Alster Model United Nations

FORUM: Fourth Committee of the General Assembly (SPECPOL)

QUESTION OF: Consequences following the use of nuclear energy and release of nuclear radiation

STUDENT OFFICER: Karla Eberle

POSITION: Main Chair

INTRODUCTION

Since the 30s the world is fascinated by the incredible potential of nuclear energy - gaining power by splitting atoms, both in a sense of physics and politics. Before nuclear energy was commercialized between the 60s and 70s as a common source of electricity, produced in nuclear power plants, the scientific focus lay on the production of nuclear weapons during World War II and later the Cold War between the United States of America and the former Soviet Union. With the upraise of nuclear power plants so did counter movements pointing out the high risks of this practice. The three most severe accidents resulting in the release of nuclear radiation were Three Mile Island in 1979, Chernobyl in 1986, and Fukushima Daiichi in 2011, causing huge areas to be contaminated by radiation and thousands people to be directly or indirectly affected by the nuclear disasters. All three nuclear meltdowns had an impact on the international awareness of security in the handling of nuclear material. Nevertheless nuclear accidents, nuclear proliferation, nuclear terrorism and especially radioactive waste disposal are still issues that concern many opponents. Another concern is the amount of uranium needed as nuclear fuel, recognizing it is not an endless resource.

Often pressured by their citizens some governments have reviewed their nuclear power policies or even decided to phase out their nuclear power program. At the same time there are some countries especially China investing a lot in nuclear energy as a power source. Since the early 2000 the subject of climate change rose and with it the need to reduce carbon-dioxide emissions. Because of its near zero greenhouse gas emissions nuclear power plays despite its risks a major role in the discussion of the global energy transition in an effort to achieve the goals of the UN Paris Agreement of keeping the global temperature rise in this century well below 2 degrees Celsius.

Therefore producing electricity with nuclear power plants is highly controversial and many positive and negative aspects have to be taken into consideration.

DEFINITION OF KEY TERMS

Nuclear energy

Nuclear energy is set free during the radioactive decay of unstable atoms. During that process the nucleus of the atom splits into two about equal fragments called fission products. The mass of those two fission products will not equal the mass of the original nucleus since approximately 0.1% of the original mass is emitted into energy in form of radiation.

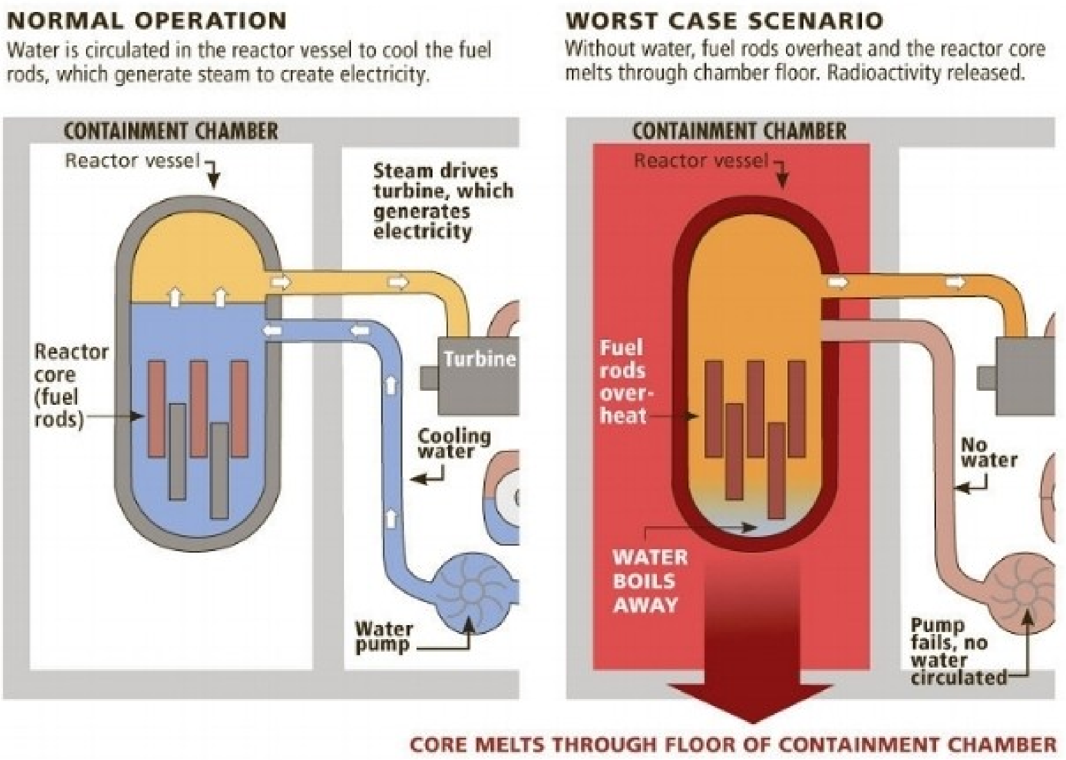
This radiation from nuclear energy is ionizing radiation that unlike radio or light waves have enough power to remove electrons from other atoms - to ionize them. This property poses a risk for any living thing since it can damage cells and the DNA. Therefore a high dosage of nuclear radiation is a severe danger for human beings, animals and the environment.

