

Forum:*Environment Commission*

Issue: *Addressing the effects of adopting Nuclear Power Plants as a source of electricity production causing disastrous radioactive waste*
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1. **Introduction**

Nuclear power plants are a type of thermal power station that use the process of nuclear fission in order to generate. Nuclear power has been called a clean source of energy because the power plants do not release carbon dioxide. While this is true, it is deceiving. Nuclear power plants may not emit carbon dioxide during operation, but high amounts of carbon dioxide are emitted in activities related to building and running the plants. Nuclear power plants use uranium as fuel. The process of mining uranium releases high amounts of carbon dioxide into the environment. Carbon dioxide is also released into the environment when new nuclear power plants are built. Finally, the transport of radioactive waste also causes carbon dioxide emissions.

Nuclear power plants constantly emit low levels of radiation into the environment.  Consequently, scientific studies have shown an increased rate of cancer among people who live near nuclear power plants. Long-term exposure to low level radiation has been shown to damage DNA. The degree of damage low levels of radiation cause to wildlife, plants and the ozone layer is not fully understood. More research is being done to determine the magnitude of effects caused by low levels of radiation in the environment.

Radioactive waste is a huge concern. Waste from nuclear power plants can remain active for hundreds of thousands of years. Currently, much of the radioactive waste from nuclear power plants has been stored at the power plant. Due to space constraints, eventually the radioactive waste will need to be relocated.

There are several issues with burying the radioactive waste. Waste would be transported in large trucks. In the event of an accident, the radioactive waste could possibly leak. Another issue is uncertainty about whether the casks will leak after the waste is buried. The current amount of radioactive waste requiring long-term storage would fill the Yucca Mountains and new sites would need to be found to bury future radioactive waste. There is no current solution to deal with the issue of radioactive waste. Some scientists feel that the idea of building more nuclear power plants and worrying about dealing with the waste later has the potential of a dangerous outcome.

Cooling systems are used to keep nuclear power plants from overheating. There are two main environmental problems associated with nuclear power plant cooling systems. First, the cooling system pulls water from an ocean or river source. Fish are inadvertently captured in the cooling system intake and killed. Second, after the water is used to cool the power plant, it is returned to the ocean or river. The water that is returned is approximately 25 degrees warmer than the water was originally. The warmer water kills some species of fish and plant life.

Safety procedures are not being followed to ensure that nuclear power plants are safe. Even if all safety precautions are followed, it is no guarantee that a nuclear power plant accident will not occur. If a nuclear power plant accident occurs, the environment and surrounding people could be exposed to high levels of radiation which is evident in the 2011 accident at the nuclear power plant in Fukushima, Japan.

1. **Definition of Key Terms**

**Nuclear energy:** the energy in the nucleus, or core, of an atom.

**Greenhouse gas:** gas in the atmosphere, such as carbon dioxide, methane, water vapor, and ozone, that absorbs solar heat reflected by the surface of the Earth, warming the atmosphere.

**Nuclear reactor:** machinery that can control nuclear fission, usually producing electricity.

**Uranium:** chemical element with the symbol U. Fuel used to produce nuclear energy.

Background radiation: The naturally-occurring ionising radiation which every person is exposed to, arising from the Earth's crust (including radon) and from cosmic radiation.

**Low-level waste (LLW):** Radioactive waste which can be handled safely without shielding.

**Radiation:**The emission and propagation of energy by means of electromagnetic waves or particles.

**Radioactivity:**The decay of an unstable atomic nucleus, giving rise to the emission of radiation.

**Nuclear Waste:**

**High-level waste (HLW)**: highly radioactive material arising from nuclear fission. It can be what is left over from reprocessing used fuel, though some countries regard spent fuel itself as HLW. It requires very careful handling, storage and disposal.

**Intermediate-level waste (ILW)**comprises a range of materials from reprocessing and decommissioning. It is sufficiently radioactive to require shielding and is disposed of in engineered facilities underground.

**Low-level waste (LLW)**is mildly radioactive material usually disposed of by incineration and burial.

1. **General Overview – Background information**

**Nuclear Waste Disposal**

Ever since the commercialization of nuclear power plants for the production of electricity for household use, the question of the disposal of nuclear waste has been coming up. All parts of the nuclear fuel cycle produce some radioactive waste (radiate). Radioactivity naturally decays over time, so radioactive waste has to be isolated and confined in appropriate disposal facilities for a sufficient period until it no longer poses a threat.

**Nuclear waste**

Nuclear waste, or radioactive waste, is nuclear fuel that is produced after being used inside of a nuclear reactor. The most significant waste from a nuclear reactor is the used nuclear fuel left after it has spent about three years in the reactor generating heat for electricity. Low-level waste is made up of lightly-contaminated items like tools and work clothing from power plant operation and makes up the bulk of radioactive wastes. Items disposed of as intermediate-level wastes might include used filters, steel components from within the reactor and some effluents from reprocessing.

