Kasen Lisonbee

Bryce Christensen

English 2010

10/6/2014

Nuclear Power

If there is one word that has sparked more controversy than almost any other word in the past century it may well be the word *nuclear*. When the United States dropped two atomic bombs on Japan to end World War II, it started a worldwide race to develop similar weapons as defense and, if necessary, as a potential method of attack. With the agreements to limit atomic arsenals which most countries with nuclear weapons have signed, and the generally less tense worldwide political atmosphere, nuclear war is not the source of fear that it once was. Even so, the word “nuclear” still inspires some measure of fear and foreboding in the general public; even with the ever advancing knowledge we have of how to safely control radiation and nuclear processes. This fear probably results from anti-nuclear propaganda from various sources, and what we see in Hollywood-style disaster movies which graphically detail the horrendous side effects of excessive radiation exposure. It is true that there are severe problems which can result from such exposure, including the possibility of developing cancer, traumatic radiation sickness with symptoms such as nausea, hair loss and internal bleeding, genetic mutation, and in extreme cases death. In reality, the chances of enough exposure to cause these results are small and most people imagine the effects of radiation to be worse than they are.

Everyone is exposed to varying amounts of radiation on a daily basis, mostly from natural sources such as radioactive elements in the Earth, radon in the air, cosmic radiation from the Sun and stars, and emissions from the myriad electronic machines that surround us. These

common sources of radiation do not normally create enough exposure to cause health issues. Sources of radiation that are strong enough to cause radiation poisoning are usually contained in a small area under protected conditions, and don't affect the general populace. Nuclear power plants are a prime example. Although they contain tremendous radioactive sources, with proper regulation nuclear power is safe and can serve as a useful tool. What makes it so useful to the power industry is its immense energy output from a small source, allowing it to be used to create a lot of power from a small amount of resources, with smaller waste output than other energy sources. Scientists and engineers have learned to harness that power to generate plentiful amounts of electricity safely and efficiently ("Outline History of Nuclear Energy"). Power plants have been built in many parts of the world, and have an overall good record of reliable use. There is a current proposal by Blue Castle Holdings Inc. to build a nuclear power plant in Green River, Utah, a remote town in Emery County with a small population. While having a nuclear power plant in Utah would increase available energy for use and export and create jobs for that area, when also considering the costs involved to build the plant and the amount of energy production already in Utah, it can be argued that this new power plant is essentially unnecessary.

As may be expected with anything which uses the word "nuclear", this project has aroused a lot of controversy. We will consider some of the arguments for and against building this nuclear power plant. The loudest arguments against this plan come from environmentalists who are concerned that it could contaminate the water of the Green River, affecting popular recreation sites and the national parks through which it flows. They are also concerned that the amount of water available for use in the sparsely populated desert area won't provide enough water to meet the needs of the power plant (Utah Chapter Sierra Club). Caring for the environment is a responsibility of all who share it, and the corporations which build nuclear

power plants need to be mindful of environmental concerns. Modern nuclear power plants are built to avoid harmful emissions of any kind into the environment. The water consumed is for cooling the nuclear reaction, and water that is released into the environment is protected from contact with and contamination from radioactive materials. Furthermore, nuclear plants do not release pollutants into the air either. The nuclear reactions that generate electricity are completely contained, and do not involve the consumption of fossil fuels. This means they are very environmentally friendly for both water and air. Environmentalists would argue that the nuclear waste generated is dangerous and does cause harm. These are concerns that the nuclear power industry is well aware of. They have taken care to reduce the impacts of this waste and protect communities and the environment with onsite and offsite storage facilities.