Nuclear fission / nuclear power plants

The nuclear decay can also be forced by shooting a neutron onto the unstable atom causing it to split. This process is called nuclear fission and is what happens in a nuclear reactor. Apart from the fission products the nuclear decay also sets free single neutrons. In a nuclear reactor this is used to trigger a chain reaction since these neutrons cause near by atoms of the nuclear fuel to fission. The nuclear fuel, mostly uranium or plutonium, is contained in nuclear fuel rods which are stored in a pool of water. This water is heated up by the released energy of the nuclear reactions and turns into steam. This steam finally powers a turbine which creates electric energy.

Nuclear melt down

A nuclear meltdown is the consequence of the failing of the cooling system of a nuclear reactor. Once the backflow of water surrounding the nuclear fuel rods stops the nuclear radiation heats up the water until it vaporizes eventually exposing the fuel rods to air. Without cooling the uranium inside, the fuel rods heat up until they reach their melting point because of the on-going chain reaction and therefore continuously released energy. As a result they can burn through their metal shell and even if not previously stopped through the power plant's floor causing widespread release of radiation. If the melted nuclear fuel hits the water it is cooled with it can also result in an explosion blowing the radioactive materials into the air.

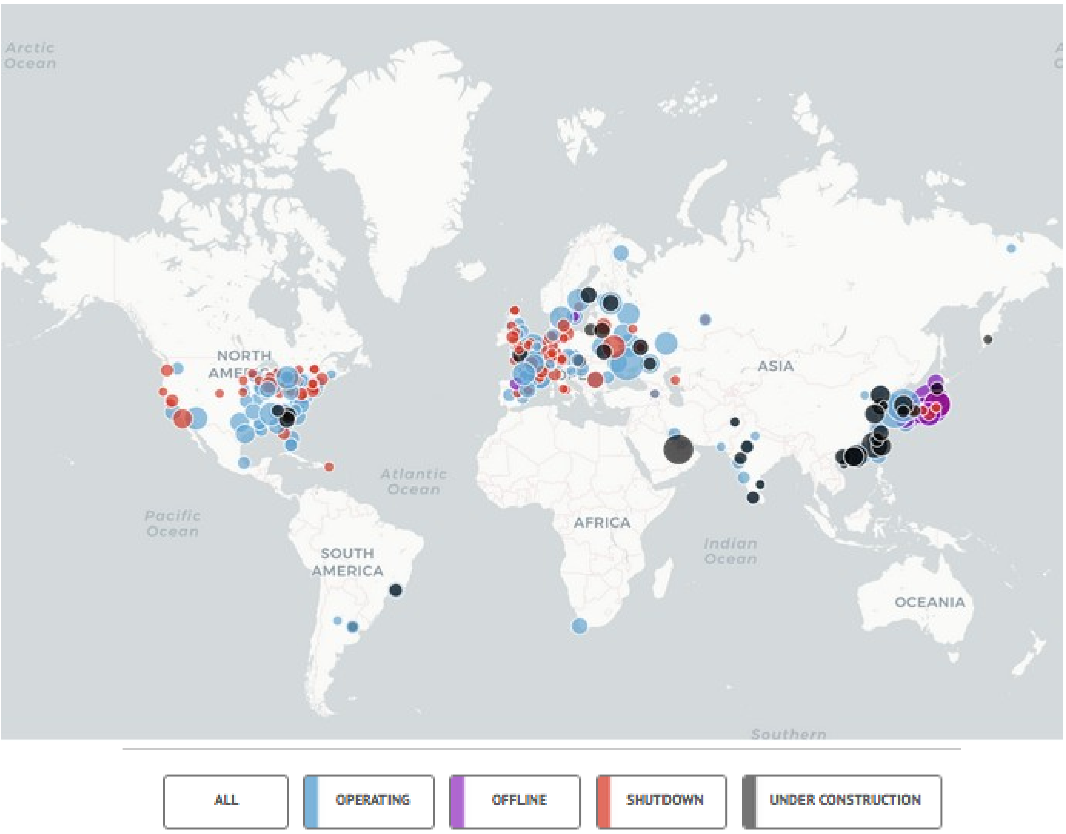


https://www.fairewinds.org/what-is-a-meltdown

BACKGROUND INFORMATION

In 1932 the physicist Ernest Rutherford from New Zealand discovered that a lithium atom after its splitting by a neutron releases a high amount of energy. He and his scientific colleagues Bohr and Einstein dismissed the idea of using this energy in a bigger scale as highly unlikely. Little did they know what was to happen in the future.

In 2018 there were 30 countries worldwide operating nuclear power plants. In total 454 nuclear reactors with a combined electrical capacity of 394 GW are operating, France being the nation that by far covers the highest percentage of their total generating capacity (50%) with nuclear power. This international electrical capacity equals 16% of the world's electricity. Currently there are 54 new nuclear power plants under construction and as of the beginning of this year 337 more are planned, the majority in Asia.

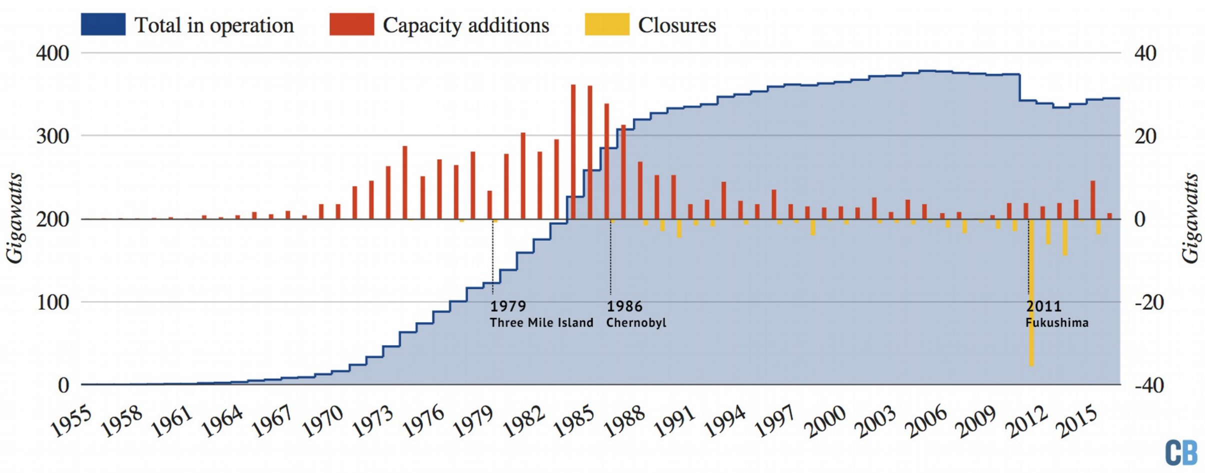


https://
www.carbonbrief.org/mapped-the-worlds-nuclear-power-plants

Other than for weapons and electricity nuclear energy is also used in the field of medicine, like x-rays and radiotherapy.