**High Level Radioactive Waste**

High-level radioactive wastes are the highly radioactive materials produced as a byproduct of the reactions that occur inside nuclear reactors. High-level wastes take one of two forms:

• Spent (used) reactor fuel when it is accepted for disposal

• Waste materials remaining after spent fuel is reprocessed.

Used nuclear fuel produces ionising radiation. This type of radiation has a strong ability to penetrate matter, so long term shielding against the radiation is required.

**Intermediate Waste**

Intermediate level waste contains higher radioactivity levels than low level waste. It requires shielding when handled. Intermediate level waste – generated during operation of a nuclear power plant – consists mostly of ion exchange resins used to clean the water circulating through the reactor.

**Low-level Waste**

Low level waste contains small amounts of radioactivity. This type of waste is generated from hospitals, laboratories and industry as well as in every stage of the nuclear fuel cycle, which refers to the series of steps to produce fuel for generating electricity. It can include many kinds of material: paper, rags, tools, clothing, shoe covers and filters. It can also include fireproof fabrics and protective plastic sheeting used in maintenance work, and equipment parts and pipes removed from a power plant.

**Nuclear Power plants**

Nuclear power is electricity created in a nuclear power plant. It’s done through a process called nuclear fission, where uranium atoms are split into smaller atoms to produce electricity. It supports everyday electricity supply and the continued electrification of society with fossil free power.

Nuclear power plants use the heat generated from nuclear fission in a contained environment to convert water to steam, which powers generators to produce electricity. Although the construction and operation of these facilities are closely monitored and regulated, accidents are possible. An accident could result in dangerous levels of radiation that could affect the health and safety of the public living near the nuclear power plant.

**Radiation**

Visible and invisible light, radio waves, heat, magnetic fields, etc. are all forms of ‘radiation’. In other words, radiation can be found everywhere. By radioactive and ionising radiation, we mean X-rays, alpha radiation, beta radiation, gamma radiation and neutron radiation. The properties of these different types of radiation can differ quite significantly. Some radiation can be blocked by just a bit of air; other types of radiation can penetrate thick walls. These properties depend on the wavelength of the ‘particle’ that is emitted by an unstable radioactive atom.

**Nuclear Waste Management**

When addressing the issue of management of nuclear waste management, countries need to consider both transport and storage of radioactive waste. Like all industries, the thermal generation of electricity produces wastes. Whatever fuel is used, these wastes must be managed in ways which safeguard human health and minimise their impact on the environment.

**Transport**

Transporting nuclear waste requires a sturdy container that can shield from radioactivity. A specially designed container called a cask is used. There are different cask types for different purposes, but they all have similar overall design to maximize the containment of radioactivity.

A cask is a strong, heavily-shielded, double-walled container. The outer structure is of several inches of high-strength steel. The inner structure is usually made of steel as well. Casks meant to transport used nuclear fuel assemblies have a rack of square openings in this inner structure to provide support for those assemblies. If the cask is being used for transporting used nuclear fuel assemblies, the rack may also contain neutronabsorbing materials to safeguard against the unlikely event of a nuclear chain reaction. For transporting used nuclear fuel assemblies, the inner canister is dried and filled with an inert gas (usually helium) to prevent long-term corrosion of the fuel assemblies. The casks also usually feature several inches of lead or depleted uranium (which is not radioactive) between the inner and outer structures to provide gamma ray shielding. The inner canister is then sealed, preventing any release of radioactive material.

Large honeycomb structures made of wood, foam, or aluminum are placed on the ends of the casks to absorb the force the cask would experience in the event of a drop.7 The International Atomic Energy Agency (IAEA) has clear standards of compliance for the transport of such material. Regulations for the Safe Transport of Radioactive Materials (SSR-6) are applicable to the national and international carriage of radioactive material by all modes of transport.

**Wet Storage**

After being removed from the reactors, used nuclear fuel bundles are stored for 7 to 10 years in storage bays (pools of water), which provide cooling and shielding against

radiation. The pools for the used nuclear fuel are constructed in-ground and are seismically qualified (which means they are built to meet seismic standards for earthquakes. They are housed in buildings that are separated from the reactor buildings.

The walls and floors of the pools are about two metres thick and made of concrete

reinforced with carbon steel. Robust, heat-resistant and water-tight liners are installed

in the pools to prevent water from leaking through possible defects in the concrete.

