

# [Code of ethics development engineering essay](https://assignbuster.com/code-of-ethics-development-engineering-essay/)

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## PART ONE: CASE STUDY

## SECTION 1: INTRODUCTORY BACKGROUND

On March 11, 2011, an earthquake led to major problems at the Fukushima Daiichi Nuclear Power Plant. A 14-m high tsunami triggered by the earthquake disabled all AC power to Units 1, 2, and 3 of the Power Plant, and flooded the emergency diesel generators causing a station-wide total blackout. Due to these events, the cooling systems of the reactor did not work and led to a nuclear meltdown of the reactor and several hydrogen explosions that damaged the facilities, releasing a large amount of radioactive material into the environment. It is the largest nuclear disaster since the Chernobyl disaster of 1986 and is the only second disaster (along with Chernobyl) to measure Level 7 on the International Nuclear Event Scale. In this report, we will perform a factual and ethical analysis on an incident that has made a huge impact on the nuclear power industry.

## SECTION 2: PROMBLEM PRESENTATION

The Fukushima Daiichi nuclear disaster was caused by the Tohoku earthquake and tsunami on 11 March 2011. The Fukushima Daiichi nuclear disaster was a series of equipment failures, nuclear meltdowns and releases of radioactive materials at the Fukushima I Nuclear Plant. It is the largest nuclear disaster since the Chernobyl disaster of 1986 and is the only second disaster (along with Chernobyl) to measure Level 7 on the International Nuclear Event Scale. Today we are going to study the violation of ethics in engineering safety of these nuclear reactors as well as the impact it created to the society and also the environment. Even though the Fukushima nuclear disaster happened due to the unavoidable natural disaster, but the real problems lies within human neglect and error and it can be avoided if actions are taken sooner. The nuclear plant comprises of six separate boiling water reactors originally designed by General Electric (GE) and maintained by Tokyo Electric Power Company (TEPCO). During the time of the quake, Reactor 4 had been de-fueled while 5 and 6 were in cold shutdown for planned maintenance. Instantaneously after the earthquake, the remaining reactors 1–3 shut down automatically with control rods inserted into the reactors cores and emergency generators came online to power electronics and coolant systems. However, the 14 meter tall tsunami following the earthquake quickly topples the sea wall and flooded the low-lying rooms in which the emergency generators were housed. The flooded generators failed, cutting power to the critical pumps that must continuously circulate coolant water through the nuclear reactors for several days in order to keep it from melting down after being shut down. As the pumps stopped, the reactors overheated due to the normal high radioactive decay heat produced in the first few days after nuclear reactor shutdown. It seems that at this point, only prompt flooding of the reactors with seawater are the only best way to cool the reactors quickly to prevent meltdown. The seawater flooding was delayed because it will permanently damage the reactors. The flooding with seawater was finally commenced after the government issued the orders however it was already too late to prevent nuclear meltdown. While the water boiled away in the reactors and the water level in the fuel rod pools dropped, the reactor fuel rods began to overheat extensively and suffered meltdown. Reactors 1, 2 and 3 experienced full meltdown after following days. With the pressure and heat building up in the reactors, the nuclear fuel metal cladding reacted with the water around them, causing explosions due to hydrogen and air reactions and workers struggled around the clock to cool and shutdown the reactors. The atmospheric venting combine with the explosions in the reactors led to widespread of radioactive gasses and evacuation to a 20km radius around the plant was done in 20 April 2011. During the early days of the accident, workers were temporarily evacuated at various times for radiation safety reasons. The damage done by earthquake and tsunami hindered external assistance but still electrical power was slowly restored for some of the reactors, allowing for automated cooling. On 16 December 2011, Japanese authorities declared the plant to be stable, although it would take decades to decontaminate the surrounding areas and to decommission the plant altogether [4].

## SECTION 3: PROBLEM ANALYSIS

## 3. 1: What went wrong?

The site of the nuclear plant is designed such a way to withstand earthquakes only not major tsunamis. Authorities have found out that the plant was not designed to withstand the 14 meter tall tsunami that hit on that day. The wave barriers protecting the plant were only designed to protect against average tsunami height of 5. 7 meters. Next, the diesel generators were placed on the ground level and therefore vulnerable to flooding. The aforementioned tsunami caused the seawater to flood the generator room. The generators that were used to supply emergency power to the cooling system of the reactor and the used fuel rod were damaged by the flooding and failed. Therefore, the stoppage of the core cooling system unit caused the water level in the nuclear reactor to fall, and the exposure of the core finally led to a core meltdown [3]. During the core meltdown progression, the radioactive element zirconium in the fuel cladding reacted with the water, generating a large quantity of hydrogen in the form of gas. This hydrogen, combined with the volatile radioactive materials, leaked out of the containment vessels and into the reactor stations, this causes the hydrogen explosions in the reactor stations. The explosion of hydrogen causes release of radioactive particles in the air, dangerously polluting it. The government, the regulators and TEPCO management lacked the preparation and the mind-set to efficiently operate an emergency response to an accident of this scope. Once the cooling system failed, only prompt flooding of the reactors with seawater are the only best way to cool the reactors quickly to prevent meltdown. The seawater flooding was delayed because it will permanently damage the reactors and TEPCO, at the time, still had hopes of preserving the rectors for future use. The flooding with seawater was finally commenced after the government issued the orders however it was already too late to prevent nuclear meltdown.

