PROMOTING THE SAFE USE OF NUCLEAR TECHNOLOGY IN THE ERADICATION OF MARINE MICROPLASTICS

Jay Kim, University of Santa Clara

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Plastic pollution has become a predominant threat toward sustainable development ("NUTEC Plastics | IAEA"). Each year it is estimated that eight million tonnes of plastic end up in the ocean, equivalent to a full garbage truck dumped into the sea every minute, as reported by the United Nations Environment Programme in 2019 ("Microplastics, Microbeads and Single-Use Plastics Poisoning Sea Life and Affecting Humans"). According to a projection from the International Atomic Energy Agency, "by 2025 the ocean will contain one tonne of plastic for every three tonnes of fish, and by 2050, there may be more plastic in the ocean than fish." As the amount of plastic increases, it has the same effect as the consequences of toxic gas being emitted into the atmosphere, affecting marine life and the health of the global environment.

The United Nations and the International Atomic Energy Agency have been monitoring the situation of plastics in the ocean as well as using tools that are currently removing the plastics in the ocean. The International Atomic Energy Agency has been supporting the concept of Nuclear Technology, specifically working with the Nuclear Technology for Controlling Plastic Pollution (NUTEC Plastics). The NUTEC "provides science-based evidence to characterize and assess marine microplastic pollution, while also demonstrating the use of ionizing radiation in plastic recycling, transforming plastic waste into reusable resources."

The International Atomic Energy Agency, through its laboratories, will continue to provide support to member states "to develop and improve nuclear and nuclear-derived tools and techniques to monitor the coastal and marine environment. The IAEA also provides safety guidance for the regulatory control of the release of radioactive effluents into the marine [ecosystem and the] assessment of radiological impacts on members of the public and the marine flora and fauna." (*IAEA ANNUAL REPORT 2020*).

The IAEA has a three step process to decrease the amount of plastics in the ocean: it will monitor the situation to determine how nuclear technology can eradicate the microplastics.

This will lead toward the next step, which is recycling with radiation; the technologies in this step include sorting the type of plastics in the ocean, breaking down the plastics into smaller pieces, categorizing the plastics, and finally converting the plastics into fuel or other sorts of use. The final steps of this process will show the benefits this has on the environment and nation states. It will increase information on the amount of plastics in the ocean, strengthen the research for microplastics that can be recycled and used for other goods, and, finally, provide new technology that may directly and positively impact the environment and the economy, depending on how well new technology is developed from nuclear technology.

The United Nations Environment Programme's campaign, the Clean the Sea Program, is another effort of the United Nations directed towards the eradication of marine microplastics.

What are Microplastics?

To begin understanding the process for eradicating microplastics, simple terms such as microplastics and nuclear technology, and the role of partner agencies for the United Nations should be explained.

Microplastics are defined as plastic debris that is less than five millimeters in length (or about the size of a sesame seed). They are usually designed as part of cosmetics, clothing, and other textiles (US). Many cosmetics, clothing, and other textiles include bigger pieces of plastics; the breakdown of these microplastics begins through solar radiation and ocean waves. As a consequence of the breakdown, many of these pieces of microplastics get attached to marine life and eventually other parts of the ecosystem, specifically communities and populations that depend on marine life for a source of food and their economies. On December 18, 2015 President Obama signed the Microbead-Free Waters Act, which prohibits the manufacturing, packaging, and distribution of rinse-off cosmetics containing plastic microbeads (Center).

The United Nations stance on plastic was adopted in 2019 during the 73rd session of the General Assembly: "To beat plastic pollution, we need to entirely rethink our approach to

designing, producing and using plastic products. We need solutions that lead to sustainable behavior change. Two elements are key to this: (1) global awareness and advocacy; and (2) strong policies and leadership. ("Plastics | General Assembly of the United Nations"). This message led toward more efforts from the International Atomic Energy Agency and the United Nations Environment Programme, to eradicate microplastics in the ocean.

New information is continually being gathered on microplastics. The United Nations Environment Programme noted in one report: "Researchers in Germany are warning that the impact of microplastics in soils, sediments and freshwater could have a long-term negative effect on such ecosystems. They say terrestrial microplastic pollution is much higher than marine microplastic pollution – estimated at four to 23 times higher, depending on the environment." (https://facebook.com/unep). The excessive amount of plastics in the ocean is of concern to the global community.

On 2 March 2022 the Heads of State, environment ministers and other representatives from 175 nations, endorsed a historic resolution at the UN Environment Assembly in Nairobi to end plastic pollution and forge an international legally binding agreement by the end of 2024 (Nations).

