Forum: Environment Committee
Issue: Nuclear Energy
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Introduction to topic

This year at ILYMUN, one of the major topics in the Environmental Committee will be nuclear energy. Nuclear power is the use of controlled nuclear fission to generate energy in the form of heat which can then be converted into electricity. Nuclear power plants provided about 13% of the world's electricity in 2012 which means it plays a major role in providing us with energy. Nuclear energy is used worldwide by only 31 countries with a total of 431 nuclear power reactors. There are currently 68 nuclear reactors under construction in a total of 15 countries.

It has been debated many times if the use of nuclear energy is the right way to go as it also brings several problems beside the advantages such as low Carbon Dioxide emissions. Nuclear energy essentially uses the fission of uranium atoms. After they are split up and energy is released, the products, which are unstable isotopes are mostly radioactive. The radioactivity of all nuclear waste diminishes with time, so eventually all radioactive waste decays into non-radioactive elements.

Over time the world has experienced several fatal accidents related to nuclear energy. Among the most famous are Chernobyl (1986) and Fukushima in March 2011.

Definition of Key terms

Nuclear energy

Nuclear energy is considered a non-renewable energy source as we do not possess infinite amounts of uranium. Usually the Uranium isotope Uranium 235 which makes up about 0,72% of all natural Uranium, is used. This fissionable material is used in the core of the reactor. The material is bombarded with Neutrons so that the atoms within the Uranium split, releasing a lot of energy in the form of heat. Each fission releases either 2 or 3 more Neutrons; this results in a chain reaction meaning that the process is continuous. Boron or Graphite rods can be inserted or removed from the core to control the amount of free Neutrons within the reactor - this keeps the chain reaction under control. The heat produced is then used to heat water which in turn becomes steam. The steam is then used to turn turbines which produce electricity.

Radioactive waste

Radioactive waste is a byproduct of nuclear power. Radioactive waste is hazardous to most forms of life and the environment, and is regulated by government agencies in order to protect human health and the environment.

Reprocessing

Nuclear reprocessing uses chemical procedures to separate the useful components of radioactive waste from the actual waste. Reprocessing of Uranium and Plutonium can potentially recover up to 95% of the remaining Uranium and Plutonium in spent nuclear fuel, putting it into new mixed oxide fuel. The downside is that Nuclear reprocessing is a very expensive process, so many countries prefer to simply use new Uranium and dispose themselves of the Radioactive waste.

Timeline of events

-Uranium was discovered in 1789 by Martin Klaproth, a German chemist, and named after the planet Uranus.
-Ionizing radiation was discovered by Wilhelm Rontgen in 1895, by passing an electric current through an evacuated glass tube and producing continuous X-rays.
-By 1911 Frederick Soddy discovered that naturally-radioactive elements had a number of different isotopes.
-In 1932 James Chadwick discovered the neutron. Also in 1932 Cockcroft and Walton produced nuclear transformations by bombarding atoms with accelerated protons which produced radionuclides. Then in 1935, Enrico Fermi found that a much greater variety of artificial radionuclides could be formed when neutrons were used instead of protons.
-At the end of 1938 Otto Hahn and Fritz Strassman in Berlin showed that the new lighter elements formed from this were barium and others which were about half the mass of uranium, thereby demonstrating that atomic fission had occurred.
-During world war 2 both the United States of America, Germany and Britain tried to conceive a weapon based on the new discovery of nuclear fission. This led to projects like the Manhattan Project (USA)which essentially consisted of attempts to construct an atomic bomb. The first atomic device tested successfully was in Alamagordo in New Mexico on 16 July 1945.
-In the 1960s scientists began to understand that nuclear fission could be used in industry instead of misusing it for destruction. On June 27, 1954, the USSR's Obninsk Nuclear Power Plant became the world's first nuclear power plant to generate electricity for a power grid, and produced around 5 megawatts of electric power.
-In 1955 the United Nations' "First Geneva Conference", then the world's largest gathering of scientists and engineers, met to explore nuclear energy in the
-Two years later, in 1957 the world saw the launch of the International Atomic Energy Agency (IAEA) which still today plays a major role in the promotion of the peaceful use of nuclear energy.
-Nuclear capacity initially rose relatively quickly, rising from less than 1 gigawatt in 1960 to 100 GW in the late 1970s, and 300 GW in the late 1980s.

Position of key members

USA

As of 2011, nuclear power in the United States is provided by 104 nuclear reactors. The USA is commercially licensed to operate at 65 nuclear power plants, producing a total of 806 TWh (Terra Watt/hour) of electricity, which was 19.6% of the Nation's electricity. The USA is considered the world's largest supplier of nuclear energy on earth. The US has experienced a total of 9 nuclear accidents which caused more than 140 million US$ of property damage each. The United States has the 4th largest uranium reserves in the world. There are some 65 000 tons of nuclear waste now in temporary storage throughout the US. Only 1 active nuclear waste reprocessing plant is located in the US.

