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ABOUT US

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“HUMAN RIGHTS VIS A VIS NUCLEAR TECHNOLOGY”

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Abstract-

Nuclear technolog yis technology that involves the nuclear reaction of atomic. Among the notable nuclear technologies are nuclear reactors, nuclear medicine and nuclear weapons. It is also used, among other things, in smoke detector and gun sights.

The human rights which are specifically affected due to the nuclear technology includes the right to life, the right not to be subject to inhuman or degrading treatment, the right to the highest standard of health and to a healthy environment, the right to an adequate standard of living, including the right to food and water.

A government commission that monitors and enforces human rights in India has opened a probe into allegations reported by the Centre for Public Integrity that villagers living near government-run uranium mines and others living downstream have persistently been exposed to high levels of radiation and suffered ill health as a result.

CHAPTER 1 INTRODUCTION

- **Nuclear technology vis a vis human right-**

The human rights which are specifically affected due to the nuclear technology includes the right to life, the right not to be subject to inhuman or degrading treatment, the right to the highest standard of health and to a healthy environment, the right to an adequate standard of living, including the right to food and water.

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A government commission that monitors and enforces human rights in India has opened a probe into allegations reported by the Centre for Public Integrity that villagers living near government-run uranium mines and others living downstream have persistently been exposed to high levels of radiation and suffered ill health as a result.

The New Delhi-based National Human Rights Commission said it had opened the probe on its own authority after reading the Center's article about toxic leaks from the Jadugoda mining complex in Jharkhand and its effects on "people, livestock, rivers, forests and agricultural produce in the area."

The commission said one of its members, Justice Shri D. Mururgesan, had "observed" that the Center's article raises "a serious issue of violation of rights to health of the workers and local residents, besides damage to the environment, flora and fauna."

The Subarnarekha river is a major river rising from the Chota Nagpur plateau of Jharkhand State, India. After passing through Jharkhand state, the river enters the Indian state of West Bengal, Orissa and finally falls into the Bay of Bengal. Jaduguda mine which is the foundation on which the Indian nuclear fuel chain rests is situated at Jharkhand state near the R. Subarnarekha course. In order to observe the contamination effect of Jaduguda mine on the river, river water samples had collected from nine different locations along the path of the river and measured alpha activity in those samples. High level of alpha radioactivity is found in all the samples even at far sites from mine region. the nuclear industry exposed tens of thousands of workers and villagers to dangerous levels of radiation, heavy metals or other carcinogens, including arsenic, from polluted rivers and underground water supplies that have percolated through the food chain -- from fish swimming in the **Subarnarekha River** to vegetables washed in its tainted water...Centre for Public Integrity has reviewed hundreds of pages of personal testimony and clinical reports in the case that...include epidemiological and medical surveys warning of a high incidence of infertility, birth defects and congenital illnesses among women living near the industry's facilities..Charting the trail of disease and ill health back to its source...the alpha radiation had recorded came from the mines, mills and fabrication plants of East Singhbhum...where the state-owned Uranium Corporation of India Ltd is sitting on a mountain of 174,000 tons of raw uranium....According to the uranium corporation's own records, 17 UCIL laborers died in 1994, 14 more in 1995, 19 in 1996 and 21 in 1997. The records seen by the Centre reveal no cause of the deaths, but critics claim most if not all were radiation-related...The mining corporation dismissed the 1995.

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Numerous studies have been done on possible effect of nuclear power in causing cancer. Such studies have looked for excess cancers in both plant workers and surrounding populations due to releases during normal operations of nuclear plants and other parts of the nuclear power industry, as well as excess cancers in workers and the public due to accidental releases.

Nuclear power reactor accidents can result in a variety of radioisotopes being released into the environment. The health impact of each radioisotope depends on a variety of factors. Iodine-131 is potentially an important source of morbidity in accidental discharges because of its prevalence and because it settles on the ground. When iodine-131 is released, it can be inhaled or consumed after it enters the food chain, primarily through contaminated fruits, vegetables, milk, and groundwater. Iodine-131 in the body rapidly accumulates in the thyroid gland, becoming a source of beta radiation.

Production of nuclear power relies on the nuclear fuel cycle, which includes uranium mining and milling. Uranium workers are routinely exposed to low levels of radon decay products and gamma radiation. Risks of leukemia from acute and high doses of gamma radiation are well-known.

1.1 HISTORY AND BACKGROUND

In 1896, Henri Becquerel was investigating phosphorescence in uranium salts when he discovered a new phenomenon which came to be called radioactivity He, Pierre Curie and Marie Curie began investigating the phenomenon. In the process, they isolated the element radium, which is highly radioactive. They discovered that radioactive materials produce intense, penetrating rays of three distinct sorts, which they labelled alpha, beta, and gamma after the first three Greek Letters. Some of these kinds of radiation could pass through ordinary matter, and all of them could be harmful in large amounts. All of the early researchers received various radiation burns, much like sunburn, and thought little of it.

The new phenomenon of radioactivity was seized upon by the manufacturers of quack medicine (as had the discoveries of electricity and magnetism, earlier), and a number of patent medicines and treatments involving radioactivity were put forward.

Gradually it was realized that the radiation produced by radioactive decay was ionizing radiation, and that even quantities too small to burn could pose a server long- term hazard. Many of the scientists working on radioactivity died of cancer as a result of their exposure.

Radioactive patent medicines mostly disappeared, but other applications of radioactive materials persisted, such as the use of radium salts to produce glowing dials on meters.

As the atom came to be better understood, the nature of radioactivity became clearer. Some larger atomic nuclei are unstable, and so decay (release matter or energy) after a random interval. The three forms of radiation that Becquerel and the Curies discovered are also more fully understood. Alpha decay is when a nucleus releases an alpha particle, which is two protons and two neutrons, equivalent to a helium nucleus. Beta decay is the release of a beta particle, a high-energy electron. Gamma decay releases gamma rays, which unlike alpha and beta radiation are not matter but electromagnetic of very high frequency, and therefore energy. This type of radiation is the most dangerous and most difficult to block. All three types of radiation occur naturally in certain elements. [1]

CHAPTER 2 NUCLEAR TECHNOLOGY AND ITS TYPES / ELEMENTS

Nuclear technology- is technology that involves the nuclear reactions of atomic nuclei. Among the notable nuclear technologies are nuclear reactors, nuclear medicine and nuclear weapons. It is also used, among other things, in smoke detectors and gun sights. [2]

Nuclear energy is often considered to be clean, stable, and reliable. When something bad happens, however, the results can be catastrophic. Events in Chernobyl and Japan involving radiation from nuclear energy have had long-lasting effects.