What is Nuclear Technology?

The idea of using nuclear power and nuclear technology as a whole is not widely accepted by people in the United States. In a recent poll done by the Pew Research Center, 35% of Americans encourage nuclear power, about 26% discourage it, and 37% neither encourage nor discourage it (Leppert). Nuclear energy may not have a positive opinion as many people may see nuclear energy related to nuclear weapons. Nevertheless, nuclear energy has benefits. Nuclear energy is defined as "a form of energy released from the nucleus, the core of atoms, made up of protons and neutrons. This source of energy can be produced in two ways: fission – when nuclei of atoms split into several parts – or fusion – when nuclei fuse together. The nuclear energy harnessed around the world today to produce electricity is done through nuclear

fission, while technology to generate electricity from fusion is at the R&D phase ("What Is Nuclear Energy? The Science of Nuclear Power"). A nuclear power plant in the United States has produced over one gigawatt of power (INFOGRAPHIC: How Much Power Does a Nuclear Reactor Produce?"). In comparison, a typical lightbulb at home needs about 60 to 100 watts of power, so one gigawatt would produce the power of about ten million light bulbs ("What the Heck Is a Gigawatt? | Williams Companies"). Nuclear energy is used in many nations around the world. A quick timeline of nuclear energy development can be found at "What Is Nuclear Energy – Nuclear Industry Association."

The recent push toward nuclear energy and nuclear technology specifically is in part because it has become the best alternative compared to coal, oil, and gas power plants, especially regarding the health of the environment. The United States Energy Information Administration explains that "Unlike fossil fuel-fired plants, nuclear reactors do not produce air pollution or carbon dioxide while operating. However, the processes for mining and refining uranium ore and making reactor fuel all require large amounts of energy ("Nuclear Power and the Environment – U.S. Energy Information Administration (EIA)"). As of 2021, 32 countries worldwide are operating 443 nuclear reactors for electricity generation and 55 new nuclear plants are under construction. By the end of 2018, 13 countries relied on nuclear energy to supply at least one-quarter of their total electricity (Nations).

The fear for nuclear safety may lead nations to not agree on using nuclear technology for the eradication of marine microplastics: With the accidents that occurred in Chernobyl and Fukushima, the world got to see the catastrophic impact they had on communities and how drastically they impacted day to day lives. However, after both those events occurred, the International Atomic Energy Agency pushed toward new policies for the safety of nuclear power. After the events of Fukushima, the IAEA developed an action plan in 2011 that "defined a programme of work to strengthen the global nuclear safety framework in response to the March 2011 accident at TEPCO's Fukushima Daiichi Nuclear power plant. The plan outlined actions to

strengthen safety in 12 areas: safety assessment of nuclear power plants; IAEA peer reviews; emergency preparedness and response; national regulatory bodies; operating organizations; IAEA safety standards; the international legal framework; Member States planning to embark on a nuclear power programme; capacity building; protection of people and the environment from ionizing radiation; communication and information dissemination; and research and development" ("IAEA Action Plan on Nuclear Safety | IAEA"). With many states in this group being part of the United Nations, the push for nuclear safety is a top agenda item.

Another question regarding nuclear technology is what happens to nuclear waste? The U.S. Energy Information Administration (IEA) notes, "A major environmental concern related to nuclear power is the creation of radioactive waste such as uranium mill tailings, spent (used) reactor fuel, and other radioactive wastes. These materials can remain radioactive and dangerous to human health for thousands of years. Radioactive wastes are subject to special regulations that govern their handling, transportation, storage, and disposal to protect human health and the environment." ("Nuclear Power and the Environment – U.S. Energy Information Administration"). The United Nations stance in regards to the storage of nuclear waste comes from Chapter 22 of Agenda 11, which explains; "The objective of Chapter 22 is to ensure that radioactive waste is safely managed, transported, stored and disposed of, with a view to protecting human health and the environment, within the wider framework of an interactive and integrated approach to radioactive waste managements and safety." ("United Nations Division for Sustainable Development Issues – Waste (Radioactive)"). In 2019, the United Nations nuclear chief suggested that ramping up nuclear technology is the best action to combat climate change. Much of the interest regarding nuclear energy outweighs the cons of not using it. In that same year, the IAEA pointed out that nuclear power contributes around one-third of all low carbon electricity, producing practically no greenhouse gasses, and some 10 percent of the total electricity produced worldwide." ("Ramp up Nuclear Power to Beat Climate Change, says UN Nuclear Chief")