**Dry cask storage**

Dry cask storage allows spent fuel that has already been cooled in the spent fuel pool for at least one year to be surrounded by inert gas inside a container called a cask. The casks are typically steel cylinders that are either welded or bolted closed. The steel cylinder provides a leak-tight confinement of the spent fuel. Each cylinder is surrounded by additional steel, concrete, or other material to provide radiation shielding to workers and members of the public. Some of the cask designs can be used for both storage and transportation.

**Near-surface disposal**

Near-surface disposal facilities at ground level. These facilities are on or below the surface where the protective covering is of the order of a few metres thick. Waste containers are placed in constructed vaults and when full the vaults are backfilled. Eventually they will be covered and capped with an impermeable membrane and topsoil. These facilities may incorporate some form of drainage and possibly a gas venting system. Near-surface disposal facilities in caverns below ground level. Unlike near-surface disposal at ground level where the excavations are conducted from the surface, shallow disposal requires underground excavation of caverns but the facility is at a depth of several tens of metres below the Earth's surface and accessed through a drift.

**Deep geological disposal**

The long timescales over which some of the waste remains radioactive led to the idea of deep geological disposal in underground repositories in stable geological formations. Isolation is provided by a combination of engineered and natural barriers (rock, salt, clay) and no obligation to actively maintain the facility is passed on to future generations. This is often termed a multi-barrier concept, with the waste packaging, the engineered repository and the geology all providing barriers to prevent the radionuclides from reaching humans and the environment. In addition, deep groundwater is generally devoid of oxygen.

**Nuclear Fuel**

Nuclear power can represent a certain measure of energy security because fuel requirements are small and fuel can thus be easily stocked for several years. Specialized services are available for reprocessing and for the management of radioactive waste; there is also experience in power plant decommissioning. It is uncertain which is presently the most economical approach, fuel reprocessing or direct disposal. There is no urgent need for reprocessing to recover fuel, as there are delays in the development of the fast breeder reactor, as well as a surplus of plutonium and of fuel for water cooled reactors.

## Need for new generating capacity

There is a clear need for new generating capacity around the world, both to replace old fossil fuel units which emit a lot of carbon dioxide, and to meet increased demand for electricity in many countries.

In 2016, 65.0% of electricity was generated from the burning of fossil fuels. Despite the strong support for, and growth in, intermittent renewable electricity sources in recent years, the fossil fuel contribution to power generation has remained virtually unchanged in the last 10 years or so (66.5% in 2005).

**Environmental impacts of Nuclear Power Plants**

To start with, the setting up of a nuclear plant requires a large area, situated near a natural water body. This is usually accompanied with clearing of forests which disturbs the natural habitat and creates an ecological imbalance of the region. Apart from this, studies have shown that due to the heat rejected into the water bodies, there have been significant drops in the populations of several species of fish. Another significant effect is the increased amount of sulfur dioxide in the air which causes acid rain to form which then leads to contamination of surface water bodies of the region, reduction of productivity of the soil, and has several other negative effects on the region's vegetation and human health.

Additionally, nuclear power plants require some means by which they can expel heat as part of their condenser system. The amount of heat varies from the different components used in the plant but on an average about 60 to 70% of thermal energy from the nuclear fuel is rejected out of the plant. Some plants use cooling towers while some use a large body of water, such as an artificial lake or a natural body of water such as a lake or a river. It also adversely affects the aquatic life of the ecosystem into which heat is rejected. In some cases, the heat rejected into water bodies can cause fluctuations in flow rates of rivers and anomalies in sea level. One particular research done showed an average rise in sea level of about 3mm/yr of the Northeast coast of US.

The gaseous emissions from a nuclear power plant can be of different forms and intensities. Nuclear power plants use diesel generators as a means for back-up electric power in case of emergencies. Most are also required to run and test these systems once every month to ensure their working. Therefore, they release greenhouses gases into the atmosphere. These gases consist of carbon dioxide, carbon monoxide, nitrous oxides and sulfur dioxides. Apart from greenhouse gases, exhaust gases from buildings containing radioactive processes is radioactive in nature. Such exhausts are passed through delay pipes, storage tanks and hydrogen recombines before release into the environment to ensure that radiation levels are in accordance to regulations. Radioactive exhaust from nuclear power plants is also known to cause skin problems of several kinds.