A milestone to get to where we are today was the discovery of a different group of scientist around Otto Hahn in 1938. They improved the methods of splitting nuclei, achieving the decay of uranium atoms into equal pieces, paving the way for nuclear fission as we know it today. Frédéric Joliot-Curie merely a year later in 1939 confirmed that during that process more protons are set free and make a self-sustaining nuclear chain reaction possible. Once this was proven the international interest in nuclear warfare on the verge of World War II was aroused. Several nations especially the United Stated of America and the former USSR continued their research for the time being only for weapon systems. In 1942 the US managed to build the first man-made reactor with self-sustaining power as part of the Manhattan

Project and three years later a production reactor creating weapon-grade plutonium for the first nuclear weapon test (Trinity Test) in July 1945. One month later followed the nuclear bombings of Hiroshima and Nagasaki in Japan as part of a strike against the German Nazi regime and its allies, killing hundred thousands of civilians. With the 1950s began the period of the Cold War. The US felt obligated to contain the communism centred in the USSR from spreading further in the eastern world. As part of their military actions both sides started building more and more nuclear weapons in an effort to overtrump the other one.
Nevertheless, both nations started taking advantage of nuclear fission on other levels - the production of electricity. In the following years the US built the first reactor generating electricity and the USSR managed to create enough nuclear energy to power the first city with it.
With the Amendments to their Atomic Energy Act in 1954 the United States of America opened classified technological information to the private sector to encourage a peaceful use of nuclear power world wide. This was the beginning of a new booming industry in the 60s and 70s. The total global nuclear capacity rose between 1960 and 1980s from 1 GW to an installed capacity of almost 300 GW.



https://www.carbonbrief.org/mapped-the-worlds-nuclear-power-plants

Despite the economical advantages that this new technology brought with it opposing voices grew louder as the industry grew. There were scientists joining forces with the early protests in the 1960s first pointing out the different risks of nuclear energy. By the 1970s there were anti-nuclear power groups in every country with a nuclear power program, especially inspired by a successful demonstration against a new power plant in Germany in the beginning of the decade.
Nevertheless the construction of nuclear power plants did not stop since countries decided to invest more and more in this seemingly very cost-effective energy source. Therefore, in the 1980s one new nuclear reactor started up every 17 days on average. At the same time nonetheless more than two-thirds of all nuclear power plants ordered after January 1970 were cancelled mainly because of the influence of the counter movements.

Beyond the constant fear of a nuclear attack during the on-going Cold War there were many other issues addressed by the critics that have not lost their relevance till today.

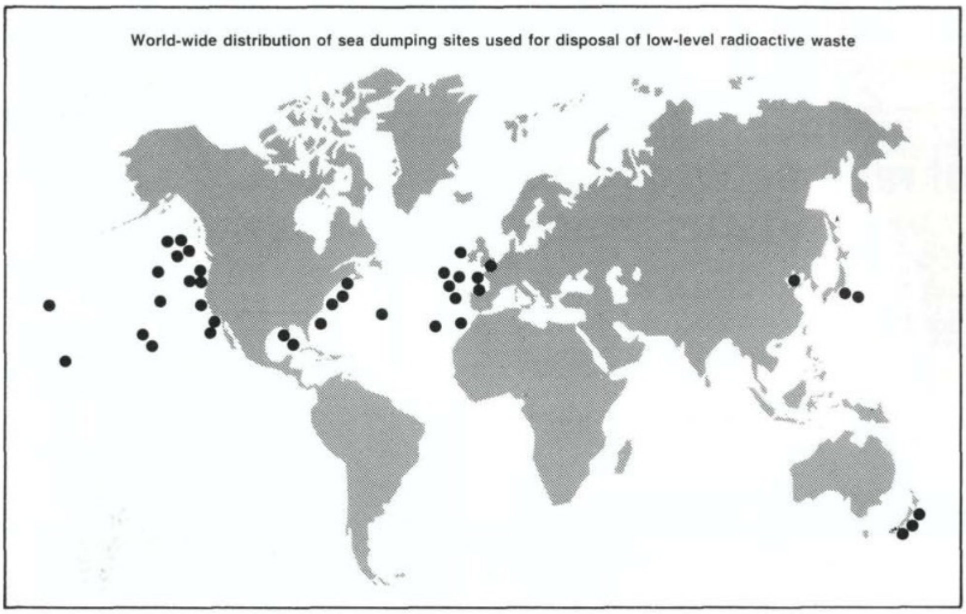
Without question the most long-lasting issue is nuclear waste disposal. The nuclear fuel consists of uranium with a high number of the radioactive uranium-235 isotope that is likely to decay and trigger the necessary chain reaction. The fission fuel rods in a nuclear reactor are used for approximately 6 years until about 3% of the uranium has been fissioned. After that time they are no longer efficient in producing electricity and called spent fuel.