Even though there has been much opposition, there has also been support from some governmental agencies, businesses, and individuals. Aaron Tilton, CEO of Blue Castle Holdings stated in an interview that, “The Blue Castle Project success is rooted in the support we have received from the public, state and local governments to deploy clean, predictable, long-term nuclear electricity generation” (Winslow; Par. 3). Some potential benefits to having a nuclear power plant in Utah would include the creation of several hundred high paying jobs, boosts to the construction and service industries, and the generation of additional energy surplus which can be sold to neighboring areas and states. Since substantially large amounts of concrete, steel, tubing, wiring and multiple other components are necessary to the construction and operation of nuclear power plants, suppliers of these commodities would experience an increase in business, helping these markets substantially. It would also be economically beneficial to the Green River area through increased traffic to the town, more new working residents and more incoming taxes.

Like other nuclear power plants in their respective locations, the plant at Green River would greatly increase the amount of energy available in Utah. In fact, it is predicted to increase the amount of power available to the state by about fifty percent (Blue Castle Holdings). Considering that most of Utah's power is generated by the combustion of coal, which is pointed to as a major source of pollution, it would seem highly desirable to have a source of clean, environmentally friendly energy, which then may decrease our reliance on coal-fired plants ("Utah - State Profile and Energy Estimates"). The increase in Utah's energy market and correlating increase in energy exported to surrounding areas would increase income to our state. The other pros of the project are mostly economic in nature, including the monetary benefit to the owner and investors in the project, and the jobs and new business in communities immediately surrounding the new power plant.

Those opposing the project are of the opinion that the majority of citizens of the state would receive the metaphorical short end of the stick, meaning that they will be paying more for power which will economically benefit a select group of people with little or no benefits to them. One of the biggest problems is the funding required to begin a project of this magnitude in the first place. These plants can cost billions to build and more to maintain and refuel. This partially explains the high cost of energy produced by such power plants. Another problem with this new power plant would be its cost of energy production. According to the Energy Information Association, power from nuclear plants costs on average $1.51 per kilowatt hour, much more than the $.897 per kilowatt hour average cost of energy in Utah for October 2014 ("Independent Statistics and Analysis, Electric Power Monthly"). This higher price may seem reasonable as an environmentally friendly alternative to consuming fossil fuels. However, if new power production from nuclear energy costs more than the energy that we currently produce, mainly

from coal along with other sources, would it not stand to reason that customers will end up paying a higher price for the electricity they use? Seeing this difference in cost should cause the citizens of Utah to question the value of bringing a nuclear plant into Utah at all, even though such plants do generate very high quantities of electricity. It seems wiser to pay less, especially considering that Utah not only produces sufficient electricity for the whole state, but already exports twenty-nine percent of its electricity to other states ("Utah - State Profile and Energy Estimates"). Do we really need to invest in another mass producer of electricity when no extra electricity is needed in the first place? And could the money, man-hours, construction materials and other resources which would be expended on such a massive project be put to use in other, more beneficial ways?

And finally, some of the major concerns about nuclear power plants are the potential environmental impacts. Opponents are very vocal about the dangers of radiation exposure from accidents and the problems of storing radioactive waste. To understand the environmental impact of nuclear power it is important to understand how it works. Nuclear power plants rely on radioactive Uranium as a fuel source. These plants are built to be safe, protecting the surrounding environment and plant personnel from excessive radiation exposure. The water that is taken from the surrounding environment to cool the reactors is protected from taking radioactive material back out into the rivers and lakes it comes from. Nuclear power plants generate electricity by placing fuel rods containing radioactive Uranium or Plutonium in a reactor surrounded by water to keep them cool. The rods are then bombarded with neutrons accelerating nuclear decay and therefore, energy release. As the decay of the radioactive material releases energy the water surrounding the rods heats up. The water is then circulated through another water tank which takes water from an outside source. The water from the reactors and the water from the second

tank do not mix, preventing the transfer of any radioactive material. The water from the second tank is converted into steam and is passed through turbines generating electricity, then it is cooled and essentially recycled. The walls in these plants are thick and designed to keep radiation from escaping, especially from directly around the reactors. The areas inside and surrounding the plant are constantly monitored for excessive radiation release so that if an emergency shutdown were necessary it could be performed before major damage was caused (Ferguson, 40-47). Even considering these protections there have been accidents in the past that have ruined homes and lives and damaged environments (Rogers, Data Summery). Unfortunately, several of these have been caused by human error and could possibly have been avoided. Accidents have also been caused by natural disasters which damaged and disrupted the normal operation of the power plants.