## Assessing the costs of nuclear power

The economics of nuclear power involves consideration of several aspects:

* Capital costs, which include the cost of site preparation, construction, manufacture, commissioning and financing a nuclear power plant. Building a large-scale nuclear reactor takes thousands of workers, huge amounts of steel and concrete, thousands of components, and several systems to provide electricity, cooling, ventilation, information, control and communication.
* Plant operating costs, which include the costs of fuel, operation and maintenance, and a provision for funding the costs of decommissioning the plant and treating and disposing of used fuel and wastes.
* External costs to society from the operation, which in the case of nuclear power is usually assumed to be zero, but could include the costs of dealing with a serious accident that are beyond the insurance limit and in practice need to be picked up by the government. The regulations that control nuclear power typically require the plant operator to make a provision for disposing of any waste, thus these costs are ‘internalised’ (and are not external). Electricity generation from fossil fuels is not regulated in the same way, and therefore the operators of such thermal power plants do not yet internalise the costs of greenhouse gas emission or of other gases and particulates released into the atmosphere. Including these external costs in the calculation improves the economic competitiveness of new nuclear plants.
* Other costs such as system costs and nuclear-specific taxes.

**Uranium Mining**

Uranium is found in rock. Natural uranium is contained in uranium orein small concentrations of only fractions of a percent. Depending on the depth in the ground of the seam of rock containing uranium, the deposit is either mined using surface (open-cast or openpit) or sub-surface (underground) mining. The uranium ore is extracted

through mechanical means such as blasting, drilling, pneumatic drilling,

picks and shovels, and then transported to the surface.

**Safety**

 Safety is an essential requirement in the application of nuclear power, since the consequences of an accident can create a severe hazard to both operating personnel and the surrounding population and environment. Good operating practices in terms of nuclear safety, reliability and economics result in power generation with minimal risk and significant benefits. The fundamental safety requirements for nuclear power are met by not one, but several, engineered systems, so that if one system fails there are others which continue to provide protection. This concept is termed 'defence in depth'. The safety of a plant is ultimately determined by the quality of plant operation. The operating staff must be qualified, properly trained and periodically retrained, work according to procedures, have access to technical support when needed, be properly organized and motivated and apply the lessons of past experience. A safety and quality culture is critical in preventing incidents and accidents, and requires procedures and training aimed at mitigating the consequences of such events, should they occur.

**Health and Environmental Aspects**

 Experience has shown that nuclear power can provide an environmentally sound option for electricity production. Energy development policies and programmes must now take into account environmental factors — not only the local environmental impact of energy options, but also national and international obligations concerning the environment. With the introduction and increasing use of nuclear power for electricity generation, the pollution associated with oil and coal fired plants will decrease. For example, in France, where over 56 000 MW(e) of nuclear capacity now produces more than 70% of the electricity, sulphur dioxide (SO2) emissions dropped from 380 000 t in 1979 to 160 000 t in 1987 and carbon dioxide (CO2) emissions declined from 500 million tonnes to 370 million tonnes. In comparison, the CO2 emissions per kW-h(e) in the United Kingdom, which has over 70% of its electricity generated by coal fired plants, are about eight times greater than those in France.

Although there is always a small risk of release of radioactive materials from an accident, affecting both public health and the environment. Normal releases of radiation from nuclear power plant operation are minimal and far below natural background levels of radiation. However, there is a small risk of potentially large accidents, for example the accidents at the Chernobyl nuclear power plant in the former USSR and at the Three Mile Island plant in the USA. With regard to radioactive wastes, the operation of all nuclear power plants in the world at present produces about 7000 t of spent fuel per year. If the electricity generated by nuclear fuel had been generated by the combustion of coal, it would have resulted in the annual emission of 1800 million tonnes of CO2. In addition to 70 million tonnes of ash produced, containing 90 000 t of heavy metals, which are not always disposed of in a long term safe manner.

**Public Acceptance of Nuclear Power**

In parallel with the necessary political. Financial and technical preparatory work that needs to be carried out to launch a nuclear power programme, it is extremely important to provide adequate and regular information to the public, the media and other opinion makers to gain support. The introduction of a major nuclear facility will attract a great deal of attention at the local and national levels. To the extent that a future plant may be located near the border with a neighbouring country, there are likely to be transboundary and international ramifications as well. Public environmental protection concerns have grown substantially everywhere over the past twenty years. At the international level, there has been a clear evolution from the 1972 Stockholm Declaration, the Conference on Security and Co-operation in Europe Helsinki Final Act of 1975, and the Global Nature Charter of the United Nations General Assembly of 1982, to the various documents adopted at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, reinforcing governmental undertakings to inform the public. In many countries, legislation on environmental protection and access to information has been developed reflecting this concern.

1. **Major Parties Involved and Their Views**

Of the 31 countries in the world with commercial nuclear power plants in 2015, the United States had the most nuclear electricity generation capacity and generated more electricity from nuclear energy than any other country. France had the second-highest nuclear electricity generation capacity and electricity generation and obtained about 78% of its total electricity generation from nuclear energy, the largest share of any other country. Fourteen other countries generated at least 20% of their electricity from nuclear power.