Harvesting the energy residing in an atom was an unimaginable idea until the mid-20th century. It was Sir Ernest Rutherford, considered the 'father of Nuclear physics', who first became aware of the energy trapped in an atom. While examining the result of an experiment conducted by John Cockcroft and Ernest Walton, the latter being his Doctoral student, he realised the massive amount of energy produced in the 'splitting' of an atom. However, he also noted that looking for

[1] https://en.wikipedia.org/wiki/Nuclear_technology.
[2] https://en.wikipedia.org/wiki/Nuclear_technology.

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a stable source of energy in this process was pointless, since the energy required to split an atom of a light element was so much that the surplus output came up to a paltry amount. While the notion holds true for lighter elements even to this day, the scientific world was yet to realize the capability of heavy radioactive elements to produce a highly energy-efficient fission chain reaction.

To understand nuclear power, we must first have a basic understanding of the structure of the atom and the phenomenon of radioactivity.

- **The Atom**

The atom consists of two regions: the central nucleus and the outlying electron orbits. The nucleus is made up of protons, which are positively charged, and neutrons, which do not have any electric charge. Protons and Neutrons are called 'nucleons' since they make up the nucleus of the atom. Electrons are negatively charged particles and orbit the nucleus at a distance directly variable with their energy level (the further an electron is from the nucleus the more energy it holds and vice versa). The characteristics of physical and chemical properties of an element are imparted due to the number of protons present in the nucleus which is known as the atomic number of the element. In other words, the number of Protons in an atoms nucleus gives the element its 'identity'. While an atom can lose or gain electrons while maintaining its atomic number (i.e., its identity), nuclear reactions bring about a change in the number of nucleus of the atom. This change or transmutes the atom of the particular element in to an atom of a different one. The loss of Protons, Neutron's, or Splitting of a large atom into smaller once is due to the radioactivity.

- **The Radioactivity**

The Radioactivity is observed in elements having an atomic number higher than 83. Bismuth, the 83rd element, is very slightly radioactive, but its half-life period is so long (a billion times more than the age of the universe) that is considered stable. The cause behind radioactivity lies in the force which hold together identically charged protons in a nucleus. As any eighth grader would know, life charges repel each other, which should result in positively charged protons repelling each other when bound together in the nucleus. The reason that does not happen is a short- range force known as 'Nuclear Force'. Within a specified range, nuclear force is one of the strongest forces in the universe and requires massive amount of energy to overcome. However, after a limit (considered to be 2.5 femtometres), it has close to not effect at all. Heavy nuclei, such as those of

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uranium and radium, have protons close to or outside the outer limit of the pull of nuclear force, rendering the atom unstable. Through radioactivity, heavy atoms may lose a variety of particles in order to acquire stability, including alfa particles, neutrons, neutrinos, photons, gamma rays, etc. This, incidentally also explains why lighter elements, tightly bound by nuclear force, cannot be a viable source of energy via fission, as noted by Rutherford, but heavy elements can.[3]

Types of Nuclear Reactions-

Nuclear reactions can be of two kinds: Fission and Fusion reactions. Fission is widely practiced and constitutes, in simple terms, the 'splitting up' of a heavy nucleus, such as that of Uranium or Plutonium, to produce energy along with a combination of lighter elements and various nuclear by-products. Nuclear fusion, on the other hand constitute joining two lighter atoms together to produce a heavier atom. It produces much more energy than fission reactions. However, the full potential of nuclear fusion has not yet been realized, and sufficient research has not been made to enable it being used on a commercial scale.

1) Nuclear fission

- In natural nuclear radiation, the by-products are very small compared to the nuclei from which they originate. Nuclear fission is the process of splitting a nucleus into roughly equal parts, and releasing energy and neutrons in the process. If these neutrons are captured by another unstable nucleus, they can fission as well, leading to a chain reaction. The average number of neutrons released per nucleus that go on to fission another nucleus is referred to as k. Values of k larger than 1 mean that the fission reaction is releasing more neutrons than it absorbs, and therefore is referred to as a self-sustaining chain reaction. A mass of fissile material large enough (and in a suitable configuration) to induce a self-sustaining chain reaction is called a critical mass.

- When a neutron is captured by a suitable nucleus, fission may occur immediately, or the nucleus may persist in an unstable state for a short time. If there are enough immediate decays to carry on the chain reaction, the mass is said to be prompt critical, and the energy release will grow rapidly and uncontrollably, usually leading to an explosion.

[3] https://en.wikipedia.org/wiki/Nuclear_technology.

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- When discovered on the eve of Woldwar 2, this insight led multiple countries to begin programs investigating the possibility of constructing an atomic bomb— a weapon which utilized fission reactions to generate far more energy than could be created with chemical explosives. The Manhattan Project, run by the United States with the help of the United Kingdom and Canada, developed multiple fission weapons which were used against Japan in 1945 at Hiroshima and Nagasaki. During the project, the first fission reactors were developed as well, though they were primarily for weapons manufacture and did not generate electricity.

- In 1951, the first nuclear fission power plant was the first to produce electricity at the Experimental Breeder Reactor No. 1 (EBR-1), in Arco, Idaho, ushering in the "Atomic Age" of more intensive human energy use

2) Nuclear fusion

- If nuclei are forced to collide, they can undergo nuclear fusion. This process may release or absorb energy. When the resulting nucleus is lighter than that of iron, energy is normally released; when the nucleus is heavier than that of iron, energy is generally absorbed. This process of fusion occurs in stars, which derive their energy from hydrogen and helium.

- Of course, these natural processes of astrophysics are not examples of nuclear "technology". Because of the very strong repulsion of nuclei, fusion is difficult to achieve in a controlled fashion. Hydrogen bombs obtain their enormous destructive power from fusion, but their energy cannot be controlled. Controlled fusion is achieved in particle accelerators; this is how many syndetic elements are produced. Abuser can also produce controlled fusion and is a useful neutron source However, both of these devices operate at a net energy loss. Controlled, viable fusion power has proven elusive, despite the occasional hoax. Technical and theoretical difficulties have hindered the development of working civilian fusion technology, though research continues to this day around the world.

- Nuclear fusion was initially pursued only in theoretical stages during World War II, when scientists on the Manhattan Project (led by Edward Teller) investigated it as a method to build a bomb. The project abandoned fusion after concluding that it would require a fission reaction to detonate. It took until 1952 for the first full hydrogen bomb to be detonated, so-called because it used reactions between deuterium and tritium. Fusion reactions are much more energetic per unit mass of fuel than fission reactions, but starting the fusion chain reaction is much more difficult.[4]

CHAPTER .3 PROS AND CONS OF NUCLEAR TECHNOLOGY

➢ Pros of Nuclear Energy

1. The costs of nuclear energy are relatively low.

Generating electricity in a nuclear power plant is cost-competitive to fossil fuels and renewable environmentally-friendly resources. This is despite the fact that the initial construction costs are often several billion dollars and there are ongoing enrichment and waste disposal issues that must be managed. Because it is such an affordable energy resource, it allows most people to have access to the power they need for the modern life.