This spent fuel now consist not only of uranium but other elements that were created during the process undertaken. Firstly, there are the fission products that are lighter elements such as cesium-137 and strontium-90 that account for most of the heat and penetrating radiation in high-level waste. On the other hand some of the uranium atoms also capture a neutron and form heavier (transuranic) elements such as plutonium. These elements do not nearly produce as much heat and penetrating radiation as the fission products but take much longer to decay into non-harmful material. They account for most of the radioactive hazard remaining in high-level waste after 1,000 years. While cesium-137 and strontium-90 have half-lives of about 30 years, meaning that half the radioactivity will decay in that period, plutonium-239 has a half-life of 24,000 years. The spent fuels consist of about 95% uranium, 4% short-lived fission products and 1% transuranic elements.
After the spent fuels are taken out of the reactor they still have an on-going process of heavy nuclear decay and are therefore still very hot and radioactive. To cool down they are put into a spent fuel pool, a water tank often integrated into a nuclear power plant, to cool down. The water around them is cooling system and shelter of radiation at the same time. They are left there for approximately 5 years, but often also up to 10 year or even longer.
After that process the still highly radioactive material needs to be stored as safe as possible.

One short-term storage solution are dry cask storage facilities. The spent fuel rods are but into these dry casks, large steel-reinforced concrete containers. These include water and other protection layers and shield the radiation so that transport, maintenance and even touching of the casks is harmless. These containers are simply stored in a designated area waiting to be send to a permanent storage facility. This poses many risks since the facilities have to be secured and checked up on by staff which can not be guaranteed until all the waste has stopped being radioactive, due to the ten thousands of years it will take. Also these facilities are not completely secure from natural or other accidents and could even pose as targets for theft or terroristic attracts.

Another option is the reprocessing of the nuclear fuel. It is a process to recover the different substances in the spent fuel to provide fresh fuel for nuclear power plants. By reprocessing one can gain some 25-30% more energy from the original uranium. On the one hand, this reduces the need of uranium mining, especially once the technology enhances even more.
On the other hand, this also decreases the amount of high-level and long-lived nuclear waste. Reprocessing reduces about one-fifth of the high-level waste that needs to disposed. Also after reprocessing the waste consists of materials with a shorter half-life, decaying to the same level as the original ore within 9000 years as opposed to 300,000 years. Lastly, the reusing of plutonium supposedly reduces the possibility of plutonium being diverted from civil use, thereby increasing proliferation resistance of the fuel cycle.
According to the World Nuclear Association between 2010 and 2030 some 400,000 tonnes of used fuel is expected to be generated worldwide, including 60,000 t in North America and 69,000 t in Europe. Several European countries, Russia, China and Japan have policies to reprocess used nuclear fuel, although government policies in many other countries have not yet come around to seeing used fuel as a resource rather than a waste, the US being one of them. The government argues the flipside of the previously mentioned argument. According to the US the production and isolation of plutonium makes it much easier to steal and use for weapons since the plutonium powder by itself is not as radioactive. Furthermore, the US relies on the waste disposal methods they are pursuing, although there is no permanent storage facility in the country. Lastly, the government argues that the cost of investing in and maintaining reprocessing reactors is much higher than the current practice of uranium mining and nuclear waste disposal.

Before it was banned by the 1972 London Convention a commonly used nuclear waste disposal was simply dumping barrels of spent fuels into the sea. While the consequences of the dumping are very poorly investigated the international community was too concerned about the effect this form of waste disposal might have on our valuable oceans.



All of these options are no long-term waste disposal facilities.
Currently there is no solution that guarantees a risk free storage of nuclear waste for the necessary amount of time until the radioactive material is harmless for humans and nature. Therefore governments are still looking for appropriate places and methods to built such a facility. In Finland they have started the first project of this kind. On an uninhabited island they are building a labyrinth of tunnels kilometres deep into the granite ground. The nuclear waste storage facility is supposed to contain 5000 t of nuclear waste only from Finland and to be sealed in 2020.