The Push for Nuclear Technology for the Eradication of Microplastics in the Ocean

In May of 2021, the International Atomic Energy Agency released information on how to tackle plastics in the ocean, “A global approach is needed that establishes a circular economy and focuses on the ‘4Rs’: reduce, reuse, recycle and renew (*Nuclear Technology of Controlling Plastic Pollution*). This report states, “The latest research shows that radiation-supported recycling offers advantages including improved process control, enhanced quality of recycled plastics and the ability to tailor the properties of products, as well as significant cost and energy savings. The advantages of the technique rest on the ability to control how chemical bonds in plastic polymers are formed or broken, thereby allowing the special properties of the polymers to be altered, creating new chemical compositions or breaking them down.

Radiation technology, and specifically gamma and electron beams, offer unique advantages to address the technological gaps that exist in plastic recycling. Radiation technologies can break down plastic polymers into smaller fragments of chain molecules that can be used as feedstocks to produce new consumer products. Irradiation, specifically low electron beam, can also be used to increase and improve recycling by enhancing the sorting of mixed plastics, as a result of electrostatic separation. This helps to keep plastic repeatedly usable, further reducing plastic waste and has implications for commercial utility and the potential to reduce the volume of virgin fossil-fuel plastics entering the plastics value chain, yielding a further environmental benefit. (*Nuclear Technology for Controlling Plastic Pollution*).

As new research is conducted, the possibility of using nuclear technology for the eradication of microplastics in the ocean has increased, and what was once a linear process can lead to a circular economy. “The Agenda 2030 makes a commitment to eradicate multidimensional poverty and achieve sustainable, equitable development for all. The use of nuclear technologies to support a shift from a linear to a circular, plastic economy is an inherent contribution to Agenda 2030. Goal 12 calls for a commitment by the international community to sustainable consumption and production patterns and SDG 12.5 specifically calls on countries

to “…substantially reduce waste generation through prevention, reduction, recycling and reuse” by 2030. (*Nuclear Technology for Controlling Plastic Pollution*).

Conclusion

Microplastics continue to go into waste daily; much of the solution for eradication can come from nuclear technology. Although the idea of using nuclear technology may cause some concerns, the International Atomic Energy Agency is promoting its safe use. As noted earlier, the IAEA’s goals are “Enhanced global understanding of the abundance and impact of marine plastic pollution” and improved recycling and production methods through the application of radiation techniques to complement conventional practices.” With the IAEA and the United Nations working together, hopefully, microplastics in the ocean will be eradicated.

Questions to Consider

1. How much waste does your country produce?
2. What protections should your country have in place to discourage plastic waste?
3. Where does your country stand regarding nuclear technology?
4. Should countries have incentives to promote nuclear technology?
5. How can your nation work together to steadily reduce the microplastics in the ocean?
6. Should your nation join the pact that the IAEA created?
7. What protections will you have for marine ecosystems in the face of climate change?

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NUCLEAR NON-PROLIFERATION, DISARMAMENT, AND SUSTAINABLE DISPOSAL

Marcus Williams, Mesa Community College
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Since the first nuclear bombs were dropped on Hiroshima and Nagasaki and the founding of the United Nations in 1945, nuclear weapons have been in the minds of many on what to do with them and what their role will be in the future. Witnessing their raw destructive and indiscriminatory capabilities, the United Nations called for the immediate removal of all nuclear weapons and created the United Nations Atomic Energy Commission (UNAEC) in the United Nation's first resolution.[1] This commission was designed to deal with any and all issues that arose from nuclear technology advancements. The UNAEC was tasked by the UN General Assembly to craft proposals for:

a. establishing an exchange network for basic information on atomic technology for all nations,
b. control of atomic energy to necessary extents to ensure that it is only used for peaceful purposes,
c. the elimination of all national atomic armaments and any other weapons capable of mass destruction,
d. effective safeguards via inspections or other means to protect complying States against the hazards of violations and evasions.

While the Atomic Energy Commission was able to craft multiple proposals that it submitted to the United Nations Security Council (UNSC), the commission was never able to come to a consensus on how to tackle the issue of disarmament and atomic weapons control both within the commission and with other Member States. Through its unfortunate inability to achieve its primary goal, the UNAEC was officially disbanded in 1952.

