ANTALYA FEN
MODEL UNITED NATIONS
CONFERENCE 2019

-IAEA-

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I.Letter from Secretary-General

Esteemed Delegates,

As the Secretary-General of this conference, I'm so honored to welcome you all to the very first session of ANTALYA FEN MODEL UNITED NATIONS CONFERENCE which will be held from June 22 to 24, 2019 at Akdeniz University, Faculty of Literature.

Our prior aim is to discover the hidden diplomat inside of you. We will provide this qualified experience with our absolute academic team that formed with the most competent and skilled MUNers and two of that skilled and experienced people is the Under Secretaries-General of this committee who are Devrim Özen and Irmak Orhan.

In International Atomic Energy Agency committee you will be debating upon Prevention of Possible Hazards by Nuclear Disposals and Biological Weapons and Bioterrorism. These are one of the most important problems in the century we live. We want you to come with the most efficient and probable solutions.

I would like to wish you luck from now. Please don't hesitate to contact me in case you face any kind of problem. I can't wait to meet you in person. See you in June 22nd

contact me via: meryemzulaldmrl@gmail.com

Meryem Zülal Demirel
Secretary-General of AFMUN19

II. Letter from Under Secretary-General

Esteemed Participants of IAEA

It is an overwhelming honor for me to welcome you all to the first session of Model United Nations Antalya Fen Conference 2019 as the Under Secretary-General responsible for IAEA. I am Devrim Özen, and I am a senior student at AAKAL.

I find it's a such a luxury for us young people to be apart of debate atmospheres where we are completely free to express our thoughts and solutions on the course of our world,particularly when we are amidst tensions that are rising continously. As of what I have observed,when you are in a committee room,it means you are in a house full of different ways thinking and different perspectives.

I highly recommend to the delegates to read this study guide to be comprehensive before the conference. If any questions regarding the study guide please do not hesitate the contact me on via.

Sincerely,

Devrim Özen

Under Secretary General responsible for IAEA

III.What does IAEA stand for?

The **International Atomic Energy Agency** (**IAEA**) is an international organization that seeks to promote the peaceful use of nuclear energy, and to inhibit its use for any military purpose, including nuclear weapons. The IAEA was established as an autonomous organisation on 29 July 1957. Though established independently of the United Nations through its own international treaty, the IAEA Statute, the IAEA reports to both the United Nations General Assemblyand Security Council.

The IAEA has its headquarters in Vienna, Austria. The IAEA has two "Regional Safeguards Offices" which are located in Toronto, Canada, and in Tokyo, Japan. The IAEA also has two liaison offices which are located in New York City, United States, and in Geneva, Switzerland. In addition, the IAEA has laboratories and research centers located in Seibersdorf, Austria, in Monaco and in Trieste, Italy.

,The IAEA serves as an intergovernmental forum for scientific and technical co-operation in the peaceful use of nuclear technology and nuclear power worldwide. The programs of the IAEA encourage the development of the peaceful applications of nuclear energy, science and technology, provide international safeguards against misuse of nuclear technology and nuclear materials, and promote nuclear safety (including radiation protection) and nuclear security standards and their implementation.

The IAEA and its former Director General, Mohamed ElBaradei, were jointly awarded the Nobel Peace Prize on 7 October 2005. The IAEA's current Director General is Yukiya Amano.

A.General

The IAEA's mission is guided by the interests and needs of Member States, strategic plans and the vision embodied in the IAEA Statute (see below). Three main pillars – or areas of work – underpin the IAEA's mission: Safety and Security; Science and Technology; and Safeguards and Verification.

The IAEA as an autonomous organisation is not under direct control of the UN, but the IAEA does report to both the UN General Assembly and Security Council. Unlike most other specialised international agencies, the IAEA does much of its work with the Security Council, and not with the United Nations Economic and Social Council. The structure and functions of the IAEA are defined by its founding document, the IAEA Statute (see below). The IAEA has three main bodies: the Board of Governors, the General Conference, and the Secretariat.