2. It provides a stable base load of energy.

In the United States, more than 800 THz of electricity is generated every year because of nuclear energy. This accounts for about 20% of the electricity that is consumed on an annual basis by US-based consumers. Nuclear energy can be produced around the clock and the amount of energy being produced can be raised or lowered based on local consumption levels. When demands are high, the reactors can be cranked up to produce more power very easily.

3. Nuclear energy produces relatively low levels of pollution.

Compared to fossil fuels, nuclear energy produces very few emissions that can affect the atmosphere. There are certainly dangers that must be managed with this power resource, but for the actual production process, nuclear energy is only slightly behind solar and wind energy when it comes to the greenhouse gases that are produced.

4. There are high levels of fuel availability.

Under current consumption levels, it is estimated that the US (and other countries that use nuclear power) have about 80 years of fuel remaining. This comes from existing uranium resources, so more uranium could be found and refined in the future. Many countries are also looking at the

[4] https://en.wikipedia.org/wiki/Nuclear_technology.

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possibility of using another type of fuel, called thorium, to power the nuclear energy facilities that are already in place. Thorium is more environmentally friendly than uranium, which adds another potential benefit to this industry.

5. It is a high energy density resource.

The amount of energy that is obtained through nuclear fission is many times greater than the amount of energy that is released through the combustion of fossil fuels. Nuclear fission is 10 million times greater than fossil fuels in this area. This means the amount of fuel that is required to produce the energy we need through nuclear energy is much smaller than what we would need when using fossil fuels.

6. It is a commodity that works with our existing distribution networks.

Nuclear energy works with our current power grid. It is a technology that is ready to be distributed to the market, even if a new nuclear facility happens to go online. This is the primary advantage that nuclear has over many renewable resources. It can be hooked into the network immediately, can be built virtually anywhere, and will provide a known resource.

7. Nuclear energy can support our greatest power needs.

Because nuclear energy is able to produce a large amount of power in a short amount of time, it can meet the heavy industrial and commercial power needs that we have today. Other power generation technologies offer a lower power density, which means they may only be able to meet local residential and light industrial needs at best.

8. Waste recycling can reduce our current costs immediately.

Nuclear waste recycling allows for the waste products from a reactor to be treated and then fed into another reactor to provide it with fuel. According to the World Nuclear Association, plutonium is recovered from used fuel and the recycled into MOX fuel. This allows us to be able to gain up to 30% more energy from current uranium or thorium fuels than if only the initial refinement process was used.

9. Nuclear energy is surprisingly safe.

Despite the levels of radiation that are created through the uranium enrichment process or the waste materials that are created, nuclear power plants are incredibly safe. Although there have been accidents in the past that have caused immense and long-term damage, not a single accident can be attributed to a malfunction in the system. Natural disasters and human error have been the causes of nuclear energy disasters.

10. The amount of radiation exposure which occurs to the average person is minimal.

According to estimates from the US Environmental Protection Agency, the radiation that nuclear power reactors produce accounts for .01% of the average total radiation exposure that is received over a lifetime. In comparison, 80% of our exposure to radiation comes from naturally-occurring sources. The average person received more radiation from indoor radon exposure than from nuclear energy.

11. It is safer to work at a nuclear power plant in the US than in other careers.

The National Research Council reports that the nuclear power plants in the US effectively protect people from radiation, despite the fact they generate power on a 24/7 basis. They are even safe for the workers who keep the facility operational. The US Bureau of Labor Statistics show that it is more dangerous to work at a McDonald's or a Safeway store than it is to work at a nuclear energy facility.

12. Nuclear energy provides high levels of consistent.

Assuming that a nuclear power plant is operating at its peak efficiency, it has the potential for running for nearly years without interruption. This means communities are able to reduce the number of power interruptions they experience that are directly associated with the source of power. There are no weather contingencies or supply factors involved either, which means nuclear energy is stable in multiple facets.

13. Nature recovers quickly, even if the unthinkable happens.

Millions are still dealing with the fallout from Chernobyl, but Mother Nature has done an excellent job adapting to what has happened. Researchers are now using Chernobyl as a pseudo nature reserve, placing endangered animals such as Przewalksi horses, into the area. This exclusion zone has also become the home of many types of wildlife, free from the influences of

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humanity.

14. It is an established technology.

We know that nuclear energy works. We know how to design nuclear power plants, disposal networks, and fuel enrichment processes. If we need to have more energy right away, then we know for a fact that nuclear energy can provide us what we need. There is no need for experimentation or network upgrades to add this energy to our networks. We can build it now and have it up and running with often a simple vote from a city council or state government.

➢ Cons of Nuclear Energy

1. Nuclear energy provides an ongoing threat to the environment.

Accidents happen, despite our best intentions. When a reactor melts down, releases nuclear waste, or has radiation escape, then the harmful effects on people and the environment can last for decades. Even though Chernobyl was evacuated immediately and casualties were minimal initially, it is estimated that up to 30,000 people were killed because of the side effects of radiation in plants, animals, and foods. Another 2.5 million people are believed to be suffering from health issues that can be directly attributed to the nuclear power plant.

2. Nuclear energy produces a different kind of emission that can be harmful.

Although the amount of greenhouse gases that are created by nuclear energy are fairly minimal, there is a different kind of threat that exists. The waste products that are produced by this type of energy increases the risks of being exposed to radiation. Radioactive waste that comes from nuclear energy has an estimated half-life of 30 years in many instances. Some isotopes, such as Plutonium-239, have a half-life that is estimated to be 24,000 years. In some ways, that makes nuclear energy more dangerous than fossil fuel power.

3. Nuclear energy is an infrastructure target.

We live in a world where people attack innocents for political or religious purposes without any regard to the consequences of their actions. For those who are looking to maximize the amount of damage that could be caused to a large population of people, nuclear energy facilities become a natural infrastructure target. This targeted can be physical or digital in nature, with both having potential long-term consequences occurring if there isn’t enough security in place.

4. The fuel for nuclear energy is still a finite resource.

Eventually the uranium will disappear. The thorium that may be used as its replacement will also eventually disappear. It may take several generations for this to occur, especially if the fuel is properly managed, but it will occur one day because these fuels are a finite resource. This means nuclear energy is really a temporary solution to our modern power needs.

5. Waivers are often required for communities to use nuclear energy.

Because of the risks that are involved in nuclear energy, many companies that use this technology require the signing of waivers in order for it to be used. These waivers are intended to limit the liabilities of those involved in case an accident should occur. If something unforeseen should happen, it is the government that would often be stuck with the final cleanup and restoration costs, which means companies shift the responsibility from themselves to the taxpayer.

