Nuclear disasters: the prevention and aftermath essay sample

This paper discusses nuclear disasters and their permanent scar on society. The paper starts by describing the transition society is making to nuclear power in order to meet stated goals for cutting carbon emissions. Also, the possibility of a nuclear accident occurring is explained. Next, the paper explains the events of the three most well-known nuclear disasters of all time: Three Mile Island, Chernobyl, and Fukushima Daiichi. The paper continues with the aftermaths of the three accidents. The aftermath includes: the health effects on the refugees and workers, the economic struggle to make up for the lost energy, and the future public outlook on nuclear energy.

Introduction and Background

Nuclear engineering is an expanding field with everybody desiring to “ go green” and cut carbon emissions to slow global warming. With the climate change, many countries are dedicating themselves to cutting back on carbon emissions, which usually includes an increase in nuclear power. But the nuclear power tends to scare the public away from the possibility as a result of nuclear disasters. These nuclear disasters led to the death of thousands of people from anywhere in the proximity of a day to decades later. The major issue with nuclear energy is the fear people have associated with it because they are not fully educated on the topic and simply fear what they do not understand. Going Green

As the knowledge of global warming is spreading across the globe, many countries are deciding to cut back on carbon emissions by meeting certain goals every few years up until they meet the final goal in the far future. The

UK passed an act called the Climate Change Act 2008 which “ legally commits the Government to reducing the UK’s carbon emissions by 35% by 2020 and by 80% before 2050” (Goodfellow et al., 2011). So to meet these ambitious goals, nuclear power plants are on the rise. Nuclear power plants generate power from the steam, which makes them ideal for cutting back the carbon emissions.

Japan made similar goals to those as of the United Kingdom for the cut back of carbon emissions in the future. The long term goals for Japan are to cut their carbon emissions by 25% by 2020 and another 80% by 2050 (Huenteler et al., 2012). So with this goal in mind, the Japanese energy indirectly concentrated on nuclear energy.

Nuclear Disasters

Probability

Calculations have been conducted to determine the most accurate number as to the safety of nuclear power plants. The calculations take into account the natural disasters, safety procedures, emergency procedures, and also the strength of the structure itself to withstand the elements as best as possible. Natural disasters, especially a disaster strong enough to render the integrity of the structure, are rare. Plus, engineers are working every day to improve upon the structures and functions of the nuclear reactors to prevent anything from happening, no matter how severe. Scientists have calculated that the chance of an extreme risk disaster – one that affects the public and environment short-term and long-term – is about 1 x 10-7. The chance of

being struck by lightning in the USA, which is 4. 2 x 10-7, is greater than the chance of dying in a nuclear disaster (Goodfellow et al., 2011).

Even though the chances of dying as a result of a nuclear disaster are extremely low, the public does not believe so. In order to incorporate the public's point of view into the overall risk of death, scientists developed two different types of risk: calculated and perceived. Calculated risk takes into account the mathematical possibilities of such events to occur. The equation's coefficients represent the probability of an occurrence of an adverse event and the severity of the consequence of such adverse event. Perceived risk takes into consideration " the psychological and sociological nature calculated does not include" (Goodfellow et al., 2011). The equation includes the history of catastrophic events and their magnitude.

Even with the chances of a nuclear disaster being extremely low, people still have a right to be scared of a nuclear disaster especially considering the three most known nuclear disasters: Three Mile Island, Chernobyl, and Fukushima Daiichi.

The events of Three Mile Island

On March 28, 1979, the Unit 2 reactor of the Three Mile Island in Pennsylvania partially melted down, releasing radioactivity. A series of events in the Pressurized Water Reactor (PWR), including equipment failure, stacked up to cause the major disaster. These actions all led to the partial meltdown of the reactor core and " a small amount of radiation exposure … [that] had negligible effects on the physical health of individuals or the environment" (Fushiki, 2012).

The events of Chernobyl

In the Ukraine on April 26, 1986, Chernobyl experienced an unprecedented nuclear accident, still the largest in history. “ One of four RBMK type reactors … was destroyed by two powerful explosions in the reactor core. The explosions were caused by gross breaches of the operating procedures by staff and technical inadequacies in the safety systems” (Balonov, 2007). Subsequently, the reactor closure head was removed, exposing the core, causing the reactor to catch fire and burn for more than a week. Released radioactive particles included gases, vapors, and aerosols that then dispersed all across Eastern Europe. The total was an estimated 14 EBq. An estimated 400, 000 people lived within the prefect and another 116, 000 were evacuated during the ensuing months with an additional 220, 000 relocated throughout the following years (Balonov, 2007).