The nuclear waste needs to be kept locked up for a million years to be harmless to its environment. This is why the requirements for such a facility are incredibly high and according to scientists even to this point not completely predictable. Because of the immense time the waste has to be contained, a facility like that needs to work without any human supervision and to last longer than any political structure. Considering that the first traces of modern humans were found to be only 200,000 years old and the once most powerful civilization on earth, the roman empire only lasted 1000 years it becomes clear why. Merely a geological approach can reach the highest level of security possible to this day. Scientists nevertheless warn that even the predictions of geological events can not be precise enough over this huge amount of time. In the specific case of Finland unexpected movement of the continental plates could lead to cracks in the inelastic granite, which could furthermore lead to a leak causing a nuclear contamination of the sea in front of Finland's coastline.
Since the facility is not especially marked as such in a larger scale critics also fear that the knowledge about the hidden toxic storages could get lost over time. In combination with the unstoppable curiosity of human kind this could end in nuclear waste storage facilities being opened by future societies clueless about the consequences. A common example from the past are the expeditions in Egypt that resulted in the opening of ancient pyramids and tombs of pharaohs.

Another issue many nuclear opponents are concerned about is terrorism in connection with radioactive material. There are two aspects to this. First of all, nuclear material could be stolen and either used to build weapons or simply to set free radiation in public places. Secondly, all kinds of facilities included in the production of nuclear electricity can pose as targets for terrorist attacks. The more this technique is used in the future the more possible targets there are due to an increase of necessary storage facilities and reactors. Lastly, no country can guarantee the security of such facilities in a state of emergency such as a war, giving easy access to radioactive materials.

While the coal industry generates electricity by burning huge amounts of fossil fuels, gaining energy through radioactive decay requires a lot less recourses. Nevertheless it is important to acknowledge that uranium is in the current way used not an endless recourse either.
Uranium is extracted from mines and converted into a stable compact form. Because of its colour at this stage it is called yellowcake. From the mines the yellowcake is transported to the processing facilities. There it is enriched and transformed into uranium hexafluoride, which contains much more than the natural 0.7% of the needed uranium-235 isotopes. After this process the uranium is called nuclear fuel.
In 2015 the worldwide production of uranium amounted to a total of 60,496 tonnes. Kazakhstan, Canada, and Australia account for 70% of this number and basically all of the mined uranium is used for nuclear power plants. As of 2015, total identified uranium resources were sufficient for more than a century of supply based on current requirements.

There are different approaches to use nuclear fuels in a more long-lasting way. One is the development of breeder reactors. This reactor type transforms fertile material into fissile fuels. Fertile material itself is not fissionable by thermal neutrons but by their absorption becomes nuclear fuel, like plutonium or uranium-233. Fertile materials are also non-renewable, but their supply on Earth is extremely large, and therefore by some considered a renewable energy source.

As previously stated nuclear power plants emit basically no greenhouse gases. Therefore many believe in the importance of nuclear energy in combating climate change. Critics point out that extending the operational life of existing nuclear plants requires substantial capital investment that could go towards modern renewable energy sources. According to the International Energy Agency (IEA) 'its cost is competitive with other electricity generation technologies, including new solar and wind projects, and can lead to a more secure, less disruptive energy transition.' [1]
A second way to make nuclear energy a renewable energy source is the extraction of uranium from seawater. Our oceans have a natural level of uranium, about 3.3 micrograms per litter. Because of the huge quantity of this resource it is hoped to extract all future nuclear fuel from the sea. While in 2013 pilot projects could only extract few kilograms of uranium from the ocean a part of the scientific community is optimistic that the process would be economically competitive if implemented on a large scale. An important factor is that it is to be assumed that the natural level of uranium in the water would maintain stable because of uranium leached from the ocean floor. Thus, seawater extraction and therefore nuclear energy would be a renewable energy source. Nevertheless, biologist are concerned that the constructions needed to meet the international uranium demand would interfere with marine currents, causing harm to maritime nature and wild life.
At the moment both of these fuel sources considered renewable are not yet commercialized mainly due to their high cost and need for investments and the currently moderate uranium prizes.

Finally, an enormous concern of many citizens is the fear of a nuclear meltdown. It is a risk that the population of a country can not shield themselves from. The effects of a nuclear

1 https://www.iea.org/newsroom/news/2019/may/steep-decline-in-nuclear-power-would-threaten-energy-security-and-climate-goals.html

