**Forum:** General Assembly 1 (DISEC)

**Issue:** Measures to enforce the sustainable disposal of radioactive waste

**Chair:** Shayan Siddiqui, Deputy Chair

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## Introduction

In every industry, the production of waste is inevitable. This is most prominent in the generation of electricity. The waste produced in generating electricity must be managed in different ways in order to safeguard human health, and minimize the impact on the environment. The transition from fossil fuels to nuclear power is due to the fact that nuclear power doesn't produce polluting combustion gases. Along these lines, as sustainable power sources, it could assume a vital part in assisting with decreasing tackling global warming, especially as electricity demand rises in the years ahead. Public confidence in thermal power took a drop from the mishaps at Chernobyl and Three Mile Island, however as plant safety has improved such dangers have lessened. Right now, the apparent issue with nuclear power from an environmental perspective is the way to deal with its radioactive waste. Solutions do exist, specifically the strategy of covering the waste far beneath the ground in engineered facilities, known as geological disposal. The challenge is to persuade general society of its security and dependability. Radioactive waste is an unavoidable result of the use of ionizing radiation, regardless of whether it be in nuclear medicine (diagnosis and therapy), industrial applications (finding new sources of petrol or producing plastics), agricultural applications, or the creation of power. The radioactive waste delivered by the last speaks to under 1% of the all out harmful materials created in those nations that utilization thermal power to produce electricity, and yet this waste has the most elevated levels of radioactivity.

Radioactive waste can be defined as any material that is either intrinsically radioactive, or has been contaminated by radioactivity, which is deemed to have no further use. To elaborate, radioactive waste is produced at all stages of the nuclear fuel cycle. Essentially, this cycle is the process of producing electricity from nuclear materials. The fuel cycle involves the mining and milling of uranium ore, the processing and fabrication into nuclear fuel, its use in the reactor, the treatment of the used fuel taken from the reactor, and finally, the disposal of the waste. Whilst waste is produced during the stages of mining, milling and fuel fabrication, the majority of the waste production comes from the burning of the uranium when producing electricity.

Radioactive waste can be classified into 3 types: low-level waste (LLW), intermediate-level waste (ILW), and high-level waste (HLW). This classification is dependent primarily on its level of radioactivity. LLW is mostly generated from hospitals and industry, as well as the nuclear fuel cycle. Items that are classified as LLW contain small amounts of mostly short lived radioactivity. To reduce its volume, LLW is usually compacted or incinerated before disposal. IIW is more radioactive than LLW but it is not sufficient for it to be taken into account the design or selection of storage and disposal facilities. Due to the higher radioactivity than LLW, the disposal of ILW requires some shielding. HLW has sufficiently radioactive to increase its temperature, and the temperature of its surroundings. Therefore, when handling HLW, it requires cooling and shielding.

The volume of HLW produced by the civil nuclear industry is relatively small. The International Atomic Energy Agency estimates that about 370 thousand of heavy metal (tHM) in the form of used fuel have been disposed of since the first nuclear power plant commenced operation and action. Therefore, the agency estimates that around 120 thousand tHM has been reprocessed.

## Definition of Key Terms

### Low-Level Waste

LLW is used to describe items that have been contaminated with radioactive material or have been exposed to neutron radiation. Hospitals and medical institutions, government laboratories, and nuclear fuel cycles create LLW on a daily basis. LLW include contaminated protective shoe covers and clothing, cleaning rags, mops, and nuclear water treatment residues.

### Intermediate-Level Waste

ILW contains higher amounts of radioactivity compared to low-level waste. It generally requires shielding, but not cooling. ILW include resins, chemical sludge, and metal nuclear fuel cladding, as well as contaminated materials from reactor decommissioning.

**High-Level Waste**

HLW are highly radioactive materials that are produced from inside nuclear reactors. HLW can take on one of the two forms: Spend reactor fuel when it is accepted for disposal, waste material remaining after the spent fuel is reprocessed.

**Nuclear Fuel Cycle**

This cycle consists of front-end steps that prepare uranium for use in nuclear reactors and back-end steps to safely manage, prepare and dispose of used, but still highly radioactive spent nuclear fuel.

**Spent Nuclear Fuel**

Spent nuclear fuel is used fuel from a reactor that can no longer create electricity as the fission process has slowed. Is still very radioactive, thermally hot, and very harmful. until a disposal repository for spent nuclear fuel is built, it must be safely stored at the reactor it was created.

