

Eng 121 Student – Nuclear Power

Thesis

Nuclear power and the facilities that produce electricity from nuclear fission are neither cheap, nor plentiful, nor safe, nor clean.

- I. The ability for a nuclear reactor to fail and release deadly toxins into the air.
 - A. Three Mile Island, Pennsylvania, 1979
 1. Classed as a 5 on INES scale
 2. According to *The Risks of Nuclear Energy Technology* written by multiple authors states that the main flaw was the feedback water loop system.
 3. When the water was not able to cool the reactor, the main pressure release valve was opened.
 4. When the pressure dropped back down to a safe level the valve was supposed to close and stay closed.
 5. The valve was stuck open and water was pushed through the valve.
 6. The water reacted violently with the chemicals in the reactor core and the core began to meltdown.
 7. The control rods that were supposed to calm down the reaction and the rods themselves melted.
 8. Once the hydrogen explosion occurred, only a small amount of radioactive material was released into the air.
 9. The cost of decontamination and the disposal of the melted core were exponentially high.
 - B. Chernobyl, Pripjat, Ukraine 1986
 1. The accident at Chernobyl occurred due to a flawed design and under trained which resulted in one of the world's most deadly radiation leak.
 2. Classed as a 7 on the INES scale.
 3. There was an experiment done on one of the four reactors which was a test for the diesel generators.
 4. An article posted by World-Nuclear.org the reactor's control rods were inserted into the reactor which caused an influx of power.
 5. This caused the 1000 ton plate to become partially detached from the top of the reactor and jammed the control rods.
 6. This caused two explosions from the hydrogen reacting with the zirconium lining which caused only 2 deaths.
 7. Over 300 tons of the graphite used to construct the control rods was ejected out of the reactor which caused a large amount of fires.
 8. Almost 250 tons of water was pumped into the reactor and over 5000 tons of boron, sand, clay, lead and other materials to stop the release of nuclear radiation into the atmosphere.
 9. According to *The Risks of Nuclear Energy Technology* over 800,000 military personal were being used to evacuate 130,000 people in the 3,000km area where the radiation was the highest.

10. The radiation exposed made the town of Pripyat, Ukraine unlivable for thousands of years.
 11. The radiation traveled all the way to western Germany and the effects of the meltdown are still affecting lives in Ukraine.
- C. Fukushima, Japan 2011
1. The most recent nuclear radiation exposurer into the air.
 2. Rated as a 7 on the INES scale.
 3. A severe earthquake, 9 on the Richter scale, hit Japan causing a large tsunami.
 4. The reactor and the reactor buildings were designed to withstand large waves and earthquakes quite easily.
 5. The backup diesel generators and their building were not built to withstand flooding.
 6. The diesel generators failed causing a problem with the cooling procedure which caused the pressure to build in the chamber.
 7. The zirconium claddings inside the chamber reacted with the hydrogen causing an explosion which created a hole in the upper structure.
 8. The pressure releasing at such a quick rate allowed the nuclear radiation to be released into the air.
 9. Reactors 2 and 3 followed behind within a large timescale.
 10. Reactor 4 also had an explosion blowing apart the outer structure but the radiation was kept inside the chamber.
 11. Japan evacuated over 200,000 people in the 20km range of the reactor and was later increased past the original 20km range.
 12. Most of the radiation was carried out to sea by prevailing winds but a large amount was still released over Japan and neighboring countries.
- D. Windscale, Cumberland, Great Britain 1957
1. Rated as a 5 on the INES scale.
 2. Facility was built to produce plutonium, byproduct of nuclear fission, to build up Great Britain's nuclear bomb project.
 3. According to Wikipedia, during construction a physicist by the name of Terrence Price had the thought of what would happen if a fuel cartridge would break open in the reactor.
 4. A very real problem was introduced but ignored by engineers which, was a large reason why the facility failed.
 5. Uranium becomes very reactive and when hot can catch fire very quickly which caused a large fire in the first reactor core.
 6. The crew realized that the first core was heating up more than normal so the crew decided to speed up the cooling fans.
 7. The crew was unaware that the heat was a fire in the core and the fans only fueled the fire.
 8. When the crew decided to inspect the reactor first hand, the inspection plug was removed and the fuel was cherry red and the fire had been burning for almost 48 hours.