6. Nuclear energy requires a large infrastructure.

Renewable energy resources and even coal-fired power are more efficient than nuclear energy when it comes to the amount of infrastructure that is required to support them. Nuclear energy is a large-scale operation, which means it requires high levels of investment and coordination in order for it to reach its full potential. This coordination can increase the costs of nuclear energy to a point where it may not be price-competitive for some communities.

7. We don’t have access to known uranium deposits.

Most of the known uranium deposits that have been identified globally lie under lands that are controlled by indigenous populations. These tribes and groups of people don’t generally support the uranium refinement process that makes nuclear energy possible. Without their support, it is difficult to obtain the element needed to create power in the first place. Should uranium and thorium stores run low, industrialized nations may consider taking the uranium by force instead of respecting local rights and customs.

8. Long-term storage is required for high-level contaminants.

In the United States, there are no operating long-term waste storage sites that support the nuclear energy industry. There are certain sites that do store this waste, but do so with the support of the local community and the state government. If the states back out of an agreement to store the waste, the national government has very little they can do to change their minds.

9. Nuclear waste can be turned into weapons.

Nuclear energy provides a number of potential threats on numerous levels. Even the waste products from a nuclear power plant can be turned into a weapon that has a devastating potential. Yet for a country like the US, which must ship these wastes out to the international community because of a lack of storage, this threat is ever-present. Less secure countries with terrorism cells present could create the foundation needed to unleash nuclear terrorism on the world.

10. The radiation from nuclear energy is a known carcinogen.

Not only does the radiation produced in the creation of nuclear energy cause cancer, but it is known to carry a number of adverse side effects which are detrimental to a person's health. Radiation can cause genetic defects in the children who have parents who were exposed to radiation. Developmental disabilities are also known to occur. According to Professor Emeritus Jeffery Patterson at the UW School of Medicine and Public Health, there is no safe dose of radiation.

11. Uranium is an unstable material.

We use uranium in nuclear energy because it is an element that is naturally unstable. This also means that advanced precautions must be taking during the entire production chain, from mining to refinement. The instability of uranium can have a dramatic impact on the health of those who mine it and transport it for refinement or use. The precautions taken to reduce the risks that uranium produces can make it difficult to access or afford the raw materials for some communities.

12. Nuclear waste can contaminate groundwater supplies.

Recycling and disposal efforts can eliminate a lot of the harmful radioactivity from nuclear waste, assuming it is appropriately handled and processed. That waste, even if it doesn't contain radioactive elements, can still be highly dangerous to the surrounding environment. Heavy metals and other pollutants can alter local groundwater tables, damaging the local ecosystem in unpredictable ways.

These nuclear energy pros and cons show that there are several benefits that can be obtained when the proper safety precautions are taken for this resource. The issue that many have is that if those precautions are not taken, the consequences of using nuclear energy can be devastating for a long period of time.

CHAPTER. 4 Interrelationship between Human Rights and Nuclear Technology:

The notion of advanced technologies refers here both to technical appliances and to methods of their usage, leading to the replacement not only of manual work but also of the mental work of the man. In this sense, an example of advanced technology is electronic communication techniques. These, like traditional technologies, have a double impact on human rights. On the one hand they may contribute to the fulfilment of certain rights, and on the other they may simultaneously hamper the fulfilment of other rights. This relationship can also be inverse, with some human rights speeding up the introduction of advanced technologies and others making the adoption of such technologies impossible.

Advanced technologies exert a positive influence on labour productivity, the improvement of quality, and others modern features of production. They eliminate a whole range of adverse side-effect of mechanization and automation, such as noise, air pollution with chemical substances, dust, etc. In countries suffering from a shortage of trend labour, advanced technologies make it possible to overcome this barrier.

Advanced technologies completely change the position of man in the process of his interaction with nature. His role in some ways becomes more and more superior, and in others increasingly subservient. Superiority comes from his increased power over nature and subservient from his increasing dependence on the technology.

➢ Production of Electric Power by Nuclear Fission

The technologies involved in the production of electric power by nuclear fission can certainly be referred to as advance. They have led to an almost complete elimination of manual work and a limitation of metal work through the use of Robots, Computers, and other modern appliances. These technologies are very efficient. They can be installed far from the sources of raw material, and they do not produce dusts or chemical substances as by-products. They are also silent and sterile. However, in the case of equipment failure, they can lead to ecological disaster that cannot be averted by man and the aftermath of which is long-lasting and possess a threat to large population in far – away regions.

This is why nuclear power stations give rise to controversy. An example is the public debate on the future nuclear power engineering, which has been going on in Poland since the middle of 1989. Although decisions on the development of nuclear power engineering were taken earlier, the change in the political system, involving different approach to human rights, has aroused broad social resistance to these decisions.

The proponents of nuclear power engineering especially atomic physics, express the opinion that it offers a better method of electric power generation than that provided by thermal power stations burning coal. In Poland, suffering from acute shortage of electric power, and virtually deprived of other possibilities for generate electric power (apart from power engineering based on coal), nuclear power engineering should, according to this opinion, command a special interest. Nevertheless, human rights in a liberal sense form a barrier to that interest.

The proponents of nuclear power engineering argue that for economic reasons electric power generation in nuclear power stations is much more worthwhile than in coal burning power stations. A yet more serious reason for the replacement of coal-burning power plants with nuclear power stations is, according to them, environmental pollution.

CHAPTER .5 CIVILIAN USES OF NUCLEAR TECHNOLOGY

- CIVILIAN USES

1) Nuclear power

Nuclear power is a type of nuclear technology involving the controlled use of nuclear fission to release energy for work including propulsion, heat, and the generation of electricity. Nuclear energy is produced by a controlled nuclear chain reaction which creates heat—and which is used to boil water, produce steam, and drive a steam turbine. The turbine is used to generate electricity and/or to do mechanical work.

Currently nuclear power provides approximately 15.7% of the world's electricity (in 2004) and is used to propel aircraft carriers, icebreakers and submarines (so far economics and fears in some ports have prevented the use of nuclear power in transport ships). All nuclear power plants use fission. No man-made fusion reaction has resulted in a viable source of electricity.

2) *Medical applications-*

The medical applications of nuclear technology are divided into diagnostics and radiation treatment.

Imaging - The largest use of ionizing radiation in medicine is in medical radiography to make images of the inside of the human body using x-rays. This is the largest artificial source of radiation exposure for humans. Medical and dental x-ray imagers use of cobalt-60 or other x-ray sources. A number of radiopharmaceuticals are used, sometimes attached to organic molecules, to act as radioactive tracers or contrast agents in the human body. Positron emitting nucleotides are used for high resolution, short time span imaging in applications known as Positron emission tomography.

Radiation is also used to treat diseases in radiation therapy.

3) *Industrial applications-*

Since some ionizing radiation can penetrate matter, they are used for a variety of measuring methods. X-rays and gamma rays are used in industrial radiography to make images of the inside of solid products, as a means of non-destructive testing and inspection. The piece to be radiographed is placed between the source and a photographic film in a cassette. After a certain exposure time, the film is developed and it shows any internal defects of the material.