**Nuclear Fission**

Nuclear Fission is an unstable atom split into two or smaller pieces that are more stable and releases energy in the process. The fission process also releases extra neutrons, which can then split additional atoms, resulting in a chain reaction that releases a lot of energy.

**Storage**

Storage of waste may take place at any stage during the management process. Storage involves maintaining the waste in a manner such that it is retrievable, whilst ensuring it is isolated from the external environment.

**Treatment**

Treatment involves operations intended to change waste streams' characteristics to improve safety or economy. Treatment techniques may involve compaction to reduce volume, filtration or ion exchange to remove radionuclide content, or precipitation to induce changes in composition.

**Conditioning**

Conditioning is undertaken to change waste into a form that is suitable for safe handling, transportation, storage, and disposal.

**Disposal**

Disposal of waste takes place when there is no further foreseeable use for it, and in the case of HLW, when radioactivity has decayed to relatively low levels after about 40-50 years.

**Legacy Waste**

This is waste that is all put together and dumped into a geological landfill. This waste exists in several countries that pioneered nuclear power and especially where power programs were developed out of military programs. It is sometimes voluminous and difficult to manage and arose in the course of those countries getting to a position where nuclear technology is a commercial proposition for power generation.

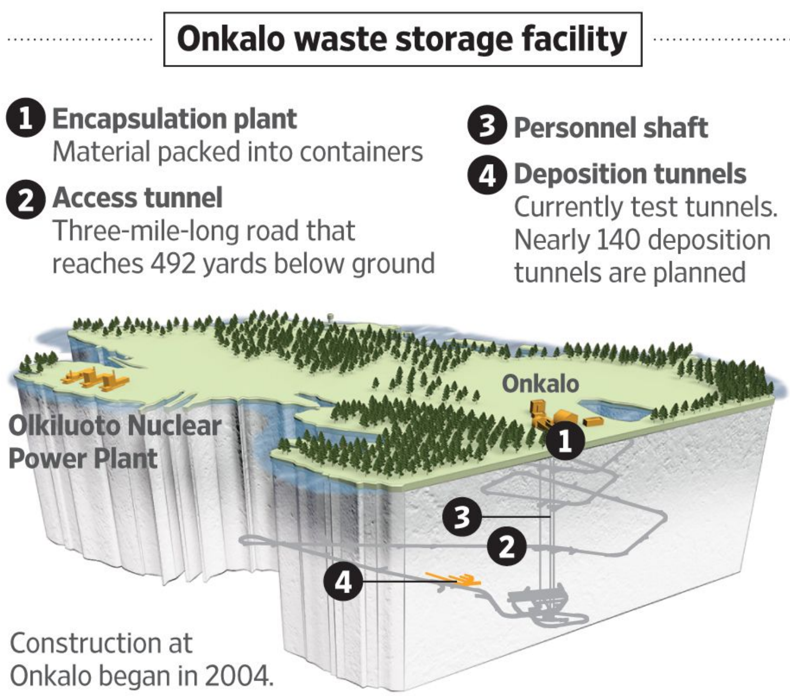
## Background Information

### History

With the increase of global climate change, nations are trying to find an alternative to fossil fuels. one in all the most effective alternatives to fossil fuels is atomic energy, because it produces energy that's on par with fossil fuels, and emits significantly less carbon into the atmosphere. The problem with energy is that after the ore has been completely used and can't produce from now on energy, the uranium becomes useless, but remains to be highly radioactive, making it a challenge to dispose. When thinking of problems that demand long-term solutions, nuclear waste management involves mind rather quickly. With half-lives starting from 30 to 24,000, or perhaps 16 million years, the radioactive elements in nuclear waste defy our typical operating time frames. The question of how best to cater to that waste has been a matter of intense debate since the 1950s when the primary electricity-generating nuclear reactors were built. Despite the short-term considerations that have hampered efforts to develop a nuclear waste management system, there's still the long-term nature of the matter.