The International Atomic Energy Agency (IAEA) was formed in 1957 as a successor to the UNAEC. Also known as the "Atoms for Peace" organization, the IAEA promotes peace and the safe use and control of atomic technology as both a weapon and a tool. Former President Dwight D. Eisenhower's "Atoms for Peace" speech inspired the IAEA's core statute which consists of twenty-three articles laying out the purpose, objectives, and functions of the IAEA.

Its primary objective is to "seek to accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world."[2]

Nuclear Non-Proliferation and prevention

Nuclear Non-Proliferation can be described as "determent of (a) the spread of nuclear weapons to entities (countries or terrorist groups) not currently possessing nuclear weapons (i.e. horizontal proliferation) and (b) increased numbers of nuclear weapons in countries already possessing nuclear weapons (i.e. vertical proliferation)."[3] After the first nuclear detonation by the Soviet Union, the United Nations' first priority was to prevent the spread of nuclear weapons to other States. In 1958, Ireland proposed the first resolution to prohibit the "further dissemination of nuclear weapons." And on 4 December 1961, the UN unanimously approved Resolution 1665 which called for negotiations to prevent the spread of nuclear weapons to additional states and those countries that already have nuclear weapons to refrain from losing control or transmitting information for their manufacture to other States.[4]

Along with UN efforts of deterrence and prevention, multiple States came together to establish Nuclear-Weapon Free Zones (NWFZ). These zones are nations and/or regions that commit to not manufacturing, acquiring, testing, nor possessing nuclear weapons. Out of the five current zones today, four span the Southern hemisphere being Latin America (1967 Treaty of Tlatelolco), the South Pacific (1985 Treaty of Rarotonga), Southeast Asia (1995 Treaty of Bangkok), Africa (1996 Treaty of Pelindaba), **and** Central Asia (2006 Treaty of Semipalatinsk).[5] As another means to prevent escalation, the bilateral Strategic Arms Limitation Talks (SALT) I and II agreements were designed to limit missile defense systems (Anti-Ballistic Missile (ABM) Treaty), place a cap on intercontinental ballistic missiles (ICBM) and submarine-launched ballistic missiles (SLBM), and limit deployable strategic bombers. However, due to the Soviet invasion of Afghanistan, SALT II (which addressed strategic bombers) never went into force.[6]

While non-nuclear states and the UN could only do so much in regulation, it was up to nuclear-armed states to set a precedent. As the leaders of nuclear proliferation, they had a

responsibility to prevent more states and non-state actors from accessing such destructive weapons. Between 1965 and 1968, terms were negotiated by the Eighteen Nation Committee on Disarmament (ENCD) and various participants which culminated in the Treaty of Non-Proliferation of Nuclear Weapons, better known as the Non-Proliferation Treaty (NPT). It was opened for signatures in 1968 and entered into force in 1970.[7] The Non-Proliferation Treaty is an international arms control agreement where non-nuclear states pledge to never pursue nuclear weapons and agree to submit to international inspections of nuclear facilities and in exchange, nuclear states will provide the peaceful benefits of nuclear technology. Per the NPT, nuclear states pledge to eventually eliminate their nuclear arsenals as well as assist in developing "civilian nuclear programs for peaceful purposes and forgo transferring nuclear weapons to other non-nuclear states."[8] While accepted as a cornerstone for disarmament and prevention efforts globally, not all nations signed on to the NPT. China and France did not sign the treaty but later acceded in 1992, and India, Pakistan, Israel, and South Sudan are currently non-signatories of the treaty.[9] The Democratic People's Republic of Korea also withdrew from the NPT in 2003.[10]

Nuclear Disarmament

There are approximately 13,000-15,000 nuclear weapons in service today across the globe.[11] While compared to the Cold War high of approximately 60,000, it is a sign of progress, but also one of stagnation and potential reversal. Nuclear disarmament is the act of reducing the total number of nuclear weapons a state has for the goal of a nuclear-free world. The process of nuclear disarmament is pivotal to maintain peace for all states, nuclear and non-nuclear. To promote and aid disarmament efforts, the United Nations Office of Disarmament Affairs (UNODA) was established under the General Assembly's recommendation at the 1982 second special session on disarmament (SSOD II). The UNODA manages all UN disarmament bodies. To effectively combat the threat posed by nuclear weapons, the UN Security Council passed Resolution 1540 (2004), which condemned the illicit trade of nuclear,

chemical, and biological weapons to terrorist organizations and decided that all States should refrain from providing any form of support to non-State actors that attempt to acquire and develop nuclear, chemical, or biological weapons and their means of delivery.[12]

The United Nations Disarmament Commission met in early 2022, its first meeting since 2018, which resulted in the approval by consensus of a draft report to the General Assembly.[13] The session consisted of two working groups, one focused on nuclear non-proliferation and disarmament, and the other on Outer Space.