4) **Gauges** - Gauges use the exponential absorption law of gamma rays

- Level indicators: Source and detector are placed at opposite sides of a container, indicating the presence or absence of material in the horizontal radiation path. Beta or gamma sources are used, depending on the thickness and the density of the material to be measured. The method is used for containers of liquids or of grainy substances
- Thickness gauges: if the material is of constant density, the signal measured by the radiation detector depends on the thickness of the material. This is useful for continuous production, like of paper, rubber, etc.

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5) **Electrostatic control** - To avoid the build-up of static electricity in production of paper, plastics, synthetic textiles, etc., a ribbon-shaped source of the alpha emitter ^{241}Am can be placed close to the material at the end of the production line. The source ionizes the air to remove electric charges on the material.

6) **Radioactive tracers** - Since radioactive isotopes behave, chemically, mostly like the inactive element, the behaviour of a certain chemical substance can be followed by tracing the radioactivity. Examples:

- Adding a gamma tracer to a gas or liquid in a closed system makes it possible to find a hole in a tube.
- Adding a tracer to the surface of the component of a motor makes it possible to measure wear by measuring the activity of the lubricating oil.

7) **Oil and Gas Exploration**-

Nuclear well logging is used to help predict the commercial viability of new or existing wells. The technology involves the use of a neutron or gamma-ray source and a radiation detector which are lowered into boreholes to determine the properties of the surrounding rock such as porosity and lithography.

8) **Road Construction** –

Nuclear moisture/density gauges are used to determine the density of soils, asphalt, and concrete. Typically, a cesium-137 source is used.

➢ **COMMERCIAL APPLICATIONS-**

- **utritium illumination**:

Tritium is used with phosphor in rifle sights to increase night-time firing accuracy. Some runway markers and building exit signs use the same technology, to remain illuminated during blackouts.

- **Smoke detector**:

An ionization smoke detector includes a tiny mass of radioactive americium-241, which is a source of alpha radiation. Two ionisation chambers are placed next to each other. Both contain a small source of ^{241}Am that gives rise to a small constant current. One is closed and serves for comparison, the other is open to ambient air; it has a gridded electrode. When smoke enters the open chamber, the current is disrupted as the smoke particles attach to the charged ions and restore them to a neutral electrical state. This reduces the current in the open chamber. When the current drops below a certain threshold, the alarm is triggered.

- ***Food processing and agriculture***

In biology and agriculture, radiation is used to induce mutations to produce new or improved species, such as in atomic gardening. Another use in insect control is the sterile insect technique, where male insects are sterilized by radiation and released, so they have no offspring, to reduce the population.

In industrial and food applications, radiation is used for sterilization of tools and equipment. An advantage is that the object may be sealed in plastic before sterilization. An emerging use in food production is the sterilization of food using food irradiation.

The Radura logo, used to show a food has been treated with ionizing radiation.

Food irradiation is the process of exposing food to ionizing radiation in order to destroy microorganisms, bacteria, viruses, or insects that might be present in the food. The radiation sources used include radioisotope gamma ray sources, X-ray generators and electron accelerators. Further applications include sprout inhibition, delay of ripening, increase of juice yield, and improvement of re-hydration. Irradiation is a more general term of deliberate exposure of materials to radiation to achieve a technical goal (in this context 'ionizing radiation' is implied). As such it is also used on non-food items, such as medical hardware, plastics, tubes for gas-pipelines, hoses for floor-heating, shrink-foils for food packaging, automobile parts, wires and cables (isolation), tires, and even gemstones. Compared to the amount of food irradiated, the volume of those every-day applications is huge but not noticed by the consumer.

The genuine effect of processing food by ionizing radiation relates to damages to the DNA, the basic genetic information for life. Microorganisms can no longer proliferate and continue their malignant or pathogenic activities. Spoilage causing micro-organisms cannot continue their activities. Insects do not survive or become incapable of procreation. Plants cannot continue the natural ripening or aging process. All these effects are beneficial to the consumer and the food industry, likewise.

The amount of energy imparted for effective food irradiation is low compared to cooking the same; even at a typical dose of 10 keg most food, which is (with regard to warming) physically equivalent to water, would warm by only about 2.5 °C (4.5 °F).

The specialty of processing food by ionizing radiation is the fact, that the energy density per atomic transition is very high, it can cleave molecules and induce ionization (hence the name) which cannot be achieved by mere heating. This is the reason for new beneficial effects, however at the same time, for new concerns. The treatment of solid food by ionizing radiation can provide an effect similar to heat pasteurization of liquids, such as milk. However, the use of the term, cold pasteurization, to describe irradiated foods is controversial, because pasteurization and irradiation are fundamentally different processes, although the intended end results can in some cases be similar.

Detractors of food irradiation have concerns about the health hazards of induced radioactivity.[citation needed] A report for the industry advocacy group American Council on Science and Health entitled "Irradiated Foods" states: "The types of radiation sources approved for the treatment of foods have specific energy levels well below that which would cause any element in food to become radioactive. Food undergoing irradiation does not become any more radioactive than luggage passing through an airport X-ray scanner or teeth that have been X-rayed."
Food irradiation is currently permitted by over 40 countries and volumes are estimated to exceed 500,000 metric tons (490,000 long tons; 550,000 short tons) annually worldwide.

Food irradiation is essentially a non-nuclear technology; it relies on the use of ionizing radiation which may be generated by accelerators for electrons and conversion into bremsstrahlung, but which may use also gamma-rays from nuclear decay. There is a worldwide industry for processing by ionizing radiation, the majority by number and by processing power using accelerators. Food irradiation is only a niche application compared to medical supplies, plastic materials, raw materials, gemstones, cables and wires, etc.[5]

[5] https://en.wikipedia.org/wiki/Nuclear_technology.

CHAPTER 6 Nuclear and radiation accidents and Nuclear safety

Accidents

Nuclear accidents, because of the powerful forces involved, are often very dangerous. Historically, the first incidents involved fatal radiation exposure. Marie Curie died from aplastic anemia which resulted from her high levels of exposure. Two scientists, an American and Canadian respectively, Harry Daghlian and Louis Slotin, died after mishandling the same plutonium mass. Unlike conventional weapons, the intense light, heat, and explosive force is not the only deadly component to a nuclear weapon. Approximately half of the deaths from Hiroshima and Nagasaki died two to five years afterward from radiation exposure.

Civilian nuclear and radiological accidents primarily involve nuclear power plants. Most common are nuclear leaks that expose workers to hazardous material. A nuclear meltdown refers to the more serious hazard of releasing nuclear material into the surrounding environment. The most significant meltdowns occurred at Three Mile Island in Pennsylvania and Chernobyl in the Soviet Ukraine. The earthquake and tsunami on March 11, 2011 caused serious damage to three nuclear reactors and a spent fuel storage pond at the Fukushima Daiichi nuclear power plant in Japan. Military reactors that experienced similar accidents were Windscale in the United Kingdom and SL-1 in the United States.

