1. Regarding the longevity of nuclear energy, how much of a threat do you believe uranium depletion is to the sustainability of nuclear energy in the future?

*As of 2008, the Uranium reserves in the United States is about 1,227 million pounds which, at our current energy consumption rates, is enough to last for about 500 years. Moreover, this number can further be increased with the reprocessing of used fuel.*

*France and India are currently involved in active research in the filed of Fast Breeder Reactors (FBR). The breeder reactors have the ability to breed (produce) more fissile material in addition to burning it. The fissile material so produced can be separated and reprocessed which can then further be used to fuel other conventional nuclear reactors. The Fast Breeder Reactors, therefore, have the ability to make Nuclear Power a renewable source of energy.*

1. With respect to question one, what do you believe could be an alternate fuel source for nuclear reactors in lieu of uranium?

*Thorium can prove to be a promising fuel source for nuclear reactors. Since, thorium does not undergo a self-sustained chain reaction, it cannot be directly used for commercial power reactors. The reactors need to breed 233U from 232Th. Since 233U is a fissile nucleus, it can undergo self-sustained fission reaction. It can then be separated and reprocessed to be used as a fuel in commercial nuclear power reactors. Currently, the only country involved in active research for Thorium-powered nuclear reactors is India.*

1. How significant of a threat do you believe nuclear waste is to the health of the environment and the health of the human population?

*Nuclear waste usually comprises of used fuel coming out of a nuclear reactor. The U.S. generates about 2,000 metric tons of used fuel each year. Since the 1950s, the U.S. has produced roughly 83,000 metrics tons of used fuel which can fit on a single football field at a depth of less than 10 yards. So in terms of quantity, we do not have a lot of nuclear waste to deal with.*

*Commercial used fuel rods are safely and securely stored at 76 reactor or storage sites in 34 states. The fuel is either enclosed in steel-lined concrete pools of water (called spent fuel pools) or in steel and concrete containers, known as dry storage casks. For the foreseeable future, the used fuel can safely stay at these facilities until a permanent disposal solution is determined by the federal government.*

*Hence with proper safety considerations, nuclear waste can be stored and disposed permanently without causing any concerns to the health of the environment and the general public. The nuclear energy scientists already have enough expertise and have developed techniques to handle long term nuclear waste. The current battle for the nuclear energy scientists is to get political approval.*

1. What are some possible methods to minimize the negative impacts of nuclear waste on the environment? Are there any methods currently in use that convert nuclear waste into a useful product?

*Used nuclear fuel can be recycled to make new fuel and byproducts. More than 90% of its potential energy still remains in the fuel, even after 5 years of operation in a reactor. The United States does not currently recycle used nuclear fuel but foreign countries, such as France and India, do. There are also some advanced reactor designs (Molten salt reactors and fast breeder reactors, for example) in development that could consume or run on used nuclear fuel in the future.*

1. What do you think have been some important changes in nuclear safety since the nuclear incident at the Chernobyl nuclear power plant?

*The Chernobyl nuclear accident happened due to an extremely faulty reactor design. It was a graphite powered reactor and it’s design did not include a reactor containment building. Post this accident, it has been universally accepted that using graphite as a coolant and moderator is not safe and thereafter no graphite cooled reactors have been built. Moreover, the US Government also implemented a law to make reactor containment buildings mandatory for every nuclear power plant.*

*The reactor containment structure houses the reactor. It is the place where all the nuclear reactions to generate heat and energy take place. The reactor is contained safely inside a lead and concrete structure that doesn’t allow any radiation to escape or reach other components. It acts as the final barrier to prevent the release of fission products. A double containment concept is also used these days.*

*In an event of a complete fuel meltdown, the reactor containment building would therefore prevent a Chernobyl-type accident to occur. The Nuclear Regulatory Commission (NRC) which is the US regulatory body ensures that all nuclear power plants have a functional containment building included in their design and engineered safety features.*

1. What do you believe are the most important impacts nuclear energy has on the environment, either positive or negative?