**United States**

The United States is the second biggest CO2 emitter in the world, and the top

country for nuclear power. In 2013, the energy sector produced 5,636.6 million metric

tons of CO2 equivalent emissions, which is around 90% of total emissions in the U.S.

Electricity accounts for 37% of total CO2 emissions in the U.S. Total electricity net generation in the U.S. is 4,048 billion kilowatt-hours in 2012, and nuclear power generates about 20% of the total, which was 797.1 billion kilowatt-hours in 2014. Additionally, around 9.5% of total primary energyproduction in the U.S. is from nuclear electricity power.

Currently, 99 licensed nuclear reactors in 61 commercial plants are operating in the United States. The oldest operating reactor is Oyster Creek in New Jersey, whose license was issued in 1969, and the newest reactor is Watts Bar 1 in Tennessee, which has been in operation since 1996. Five more reactors are under construction, and additional reactors are under consideration or have already been licensed. 19 new reactor applications are under review. Nuclear capacity in the United States

rapidly increased during the 1970s and 1980s before it stabilized in the 1990’s.

Although some reactors have been decommissioned, the nuclear capacity will stay at

approximately the same level due to the new reactors’ installation.

As of January 2018, there were 99 operating nuclear reactors at 61 nuclear power plants in 30 states. Thirty-six of the plants have 2 or more reactors. Nuclear power has supplied about one-fifth of total annual U.S. electricity since 1990. Nuclear power plants operate in most states in the country and produce about 20 percent of the nation’s power. Nearly 3 million Americans live within 10 miles of an operating nuclear power plant.

**Japan**

Japan has developed the research of nuclear power generation since the middle of the 1950s. A test power reactor, JPDR, started operation in 1963 and Tokai Power Station, the first commercial reactor went into commercial operation in 1966 with a generation capacity of 166 MW.

Before the Fukushima Daiichi Nuclear Power Station Accident brought by the Great East Japan Earthquake on March 2011, 54 commercial nuclear reactors were in operation with a total generation capacity of 48,847 MW and about 30% of electricity comes from nuclear power. But after the accident, nuclear reactors were gradually shutdown, and on May 2012, all reactors were shutdown.

Six years have passed since the Fukushima nuclear disaster on March 11, 2011, but Japan is still dealing with its impacts. Decommissioning the damaged Fukushima Daiichi nuclear plant poses unprecedented technical challenges. More than 100,000 people were evacuated but only about 13 percent have returned home, although the government has announced that it is safe to return to some evacuation zones.

In late 2016 the government estimated total costs from the nuclear accident at about 22 trillion yen, or about US$188 billion – approximately twice as high as its previous estimate.

The Japanese public has lost faith in nuclear safety regulation, and a majority favors phasing out nuclear power. However, Japan’s current energy policy states that nuclear power will play a role in their electricity demand in the future.

When the earthquake and tsunami struck in 2011, Japan had 54 operating nuclear reactors which produced about one-third of its electricity supply. After the meltdowns at Fukushima, Japanese utilities shut down their 50 intact reactors one by one. In 2012 then-Prime Minister Yoshihiko Noda’s government announced that it would try to phase out all nuclear power by 2040, after existing plants reached the end of their 40-year licensed operating lives.

Now, however, Prime Minister Shinzo Abe, who took office at the end of 2012, says that Japan “cannot do without” nuclear power. Three reactors have started back up under new standards issued by Japan’s Nuclear Regulation Authority, which was created in 2012 to regulate nuclear safety. One was shut down again due to legal challenges by citizens groups. Another 21 restart applications are under review.

In April 2014 the government released its first post-Fukushima strategic energy plan, which called for keeping some nuclear plants as baseload power sources – stations that run consistently around the clock. The plan did not rule out building new nuclear plants. The Ministry of Economy, Trade and Industry (METI), which is responsible for national energy policy, published a long-term plan in 2015 which suggested that nuclear power should produce 20 to 22 percent of Japan’s electricity by 2030.

**International Atomic Energy Agency**

The [International Atomic Energy Agency](http://www.iaea.org/) works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies. The IAEA’s relationship with the United Nations is guided by an [agreement](http://www.iaea.org/sites/default/files/publications/documents/infcircs/1959/infcirc11.pdf) signed by both parties in 1957. It stipulates that: “The Agency undertakes to conduct its activities in accordance with the Purposes and Principles of the United Nations Charter to promote peace and international co-operation, and in conformity with policies of the United Nations furthering the establishment of safeguarded worldwide disarmament and in conformity with any international agreements entered into pursuant to such policies.”.

**France**

The French government has established national systems for the progressive development of nuclear power to be a key source of energy in the country. Accounting for 80% of electricity generation, nuclear power has enabled France reduced carbon emissions which in turn provide better air quality for its citizens.