The IAEA exists to pursue the "safe, secure and peaceful uses of nuclear sciences and technology" (Pillars 2005). The IAEA executes this mission with three main functions: the inspection of existing nuclear facilities to ensure their peaceful use, providing information and developing standards to ensure the safety and security of nuclear facilities, and as a hub for the various fields of science involved in the peaceful applications of nuclear technology.

The IAEA recognises knowledge as the nuclear energy industry's most valuable asset and resource, without which the industry cannot operate safely and economically. Following the IAEA General Conference since 2002 resolutions the Nuclear Knowledge Management, a formal programme was established to address Member States' priorities in the 21st century.[15]

In 2004, the IAEA developed a Programme of Action for Cancer Therapy (PACT). PACT responds to the needs of developing countries to establish, to improve, or to expand radiotherapy treatment programs. The IAEA is raising money to help efforts by its Member States to save lives and to reduce suffering of cancer victims.[16]

The IAEA has established programs to help developing countries in planning to build systematically the capability to manage a nuclear power program, including the Integrated Nuclear Infrastructure Group,[17] which has carried out Integrated Nuclear Infrastructure Review missions in Indonesia, Jordan, Thailand and Vietnam.[18]The IAEA reports that roughly 60 countries are considering how to include nuclear power in their energy plans.[19]

To enhance the sharing of information and experience among IAEA Member States concerning the seismic safety of nuclear facilities, in 2008 the IAEA established the International Seismic Safety Centre. This centre is establishing safety standards and providing for their application in relation to site selection, site evaluation and seismic design.

IV.Biological weapons

Biological weapons, also called **germ weapon**, any of a number of disease-producing agents—such as bacteria, viruses, rickettsiae, fungi, toxins, or other biological agents—that may be utilized as weapons against humans, animals, or plants.

The direct use of infectious agents and poisons against enemy personnel is an ancient practice in warfare. Indeed, in many conflicts, diseases have been responsible for more deaths than all the employed combat arms combined, even when they have not consciously been used as weapons.

Biological weapons, like chemical weapons, radiological weapons, and nuclear weapons, are commonly referred to as weapons of mass destruction, although the term is not truly appropriate in the case of biological armaments. Lethal biological weapons may be capable of causing mass deaths, but they are incapable of mass destruction of infrastructure, buildings, or equipment. Nevertheless, because of the indiscriminate nature of these weapons—as well as the potential for starting widespread pandemics, the difficulty of controlling disease effects, and the simple fear that they inspire—most countries have agreed to ban the entire class.

As of 2013 a total of 180 states and Taiwan had signed the Biological Weapons Convention (BWC) and 170 of those states and Taiwan had signed and ratified the treaty, which was opened for signature in 1972. Under the terms of the BWC, member states are prohibited from using biological weapons in warfare and from developing, testing, producing, stockpiling, or deploying them. However, a number of states have continued to pursue biological warfare capabilities, seeking a cheaper but still deadly strategic weaponrather than following the more difficult and expensive path to nuclear weapons. In addition, the threat that some deranged individual or terrorist organization will manufacture or steal biological weapons is a growing security concern.

A.Biological Warfare Agents

Biological warfare agents differ greatly in the type of organism or toxin used in a weapons system, lethality, length of incubation, infectiousness, stability, and ability to be treated with current vaccines and medicines. There are five different categories of biological agents that could be weaponized and used in warfare or terrorism. These include:

- Bacteria—single-cell organisms that cause diseases such as anthrax, brucellosis, tularemia, and plague.

- Rickettsiae—microorganisms that resemble bacteria but differ in that they are intracellular parasites that reproduce inside cells. Typhus and Q fever are examples of diseases caused by rickettsia organisms.

- Viruses—intracellular parasites, about $^1/_{100}$ the size of bacteria, that can be weaponized to cause diseases such as Venezuelan equine encephalitis.

- Fungi—pathogens that can be weaponized for use against crops to cause such diseases as rice blast, cereal rust, wheat smut, and potato blight.

- Toxins—poisons that can be weaponized after extraction from snakes, insects, spiders, marine organisms, plants, bacteria, fungi, and animals. An example of a toxin is ricin, which is derived from the seed of the castor bean.