Another environmental concern regarding nuclear power is the disposal of spent fuel rods which still contain radioactive materials. Eventually the fuel rods no longer produce enough energy to be of value to the plant and are replaced. Even though they are of no use they still emit unsafe amounts of radiation. The only way to stop the emission of these particles is to allow the fuel to undergo normal radioactive decay, which can take hundreds of years. If simply dumped in a landfill or open storage area like normal waste, this would pose a significant radiation risk for natural habitats. The nuclear power industry knows how to safely remove, transport and store radioactive waste. Containment facilities exist both on the plant site and in remote locations to house the spent fuel rods and contain the radiation from them until they can decay to safe levels (“Radioactive Wastes – Myths and Realities,” 4). The potential hazard that poses the greatest risk is an emergency at the plant, where something either malfunctions or is damaged and radioactive material is spread to the surrounding environment. Because the threat of dangerous accidents at

nuclear power plants has been proved to exist, it is worthwhile to examine some past occurrences. Some of the most well-known radiation leakage emergencies are Chernobyl in Ukraine, Three Mile Island, New York, and the recent Fukushima, Japan accident.

The accident at the nuclear power plant in Chernobyl, Ukraine took place in April 1986. While the workers were running some tests, they disabled some of the equipment and regulatory processes due to inadequate training. There was a power surge to the reactor, which overheated and caused a buildup of pressure. There was a resulting explosion, blowing off the thousand ton reactor cap and spewing radioactive material high into the atmosphere. This was carried into the surrounding area by winds, contaminating the environment for miles around. Evacuation orders to the surrounding cities were delayed and as a result many people suffered severe problems due to the high levels of radiation. Although only about thirty five people died at the time of the disaster or shortly thereafter from radiation poisoning, an estimated 600,000 people may have received enough exposure to cause long-term effects (Greenfacts, 2). A concrete shell was erected over the destroyed reactor to allow for continuing use of the other reactors. The shell was hastily erected and still contains about two hundred tons of radioactive material that pose an environmental hazard until they can be properly contained. A new, safer structure is set to be completed in 2016. People have been allowed to return to live in the contaminated areas ("Chernobyl Accident 1986"). A study published this year by Timothy A. Mousseau of the Department of Biological Sciences and the Environment and Sustainability Program, University of South Carolina and Anders P. Møller from Université Paris-Sud in France shows that many of the animals and vegetation surrounding Chernobyl still suffer the effects of the radiation in their physiology. Traces of radioactive material remain in the area and have caused changes in the DNA of the local plants and animals (Mousseau, 704-709). This accident and its long lasting

repercussions could be viewed as a reason to oppose the construction of new nuclear power plants to avoid risk of emergency. Plans and blueprints for nuclear power plants have improved since that time, increasing safety and reliability. While having a safe plant is of utmost importance, having qualified personnel running the plant is just as important so that they can run the plant safely, and can identify and control situations before major problems occur.

If the planned nuclear power plant in Green River were to experience an emergency, the citizens of the town and surrounding areas could potentially be exposed to high enough levels of radiation to cause serious health problems, like what happened to the residents of the Chernobyl area. All extreme exposure to radiation increases the risk of cancer, acute radiation sickness, burns, prenatal problems including infertility and birth defects, and the possibility of psychological problems from worry and stress. Radiation affects the cells in the body disrupting the proper functions they have and often leading to radical replication of cells causing tumors among other problems. One of the quickest results of excessive radiation exposure is acute radiation sickness. This is a group of symptoms that can include nausea, vomiting, diarrhea, headaches, internal bleeding, and hair loss. It can be of short or long duration or come and go. Radiation can also cause burns just like heat exposure. Since it affects the cells of the body, changing their functions and disrupting their systems, it can cause problems in development of prenatal children and can cause infertility. As mentioned previously, everyone is exposed to low levels of radiation every day from natural and man-made sources. The level of exposure from these sources is low enough that it is not likely to cause even minor reactions, except perhaps with extended or repeated exposures, such as sunburn or concentrations of radon gas which collect in low areas like basements. High exposure levels can have one or more of the side effects mentioned (U.S. National Library of Medicine). The risks of excessive exposure and