The key aspect in France’s success is the presence of political will and resilience to ensure energy independence without reliance on fossil fuels. The dedication to such beliefs saw the establishment of Electricite de France, the country’s main country responsible for generating and distributing electricity. The commitment of the government to provide energy security through nuclear power also explains the consistent funding given for construction of nuclear reactors, often imbued with the latest technology and safety standards. The management strategy also benefits economically as large-scale production of electricity allows France to become one of the world’s largest net electricity exporter.

On a local scale, the efficient management of fuel waste products have also aided in saving on material costs, in addition to the benefits of reducing environmental impact since less uranium fuel is needed to be mined. This would one of the main reasons why despite having half the number of reactors which USA has, France is still able to generate a comparable amount of electricity for its people.

France is a prime example of how effective management, of a potentially dangerous resource, is the underlying reason in ensuring that nuclear power remains a safe and useful energy resource.

**Korea**

The Republic of Korea has been one of top ten emitters in the world, emitting 657 million metric tons of CO2 equivalent in 2012. The total electricity net generationin the Republic of Korea is 500 billion kilowatt-hours. Korea is highly dependent on nuclear power generation, around 30% of total energy production. Recently,the Shin-Walsung reactor has started to operate, so in total 24 nuclear reactors are licensed and operating. Moreover, two more new reactors at the Shin-Kori site and two at the Shin-Hanul site are under construction. Even without these sites in operation, Korea is the fourth ranked country for nuclear power by electricity output.

 Nuclear power plants in Korea significantly threaten national security, since

Korea has the highest concentrated rate of nuclear power plants. The Republic of Korea has a small territory. In this small land, there are 24 nuclear reactors with high concentration. As Fukushima dai-ichi and dai-ni accidents prove, when one nuclear reactor has an accident, nearby reactors are exposed to great risks and could potentially explode as well. The Kori and Shin-Kori Plants nowhave 6 reactors, and the Korea Hydro and Nuclear Power corporation is in the process of licensing two more reactors at this plant. After these are built, the Kori and ShinKori plants site will be the world’s highest concentrated nuclear reactor site, which poses a threat to Korean national security. The resident population in the 30 km evacuation zone is 3.4 million including the second biggest city in Korea.

Moreover, although the Korean government has declared that nuclear power helps to reduce carbon emissions, Korea has achieved less progress in reducing carbon emissions than expected, and the least development of renewable energy compared to other OECD countries. The government was only attentive to increasing supply, but not managing demand, and as a result, there was inefficient energy use through over consumption and waste. Korea had been through blackouts, electricity shortages, and skyrocketing carbon emissions at the same time. Since the increase of nuclear reactors and carbon emissions were directly proportional, it is doubtful that nuclear power generation really lowers the amount of carbon from society. Unlike the United States, all Korean nuclear plants are operated by a state owned company, KHNP, which follows directions from the government.

1. **Timeline of Events**

*Example (about a page long)*

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| **Date** | **Description of event** |