The events of Fukushima Daiichi

The Fukushima Daiichi nuclear power station had a total of six Boiling Water Reactors (BWRs) that were all connected to the grid during the 1970s. On March 11, 2011, a 9. 0 magnitude underwater earthquake caused a massive tsunami to hit along the coast of Japan. One part of the coastline the tsunami hit was the Fukushima Daiichi nuclear power plant. “ The earthquake automatically triggered a shutdown as designed and halted fission reaction, the main source of energy production, in the three operating reactors” (Srinvasan & Rethinaraj, 2012). The other three reactors were shut down already for maintenance. After an emergency shutdown, the back-up generators are to start up to run the cooling system. But the tsunami had

flooded them with seawater ultimately destroying them. With this development, the operators had to restore power rather than flooding to prevent the escape of radioactivity. But the reactor got too far out of control. According to Srinvasan and Rethinaraj (2012) the sequence of events at the nuclear facilities of Fukushima Daiichi went as so:

…[the] operators tried to restore power and save the reactors rather than flooding them with seawater and reduce the risk of releasing large amounts of radioactivity into the environment. With the plant getting out of control, operators alternatively injected fresh and seawater by using fire engines and pumps…When adequate water did not reach reactor pressure vessel, the fuel in reactor core was exposed and resulted in partial or substantial meltdown…violent chemical reactions between high temperature steam and the fuel cladding tubes made of zirconium alloy generated hydrogen and radioactivity from the melted fuel escaped into the primary containment structure and resulted in subsequent explosions that tore off the secondary containment structure in Units 1, 3, and 4.

Continued complications included the poor design that left large amounts of spent fuel in the storage pool that led to the leakage of hydrogen.

The aftermath

The Health risks

Radiation is a material that comes in various forms and humans can intake it in a couple different ways. Radioactive materials can be “ taken into the body (1) by consuming food or liquids with radioactivity in them, (2) by

inhaling radioactive gases or aerosol particles, or (3) by absorption through wounds in the skin” (Fushiki, 2012). Once inside, the materials are in contact with and damage the organs until it has exited the body.

The long-term exposures are well known and studied comprehensively. Since the Chernobyl event was several decades ago, the long-term effects are starting to be seen in the locals near the disaster site. As a result of the Chernobyl meltdown, nuclear fallout contaminated the environment: farms, forests, and urban populations. “ During [the] first weeks after the accident, elevated 131I concentration in milk from grazing cattle led to substantial 131I intake in the human body and high thyroid doses of children” (Balonov and Environ, 2007). There were also high levels of cesium in the milk and meat, including the wild game. Now decades later, the result of the high doses of radioactive iodine, 131I, are being seen with high statistics of thyroid cancer among these people exposed at such a young age (Balonov and Environ, 2007). The staff was exposed to high doses of radiation with only 28 of the 134 plant staff that resulted in fatality (Fushiki, 2012). But otherwise, “ most of the workers and members of the public were exposed to low level radiation comparable to or, at most a few times higher than the annual natural background levels” (Fushiki, 2012).

The short-term exposures to radiation exposure are a bit more challenging to study and are even believed to be slightly beneficial. High doses are found to cause “ structural changes in the genome… like DNA mutations. [In lower doses], alterations in mRNA expression and proteins were detectable” (Fushiki, 2012).

The Economic Effects

After a nuclear disaster in a given country, the public generally strays away from nuclear power as a resource. In order to compensate, that country will have to import more fossil fuels from other countries, leaving said country with vulnerable energy security. This effect was seen in Japan: their “ energy situation begins and ends with structural constraints. Because Japan is a resource-poor industrial giant, it imports much of its primary energy supply” (Vivoda, 2012). The country’s “ long-term energy strategy had revolved around the ever-increasing share of nuclear energy” (Huenteler et al., 2012). It really did not help the Japanese energy crisis when only three facilities of the fifty-four total were operating by late January 2012 (Vivoda, 2012). V. Vivoda (2007) continues to state in his paper, “ that the most feasible option for Japan to remain economically competitive is that, if public opposition can be overcome, nuclear reactors are restarted as soon as possible.” Public views of nuclear engineering

After a nuclear accident, the public tends to turn far, far away from nuclear energy. Even though the probability of a nuclear disaster is extremely low and they usually occur as a result of something not taken into account during the design, the public perceives different risks and risk values. For example, there was a distinct drop in the number of new built nuclear power reactors that is at least partly attributable to the new government policies resulting from Three Mile Island and Chernobyl (Goodfellow et al., 2011). Plus, according to Goodfellow et al. (2011), the UK is warming up to the idea of nuclear reactors, even though the government is in the process of shutting down all of the nuclear reactors. One of the mentioned polls showed

that “ the number of people opposed to nuclear power had significantly decreased, from nearly 50% in 2001 to around 20% in 2009.” Goodfellow et al. (2011) continues to state that a major drawback to nuclear design and acceptance is that nuclear energy is a complex area; the majority of people do not understand the safety on a technical level.

Conclusion

After seeing how all the major nuclear accidents were caused, the proposed solution to the prevention of nuclear disasters would be to project into the future and use the calculated risk when deciding a location. The structure of the reactors should be built to withstand to elements and equipped with the best computer system that is easy to operate in emergencies. The three events described were all caused by cutting corners and not planning ahead. The designers at Fukushima Daiichi had the right idea for five of the reactors, but didn’t plan ahead to far as to the elevation of the reactor being below sea level. Three Mile Island should have had a better computer control panel and emergency situation plan. In addition, Chernobyl should not have cut corners and had a better emergency situation plan as well.

The several major nuclear accidents have had, and still have, major impacts on society. They have affected the government’s policy making on the future of nuclear power, the lives of those living near the sites and may or may not have gotten sick as a result thereof, and the energy security of the countries of the world.

References

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