During the Cold War, when nuclear tensions were at their highest, the United States and the Soviet Union came together to prevent Mutually Assured Destruction (MAD). While both nations had rational leaders during these times, measures had to be put in place to ensure that impulses and mistakes don't result in an undesirable outcome. Unlike SALT, which only addressed limitations, the Strategic Arms Reduction Treaty (START) addressed the path to disarmament. START I (1991) required that the United States and the Soviet Union reduce their strategic arsenals to 1,600 delivery vehicles, carrying no more than 6,000 warheads, and destroy excess delivery vehicles. START II (1993) called for reducing warheads to 3,000-3,500 and banning the deployment of multiple-warhead land-based missiles.[14] These agreements between the United States and the Soviet Union, and multiple international treaties and UN resolutions were a sign of progress towards a nuclear-free world becoming increasingly feasible.

However, despite these progressions, there are still states that continue to develop and advance their nuclear arsenal. The Democratic People's Republic of Korea has shown no signs of slowing, or outright stopping, production of nuclear warheads. India and Pakistan continue to increase the size and complexity of their arsenals, and Israel continues to deny possessing nuclear weapons. During the past few years, both the United States and Russian Federation reversed decades of progress and began rebuilding and advancing their nuclear capabilities, even though this potentially violated treaties made in the past to prevent such actions.[15] As a response to these impending threats, the United Nations General Assembly decided to convene

in 2017 to “negotiate a legally binding instrument to prohibit nuclear weapons, leading towards their total elimination.”[16] While Resolution 71/258 passed with 122 States in favor, one against, and one abstention, not a single nuclear state voted on this resolution.

Sustainable disposal and reuse

While nuclear weapons are an immediate threat to life, nuclear waste is a long-term threat that could poison arable land and water systems. Nuclear waste is produced by any activity that utilizes radioactive material such as: nuclear research, nuclear medicine, and nuclear power generation. However, of all nuclear waste produced from such activities, only 5%[17] of it is used for energy. The rest is either stockpiled or thrown away. In order to promote a more sustainable future, methods of safe disposal and containment are necessary to prevent potential contamination. One method proposed to reduce nuclear waste is through recycling the fuel through *Fast* reactors. These reactors use lead or sodium as a coolant to allow the reactor to get more electricity out of the leftover waste.[18]

To address the issue of radioactive waste, the European Union adopted a method called geological disposal. In 2009, the European Commission launched an initiative called Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP).[19] This platform hosts 128 waste management organizations and aims to facilitate the stepwise implementation of safe, deep geological disposal facilities in Europe for spent fuel, high level waste, and other long-living radioactive waste by 2025. From 2013-2015, the secretariat of the IGD-TP was renewed for phase 2 (SECIGD2). This phase tasked the secretariat with deepening collaboration between waste management organizations as well as training. The secretariat also managed operations which informed the public of the benefits of geological disposal.[20]

To ensure related agreements are met, and that nuclear material is cleaned and disposed safely, the IAEA has an expansive set of safety procedures that provides recommendations to ensure safety. The IAEA also promotes the need for international cooperation for nuclear safety because some cleanup efforts transcend borders.

Conclusion

Aside from the IAEA and other related UN bodies' efforts to achieving national and international goals of non-proliferation, disarmament, and sustainable disposal, this process requires complete cooperation between Member States and non-governmental organizations. Combating these issues should be a global effort because its effects are global, and inaction could be catastrophic. Sharing resources, knowledge, and methods of addressing various situations needs to be a priority for all nations. States lacking in the technical advancements are more likely to bear the brunt of inaction. Ensuring that both national and international goals are met is of utmost importance for all States that seek to become a force for good.Page Break

Questions to Consider

1. What is your country's policy on nuclear weapons and nuclear disarmament? Does your country's policy help contribute to a nuclear free world?

2. How can non-nuclear states convince nuclear states to disarm?

3. How does the presence of nuclear weapons affect global peace?

4. How likely is the increase of more Nuclear Weapons Free Zones? How can your country contribute to more NWFZ?

5. What more could/should the IAEA and related bodies do to address nuclear proliferation?

6. What can the IAEA do to promote the safe disposal or reuse of nuclear waste?

7. How might disarmament of nuclear weapons and proper disposal of nuclear waste contribute to furthering a sustainable future?

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