Some of these biological agents have properties that would make them more likely candidates for weaponization, such as their lethality, ability to incapacitate, contagiousness or noncontagiousness, hardiness and stability, and other characteristics. Among the agents deemed likely candidates for biological weapons use are the toxins ricin, staphylococcal enterotoxin B (SEB), botulinum toxin, and T-2 mycotoxin and the infectious agents responsible for anthrax, brucellosis, cholera, pneumonic plague, tularemia, fever, smallpox, glanders, Venezuelan equine encephalitis, and viral hemorrhagic fever. Various states at various times have looked into weaponizing dozens of other biological agents in addition.

B.Defense Against Biological Weapons

Military defense

Most weaponized lethal biological agents are intended to be delivered as aerosols, which would cause infections when breathed by the targeted personnel. For this reason, the most-effective defense against biological weapons is a good protective mask equipped with filters capable of blocking bacteria, viruses, and spores larger than one micron (one micrometre; one-millionth of a metre) in cross section from entry into the wearer's nasal passages and lungs. Protective overgarments, including boots and gloves, are useful for preventing biological agents from contacting open wounds or breaks in the skin. Also, decontaminants can neutralize biological agents in infected areas after a biological attack.

Developing and fielding effective biological weapon sensors that can trigger an alarm would allow personnel to don masks before exposure, get into protective overgarments, and go inside, preferably into toxic-free collective protection shelters. Medical teams could then immediately go into action to check and treat those who may have been exposed. Biological warfare attacks can be made less effective, or ineffective, if the targeted persons have been vaccinated against the specific disease-causing agent used in an attack.

Civil defense

Civil defense against biological weapons has greatly improved since the September 11, 2001, attacks in the United States, but progress does not necessarily equal success. A successful civil defense against major biological attacks requires that significant progress be made in sensors, warning systems, vaccines, medicines, training of responders, and public education as well as in planning of emergency procedures. These aspects of civil defense are described briefly in this section, using as examples certain practices put into effect in the United States since September 11.

The foundation of any civil defense against a biological weapons attack is the medical system that has already been set up to deal with naturally occurring diseases. Special vaccines have been created, tested, and approved to deal with the two most lethal biological agents that can also be most easily weaponized: anthrax and smallpox. For example, the U.S. government has enough smallpox vaccine to vaccinate the entire American population and enough anthrax vaccine to inoculate at least every member of the U.S. military.

Effective vaccines for plague and cholera now exist and have been approved for use, but only small quantities have been produced, far short of what might be needed if large numbers of people were to be infected. Furthermore, in the United States a number of vaccines are still in the Investigational New Drug (IND) category and await further trials before the Federal Drug Administration (FDA) can validate their effectiveness and safety. Included among these are vaccines for Q fever, tularemia, Venezuelan equine encephalitis, viral hemorrhagic fever, and botulism.

At present no effective vaccines exist for preventing infections from glanders, brucellosis, staphylococcal enterotoxin B, ricin, or T-2 mycotoxins—all biological agents that some countries have researched for military use or have weaponized in the past. However, in some cases where vaccines are not yet available, medicines have been developed that help the sick to recover.

Long-term medical research is being conducted to investigate the possibility of developing vaccines and supplements that, when administered, might raise the effectiveness of the recipient's immune system to protect against the whole spectrum of probable biological warfare agents.

One U.S. civil defense program that might make a difference in a biological emergency is the Strategic National Stockpile program, which has created 50-ton "push packages" of vaccines, medicines, decontamination agents, and emergency medical equipment, which are stored in a dozen locations across the country in preparation for emergencies.
Furthermore, every U.S. state has bioterrorism response plans in place, including plans or guidelines for mass vaccinations, triage, and quarantines. The U.S. Centers for Disease Control and Prevention (CDC) has also drafted model legislation on emergency health powers for states to adopt in order to deal with such crises.
A new emergency response system was created in the United States following the September 11 attacks. The National Guard increased the number of its Weapons of Mass Destruction Civil Support Teams, which respond to chemical, biological, radiological, or nuclear weapons attacks—augmenting the police, fire, and medical first responders in the local area of any attacks. In addition, the Department of Homeland Security, working with the Department of Health and Human Services, invested heavily in passive defenses against biological attacks, focusing on such programs as Project BioShield and the Laboratory Response Network. The CDC also embarked on a training program on bioterrorism for thousands of medical lab technicians, and the National Institutes of Health funded new biocontainment research laboratories to further research in vaccines, medicines, and bioforensics.