Military accidents usually involve the loss or unexpected detonation of nuclear weapons. The Castle Bravo test in 1954 produced a larger yield than expected, which contaminated nearby islands, a Japanese fishing boat (with one fatality), and raised concerns about contaminated fish in Japan. In the 1950s through 1970s, several nuclear bombs were lost from submarines and aircraft, some of which have never been recovered. The last twenty years have seen a marked decline in such accidents.

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CHAPTER 7 INTERNATIONAL CONFERENCE

The international conference on Human Rights, Future Generations and Crimes in the Nuclear Age-

The international conference on Human Rights, Future Generations and Crimes in the Nuclear Age, held in Basel from September 14-17, 2017, affirm that the risks and impacts of nuclear weapons, depleted uranium weapons and nuclear energy, which are both transnational and trans-generational, constitute a violation of human rights, a transgression of international humanitarian and environmental law, and a crime against future generations.

Uranium mining

· Uranium mining and enrichment, which provide the fuel for nuclear energy, release long-lasting and highly toxic radionuclides into the environment causing severe impact on the health of current and future generations exposed to the radiation;

· The nuclear fuel chain, especially uranium enrichment and plutonium reprocessing, provide possibilities for countries with these technologies to also produce nuclear weapons, creating additional threats to current and future generations.

Nuclear energy

· Along the chain of production, regular use and waste management of nuclear fuel for energy generation as well as after nuclear power plant accidents huge amounts of radioactive isotopes are released into the biosphere. Severe health effects as cancer and non-cancer diseases have been demonstrated in populations exposed. In particular resulting genetic changes impact on the health of current and future generations.

· Many nuclear power plants, particularly in Europe, are located in regions of high population density;

· Any nuclear disaster has cross border effects affecting population of several countries, and would be an infringement of international law requiring states to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states.

· The 2015 Sendai United Nations declaration recognized that accountability for disaster risk creation is needed at all levels. Furthermore, all human rights need to be promoted and protected in any disaster situation, including man made hazards and technological risks;

· The exorbitantly high costs of nuclear energy production and management (including waste storage) make it an inappropriate investment as compared to renewable energies;

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· Nuclear disasters like those at Mayak, Three Mile Island, Sellafield, Chernobyl and Fukushima, release massive quantities of radionuclides into the environment impacting on the health of current and future generations;
(The 2011 Fukushima Daiichi nuclear disaster, the world's worst nuclear accident since 1986, displaced 50,000 households after radiation leaked into the air, soil and sea. Radiation checks led to bans of some shipments of vegetables and fish.
(In March 2011 an earthquake and tsunami caused damage that led to explosions and partial meltdowns at the Fukushima I Nuclear Power Plant in Japan.)
· Nuclear power plants, in operation and after their dismantlement, generate huge amounts of radioactive waste, which is dangerous for thousands of years, even longer than any known civilization has lasted. The question of safe long-term storage of radioactive waste over centuries has not been answered so far.

Nuclear weapons

· The use and testing of nuclear weapons has generated severe, trans-generational damage to health and the environment of those in the vicinity of the detonations and also to humanity as a whole;
· Recent research, highlighted by the series of international conferences on the humanitarian impact of nuclear weapons, indicates that any use of nuclear weapons on a populated area would cause disastrous humanitarian and environmental consequences, and any multiple use of nuclear weapons would cause catastrophic and irreversible damage to the climate in addition to the radiation and blast impacts;
· Nuclear deterrence is immoral, illegal and of doubtful value for security.
· The financial and human investments in the nuclear arms race are deviating required resources from human, social and environmental needs. This includes promoting education, providing basic universal health care, protecting the climate and implementing the sustainable development goals

Depleted uranium (DU) weapons

· Epidemiological reports indicate that exposure to depleted uranium has health impacts on those exposed and their offspring;
· Use of uranium for armor plating and piercing projectiles release depleted uranium into the environment, where it will be deposited for thousands of years, causing risks to combatants and non-combatants alike.

CHAPTER 8 INTERNATIONAL LAWS APPLICABLE TO NUCLEAR WEAPONS AND ENERGY

➢ International law applicable to nuclear weapons and energy

In addition to general international law, the following branches, inter alia, are applicable to nuclear weapons and nuclear energy:

1) **International human rights law** protects, in particular, the right to life, the right not to be subject to inhuman or degrading treatment, the right to the highest standard of health and to a healthy environment, the right to an adequate standard of living, including the right to food and water, as well as the freedom of expression and the right to seek and receive information. Moreover, special instruments for particularly vulnerable groups, such as women, children, indigenous peoples or persons with disabilities, have been adopted and concluded.
2) **International humanitarian law**: This body of law prohibits the use of weapons or methods of warfare that would indiscriminately impact on civilians, cause unnecessary suffering to combatants, violate neutral territories, be dis-proportionate to the provocation or cause severe, long-term or irreversible damage to the environment.
3) **The law of peace and security:** This body of law, expressed primarily through the UN Charter, prohibits the threat or use of force except in legitimate self-defence.
4) **Law protecting the environment and future generations:** This body of law, expressed in a number of international treaties, provides a responsibility to ensure a sustainable environment for current and future generations, and to prohibit activities which are known to seriously threaten this. There is also a legal responsibility to prevent and protect the public from exposure to harm, when scientific investigation has found a plausible risk.

The production of nuclear energy violates human rights law and international law protecting the environment and future generations due to the impacts of nuclear energy on human health and the environment as outlined above.

The production, threat and use of nuclear weapons violate all four bodies of law outlined above.

'the destructive impact of nuclear weapons cannot be contained in time or space' and with the affirmation of the Treaty on the Prohibition of Nuclear Weapons that 'any use of nuclear weapons would be contrary to the rules of international law applicable in armed conflict, and in particular the principles and rules of international humanitarian law.'