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| 1905  | The special theory of relativity was introduced by physicist Albert Einstein introduces his special theory of relativity, which states that the laws of nature are the same for all observers and that the speed of light is not dependent on the motion of its source. |
| 1932 | The neutron is discovered by english physicist and Nobel laureate James Chadwick, and exposes the metal beryllium to alpha particles and discovers the neutron, an uncharged particle. |
| 1932 | British physicist John Cockcroft teams with Ernest Walton of Ireland to split the atom with protons accelerated to high speed. Their work wins them the Nobel Prize in physics in 1951 |
| 1937  | The Westinghouse Corporation builds the 5-million-volt Van de Graaff generator. The generator gathers and stores electrostatic charges. Released in a single spark and accelerated by way of a magnetic field, the accumulated charge, equivalent to a bolt of lightning, can be used as a particle accelerator in atom smashing and other experiments. |
| 1939 | Physicists Otto Hahn and Fritz Strassmann split uranium atoms in a process known as fission. The mass of some of the atoms converts into energy, thus proving Einstein’s original theory. |
| 1939-1945 | The U.S. Army’s top-secret atomic energy program, known as the Manhattan Project, employs scientists in Los Alamos, New Mexico, under the direction of physicist J. Robert Oppenheimer, to develop the first transportable atomic bomb. Other Manhattan Project teams at Hanford, Washington, and Oak Ridge, Tennessee, produce the plutonium and uranium-235 necessary for nuclear fission. |
| 1945 | U.S. stages first test of a plutonium weapon, code-named “Trinity”, before dawn in the New Mexico desert. On Aug. 6 an American bomber drops atomic bomb on Japanese city of Hiroshima. Three days later a second bomb is dropped on Nagasaki. |
| 1951 | An experimental breeder reactor in Idaho produces the world’s first useable electric power from nuclear energy - illuminating four light bulbs. The Experimental Breeder Reactor-1 (EBR) proves that a breeder reactor can produce more fuel than it uses. |
| 1954-1956 | The Soviet Union opens a 5 MW nuclear power plant in 1954, the first to generate electricity for a power grid. Two years later, Britain opens Calder Hall in Sellafield, the first commercial nuclear power station for civil use. The power station, with an initial capacity of 50 MW that later increased to 200 MW, closes in 2003. France’s nuclear programme generates its first electricity with the opening of a reactor at Marcoule in 1956. |
| 1957 | The first large-scale nuclear power plant in the United States begins operation in Shippingport, Pennsylvania. Built by the federal government but operated by the Duquesne Light Company in conjunction with the Westinghouse Bettis Atomic Power Laboratory, the pressurised-water reactor supplies power to the city of Pittsburgh and much of western Pennsylvania. |
| 1979 | A plant at Three Mile Island near Harrisburg, Pennsylvania, experiences a major failure when a water pump in the secondary cooling system of a pressurised-water reactor malfunctions. A jammed relief valve then causes a buildup of heat, resulting in a partial meltdown of the core and releasing radioactive material into the atmosphere. The worst U.S. nuclear accident hurts the image of nuclear power around the world. |
| 1986 | World’s nuclear jitters intensify when a major accident at Chernobyl power station near Kiev sends radioactive dust across Ukraine, Russia, Belarus and western Europe. Thirty-one people die in the immediate aftermath. |
| 1996 | Tokyo Electric Power Co Inc (TEPCO), Japan’s biggest power utility, starts commercial operation of the world’s first advanced boiling water reactor (ABWR). The reactor, at the utility’s Kashiwazaki Kariba nuclear power complex, has a capacity of 1,350 MW. TEPCO starts commercial operations of the plant’s seventh reactor in July 1997, raising the total power generation capacity of the plant to 8,212 MW, making the complex the world’s largest nuclear power plant, surpassing a plant in Canada. |
| 2005 | Finland approves construction of one of the world’s largest nuclear power plants, raising the dormant atomic power industry’s hopes for a revival. The first of the third-generation units ordered for Finland - the 1,600 MW European PWR (EPR) Olkiluoto 3 - suffers repeated delays in construction work, pushing back an initial 2009 start date. The reactor will not be ready for electricity production before August 2014. |
| 2007 | Construction starts on France’s Flamanville 3 reactor. Initially expected to open in 2012, it is delayed to 2016 as costs have escalated. The 1,600 MW European Pressurised Reactor (EPR) - France’s first - will test a technology that could be used to replace France’s existing 58 reactors, which produce 80 percent of the country’s power. |
| 2011 | A 9.0 magnitude earthquake and tsunami on March 11, 2011 wrecks the Fukushima nuclear plant, triggering nuclear meltdowns that contaminated food and water and forced mass evacuations. Nearly 16,000 people are killed in the earthquake and the tsunami and 3,300 remain unaccounted for. |
| 2012 | Japan shuts its last working nuclear power reactor following the nuclear disaster, leaving it without nuclear power for the first time since 1970. Nuclear power had provided almost 30 percent of the electricity before 2011. (Reporting by David Cutler, London Editorial Reference Unit, editing by Jane Baird) |

1. UN Involvement, Relevant Resolutions, Treaties and Events:

*Name of the Resolution, Date of the Resolution (Resolution Number) and explanation of what the resolution attempted or did, example:*

* The United Nations 70th General Assembly today adopted a resolution that recognizes the importance of the IAEA’s work and supports its indispensable role “in encouraging and assisting the development and practical application of atomic energy for peaceful uses” as well as in transferring technology to developing countries and ensuring nuclear safety, security and verification. Resolution A/70/10 also highlights the cooperation between the United Nations and the IAEA. Although an autonomous international organization, the IAEA’s work is closely in line with that of the United Nations in that it promotes peace and international cooperation.
* The main event held at the International Atomic Energy Agency (IAEA) in recent months was the 60th General Conference, where new policy measures concerning nuclear waste management were discussed and adopted.14 The General Conference adopted resolution GC(60)/RES/9 on “Measures to strengthen international cooperation in nuclear, radiation, transport and waste safety,” which urges the IAEA Secretariat to continue with cooperation and assistance provision in the field of nuclear safety through the incorporation of the safe transport, storage, and supervision of nuclear waste.15 It also outlines waste safety as a key element to the peaceful usage of nuclear energy and the minimization of risks of nuclear material. In the same session, the Director General submitted a report on “Measures to strengthen international cooperation in nuclear, radiation, transport and waste safety,” which is primarily concerned with safety aspects in handling and processing nuclear material.16 The report outlines and describes the activities and cooperation of the Agency, including the publication on the IAEA’s Safety Standards Program, the Agency’s cooperation with Member States on Nuclear Installation Safety, the collaboration with the United Nations Scientific Committee on the Effects of Atomic Radiation on Radiation Safety and Environmental Protection Standards, and the publications by the Transport Safety Standards Committee within the IAEA Safety Standard Series. The issue is further clarified in the information document provided by the Director General, which relates to “Building the Action Plan on Nuclear Safety.”17 The document concludes that explicit priorities within the thematic area of nuclear radiation, transport, and waste safety should be outlined and yearly reports should be submitted to the Board of Governors on the progress of nuclear safety.
1. Evaluation of Previous Attempts to Resolve the Issue