C. Advertisement

Sensors to detect the presence of biological agents in the air, in water, or on surfaces are still relatively ineffective, but the aim of research is to create a "detect-to-warn" system that would provide enough time for potential victims to don masks, cover up, and take shelter before they are infected. The current "detect-to-treat" capability is unsatisfactory because responders would be treating many persons already infected. Most current biological detectors are point detectors, which are not capable of giving advance warning after scanning an airborne cloud of particles to discern if those particles contain biological agents of a specific type.

D. Biological Weapons In History

Pre-20th-century use of biological weapons

One of the first recorded uses of biological warfare occurred in 1347, when Mongol forces are reported to have catapulted plague-infested bodies over the walls into the Black Sea port of Caffa (now Feodosiya, Ukraine), at that time a Genoese trade centre in the Crimean Peninsula. Some historians believe that ships from the besieged city returned to Italy with the plague, starting the Black Death pandemic that swept through Europe over the next four years and killed some 25 million people (about one-third of the population).
In 1710 a Russian army fighting Swedish forces barricaded in Reval (now Tallinn, Estonia) also hurled plague-infested corpses over the city's walls. In 1763 British troops besieged at Fort Pitt (now Pittsburgh) during Pontiac's Rebellion passed blankets infected with smallpox virus to the Indians, causing a devastating epidemic among their ranks.

E. Biological weapons in the World Wars

During World War I (1914–18) Germany initiated a clandestineprogram to infect horses and cattle owned by Allied armies on both the Western and Eastern fronts. The infectious agent for glanderswas reported to have been used. For example, German agents infiltrated the United States and surreptitiously infected animals prior to their shipment across the Atlantic in support of Allied forces. In addition, there reportedly was a German attempt in 1915 to spread plague in St. Petersburg in order to weaken Russian resistance.

The horrors of World War I caused most countries to sign the 1925 Geneva Protocol banning the use of biological and chemical weapons in war. Nevertheless, Japan, one of the signatory parties to the protocol, engaged in a massive and clandestine research, development, production, and testing program in biological warfare, and it violated the treaty's ban when it used biological weapons against Allied forces in China between 1937 and 1945. The Japanese not only used biological weapons in China, but they also experimented on and killed more than 3,000 human subjects (including Allied prisoners of war) in tests of biological warfare agents and various biological weapons delivery mechanisms. The Japanese experimented with the infectious agents for bubonic plague, anthrax, typhus, smallpox, yellow fever, tularemia, hepatitis, cholera, gas gangrene, and glanders, among others.

Although there is no documented evidence of any other use of biological weapons in World War II, both sides had active research and development (R&D) programs. The Japanese use of biological warfare agents against the Chinese led to an American decision to undertake biological warfare research in order to understand better how to defend against the threat and provide, if necessary, a retaliatory capability. The United Kingdom, Germany, and the Soviet Union had similar R&D programs during World War II, but only Japan has been proved to have used such weapons in the war.

F. Biological weapons in the Cold War

In the Cold War era, which followed World War II, both the Soviet Union and the United States, as well as their respective allies, embarked on large-scale biological warfare R&D and weapons production programs. Those programs were required by law to be halted and dismantled upon the signing of the Biological Weapons Convention (BWC) in 1972 and the entry into force of that treaty in 1975. In the case of the United States and its allies, compliance with the terms of the treaty appears to have been complete. Such was not the case with the Soviet Union, which conducted an aggressive clandestine biological warfare program even though it had signed and ratified the treaty. The lack of a verification regime to check members' compliance with the BWC made it easier for the Soviets to flout the treaty without being detected.

