated the event, the Fukushima Daiichi nuclear disaster can be attributed to the poor response by those in charge of the situation. Although we would like to think that the United States is exempt from any chance of a nuclear disaster occurring, and even though it is less likely, a similar situation could occur.

Boiling-water reactors, the type of nuclear power plant utilized at the Fukushima Daiichi nuclear power plant, makes up about one-third of all the nuclear reactors in the United States [1]. More specifically, the Mark 1 reactor, utilized at Fukushima, is also utilized in almost one-fourth of the United States nuclear power plants [2]. This is troubling, as the containment design for the Mark 1 reactor has been repeatedly criticized because it did "not take into account the dynamic loads that could be experienced with a loss of coolant"[3]. Although the US does utilize the same type of reactor, the poor location of the Fukushima Daiichi can take a large part of the blame for the nuclear disaster.

One element that US nuclear power plants do not share with Fukushima is the poor location. Japan is located right along the Pacific Rim, and is extremely "vulnerable to natural disasters like earthquake or tsunami"[4]. In contrast, the United States experiences much fewer of these types of natural disasters and the nuclear power plants are more strategically located. Figure 1 below shows the locations of nuclear power plants in the United States; the triangles represent the locations of Mark 1 nuclear reactors, while the squares represent varieties of nuclear reactors.

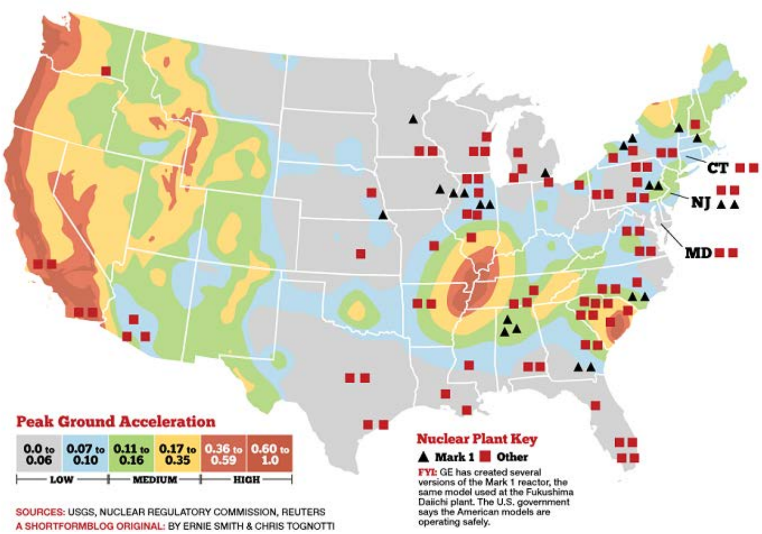

Figure 1. Locations of nuclear power plants in the US (http://strangesounds.org/2013/07/us-nuclear-reactors-vs-fault-line-map-this-map-shows-where-earthquakes-could-result-in-nuclear-nukes-in-the-usa.html)

As the figure above shows, all of the Mark 1 reactors are located on the east coast, far from the highly active fault lines located on the west coast. However, the map also shows the four active power plants located within areas of highly active seismic actively on the west coast. These power plants are more robust than the Mark 1 reactors, but they still pose a great risk due to the potential natural disasters that can occur in the area. As important as location is in respect to nuclear power plants, there are still other factors that led to the Fukushima Daiichi nuclear disaster.

US nuclear power plants are now more resistant to meltdowns because of the lessons learned at Fukushima. The sea walls protecting the nuclear power plant were too low, but they are now being built taller. The communication by Japanese officials in charge of containing the situation was very poor; plant workers, company officials, and government officials alike had no plan to respond to a nuclear disaster. The plant only had about eight hours of batteries to continue cooling the reactors after the generators failed; the batteries should have lasted long enough to transport more batteries to plant, however, unforeseen conditions did not allow this to happen. Now, power plants are more cautious and keep a three day supply of backup batteries to run the plant[4]. Lastly, new technologies to cool reactors are being utilized in case of emergency, which requires much less power by taking advantage of natural convection and gravity[1]. Past experiences have allowed new technologies and regulations to enter the nuclear power plant industry and will hopefully prevent future nuclear disasters from occurring in the United States.

Even though the tsunami at Fukushima occurred two and a half years ago, the effects of the incident at are still being felt in Japan as well as around the world. This incident has proven how dangerous and costly an unforeseen event can be when proper safety precautions are not followed. While earthquakes are not uncommon, catastrophic events such as this can occur all over the world even in the United States. Even though nuclear power is known to be much more efficient than other power sources, it has proven to be an incredibly dangerous source if not properly maintained.

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