### Storage and Disposal

Nuclear energy plants store spent fuel in areas called “spent fuel pools” These pools are fabricated from concrete several feet thick. The water in these pools are typically 40 feet deep and serves both to shield the radiation and cool the waste. When these pools are near capacity, the older spent fuel is moved into places called the “dry cask” storage. These storage canisters are products of stainless steel surrounded by concrete. Both the spent fuel pools and dry casks both provide adequate protection for public health and safety and also the environment. The spent fuel storage at power station sites is taken into account temporary, because the ultimate goal is permanent disposal. At this point, there aren't any facilities for permanent disposal of HLW.




*Caption #1: Plants for the Onkalo waste storage facility in Finland.*

## Major Countries and Organizations Involved

### United States of America

In the United States, after nuclear fuel gas has been in a reactor for about five years, it is removed in bundles of nuclear fuel, which is then sent for permanent storage, in a 40 feet deep cooling pool, allowing decay to occur, removing 87% of the initial radiation. After the fuel is cooled, it's placed during a concrete and steel container which needs little maintenance. The waste that the U.S. nuclear industry has created since the 1950s has taken up a comparatively low amount of space and is safely contained. The U.S handles waste with compliance to the U.S Nuclear Regulatory Commission, the U.S. Department of Energy, and the U.S. Environmental Protection Agency, setting a really high standard for handling nuclear waste.

### France

France has one of the world's largest nuclear energy power plant fleets in the world, beaten only by the US. The cheap and abundant energy produced by these assets provides up to 75% of the country's power supply and has made France one amongst the biggest net exporters of electricity within the world. Along with energy, however, this fleet is also responsible for producing a significant amount of spent nuclear fuel and radioactive waste. Although there are short-term solutions in getting rid of high-level waste like storing the waste, there's no long run solution to the current problem as of now.

### People's Republic of China

The management system of radioactive waste consists of the institutional system and the regulatory system. During the last 30 years, more than 50 national standards and trade standards are issued, are published, or are being prepared, covering essentially all the methods of waste management. The Accompanying Mineral radioactive wastes can be stored within the tailing dumps or connected to the storage place for temporal storage, then transported to the nearby tailing dumps of installation or tailing dumps of mineral-accompanying waste for eventual storage.

### Russian Federation

The end of World War II, and also the beginning of the active development of nuclear energy generation within the USSR, and later Russia, resulted during a significant increase within the volume of accumulated nuclear waste within the country. Most of this waste has never been the topic of any disposal or treatment within the country which led to significant growth of its accumulated volumes. Consistent with various assessments, the current volume of accumulated nuclear waste in Russia is estimated at a total of 500 million tonnes, with figures continuing to grow.

### United Kingdom

All of the UK's nuclear waste is securely contained with an ever-increasing amount being solidified to make it suitable for long-term management. Other countries have already demonstrated how safe and secure long-term management and permanent disposal of nuclear waste is possible. Countries like Finland and Sweden are within the process of constructing deep geological radioactive material disposal sites.

### Finland

Finland has made massive efforts in terms of nuclear waste management with its new nuclear waste disposal project, the Onkalo spent fuel repository. This deep geological disposal facility is being in-built Olkiluoto, off the south-west coast of Finland, near one amongst the country's nuclear energy plants. Up to approximately 450 meters below ground level, spent fuel from all of Finland's atomic power reactors are going to be isolated in Onkalo for thousands of years.

### Norway

The Norwegian Nuclear Decommissioning Agency (NND) said that one among Norway's most vital tasks are to determine a repository for the disposal of all of Norway's radioactive material. This, it noted, includes the high-activity long-lived used fuel from the 2 research reactors, waste from their decommissioning, further as radioactive sources from medicine, research, and industry. Norway has about 17 tonnes of fuel, which is currently stored at Halden and Kjeller. While a number of this fuel can be placed directly into a repository, around 10 tonnes of it's unstable metallic fuel.

### International Atomic Energy Agency (IAEA)

A number of disposal options are developed for the ultimate management of radioactive material. The choices reflect variations within the amount and characteristics of various waste types, the specifics of national legislation, and geological differences. International projects and dealing groups are organized to figure towards harmonization of approaches to the protection of radioactive material disposal and to supply a forum for exchanges for the Member States.

### United States Nuclear Regulatory Commissions (U.S. NRC)

The NRC has the responsibility to control facilities used primarily for receiving and storing HLW from activities defined under the Atomic Energy Act. They even have the responsibility to conduct research and develop facilities that are authorized for the express purpose of long-term storage of radioactive generated waste.