## 3. 2: Aftermath.

The government and the nuclear power plant management, TEPCO took responsibility for the incident. TEPCO management was sued billions of dollar for poor design of the structure of the site. People responsible for the handling of the incident like engineers and authorities were sacked and jailed for acting against the law of ethics. Next, the government was condemned heavily for not taking care the situation carefully, forcing the Prime Minister and other ministers to step down. After the incident, many lost their jobs and business as the radioactive particles spreads through crops. The situation forced Japan to borrow money to cover the incident which cost more than 200 billion dollars. Currently, the government is looking aggressively into safety issues of the nuclear power plants throughout Japan. The government is also trying to reduce reliance on nuclear power plants for the nation’s electricity needs by shifting slowly to green, renewable energy sources like solar energy.

## 3. 3: Impact and Effects.

The primary impact of the incident is the loss infrastructure and property around the site. Many people around the Fukushima site lost their homes when they were forced to evacuate the area. Next, the health of those in the vicinity of the plant is under threat because of the radioactive particles released into the environment due to the incident. These particles could cause major sickness like cancer. Radioactive particles were also in danger of leaking into the drinking water system. Therefore, the company that supplied drinking water had to stop supplying water for couple of days while they took measures to ensure that the water was safe to drink. This caused water shortages throughout the area. Agricultural products such as vegetables and seafood were contaminated as well, causing the agricultural business to suffer heavy losses as they were unable to sell their products to other countries. The government suffered major financial problems too. The stock market in Japan plummeted tremendously for the first time in 50 years following the incident. The government spent almost 500 billion dollars on the incident. Many investors and multinational company pulled out their businesses from Japan. During that time, the Prime Minister stepped down. New government policies were introduced with the help of experts in the field of nuclear science and safety engineering to ensure this incident does not happen again.

## 3. 4: Ethical Analysis.

One of the principal ethics that was failed to be followed by the Japanese government, the regulators (NISA) and Tokyo Electrical Power Co (TEPCO) in the prevention of this nuclear disaster was failure to place public safety as their top priority. The Nuclear Accident Independent Investigation Commission (NAIIC) reported that TEPCO had been aware since 2006 that Fukushima Daiichi could face a station blackout if flooded, as well as the potential loss of ultimate heat sink in the event of a major tsunami. However, the regulator, NISA, gave no instruction to the company to prepare for severe flooding, and even told all nuclear operators that it was not necessary to plan for station blackout. TEPCO admitted on the 12 October 2012 that it had failed to take stronger measures to prevent disasters for fear of inviting lawsuits or protests against its nuclear plants. Those responsible for the response to the incident also behaved unethically by being unprepared to handle emergency situations such as this. The operators of the nuclear plant were completely unprepared for the possibility of a complete blackout and the failure of their diesel backup generators. During the initial response to the tsunami, this lack of readiness for station blackout was compounded by a lack of planning and training for severe accident mitigation. Plans and procedures for venting and manual operation of emergency cooling were incomplete and their implementation in emergency circumstances proved very difficult as a result. The operators of the nuclear power plant also failed in their ethical obligation to safeguard the environment. Radioactive emissions released due to the incident caused widespread radioactive contamination of the entire region. The vast majority of the nuclear fallout occurred over the North Pacific, constituting the largest radioactive contamination of the oceans ever recorded. Soil and water samples, as well as marine animals have been found to be highly contaminated [2]. However, despite the aforementioned unethical conduct, those responsible for the nuclear power plant must be lauded for making the ethical decision to take responsibility for the disaster try to make amends for their past actions. TEPCO is paying out billions in compensation to the victims of the disaster and overseeing the cleaning-up of the radioactive fallout. Officials and engineers who failed to properly respond to the incident or were responsible for failing to prevent the disaster either stepped down or were sacked.