9. For 3 days the fire burned at temperatures over 1300 degrees Celsius.
 10. After the fire was stopped, the reactor tank was sealed and the second reactor was closed down due to safety inspections.
 11. The sealed tank still has almost 15 tons of nuclear fuel still inside
 12. Considered the worst nuclear incident in Great Britain's history.
- II. Power produced by nuclear energy is nowhere near a financially viable option.
- A. The sheer amount of money needed to just build a nuclear reactor facility is almost 10 billion dollars according to an article posted by World-Nuclear.org
 - B. A new reactor was planned to be built for only 3.5 billion dollars.
 - C. Five years later it still is not built and the new budget is nearing 30 billion dollars.
 - D. 30 billion dollars could be used to buy 750,000,000 tons of coal which could produce over 150,000,000,000 gigajoules of electricity.
 - E. A ton of coal only costs 40.00 including transportation fees while a ton of enriched fuel for a common reactor costs nearly 2 million dollars.
 - F. According to an article by PSR.org many of the newest reactor builds have not been complete or even started due to financial problems.
 - G. Another article by PSR.org states that the nuclear committee has asked for 122 billion dollars for another 21 nuclear reactors.
 - H. If this plan was to be passed, 61 billion dollars would be put onto tax payers along with any repair fees to the current reactors.
- III. The byproducts of nuclear reactions are handled with little caution and safety.
- A. The reprocessing of the nuclear materials is considered the most risky and least thought of process of a nuclear facility.
 - B. In a world where terrorism is a word that is thrown around a lot, plutonium is a prime material in nuclear weapons.
 - C. According to PSR.org the reprocessing plant in France has had multiple instances where nuclear byproducts have gone missing or have been leaking into the air and sea.
 - D. Another part of the article states that the nuclear facility located in Westchester, New York could be a large target for a terrorist attack.
 - E. It also states that nuclear facilities are not built to withstand attacks from the ground.
 - F. If an attack were to happen to the nuclear facility, PSR.org estimates over 45,000 deaths in a short time period and over 500,000 in a long term period.
- IV. Nuclear facilities have serious health and safety concerns.
- A. Even though many of the nuclear facilities that are being built have had constant changes to the engineering, once a facility is complete it must pass a vigorous checklist to be able to produce electricity.
 - B. Three Mile Island paved the way for a very in depth checklist for current nuclear reactors.
 - C. This checklist was supposed to weed out any flaws and make sure they are taken care of before start up.
 - D. This checklist however did not help and gave false hope to nuclear supporters.

- E. Another nuclear facility in Utah had a near perfect safety checklist and that facility almost ending in a large disaster.
- F. An article posted by PSR.org states that the American government has said that they could not verify the safety of 58 percent of American reactors.
- G. That means almost 60 American reactors could have a meltdown at any moment and The United States government knows this.
- H. The same article by PSR.org states that Chernobyl will average another 60,000 deaths.
- I. A nuclear meltdown in a closely populated state like New York or California would have catastrophic consequences on the health of millions in the state and the nearby states

What is nuclear power? Nuclear power is using the energy produced by splitting atoms and heating water to produce steam which turns large turbines. Nuclear fission uses very specific isotopes of Uranium and Plutonium. Both of these materials are very rarely found in nature and are very hard to manufacture by hand. Most countries that have access to a nuclear reactor facility have already had either found a source of the precious material in their own country or have set up a deal with another country to buy some. Having a nuclear reactor in a country just puts that country in a huge risk. Nuclear reactors have continuously shown that design and structural weakness will always be present. **Nuclear Energy an Introduction to the Concepts, Systems, and Applications of Nuclear Processes, written by Raymond Murray and Keith Holbert describes the scale used to measure nuclear disasters.** The INES scale or the International Nuclear and Radiological Scale rates disasters from 1, being the best possible scenario, to 7, being the worst possible scenario. Nuclear power and the electricity produced by it is neither cheap, nor plentiful, nor safe, nor clean.