After the demise of the Soviet Union in 1991 and its subsequent division into 15 independent states, Russian Pres. Boris Yeltsinconfirmed that the Soviet Union had violated the BWC, and he pledged to terminate what remained of the old Soviet biological weapons program. (*See also* yellow rain.) However, another problem remained—that of the potential transfer of information, technical assistance, production equipment, materials, and even finished biological weapons to states and groups outside the borders of the former Soviet Union. The United States and the former Soviet republics pledged to work together to contain the spread of biological warfare capabilities. With financing from the U.S. Cooperative Threat Reduction Program and other sources, help in obtaining civilian jobs in other fields was also made available for some of the estimated 60,000 scientists and technicians who had worked in the Soviet biological warfare programs.

G. Biological Weapons Proliferation

Of the more than 190 members of the United Nations, only a dozen or so are strongly suspected of having ongoing biological weapons programs. However, such programs can be easily hidden and disguised as vaccine plants and benign pharmaceutical-production centres. Biological weapons are not as expensive to manufacture as nuclear weapons, yet a lethal biological weapon might nonetheless be the strategic weapon that would win a war. This prospect of military advantage might tempt some regimes to acquire the weapons, though perhaps clandestinely.

Since the Biological Weapons Convention (BWC) has no existing verification or inspection procedures to verify compliance by its signatories, cheating on the treaty might be done with no outside proof to the contrary. It is entirely possible that even a small and relatively poor state might successfully embark on a biological warfare program with a small capital investment and a few dozen biologists, all of which could be secretly housed within a few buildings. In fact, a biological weapons program might also be within the technical and financial reach of a terrorist organization. In summary, the degree of biological weapons proliferation is highly uncertain, difficult to detect, and difficult to quantify.

V. Biological Terrorism

Biological weapons have been used in a few instances in the past by terrorist organizations. In the 1980s followers of the exiled Indian self-proclaimed guru Bhagwan Shree Rajneesh settled on a ranch in Wasco county, Oregon, U.S. The "Rajneeshies" took political control of the nearby town of Antelope, changing its name to Rajneesh, and in 1984 they attempted to extend their political control throughout the county by suppressing voter turnout in the more populous town of The Dalles. Leading up to the countywide elections, cult members experimented with contaminating groceries, restaurants, and the water supply in The Dalles with *Salmonella* bacteria. Their efforts made at least 751 people ill. The plot was not discovered until the year after the attack, when one of the participants confessed.
In the period from April 1990 to July 1995, the AUM Shinrikyo sect used both biological and chemical weapons on targets in Japan. The members' biological attacks were largely unsuccessful because they never mastered the science and technology of biological warfare. Nevertheless, they attempted four attacks using anthrax and six using botulinum toxin on various targets, including a U.S. naval base at Yokosuka.

Al-Qaeda operatives have shown an interest in developing and using biological weapons, and they operated an anthrax laboratory in Afghanistan prior to its being overrun by U.S. and Afghan Northern Alliance forces in 2001–02. In 2001 anthrax-laden letters were sent to many politicians and other prominent individuals in the United States. The letters killed 5 people and sent 22 to the hospital while forcing the evacuation of congressional office buildings, the offices of the governor of New York, several television network headquarters, and a tabloid newspaper office.

This event caused many billions of dollars in cleanup, decontamination, and investigation costs. In early 2010, more than eight years after the mailings, the Federal Bureau of Investigation finally closed its investigation, having concluded that the letters were mailed by a microbiologist who had worked in the U.S. Army's biological defense effort for years and who committed suicide in 2008 after being named a suspect in the investigation.

Information on the manufacture of biological and chemical weapons has been disseminated widely on the Internet, and basic scientific information is also within the reach of many researchers at biological laboratories around the world. Unfortunately, it thus seems likely that poisons and disease agents will be used as terrorist weapons in the future.

VI. Nuclear Dısposals

Nuclear waste epitomizes the double-edged sword of modern technology. It's a toxic and radioactive byproduct of nuclear medicine, nuclear weapons manufacturing and nuclear power plants. In short, it's the type of waste that reflects one of humankind's greatest leaps in technology, but it also demonstrates our inability to deal with our own advances.

Radioactive waste can take the form of different states of matter, including gas, solids and liquids. Depending on the waste's source, the radioactivity can last from a few hours to hundreds of thousands of years. If disposed of improperly, radioactive waste can devastate the environment, ruining air, water and soil quality. What's more, these materials can have long-term negative effects on human health, and can be fatal.