especially extended exposure can be avoided with prompt evacuation in the event of an emergency. This was key in protecting many of the citizens of Fukushima from radiation related problems. As it stands, the majority of Utahns would be at low risk of radiation exposure were this power plant to be completed, especially with current safety precautions.

Three nuclear power plants were mainly involved in the recent emergency at Fukushima, Japan (“Fukushima Accident”). Everything was normal until a powerful earthquake caused a tsunami which hit the plants. This natural disaster disrupted the flow of water to cool the reactors and the result was a nuclear accident later classified as a class 7 disaster by the INES. While other Japanese nuclear power plants were affected, the three in Fukushima were the cause of what became a large and devastating disaster. All of the reactors were shut down when the earthquake hit and were found undamaged immediately afterwards. The real problem was the tsunami, which disabled some backup generators and heat exchangers whose function was the transfer of used heat into the sea. Circulation of water stopped, causing some of the reactors to overheat which caused some explosions. In another plant the batteries and the plant circuitry failed causing a blackout complicating cleanup and repair efforts ("Fukushima Accident.", Events at Fukushima Daiichi 1-3 & 4). Water that had become contaminated with radioactive material flowed back into the sea for the next two months as well as seeping gradually into the water table. This water is still a concern today. Cleanup at all plants on all levels was difficult and dangerous as a result of the tsunami. One of the biggest tasks for the crew was containing the leakage of radioactive material and especially contaminated water from the overheated reactors ("Fukushima Accident." Managing contaminated water).

Within a few weeks the situation was stable, but there was still significant work to be done. Some workers were killed by the earthquake and the tsunami, however there are no deaths

on record that were caused by radiation from the nuclear accident. Prompt evacuation of the surrounding areas ensured protection of the populace and it is expected that no one was exposed to enough radiation to cause much harm ("Fukushima Accident.", Events at Fukushima Daiichi 1-3 & 4). Japan has already reopened some surrounding towns as they have been deemed safe, allowing many to return to their homes (“The Situation at Fukushima”). While modern nuclear reactors are built to withstand radiation from within and the elements from without, major natural disasters can still pose a threat.

Water is a valuable resource, especially in desert areas like Utah where there is a limited supply. The use of water from the Green River has some people worried because of the additional question of water availability (O’Donoghue).. If the water of the Green River became contaminated, like the water at Fukushima did, many people, plants, and animals that depend on the water from this river would suffer. The Green River flows through popular rafting and recreation areas and a few national parks, which could be rendered dangerous through radiological contamination in the event of an emergency. If a disaster were to occur and water to the plant were to be cut off, an accident similar to the Fukushima accident could be the result. Environmental reporter O’Donoghue’s article documents statements about the approval of the water rights for the project. The approval process has taken two years to complete. The article states that the water needed to run the plant represents one percent of the water in Utah. Although that may not seem like very much, the question is exactly how much water can the Green River area specifically supply. As a protection against a water related emergency occurring, the plant may store additional water for emergency use, solving this problem. Even though nuclear power plants run without depositing radioactive material into the rivers, if there is insufficient water to the plant to regulate the nuclear reaction, there is the risk of an emergency.

