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# Team 1 “Fukushima Nuclear Disaster”

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## Introduction

On March 11th, 2011 there was an earthquake that hit Fukushima, Japan with a magnitude of 9.0 on the Richter scale. It was one of the strongest earthquakes recorded in Japanese history. It 150 kilometers north-east of both the Fukushima Nuclear power plants named Daiichi and Daini. Three units were active at the Daiichi site and an emergency shutdown was initiated once the earthquake hit. The earthquake shut down the entire electric grid but, all of the diesel back-up generators turned on to provide power to the emergency systems. One hour after the earthquake, a 15 meter high tsunami, named Tohoku, hit the nuclear power plant Daiichi. The report investigates what happened after the tsunami hit the power plant, why the disaster is still a problem, and how can we prevent it from happening in the future [1].

## What Happened?

The 15 meter high tsunami, that struck the Pacific coast of Japan, made the situation at Daiichi far greater than just the earthquake. The plant's design only accounted for a 5.7 meter high tsunami so the water breached the seawall an entered the power plant facilities. The water caused flooding throughout the facility and destroyed all electrical power to the plant. Units one, two, and three experienced massive failure with its power supplies and access to the ultimate heat sinks that cooled the nuclear core.

There was a reduced cooling capacity due to the inability to add water to the fuel pool [1]. Without proper cooling, the nuclear fuel rods in building 1, 2, and 3 experienced significant damage. When the nuclear fuel rods were damaged, the core of the reactor started to melt. Explosions occurred due to hydrogen being generated from the melting of the reactor cores which destroyed the structures releasing radioactive material into the atmosphere. Radiation spiked in the surrounding area by 770 Becquerel (PBq) after the incident [2].

## Water Contamination

While the Tohoku earthquake and tsunami happened in March of 2011, there are still many lingering effects and concerns for the future. People are still not able to enter buildings 1, 2, and 3 because of the high levels of radiation. Since no one is able to enter the buildings, it is impossible to remove the cores, likely for hundreds of years. The inability to properly seal the cores has led to continued exposure to the ground water supply.

According to the Japanese Ministry of Industry, an estimated 330 tons of contaminated ground water per day has been flowing into the ocean since the disaster in March of 2011[3]. A sea wall was constructed to prevent the flow of the ground water into the ocean, but recently the water level had risen above the wall height.

Since the disaster, water underneath the plant has been mixing with the ground water and flowing into the ocean. A recent sample of water in an underground passage under the plant showed 2.35 billion Becquerels of Cesium per liter; levels comparable to right after the disaster in March 2011[4]. These levels of radiation are more than 16 million times the limit. The drainage system under the plant is capable of containing 20,000 tons of water, but system is quickly filling up [4]. The Tokyo Electric Power Company (TEPCO) needed to quickly build new tanks in order to accommodate the extra volume. Since these tanks were built in such a hurry, the reliability of the design and strength of the material is questionable.

**Food Contamination**

Due to the volume radioactive contaminants that are flowing into the ocean, food safety has become a large concern. Fish caught in the Pacific Ocean, especially near Japan should be tested for levels of radiation. In a global economy where fish from the region are exported internationally, there is a potential for the effects of the radiation leak to become a worldwide problem.

**Building 4**

Building 4 at the Fukushima plant did not experience a meltdown like buildings 1, 2, and 3, but the structure was badly damaged by the earthquake. The building sank 31 cm from the quake, greatly weakening the structural integrity of the building. If there is another earthquake, even one of much smaller magnitude, the building could collapse and expose the core. If the reactor in building 4 were to become exposed, some experts have placed the radiation exposure levels to be comparable to 14,000 Hiroshima bombs [5].

**2020 Tokyo Olympics**

Part of Tokyo has already been contaminated, and the ground water contamination could make the radiation levels raise. Athlete housing would be in radioactive areas, posing a serious

safety issue for the Olympic athletes. Unless food is imported, all food for the athletes could still be dangerous 9 years after the initial disaster.

In addition to safety concerns for the athletes, there are ethical concerns for the people displaced by the disaster. The luxury housing for the athletes would be in poor taste for the refugees from the Fukushima disaster. If the government can afford to build houses for the Olympic athletes then they should be able to provide more assistance for their own citizens affected by the disaster.

**How to prevent future Nuclear Disasters**

First, you have to look at what issues caused the largest problems at the Fukushima Nuclear reactors. The issues they faced the most were their normal and backup electrical systems failing and possible damage to their cooling systems that support their spent fuel sources [6]. Since losing power and backup power is a very real possibility a third safety factor should be implemented. Potently adding mobile power sources such as diesel generators can be immediately deployed if power is lost to specific sectors of the nuclear plant. Other options would be to have better containment centers for their secondary generators. If these were better sealed off or had larger and stronger containment centers to keep the potential from failing would be a way to help prevent future failures of the secondary electrical system. However they should still have a backup for the electrical systems that don't require electricity generated by the plant, instead a secondary source of electricity generated by an alternative source such as the diesel generator.

Next stronger safety regulations should be employed to the nuclear power industry. The Fukushima Tsunami plan was originally put in place in 1960 for a 3.1 meter Tsunami wave then reviewed and revised in 2002 but only for a 5.7 meter Tsunami wave. Yet 8 separate events have happened in the last century causing Tsunamis with heights about 10 meters. One in 1983 with a max height of 14.5 meters and one in 1993 with a max height of 31 meters [2]. Yet after these happened the nuclear plants did not revisit their Tsunami plans to see how to prevent these sizes of Tsunamis from flooding and shutting their reactors down. Nuclear plants should be revisiting their safety plans every 5 t o10 years to review natural occurrences happening in their region and determine how they could affect their plants. Had the Fukushima plants done this they could have been better protected from potential Tsunamis. Too often the Fukushima plants have lived

by: “this couldn’t happen to us”. For example the a Nuclear plant Blayais located in France flooded in 1999 and almost experienced an electrical loss of power that would have cause the plant to lose cooling operation and a meltdown would have happened. After this the European states examined their nuclear plant designs for vulnerabilities and implemented new safety procedures that could withstand a large range of hard to predict extreme events and hazards [7]. Fukushima did not review their safety plans and did not implement new safety standards. Had they followed along with the Europeans revisions many of the problems at Fukushima would not occurred.

If Fukushima plans on building a new nuclear power plant to replace the current one, they should consider moving the plant to the west side of the country or further inland. If the plant was located on the west coast of the country, it would move it further from the earthquake fault lines as well as make it much harder for a Tsunami to impact the plant. If they placed it further inland it would take larger tsunamis to affect the plant. If Fukushima looks more a strategic plant location for protection of the plant, implement more stringent safety regulations as well as use better electrical backup systems this would help to prevent future nuclear disasters. For example if Fukushima would place the nuclear power plant inland at Inawashiro approximately 40 miles away from the current plant so they could still pump water from the ocean to cool the reactors however they would be close to a large lake for back up water if the pipe line failed or was destroyed. Fukushima must consider better and safer locations for their operations to keep disasters like this from happening in the future.

## References


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