The greatest bulk of nuclear waste is related to the generation of nuclear power. There are two primary byproducts, including spent nuclear fuel from nuclear reactors and high-level waste (HLW) from the reprocessing of spent nuclear fuel.

The reactors in nuclear power plants use fuel in the form of ceramic uranium dioxide pellets that are sealed within metal rods. After the usable uranium is gone from the rods, the rods must be disposed of. But first, the rods are often processed with chemicals to draw out any unused uranium; this results in HLW, which is liquid waste. Then the rods are usually stored in pools of water near the reactor until a permanent location is prepared.

Finding suitable locations for radioactive waste is no easy task. In short, no one wants nuclear waste near their communities, even if it's buried many miles away in a vault in the desert. The proposed Yucca Mountain storage facility, located in Nevada about 100 miles (160.9 kilometers) northwest of Las Vegas, is a good example of the problems associated with nuclear waste disposal.

A.Some Nuclear Waste Dısposal Methods

Geological Disposal

The process of geological disposal centers on burrowing nuclear waste into the ground to the point where it is out of human reach. There are a number of issues that can arise as a result of placing waste in the ground. The waste needs to be properly protected to stop any material from leaking out. Seepage from the waste could contaminate the water table if the burial location is above or below the water level. Furthermore, the waste needs to be properly fastened to the burial site and also structurally supported in the event of a major seismic event, which could result in immediate contamination. Also, given the half-life noted above, a huge concern centers around how feasible it would be to even assume that nuclear waste could simply lie in repository that far below the ground. Concerns regarding terrorism also arise.

A noted geological disposal project that was recently pursued and could possible still be pursued in the future by the United States government is the Yucca Mountain nuclear waste repository. The federal government has voted to develop the site for future nuclear storage. Although the Obama administration has been adamant in stating that Yucca Mountain is "off the table," Congress voted by a margin of 10 to 1 in 2009 to keep funding the project as part of the federal budget. A number of concerns surround this project and the ultimate long-term viability of it are yet to be seen given the political uncertainty surrounding it.

Reprocessing

Reprocessing has also emerged as a viable long term method for dealing with waste. As the name implies, the process involves taking waste and separating the useful components from those that aren’t as useful. Specifically, it involves taking the fissionable material out from the irradiated nuclear fuel. Concerns regarding re-processing have largely focused around nuclear proliferation and how much easier re-processing would allow fissionable material to spread.

Transmutation

Transmutation also poses a solution for long term disposal. It specifically involves converting a chemical element into another less harmful one. Common conversions include going from Chlorine to Argon or from Potassium to Argon. The driving force behind transmutation is chemical reactions that are caused from an outside stimulus, such as a proton hitting the reaction materials. Natural transmutation can also occur over a long period of time. Natural transmutation also serves as the principle force behind geological storage on the assumption that giving the waste enough isolated time will allow it to become a non-fissionable material that poses little or no risk. [6]

Space Disposal

Space disposal has emerged as an option, but not as a very viable one. Specifically, space disposal centers around putting nuclear waste on a space shuttle and launching the shuttle into space. This becomes a problem from both a practicality and economic standpoint as the amount of nuclear waste that could be shipped on a single shuttle would be extremely small compared to the total amount of waste that would need to be dealt with. Furthermore, the possibility of the shuttle exploding en route to space could only make the matter worse as such an explosion would only cause the nuclear waste to spread out far beyond any reasonable measure of control. The upside would center around the fact that launching the material into space would subvert any of the other issues associated with the other disposal methods as the decay of the material would occur outside of our atmosphere regardless of the half-life. [7]

Conclusion

Various methods exist for the disposal of nuclear waste. A combination of factors must be taken into account when assessing any one particular method. First, the volume of nuclear waste is large and needs to be accounted for. Second, the half-life of nuclear waste results in the necessity for any policymaker to view the time horizon as effectively being infinite as it is best to find a solution that will require the least intervention once a long-term plan has been adapted. Last, the sustainability of any plan needs to be understood. Reducing the fissionability of the material and dealing with adverse effects it can have on the environment and living beings needs to be fully incorporated. Ultimately, nuclear waste is a reality with nuclear power and needs to be properly addressed in order to accurately assess the long-term viability of this power source.