Germany

Nuclear power in Germany accounted for 17.7% of national electricity supply in 2011 On 30 May 2011, Germany formally announced plans to abandon nuclear energy completely within 11 years. They have also announced to further explore renewable energy such as Wind, Solar and Hydroelectric which already sustains over 20% of the country's energy needs. Germany experienced a total of 4 major nuclear accidents in its history costing the country a total of over 1 billion US$.

France

Nuclear energy is the major energy source in France and accounts for 78.8% of France's electricity. France is in the possession of a total of 58 nuclear reactors as of 2011. Fission energy is considered a success in France as it is cheap and doesn't emit Carbon Dioxide. Following François Hollande's victory in the 2012 Presidential Election, there may be a partial nuclear phase out in France, with his Socialist party in favor of closing the oldest 24 reactors by 2025. France has had fairly few property damage caused by nuclear reactor accidents with a total of only 262 million US$ of damage property accumulated over a total of 12 accidents. France owns a total of 3 Nuclear waste reprocessing plants

Russia

Russia's nuclear energy makes up 17% of its electricity needs. It currently has 31 reactors but is planning to expand this to 59. At the time of the USSR one of the most relevant nuclear disasters occurred in Chernobyl, Ukraine in 1986. Russia currently operates one nuclear waste reprocessing plant.

UK

The United Kingdom is currently runs 16 operational nuclear reactors in a total of 9 plants which produced 16% of UK's needs in 2009. However, in 2010 the British government gave allowance for the construction of 8 new plants. Just like France, accidents have cost Britain fairly low amounts compared to other countries. A total of only 143 million US$ of property damage was caused by nuclear accidents. Nuclear energy

China

The People 's Republic of China is in possession of a total of 16 nuclear reactor but is currently expanding to 42. Only 1% of China's electricity is generated by nuclear fission. The government is planning to increase this to 6% by 2020.

Canada

As of October 2012, about 15.2% of Canada's electricity is produced by nuclear power. Canada plans to expand its nuclear capacity over the next decade by building two more new reactors making it a total of 21. For many years Canada has been a leader in nuclear research and technology, exporting reactor systems developed in Canada as well as a high proportion of the world supply of radioisotopes.

Japan

The country's 50 main reactors have provided some 30% of the country's electricity and this was expected to increase to at least 40% by 2017. Although Japan has had bad experience with nuclear energy such as the Fukushima catastrophe in March 2011 when units 1-4 of the reactor where seriously damaged, it still continues to expand its nuclear energy.
Other countries in the possession of nuclear reactors are Argentina, Armenia, Belgium, Brazil, Bulgaria, Czech Republic, Finland, Hungary, India, Iran, Mexico, Netherlands, Pakistan, Romania, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan and Ukraine.
As of 2011 the main opponents of nuclear energy are Australia, Austria, Denmark, Greece, Ireland, Italy, Latvia, Liechtenstein, Luxembourg, Malaysia, Malta, New Zealand, Norway and Portugal

Background information

The main problem related to nuclear energy is not really the plants themselves but the hazardous, radioactive byproducts. There are several methods of disposal of nuclear waste but all have their advantages and downsides.

Possible solutions

Geological disposal

The process of geological disposal centers on storing nuclear waste in the ground to the point where it is out of human reach. There are a number of issues that can arise as a result of placing waste in the ground. The waste needs to be properly protected to stop any material from leaking out. Leakage of the waste could contaminate the water if the burial location is above or below the water level. Furthermore, the waste needs to be properly fastened to the burial site and also structurally supported in the event of a major seismic event, which could result in immediate contamination.

Reprocessing

Reprocessing has also emerged as a viable long term method for dealing with waste. As the name implies, the process involves taking waste and separating the useful components from those that aren't as useful. Specifically, it involves taking the fissionable material out from the irradiated nuclear fuel. However, nuclear reprocessing is very expensive so it isn't very widespread.

Transmutation

Transmutation also poses a solution for long term disposal. It specifically involves converting a chemical element into another less harmful one. Common conversions include going from Chlorine to Argon or from Potassium to Argon. Natural transmutation also occurs over time. Natural transmutation also serves as the principle of geological storage on the assumption that giving the waste enough time will allow it to become a non-fissionable material that poses little or no risk.

Space disposal

Space disposal has emerged as an option, but not as a very viable one. Specifically, space disposal centers around putting nuclear waste on a space shuttle and launching the shuttle into space. This becomes a problem from both a practicality and economic standpoint as the amount of nuclear waste that could be shipped on a single shuttle would be extremely small compared to the total amount of waste that would need to be dealt with. Furthermore, the possibility of the shuttle exploding on its way to space could only make the matter worse as such an explosion would only cause the nuclear waste to spread out far beyond any reasonable measure of control.

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