In the year 1979, in Dauphin County, Pennsylvania, Three Mile Island nuclear reactors had a design flaw which resulted in meltdown and nearly 15 billion dollars in damage. This event was rated as a 5 on the INES. **According to The Risks of Nuclear Energy Technology, the main flaw of the nuclear facility was a pressure release valve in the reactor casing.** When the reactor began to produce a large amount of heat, the water system had a small problem cooling the system. Since the water would not cool fast enough, the pressure inside the system was building to dangerous numbers. When pressure builds to a certain number, operators have to open a pressure release valve. This valve allows steam to escape the chamber without rupturing a pipe or the casing itself. The valve was supposed to close once the pressure decreased down to a safe level. The valve malfunctioned and stayed open and what water was pumped back in, water was released through the valve into the core. Water has hydrogen in it and the zirconium lining inside reacts violently with hydrogen. The control rods were the final hope in stopping the explosion but the rods themselves melted from the extreme heat. This

caused an explosion resulting in a small amount of radioactive material being released into the air. The costs of decontamination and disposal of all the radioactive parts nearly exceeded the price of 6 billion dollars.

Quite possibly the most renowned nuclear disaster was Chernobyl, located in Pripjat, Ukraine. The meltdown at Chernobyl is considered one of the worst nuclear disasters in the world. It was classed as a 7 on the INES, the highest a meltdown and contamination could be. The reactor melted down due to an experiment done by untrained workers which went wrong from the start. According to an article posted by World-Nuclear.org, the experiment was to see if the reactor could function just off of the diesel generators. The same article states that the control rods were inserted at the wrong time which caused an influx of heat and power in the core. This large amount of force and power caused the 1,000 ton door that sealed the core to become partially loose and jammed the control rods. This caused the hydrogen to react with the lining which caused two violent explosions which initially caused only 2 deaths. Over 300 tons of the 1,200 tons of graphite used to build the control rods was ejected which caused a large amount of fires. Over 250 tons of water was dropped on the reactor and over 5,000 tons of boron, sand, clay, lead and other materials were dropped trying to limit the amount of nuclear radiation that was going to be released. This however did not stop the mass amount of radiation that was released. Over 800,000 military personnel were used to evacuate the 130,000 people in the 300km area where the radiation was the highest. The radiation that was released made the town of Pripjat unlivable for thousands of years. The radiation was detected in Western Germany, over 1,700km away and the effects of the radiation are still affecting people today.

The most recent nuclear disaster happened in Fukushima, Japan in 2011. A severe earthquake, rated as a 9 on the Richter scale, hit Japan and caused a large tsunami which hit the facility. The reactor housing and the buildings that surrounded the reactors were made to resist large waves and earthquakes. The diesel generator building was built to withstand earthquakes but not water. Once the generators shut down, a cooling problem developed causing pressure to build in the core. This core was also lined with zirconium as history has proven, does not react lightly with hydrogen. The reaction in reactor one blew a hole through the outer casing releasing nuclear radiation into the air. Reactor 2 and 3 followed in the same manner but in a large time scale. Reactor 4 had an explosion but the radiation was kept in the core. Reactor 5 and 6 had minor damage but were shut down due to safety issues. Japanese government evacuated over 200,000 people in a 20km range but that range was considered too small and was increased to 30km according to The Risks of Nuclear Energy Technology. Most of the radiation was carried out to sea by winds and a large amount was still released over Japan and neighboring countries.