*It is a well-known fact that burning coal or natural gas produces a lot of carbon dioxide and other greenhouse gases which are very harmful for the environment. The burning of Uranium, on the other hand, does not produce any greenhouse gases. The only carbon dioxide that it releases is during the uranium mining phase which when compared with the coal statistics comes out to be of little importance. All the radiation generated in a nuclear power plant is safely contained within the reactor building by thick lead and concrete shielding all around it.*

*For more information on this topic, please refer to an article on my website here:* [*https://thebetterenergy.net/nuclear-power-vs-everything-else*](https://thebetterenergy.net/nuclear-power-vs-everything-else)

1. What are some important innovations in the field of nuclear power that have emerged in recent years? How do you believe these innovations will impact certain aspects of nuclear energy, like safety and accessibility?

*Some examples include advanced nuclear reactors like Fast Breeder reactors, gas cooled reactors and more recently developed molten salt reactors. These reactors are upgraded versions of the more commonly used water boiled reactors. The design improvements in these new reactors enable safer operational practices. These newer designs are also more robust and provide immunity to the reactor when facing with natural calamities or any accidents.*

*Molten salt and fast breeder reactors can also help in burning nuclear waste thereby reducing the quantity of the net waste produced.*

*High-end research is also being done to produce certain kinds of glasses that are non-biodegradable and can be used to store long-term nuclear waste for thousands of years In deep underground repositories safely without any concerns of leakage or contamination of ground water.*

1. How significant of a threat is radiation from nuclear power plants?

*The entire procedure involved in a Nuclear fuel cycle, right from the mining of Uranium to power production exposes the general public to a very small radiation dose. To be specific, the average dose equivalent to the US population from the fuel cycle is only about 0.05 millirem per year which is much less than the dose received by any of the natural sources of radiation (which is about (0.2 rem per year). It is also much less than the radiation received from any consumer products like smoke detectors, bananas, cement etc. Procedures involving nuclear medicine (like X-rays or CT scans) also expose the public to a much larger radiation dose.*

*For more accurate information about radiation dose from various natural and artificial sources of radiation, please refer to my article here:* [*https://thebetterenergy.net/radiation-and-the-fear-factor*](https://thebetterenergy.net/radiation-and-the-fear-factor)

1. How cost efficient do you believe nuclear energy is to operate? What do you believe are some recent changes or developments that have driven the cost of nuclear energy up or down?

*The cost of electricity has three major components - Fixed cost, Operation and maintenance cost and Fuel cost. For thermal power, the fuel cost varies from 30 – 40% of the total cost while for nuclear power, it is only 8% of the total cost. Therefore if coal price is doubled, the cost of electricity will increase by 40% while for a similar situation, nuclear electricity price will only increase by 8%.*

*According to the statistics published by the Nuclear Energy Institute (NEI) (U.S. Electricity Production Costs and Components (1995-2014)) in 2015, while petroleum showed the maximum price hike with cost of electricity generation going up to 22.49 cents per kilowatt hour in 2014, coal amounted to 3.29 cents and nuclear amounted to only 2.4 cents per kilowatt hour.*

*Very recently, a lot of research is being done on Molten salt reactors, which use less fuel for their operation. Reducing the amount of fuel required would also result in a decrease in the cost of electricity produced.*

1. Do you believe that nuclear energy can become the main source of energy for the United States, after accounting for factors like cost, environmental impact, and safety?

*Currently, the U.S. produces about 20% of its electricity from Nuclear power and contributes to about 55% of the total amount of clean energy that the country produces. So as far as the environmental impacts of nuclear power are concerned, this form of energy does have the potential to positively deal with the climate change situation by cutting down our carbon emissions considerably.*

*Economically, nuclear electricity is more cost effective than thermal electricity. With multiplication of nuclear power plants, the cost of nuclear electricity is set to further go down in future.*

*The Nuclear Regulatory Commission ensures the safety of all nuclear power plants by implementing design features that enable the complete containment of radiation. The safety and engineering design features also ensure minimum damage in situations of accidents and natural calamities.*

*Nuclear power, thus, has the potential to become the main source of energy in the country. The problem however lies in the incomplete knowledge and misconceptions within the public regarding the use of nuclear energy. Media driven hysteria is also responsible in creating a stigma that the society has towards this source of energy.*