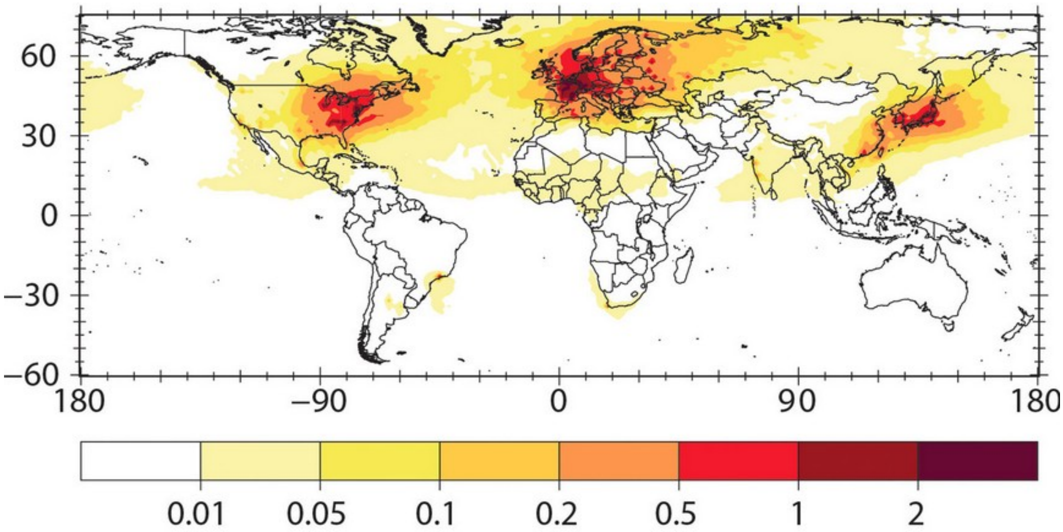
accident spread over a much larger area compared to other accidents in the energy industry and most importantly cause much more long-lasting harm to humans and nature due to their radioactive contamination. Since 1952 there have been fourteen meltdowns of varying severity at both commercial, military, and experimental reactors. The three most severe meltdowns were the Chernobyl accident in the Soviet Union in 1986, the Fukushima Daiichi accident in Japan in 2011 and the Three Mile Island accident in the United States in 1979. Those three examples show why the threat of such a nuclear disaster causes constant fear.

It has to be considered that first of all nuclear power plants have to be built fairly close to the civilisation since they produce electricity used by humans. Secondly, in many areas, especially in Europe where nuclear energy is a common power source due to the small size and high population density of nations it is not possible to isolate nuclear power plants to reduce the risk of severe consequences after a possible meltdown. Furthermore, the radius of possible radioactive contamination goes beyond borders and therefore possibly effects also countries that due to mentioned concerns restrain from using nuclear energy as a power source.
This effect was shown during the catastrophe of Chernobyl. After the out-dated and not sufficiently safe reactor caught fire during the meltdown the cloud of smoke that spread rapidly carried radioactive particles with it over a large area. Since radioactivity can be spread by contaminated particles wind and radioactive rain increase the affected regions immensely. In this case high radioactivity could be measured over all of eastern Europe. In total 600,000 people were exposed to high nuclear radiation and the number of people with disabilities had to register a rapid increase from 40,000 in 1995 to 107,000 in 2018. There are nearly 20,000 documented cases of thyroid cancer among individuals who were under 18 years of age at the time of the accident in the three affected countries including Belarus, Ukraine and the Russian Federation. The radiation of the meltdown caused those especially through cow's milk, since the cows ate the contaminated milk that was fed to children.

Other consequences nuclear radiation can have on the human body depend on the form of radiation and the period of time you are exposed to it. They include hair loss, nose bleeds, skin blisters, tumours, and cancer. An exposure to a very high level of radioactivity, equivalent to about 18,000 chest x-rays within minutes to hours, can cause so called radiation syndrome. Symptoms are nausea and vomiting and it can lead to death over the following days or weeks.

These examples show the range of effects radioactivity has and the long period of time it can affect us. Data demonstrate that nuclear power has the lowest number of fatalities per unit of energy generated compared to fossil fuels and hydropower but Chernobyl to this day 30 years later is still evacuated and the impact can last for hundreds of years. The numbers might say one thing but the fear of such an accident is based on the enormous consequences meltdowns have on so many individuals at once.

After the nuclear accidents the whole world held their breath in shock. But they were also motivation to some institutions and governments to establish or review policies in this field. After the Three Mile Island in the US the white house drew regulatory consequences about safety measurements that decreased the growth of nuclear power sector in the US. As an outcome of the Chernobyl crisis the World Association of Nuclear Operators (WANO) was created to chare knowledge to increase safety. Before this incident a lot of information was withhold as part of the secrecy during the cold war. And as a result of Fukushima Daiichi Japan shut down all but one nuclear reactor and many countries reviewed their nuclear safety and power policies, some even deciding to phase out their nuclear power program.