Great Britain's most devastating nuclear disaster happened in 1957, in Cumberland. Great Britain wanted a way to create nuclear bombs and both uranium and plutonium are both very rare in nature, Great Britain decided to build a nuclear power plant. Plutonium is a byproduct of nuclear fission and Great Britain had acquired Uranium. The facility was flawed from the beginning and was pointed out by physicist Terrence Price. Price notified the engineers how there was a problem on how if a fuel cartridge got stuck in the core, it could ignite. The engineer's felt it was not financially useful to solve the problem. During the first month of operation, the reactor had a problem. The reactor was heating up quicker the usual and the crew turned up the cooling fans to try and solve the problem. They did not know that the Uranium cell had caught fire and was burning inside the core. The fans only fueled the fire and the crew only continued to put more cells into the core. Once the inspector finally decided to check the reactor, the plug used for inspecting was removed and the fuel cells were cherry red with heat. The firing had been burning for almost 48 hours. The fire reached temperatures of 1,300 degrees Celsius for 3 days. After the fire was finally stopped, the first reactor core was sealed with over 15 tons of fuel still inside and reactor 2 was shut down due to safety issues.

Power produced by nuclear fission is nowhere near financially inviting as coal or natural gas. According to World-Nuclear.org, it costs almost 10 billion dollars to build a current reactor. A new reactor which utilized money saving materials that were supposed to cut the cost of nuclear power only resulted in more damage to why it is not useful. Over 5 years later and a budget increase to nearly 30 billion dollars and the reactors are still in construction. 30 billion dollars could be used to buy nearly 750,000,000 which could produce over 150,000,000,000 gigajoules of electricity. A ton of coal only costs around 40.00 including transportation while a ton of enriched Uranium costs nearly 2 million dollars. According to an article by PSR.org, most of the newest reactors have not been built or even started due to financial problems. The same article states that the nuclear committee asked for 122 billion dollars for 21 new reactors. If the plan is passed that would put 61 billion dollars on taxpayers and that is before any new budget increases.

The byproducts and the disposal of them is handled with little caution and safety. The reprocessing of the harmful byproducts of nuclear fission is the more radiation leaking process of nuclear fission. In the current world, terrorism is always a word that people are afraid of. Terrorists will use any way they can think of to acquire materials that will cause mass havoc. The disposal of plutonium, a harmful and dangerous byproduct of nuclear fission, is treated as it is any other kind of material. According to PSR.org, the reprocessing plant in France has had multiple instances where nuclear materials have gone missing or leaked into the air or sea. Another part of the article states that nuclear facilities are not built to withstand attacks from the ground. The nuclear facility in Westchester, New York could be a large target for a terrorist

attack due to its location. If an attack were to happen to that facility, PSR.org predicts the initial death toll would be 45,000 and the long term toll would be near 500,000.

Nuclear facilities have serious health and safety concerns that are overlooked by governments and officials. Even though many of the current in construction reactors still are nowhere near completed, the ones that have been complete have a vigorous safety checklist they have to pass to operate. Three Mile Island paved the way for this in depth checklist that checks everything from the procedures and a triple walk through. This checklist still does not stop and detect all flaws in a nuclear facility. A facility in Utah had a near perfect safety run and still had an almost catastrophic disaster. An article posted by PSR.org states that the American government could not verify the safety of 58 percent of American reactors. That means nearly 60 reactors could have a meltdown at any moment and release millions of tons of radiation into the air. The same article by PSR.org states that Chernobyl will have an estimated 60,000 more deaths. Nuclear meltdowns in a closely packed area like New York or California would have catastrophic consequences to the health and safety of millions of Americans.

Using nuclear fission to produce electricity has to the biggest risk to the health and safety of people around the world. Nuclear reactors can always go wrong and always have the chance to create a disaster of global affection. The smallest chance that a nuclear meltdown could happen makes nuclear fission to much of a risk to be a reliable source of energy. Uranium and Plutonium are both nonrenewable resources which make the sources of these materials deplete over time. Nuclear fission is just a way of a fix to try and steer away from coal and natural gas to a much cleaner power solution. Since the first nuclear radiation leak till the one in Japan, the environment has been harmed by radiation more than it has been coal and natural gas combined. Radiation is a truly dangerous risk that every time a new nuclear reactor is started up, millions and billions of lives are put into risk.

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