B. Prevention of Possible Hazards

Radioactive wastes are stored so as to avoid any chance of radiation exposure to people, or any pollution.

The radioactivity of the wastes decays with time, providing a strong incentive to store high-level waste for about 50 years before disposal.

Disposal of low-level waste is straightforward and can be undertaken safely almost anywhere.

Storage of used fuel is normally under water for at least five years and then often in dry storage.

Deep geological disposal is widely agreed to be the best solution for final disposal of the most radioactive waste produced.

Nuclear power does not produce polluting combustion gases. So, like renewable energy sources, it could play a key role in helping to reduce global greenhouse gas emissions and in tackling global warming, especially as electricity demand rises in the years ahead. Public faith in nuclear energy took a knock from the accidents at Chernobyl and Three Mile Island, but as plant safety has improved such risks have greatly diminished. Currently, the perceived problem with nuclear energy from an environmental point of view is how to manage its radioactive waste. Solutions do exist, in particular the technique of burying the waste deep below the ground in engineered facilities, known as geological disposal. The challenge is to convince the public of its safety and reliability.

Radioactive waste is an inevitable by-product of the application of ionising radiation, whether it be in nuclear medicine (for diagnosis and treatment), industrial applications (for example, for finding new sources of petroleum or producing plastics), agricultural applications (notably for the conservation of foodstuffs), or of course the production of electricity. The radioactive waste produced by the latter represents less than 1% of the total toxic wastes generated in those countries that use nuclear energy to generate electricity, but at the same time this waste has the highest levels of radioactivity.

The long-term solution currently preferred by specialists consists of placing the waste in a deep (500 metres below the surface) and stable geological setting, such as granite, clay, tuff and salt formations that have remained virtually unchanged for millions of years. The aim is to ensure that such wastes will remain undisturbed for the few thousand years needed for their levels of radioactivity to decline to the point where they no longer represent a danger to present or future generations. The concept of deep geological disposal is more than 40 years old, and the technology for building and operating such repositories is now mature enough for deployment. As a general rule, the natural security afforded by the chosen geological formation is enhanced by additional precautionary measures. The wastes are immobilised in an insoluble form, in blocks of glass for example, and then placed inside corrosion-resistant containers; spaces between waste packages are filled with highly pure, impermeable clay; and the repository may be strengthened by means of concrete structures. These successive barriers are mutually reinforcing and together ensure that wastes can be contained over the very long term. The waste can be recovered during the initial phase of the repository, and also during subsequent phases, albeit at increased cost. This provides freedom of choice to future generations to change waste management strategies if they wish.

Repositories are designed so that no radioactivity reaches the Earth's surface. Following the precautionary principle, environmental impact assessments spanning 10,000 years analyse worst-case scenarios, including geological and climate changes and inadvertent human intrusion. The assessments maintain that even under those conditions, the impact on the environment and mankind would be less than current regulatory limits, which in turn are lower than natural background radiation.

The safety of geological disposal has been demonstrated in nature. Until about two thousand million years ago a natural reactor moderated by natural currents of water operated intermittently for millions of years at a uranium ore deposit beneath Gabon in Africa. Throughout that time the material produced during the nuclear fission reaction hardly moved from its original location. The first man-made geological disposal facility for long-lived waste started operation in New Mexico, USA in March 1999 and will provide industrial experience. Another partial solution is to reduce the mass of long-lived, high-level waste using a technique known as partitioning and transmutation (P&T). This involves isolating the transuranic elements and long-lived radionuclides in the waste and aims at transforming most of them by neutron bombardment into other non-radioactive elements or into elements with shorter half-lives. Some countries are investigating this option but it has not yet been fully developed and it is not clear whether it will become available on an industrial scale. This is because in addition to being very costly, P&T makes fuel handling and reprocessing more difficult, with potential implications for safety.

VII. Questions To Be Addressed

What do biological weapons do?

What is biological terrorist?

What would happen in a biological attack?

What is an example of bioterrorism?

What causes bioterrorism?

What is the proper way to dispose of nuclear waste?

Why is nuclear waste disposal so difficult?