All aspects of the plan to build a new nuclear power plant at Green River, Utah need to be carefully analyzed, and the balance of power production and economic benefits contrasted with safety, environmental and cost concerns. Modern nuclear power plants are designed and constructed to be safe, with safety controls built in to prevent excessive radiation exposure from man-caused errors and natural disasters. They have less environmental effects than other forms of power production. The electricity provided would serve much of Utah and provide surplus for exportation, providing greater energy self-sufficiency and revenue for the state. The plant would generate many skill based jobs and give investors and the state significant profits. In contrast to these benefits there is no guarantee for complete safety in the event of a natural disaster, such as a major earthquake, or water to the plant being cut off. The danger exists and it is natural to be concerned about it. No matter how well the environment is protected, there are still impacts of any new construction, as well as possible effects of nuclear disaster and the resultant contamination which could last for many years as shown by previous accidents. While the thought of having a nuclear power plant here in Utah should not be terrifying or objectionable, the benefits of this alternative are outweighed by the cost and current availability of other types of energy production. Utah does not need additional energy at this time, and the extremely high cost of building and maintaining these plants is unnecesary. For these reasons it is not a wise decision for the citizens of Utah, investors or government to support this project. It can be expected that in the future nuclear power plant designs will improve their safety and operational systems, and the costs of construction and production may be brought down. Populations will also continue to increase, requiring more power to be created and at that time, the construction of a nuclear power plant in Utah may prove useful or even necessary.

Works Cited

Energy Information Association. "Independent Statistics and Analysis. Electric Power Monthly" *Energy Information Association*. EIA, 24 Oct. 2014. Web. 6 Nov. 2014.

Energy Information Administration. "Utah - State Profile and Energy Estimates" *U.S. Energy Information Administration (EIA)*. Web. 6 Nov. 2014.

Blue Castle Holdings. "FAQ What Are the Considerations for Water Use." *Blue Castle Project*. Blue Castle Holdings Inc. Web. 6 Nov. 2014.

Ferguson, Charles. "Fundamentals." *Nuclear Energy: What Everyone Needs to Know*. New York: Oxford UP. 2011. 40-47. Print.

Greenfacts. "Chernobyl Nuclear Accident." *Greenfacts*. Greenfacts. Web. 18 Nov. 2014.

Mousseau, Timothy A., and Anders P. Møller. "Genetic And Ecological Studies Of Animals In Chernobyl And Fukushima." *Journal Of Heredity* 105.5 (2014): 704-709. *Academic Search Premier*. Web. 10 Oct. 2014.

Nuclear Energy Institute. "Costs: Fuel, Operation, Waste Disposal & Life Cycle." *Nuclear Energy Institute*. Web. 6 Nov. 2014.

O'Donoghue, Amy Joi. "Fate of Proposed Green River Nuclear Power Plant Depends on Water." DeseretNews, 29 Sept. 2013. Web. 8 Nov. 2014.

Rogers, Simon. "Nuclear Power Plant Accidents: Listed and Ranked since 1952." *The Guardian*. The Guardian News and Media, 18 Mar. 2011. Web. 15 Nov. 2014.

Utah Chapter Sierra Club. "Blue Castle-Green River Nuclear Power Plant." *Utah Chapter Sierra Club*. Web. 8 Nov. 2014.

U.S. National Library of Medicine. "Radiation Sickness: MedlinePlus Medical Encyclopedia." *U.S National Library of Medicine*. U.S. National Library of Medicine. Web. 10 Nov. 2014.

Winslow, Ben. "Deal Inked to Develop Nuclear Power Plant near Green River." Fox 13, 20 Aug. 2014. Web. 7 Nov. 2014.

World Nuclear Association. "Chernobyl Accident 1986." *World Nuclear Association*. Web. 9 Nov. 2014.

World Nuclear Association. "Outline History of Nuclear Energy." *History of Nuclear Energy*. 1 Mar. 2014. Web. 14 Nov. 2014.

World Nuclear Association. "Radioactive Wastes - Myths and Realities." *World Nuclear Association*, 1 Oct. 2012. Web. 15 Nov. 2014.

World Nuclear Association. "The Situation at Fukushima." *World Nuclear Association*. Web. 8 Nov. 2014.

World Nuclear Association. "Fukushima Accident." *World Nuclear Association*, 1 Nov. 2014. Web. 8 Nov. 2014.