### The Department of Energy  (DOE)

The DOE carries out programs for the safe handling of radioactive wastes, develops waste disposal technologies, and can design, construct and operate disposal facilities for commercial HLW.

### Environmental Protection Agency (EPA)

The Environmental Protection Agency develops environmental standards for federal radiation protection guidance for offsite radiation caused by the disposal of spent fuel, HLW, and radioactive wastes. They limit the quantity of radioactive material entering the biosphere outside the boundaries of the facility, while also limiting the radiation exposure to the general public from management of spent fuel and waste before disposal.

### The Department of Transportation (DOT)

The Department of Transportation regulates the packaging and carriage of all hazardous materials including radioactive material. The DOT sets limits for external radiation levels and contaminations, while also controlling the mechanical condition of carrier equipment and therefore the qualifications for career personnel.

### The Department of the Interior (DOI)

The Department of the Interior conducts laboratory and field geological surveys in support of the waste disposal programs and works on natural science technical activities. The Bureau of Land Management, within DOI, manages certain public lands. DOI can withdraw public lands for the exclusive use of disposing of radioactive waste..

## Timeline of Events

| Date | Description of event |
|---|---|
| December 2nd, 1942 | The first nuclear reactor was built |
| 1951 | An experimental nuclear reactor in Idaho produces the world’s first useable electrical power |

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|---|---|
| 1954 | The Soviet Union opens a nuclear plant in 1954 to get electricity for an electricity grid |
| 1956 | Britain opens the first commercial nuclear power station for civil use |
| July 29th, 1957 | The International Atomic Energy Association (IAEA) was founded |
| 1979 | A plant at Three Mile Island experiences a major failure, resulting in a partial meltdown of the core and releasing radioactive material into the atmosphere |
| 1986 | Chernobly power station near Kiev sends radioactive dusts across western Europe |
| 1996 | Tokyo Electric Power Co Inc (TEPCO), starts commercial operation of the world's first advanced billing water reactor (ABWR) |
| 2005 | Finland approves construction of one of the world's largest nuclear power plants |
| 2007 | France starts construction on the Flamanville 3 reactor |
| 2012 | Japan shuts down it's last working nuclear power reactor after the nuclear disaster |
| April 2014 | Construction of the Onkalo underground research facility was completed |

## Relevant UN Resolutions and Treaties

- Effects of atomic radiation (**A/RES/69/84**)
- Report of the International Atomic Energy Agency (**A/RES/69/7**)
- Prohibition of the dumping of radioactive wastes (**A/RES/56/24**)
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. 5 September 1997

## Possible Solutions

**Create a permanent storage facility under the surface for High-Level Waste.** The long-term solution currently preferred by specialists consists of placing the waste in a very deep hole about five hundred feet below the surface. The stable geological settings, like granite, clay, tuff, and salt formations that have remained virtually unchanged for many years. The aim is to make sure that such wastes will remain undisturbed for the few thousand years needed for his or her levels of radioactivity to say no to the purpose where they do not represent a danger to present or future generations. Finland has already begun to implement this solution and are already storing their waste in a very secure facility many feet below the surface. The biggest problem for this solution is that we've got no way of telling future generations that this site is dangerous and may not be dug up, since new generations might discover the location and be curious enough to obtain the radioactive material.

**Allowing the radioactive material to decay in storage.** For used fuel designated as high-level radioactive material, the primary step is storage to permit decay of radioactivity and warmth, making handling much safer. Storage of used fuel could also be in ponds or dry casks, either at reactor sites or centrally. Beyond storage, many options are investigated which seek to supply publicly acceptable, safe, and environmentally sound solutions to the ultimate management of radioactive material. The foremost widely favored solution is deep geological disposal. This is often a short- term solution and can eventually result in storing radioactive material in a very deep geological disposal facility once 75% of the radioactive material has decayed.

**Create a consent-based siting and pilot interim storage process.** This process is implemented to make sure that communities are comfortable with the situation of future storage and disposal facilities before the development process begins. This is able to also add on the primary step for commercial spent fuel on the event of a pilot interim storage facility which will mainly accept used fuel from reactors that are close up. This may support the various elements of an integrated waste management system, and also emphasize the importance of a consent based approach to siting waster and storage and disposal facilities throughout the choice making process.

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