- **<u>On rights and responsibilities under the law</u>**

1. We call for full redress for all people whose health, well-being or livelihoods have been negatively impacted by uranium mining, nuclear energy and nuclear weapons;
2. We welcome the provision in the Treaty on the Prohibition of Nuclear Weapons on victim assistance and environmental remediation and call for its full implementation;
3. We appeal to all those in the nuclear weapons and energy industries and administrating government departments to recognize the illegality of the production of nuclear weapons and energy, and to cease such activities;
4. We welcome the conclusions of the International Peoples' Tribunal on Nuclear Weapons and the Destruction of Human Civilisation. held on July 7-9, 2016, that convicted (in absentia) the leaders of the nuclear-armed States (and one of the allied States as a test case) for war crimes, crimes against humanity, crimes against peace, crimes against future generations and crimes of threatening, planning and preparing acts which would constitute ecocide, which is understood as causing serious damage to, or destruction, of an ecosystem or ecosystems, or of causing serious, long-term or irreversible damage to the global commons.
5. We welcome the fact that the majority of countries neither produce nuclear energy nor possess nuclear weapons, and we call on all other countries to join them.
6. We welcome the establishment of the International Renewable Energy Agency, which provides assistance to countries to develop renewable energies, and we highlight it's 2016 Report Rethinking Energy: Renewable Energy and Climate Change which demonstrates the possibilities to completely replace fossil fuels by safe renewable energies, without relying on nuclear energy, by 2030.
7. We commend the 184 countries who have joined the Non-Proliferation Treaty as non-nuclear States and the 122 countries who voted in favour of the Treaty on the Prohibition of Nuclear Weapons which also prohibits the threat or use of nuclear weapons. We call on all countries to agree to the prohibition and elimination of nuclear

weapons and to adopt, at the 2018 UN High Level Conference on Disarmament, a framework to implement this.

8. We call on all countries utilizing nuclear energy to announce a program for phasing out their use of nuclear energy and replacing it with renewable energy sources.
9. Finally, as doctors, lawyers, scientists and nuclear experts from 27 countries we consider it as our moral duty to highlight the facts regarding nuclear energy and weapons, and promote a safe, sustainable and peaceful future for humanity and our planet consistent with human rights and the rights of future generations.

- **<u>As such we make the following proposals:</u>**

1. All countries at the United Nations shall promote human rights, the rights of future generations, and the legal requirements to phase out nuclear energy and nuclear weapons. We support the initiatives that Switzerland has taken to phase out nuclear energy domestically and to prohibit nuclear weapons globally, and we encourage Switzerland to take further efforts at the United Nations to prohibit all aspects of the nuclear energy and weapons industries.
2. The Linear No Threshold [LNT] concept and collective dose-calculations allow extrapolations of health risks in large populations exposed to low doses of ionizing radiation. Current scientifically based understanding calls for acceptance of risk estimations at doses as low as 1 mSv and therefore asks for a revision of the ICRP-recommendations, which are outdated one decade after their effective date.
3. Violations of human rights by ionizing radiation sources must be documented epidemiologically. In this regard medical standards for compensation of victims have to be established. Companies / people found to violate the rights of the concerned workers must be held responsible by national and international courts. Everyone has the right to seek and receive information. Victims must be compensated.
4. The employment of nuclear weapons, as well as indiscriminate damage to health and to the environment resulting from other nuclear activities, should be included as a crime against humanity under the Rome Statute of the International Criminal Court. We also call for amendment of the Rome Statute to include the crime of ecocide.
5. Young people and students need to be alerted to the relation between Nuclear energy / nuclear weapons – Violations of human rights – Rights of future generations. Their human rights are endangered and therefore they need to become active and encouraged to have

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their current and future interests respected. Law and medical faculties are encouraged to consider teaching on human rights in their corresponding curricula, in general but also in the mentioned context of the 'Nuclear fuel chain', and this also in view of the rights of future generations.[6]

CHAPTER 9 International Atomic Energy Agency

International Atomic Energy Agency as an International Inspectorate and Review Body
International Atomic Energy Agency (IAEA) was the product of compromise following failure to agree on the proposals proposed by US for international single head management of all nuclear power plants by an international body. Its main tasks were confined to encouraging and facilitating the development and inspection of nuclear power, and ensuring through the non-proliferation safeguards that it was used only for peaceful purposes. It had the important responsibility to set the standards for health and safety of humans in collaboration with other international agencies. IAEA has only limited power to act as an important nuclear safety inspectorate under its statute. However, the Agency can, if requested, also provide safety advice and a review of safety practices for any nuclear installation or waste disposal site.

The IAE laid down certain principles to be followed by its member states for nuclear safety and precautions. They principles are as follows:

(a) **The Safety Principle**: This principle lays emphasis that the legal regimes in a country should adopt certain minimum standards of safety for the purposes of protecting health and minimize the danger to life and property from exposure to radiation. This principle is further divided into two subsidiary principles.

They are as follows:

(i) Prevention and Protection Principle: This principle lays down that every legal regime should adopt standards of safety for radiation protection, transport and handling of radioactive materials, radioactive waste disposal and safety of nuclear installations.

(ii) Precautionary Principle: This principle lays emphasis on establishing basic international minimum safety standards and guiding principles regulating the design, construction, siting and operation of nuclear power plants. The utmost priority should

[6] https://www.google.com/search?q=laws+applicable+to+nuclear+technology+in+india

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be given to protecting public health, security, safety and the environment.

(b) **Security Principle:** The Security Principle suggests the legal system should include the provisions against, both accidental and intentional radiation which can pose threat to the life and property of the people. This principle also cautions against illegal acquisition of nuclear materials by criminal or terrorist groups.

(c) **Responsibility Principle:** When there are Trans boundary nuclear accidents, it becomes difficult to find most preferred method for ensuring safety and reallocating the costs for accident. Generally, the principle of equal access and non-discrimination to nuclear risks and a number of national legal systems facilitate trans-boundary proceedings.

(d) **Permission Principle:** Prior permission is required to do those things, which may pose serious threat or injury to persons or environment. Use of nuclear technology inherently involves some risk; prior permission is always required. The law also clearly needs to identify those activities that require prior permission.

(e) **Continuous Control Principle:** A continuous monitoring of the activities to provide safety advice and a review of safety practices for any nuclear installation or waste disposal site. IAEA safety inspections are valuable to governments because of their independence and the reassurance they provide.

(f) **Compensation Principle:** The states should create a common scheme for loss distribution among the victims, focusing liability on the operator of a nuclear installation, based on the principle of absolute or strict liability and re-enforced by state-funded compensation schemes.

(g) **Sustainable Development Principle:** The principle of sustainable development has special relevance in nuclear energy production. It is "because some fissile material and sources of ionizing radiation can pose health, safety and environmental risks for very long periods of time."

(h) **Compliance Principle:** Nuclear energy production involves particular risks of radiological contamination transcending national boundaries. There are many bilateral and multilateral instruments that aim at determining an international law of nuclear energy. The fundamental question is to what extent a particular state has adhered to these international legal regimes. It is also important that the national legal regime incorporates the provisions of customary international law also.

(i) **Independence Principle:** It is very important that the powers, functions and decisions of the Regulatory Authority that is constituted under the nuclear law are not interfered by the executive or other branches of the State and also from entities involved in the development or promotion of nuclear energy.

(j) **Transparency Principle:** Erstwhile, information of nuclear materials was guarded, categorizing it as 'sensitive' and 'confidential'. In the recent past, however, the emphasis is "with the development of the peaceful uses of nuclear energy, however, public understanding of and confidence in the technology have required that the public, the media, legislatures and other interested bodies be provided with the fullest possible information concerning the risks and benefits of using various nuclear related techniques.