## SECTION 4: CONCLUSIONS AND SUGGESTIONS

The Nuclear Accident Independent Investigation Commission (NAIIC) reported in July 2012 that the accident was a " manmade disaster." The entire unfortunate incident could have been avoided had those responsible for designing the power plant taken the necessary precautions to mitigate the effects of natural disasters on the nuclear power plant. Furthermore, the damage caused by the incident could have been reduced had there been an effective emergency response procedure in place that dealt with such situations. The following are a few suggestions on what should have been done differently to prevent an incident like the Fukushima nuclear disaster and how to properly manage the crisis should it inadvertently occur.

## 4. 1: Suggestions.

## 4. 1. 1: Establishment of a chain command system.

A system should be created that will enable quick launch of a headquarters- type organization in the government. This particular government, similar to the Security Council, should be given a framework that enables it to bring a about unity of purpose in the government as a whole and comprehensively coordinate response guidelines, and should be able to oversee institutions that can facilitate information sharing. Furthermore, a " chain of command system" must be established under this organization for the SDF, police, and other relevant institutions (for example, the NISA and TEPCO) in the event of a nuclear crisis.

## 4. 1. 2: Modularization of disaster prevention manual (increased flexibility)

In a real emergency, it is rare that events unfold as previously imagined. For that reason, while improving the contents of the manual, it should not be a rigid, detailed manual, but rather should be modularized to facilitate the combining of necessary methods of handling the emergency in a way that allows a flexible response to evolving conditions. Operational expertise is needed to respond as well to such modularization.

## 4. 1. 3: Redundancy.

In engineering, redundancy is the duplication of critical components or functions of a system with the intention of increasing reliability of the system, usually as a backup or fail-safe. In short applying redundancy to the nuclear power plant would mean to have multiple backups of critical systems in the plant. An example of this would be to have more than one backup generator to power the cooling system in the nuclear reactor should there be a power failure. Applying redundancy would increase construction and operating costs but would increase the safety and reliability of the plant.

## 4. 1. 4: Allocating personnel to take charge of crisis management.

In organization such as nuclear regulatory institutions where the threat of crisis is anticipated, there is a need to create departments focused on crisis management that have the necessary authority and expertise. This post should not be included in the normal personnel rotations of people seeking to be generalists, but should rather be held by someone possessing a high degree of expertise, and there needs to be a scheme within the organization’s personnel system that allows people to accumulate knowledge and experience [5].

## PART TWO: CODE OF ETHICS

## SECTION 1: PREVENTION

Ever since the Fukushima Daiichi disaster, the world has come to realize the importance of safety management at nuclear power plants. To prevent such catastrophe from happening again, every aspect of safety must be taken seriously. The following are the code of ethics in order to minimize the risk of nuclear disaster. We will prioritize health and safety aspect of our workers, any party that related to our work force, the society as well as our environment as the heart of our operation. Always choose safety over financial profit. Avoid unnecessary risk taking in decision making progress for the sake of safety. Safety and environmental aspect are primary concern in the business practicesMinimize the human error in all aspects of operation in the facilityStrive to ensure a better communication between employees so that message can be conveying smoothly without misunderstanding. We do not let personal relation compromise safetyGuilelessness toward the company, government and society. Speak truthfully when making a statement to the societyAvoid deception between high ranking employees as well as third party which involve. Reject all forms of bribery and coercion and give none. Do not hide truth from any party when safety issue is concern. Participate in discussion at local or internationally level to share operating experience to achieve a healthier competitive work field. Do not use company resource for personal gain. Discipline and follow SOP (Standard Operational Procedure)Employees must possess certain knowledge and go through certain training to be able to operate in the plant. Employees must be responsible for the job he or she entitled. Employees especially operator mustn’t compromise the safety of other because of the sake of saving time and not following SOP. Strive for zero injury goals. Report to or seek opinion of superior officer when in doubt.

## SECTION 2: PUBLIC RELATIONS DURING A CRISIS

Despite their failure to effectively respond to the incident and prevent the nuclear meltdown at the site, the authorities in charge of the incident should be lauded for their efforts in effectively evacuating the populace in the vicinity of the plant. Thus, we feel the following code of ethics should be adopted to ensure the public is fully aware of any potentially hazardous crisis that occurs in a nuclear power plant and respond appropriately. Openness and honesty in response of accident. Provide the public with the accurate details and complete information without holding back as safety issues are concern. Make public statement with positive manners without deception from the company or any third party that involve. Respect the integrity of the society and do not violate their right. Responsibility towards society. Treat everyone fairly without discrimination towards different skin colours, culture, religion or language spoken. Deal with the society with ethical manner. Do not tolerate crime that comes into our knowledge. Recognize everyone’s contribution and do not belittle other. Help those who victim solely base on who needed the help the most instead of personal gain. Not compromise professional judgment because of society pressures [1].