#### Yucca Mountain, USA

At the end of 1987, the Nuclear Waste Policy Act was amended to designate Yucca Mountain, located in the remote Nevada desert, as the sole US national repository for spent fuel.

The repository would exist 300 metres underground in an unsaturated layer of welded volcanic tuff rock. Waste would be stored in highly corrosion-resistant double-shelled metal containers, with the outer layer made of a highly corrosion-resistant metal alloy, and a structurally strong inner layer of stainless steel. Since the geological formation is essentially dry, it would not be backfilled but left open to some air circulation. Drip shields made of corrosion-resistant titanium would cover the waste containers to divert possible future water percolation and provide protection from possible falling rock or debris.

Although, the project has experienced many delays since its inception and following the 2009 presidential election the Barack Obama administration decided to cancel it.. However, in June 2010, the Nuclear Regulatory Commission's Atomic Safety and Licensing Board (ASLB) rejected the DOE's motion to withdraw the license application, and in August 2013 the federal Appeals Court ordered the NRC to resume its review of the DOE's application for a license to construct and operate the Yucca Mountain repository. The NRC’s safety evaluation reports were published early in 2015, which contain the agency's technical review of safety of the repository. In May 2016, the NRC released its final supplement to the US DOE's environmental impact statement on the proposed Yucca repository. Both the environmental impact assessment and the NRC's experts established that the repository design would prove safe for one million years.

#### Nirex Phased Disposal Concept, UK

The UK's Nirex Phased Disposal Concept has been developed for relatively large volumes of ILW and LLW, usually cemented into stainless steel containers[m](https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/storage-and-disposal-of-radioactive-waste.aspx#References). These containers would be emplaced into a repository in a host rock environment below the water table. The waste would be monitored and remain retrievable and the groundwater managed to prevent contact with the wastes, until such a time that the repository is sealed. When this happens, the waste will be surrounded (backfilled) by specially formulated cement and the repository allowed to resaturate. The cement would provide a long-lasting alkaline environment that contributes to containment of the waste by preventing many radionuclides from dissolving in the groundwater. Similar cement-based schemes for ILW disposal have been proposed in France, Japan, Sweden and Switzerland.

1. Possible Solutions

1. A possible solution would be to monitor the environmental radiation around the facility and radioactivity in environmental samples in order to confirm that there is no harmful effect on the surrounding environment. Local governments as well as utilities must independently measure radiation dose in the air by radiation monitoring systems around nuclear power plants. In addition, there must be periodical collection of seawater, soil and agricultural as well as sea products to measure and analyze them for radioactive material content and to ensure that power plants have no adverse impact on the surrounding environment.

2. Another solution would be that the electric power companies should take both tangible and intangible measures, starting with emergency safety measures including the installation of additional emergency power source vehicles and fire engines, as well as upgrading procedure manuals and conducting drills. To ensure that these measures are effective, there must be on-site reinforcement of communication system and preparing high-dose resistant protective clothing to allow necessary actions to be taken even in case of a severe accident. The companies are also taking medium- to long-term measures which include installing additional permanent emergency power supply units on high ground, constructing coastal levees, modifying watertight facilities, and large-capacity temporary seawater pumps, in case of a station blackout and loss of sea water cooling systems, and to increase their safety margin.

1. Guiding Questions

*(10-15 questions that your delegates could use as guidelines while researching the issue themselves and their countries’ stance on the issue)*

1. Which contributions can member states make to further new technologies, especially regarding nuclear waste disposal?

2. Are all member states complying with current IAEA rules and regulations?

1. Appendices and useful links
2. <http://sitn.hms.harvard.edu/flash/2016/reconsidering-risks-nuclear-power/>
3. <https://www.hoddereducation.co.uk/media/Documents/Magazines/Sample%20Articles/JanFeb%202018/GeogRev31_3_Feb2018.pdf>
4. Contact Info

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