CHAPTER 10 Nuclear technology regulation in India

➢ Nuclear technology regulation in India-

Listed below are some of the Acts and Rules pertaining to Nuclear energy in India.

1. The Atomic Energy Act, 1962-Activities concerning establishment and utilisation of nuclear facilities and use of radioactive sources are carried out in India in accordance with the relevant provisions of the Atomic Energy Act, 1962.
   (a) The environment protection aspects are governed by the Environmental Protection Act, 1986.
2. Atomic Energy (Working of the Mines, Minerals and Handling of prescribed substances) Rules, 1984-Safety aspects in mining and milling of prescribed substances are governed by the Mines Minerals Prescribed Substance Rules, 1984.
3. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987-Safe waste disposal is ensured by implementation of the Atomic Energy Safe Disposal of Radioactive Waste Rules, 1987.
4. Atomic Energy (Factories) Rules, 1996
5. The regulations for radiation protection aspects are as governed by the Radiation Protection Rules, 1962. Radiation Protection Rules, 2004
6. Civil Liability for Nuclear Damage Act 2010

7. Notification of Civil Liability for Nuclear Damage Rules 2011

➢ The Civil Liability for Nuclear Damage Act, 2010

Operators of nuclear establishments are liable as per law for any damage caused by them. The liability of operators is not based on fault principle but on the principle of no fault or strict liability, regardless of fault. This damage will have its impact not only in the country of the disaster but also in the neighbouring countries as well. Normally to certain extend the operators of the plants/nuclear establishments are made liable for the damage, which they may pay through insurance. Beyond that, according to international law and practice, States accept responsibility as the insurer of the last resort.

Currently there are three major international agreements, which form the international framework of nuclear liability. They are:

a. The Paris Convention of 1960.
b. The Vienna Convention of 1963 along with the Protocol to amend the Vienna Convention, 1997.
c. The Convention on Supplementary Compensation for Nuclear Damage of 1997.

Among these conventions, India is a signatory to only the Convention on Supplementary Compensation for Nuclear Damage, but she has signed few bilateral agreements with other countries, including USA, UK, Russia, France, and Canada, for co-operation in using of nuclear energy for civilian purposes. The India-France bilateral agreement explicitly states that India has to create a civil nuclear liability regime for compensating damage caused by incidents involving nuclear material and nuclear facilities.

The Civil Liability for Nuclear Damage Act, 2010 received the president's assent on 21st September 2010. The main purpose of this legislation is to provide for civil liability for nuclear damage and give prompt compensation to the victims of a nuclear incident through a no-fault liability regime channelling liability to the operator and also on the State. This Act also aims at appointing a Claims Commissioner and establishment of a Nuclear Damage Claims Commission. It is also stated that it is being enacted to provide for liability arising out of a nuclear incident, and also due to the "necessity of joining an international liability regime.

The Act applies to nuclear damage suffered in or over the maritime areas beyond the territorial waters of India, in or over the exclusive economic zone, on board or by a ship registered in India or on or by an artificial island, installation or structure under the jurisdiction in India. At the same time, it applies only to the nuclear installation owned or controlled by the Central Government either by itself or through any authority or corporation established by it or a government company.

➢ Liability for Nuclear Damage

Chapter II of the Act, (sections 3 to 8) lays down the law and procedures on the liability for nuclear damage. Within 15 days from the occurrence of any nuclear incident, the Atomic Energy Regulatory Board (AERB) shall notify a nuclear incident if it feels that the gravity of the threat and risk involved is not insignificant. Once notified, the Board shall also give wide publicity to the incident so that people can be cautious and take all the necessary precaution. However, the word 'insignificant' that is used in this section seems to be confusing. It gives room for the AERB to determine what is significant and what is not significant as there are no criteria laid down.

For any such nuclear incident the Operator shall be liable for the resultant 'Nuclear Damage' if it involves the 'nuclear installation' or 'nuclear materials' under its control. Where there is more than one operator and damage attributable to each operator is not separable, the liability of each operator shall be 'Joint and Several.' However even in case of such joint and several liabilities, the total liability of such operator shall be as specified under section 6(2). At the same time if there are several nuclear installations by the same operator that are involved in a nuclear incident, such operator shall, in respect of each such nuclear installation be separately liable to the extent pre-scribed under section 6 (2).

➢ Liability of an Operator to be 'Strict Liability' based on the principle of 'No-Fault Liability'

The Indian version of strict liability, the 'absolute liability' principle, stipulates that "where an enterprise is engaged in a hazardous or inherently dangerous activity and harm results to anyone on account of an accident in the operation of such hazardous or inherently dangerous activity resulting, for example, in escape of toxic gas, the enterprise is strictly and absolutely liable to compensate all those who are affected by the accident and such liability is not subject to any of the exceptions which operate vis-à-vis the tortious principle of strict liability under the rule in Rylands v. Fletcher" (1868) LR 3HL 330. In other words absolute liability is strict liability

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without any exception. This liability standard has been laid down by the Indian Supreme Court in M.C. Mehta v. Union of India (Oleum Gas Leak Case) AIR 1987 SC 1086.

However, the nature of liability in the event of a nuclear catastrophe in India is not prescribed. The Act itself provides for certain exceptional circumstances under which an operator shall not be liable (however, even under these circumstances the victim will get compensation as the liability is transferred to the Central Government).

These circumstances are as follows:

(a) A grave natural disaster of an exceptional character. However, the phrase 'exceptional character' has not been defined under the Act. This leaves a lot of discretion with the authorities.

(b) An act of armed conflict, hostility, civil war, insurrection or terrorism.

If these circumstances directly cause the nuclear damage, the Central Government assumes liability instead of the operator. Further the list continues to include any nuclear damage that is caused to:

a. The nuclear installation itself and any other nuclear installation, fully or partially constructed, on the site where such incident occurred.
b. To any property on the same site which is used or to be used in connection with such installation.
c. To the means of transport upon which the nuclear materials involved was carried at the time of nuclear incident. These provisions, though aimed at preventing the operator from getting compensation for nuclear incident caused by him, may go against the interest of another party whose property at the time of the nuclear incident was on the same site.[7]

CHAPTER 11 CONCLUSION

Mind you the utility of nuclear technology is not just limited to energy production but it is known (not by many people though) to have made strides in the field of medicine and agriculture as well. So a technology that can be both a bane or a boon calls out for regulation and not for prohibition.

[7] https://www.google.com/search?q=laws+applicable+to+nuclear+technology+in+india

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It is in the interest of the humankind to develop nuclear technologies for the true purposes rather than prohibit it altogether because of its potential misuse

CHAPTER 12 BIBILOGAPGY

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