Worldwide probability of radioactive contamination: The map shows in percent the annual probability of radioactive contamination of over 40 kilobecquerels per square meter. In Western Europe, it is about two percent in one year.
https://www.mpg.de/forschung/kernenergie-nuklearer-gau

Today, especially Asian countries focus on the positive aspects of nuclear energy and invest heavily in this power source. Even Japan is planning to start up their reactors again. Some specialists even predict the global nuclear power generation to double until 2040 because of that growth. Many western countries on the other hand are pressured by the concerned population pointing out the risks and unsolved issues of nuclear energy. At the same time especially those nations have to find a way to sufficiently contribute to the fight to combat climate change. The various controversial aspects of this topic offer many opportunities for international debate.

TREATIES

- 1972 London Convention
    - established by the IAEA
    - prohibits radioactive waste disposal in the sea
- International Basic Safety Standards (BSS) for Protection Against Ionizing Radiation and for the Safety of Radiation Sources
    - established by the IAEA, ILO, WHO, and NEA
    - provided a worldwide basis for harmonized and up-to-date standards
- 2016 The Paris Agreement
    - signed by 195 UN member states
    - effort to combat climate change

A LIST OF ISSUES THAT ARE LIKELY TO ARISE

- Dependencies of energy supply between nations
- Climate change
- Long-term nuclear waste disposal / Reprocessing
- Uranium recourses
- Nuclear safety

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

- Countries with nuclear power plants, especially
    - French Republic
    - Russian Federation
    - United States of America
- Countries heavily investing in nuclear power, especially
    - People's Republic of China
    - Republic of Korea
    - Republic of India
- Countries with uranium mining, especially
    - Republic of Kazakhstan
    - Canada
    - Commonwealth of Australia
- International organisations taking measures for nuclear safety
    - United Nations Committee on the Effects of Atomic Radiation (UNSCEAR)
    - International Commission on Radiological Protection (ICRP)
    - European Atomic Energy Community (EURATOM)
    - World Association of Nuclear Operators (WANO)
    - International Atomic Energy Agency (IAEA, UN Department of Nuclear Safety and Security)
    - International Energy Agency (IEA)

QUESTIONS DELEGATES SHOULD CONSIDER

- How does my nation meets its energy needs?
- How is my country planning on meeting its energy needs in the future?
- Does my country have nuclear fuel resources?
- How is my country's electricity supply dependent on other nations?
- How does my country deal with nuclear spend fuels?
- Are there anti nuclear power movements in my country, and if so how does my government react to them?
- What is my nations opinion on climate change and what measures have been or will be taken in this field?
- Do other nations depend on nuclear energy produced in my country?
- Did my country sign the mentioned treaties and participate in the mentioned councils?

USEFUL LINKS/SOURCES:

- https://www.carbonbrief.org/mapped-the-worlds-nuclear-power-plants(Countries involved)
- https://www.cia.gov/library/publications/the-world-factbook/fields/258rank.html(Countries involved)
- https://en.wikipedia.org/wiki/Nuclear_power(General information)
- https://www.un.org/en/sections/issues-depth/atomic-energy/index.html(UN general information)
- https://www.iaea.org/sites/default/files/37302081625.pdf(UN legal framework)
-https://www.ucsusa.org/nuclear-power/nuclear-plant-security/nuclear-reprocessing(Reprocessing)
- https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/radioactive-waste-management.aspx(Waste management)
- https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html - stor(Radioactive waste)
- https://www.nationalgeographic.com/environment/energy/reference/nuclear-energy/(Climate change)
-https://www.epa.gov/radiation/radiation-health-effects(Health effects)
- https://en.wikipedia.org/wiki/Nuclear_power_proposed_as_renewable_energy#Fusion_fuel_supply (Climate Change)
- https://www.iaea.org/
- https://www.unscear.org/unscear/en/index.html- https://www.iea.org/
- https://www.nei.org/
- https://www.iaea.org/sites/default/files/publications/magazines/bulletin/bull36-2/36205981216.pdf(London Convention)