Introduction

Many countries around the world today have the capabilities to operate nuclear power plants for the generation of energy, which may be used to power basic and necessary infrastructure, such as the electricity grid. As a result, nuclear power produced 10.9% of the world’s electricity production in the 2012 calendar year. Nuclear energy could help reduce carbon emissions and other green gases, however, radioactive waste, as a byproduct of such processes, may outweigh this advantage. Radioactive waste, unlike that of materials in other industries, poses a significant hazard to people and the environment. Although the amount of waste is small, relative to that of other industrial processes, its toxic nature makes the management of radioactive waste an important issue for countries to address. As radioactivity is decreased over time, the wastes are held in a monitored and secure storage facility, usually a geologic repository, until it is deemed by tests to be no longer radioactive, and can be integrated back into the environment or disposed of as regular trash.

Considering the previous dangers associated with nuclear power generation alone, such as the accidents in Chernobyl in 1986, in the Three Mile Island Nuclear Reactor in 1979, the effects of heat waves in Europe in 2003, and Fukushima in 2011 it is clear that this is an issue of serious concern and actions should be taken to prevent such incidents in the future. When taking into account the potential dangers of radioactive waste as well, the effects of any mistakes may be catastrophic.

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3 Ibid.
On the plus side, however, nuclear energy does not produce carbon dioxide, nitrogen oxide, or sulfur dioxide emissions, making it the only renewable, clean-air source of energy operating 24/7. Therefore, the radiation and radioactive wastes are the only downside, to the use of normal day-to-day operations of nuclear energy production. In normal, day-to-day operations little radiation is emitted. In fact, studies have concluded that no health effects were measured on neighboring populations. That is of course, only with the proper monitoring of such facilities. It is paramount for nations with the capabilities for the creation of nuclear energy to maintain high standards for inspections of facilities and the waste, as well as develop storage facilities to hold the waste as it reduces in radioactivity over time.

7 Ibid.
8 Ibid.
Definition of Key Terms

Radioactive waste:
A byproduct of nuclear reactors, as a result of nuclear fission.⁹

Low-level waste (LLW):
There are two general types of nuclear waste: low-level waste (LLW) and high-level waste (HLW). Low-level waste is defined as all radioactive wastes which are not considered high-level waste, because of their relatively low levels of radiation. Low-level waste is typically deposited in near-surface facilities, instead of geologic repositories because of their relatively low level of radiation.¹⁰

High-level waste (HLW):
Generally defined as the uranium fuel that has been used up, so to say, and can no longer be used for the production of electricity in a reactor. During nuclear fission, two things happen to the uranium fuel: the uranium atoms split which generates heat to create electricity and creates lighter radioactive isotopes. These are called fission products, which account for a big part of HLW. The other thing that happens is that some uranium atoms gain neutrons, forming heavier isotopes, called “transuranic” elements. These elements cannot be used to create electricity, so they are waste, called TRU. However, this waste takes a long time to decay. For example, plutonium-239 has a half-life of 24,000 years, meaning that it will only lose half of its radioactivity after 24,000 years.¹¹ HLW is extremely hazardous in direct exposure and is therefore stored in highly secured storage facilities.¹²

Nuclear fission:
The splitting of uranium atoms to produce heat. The heat is used to make water into steam, which in turn spins a turbine to generate electrical power.¹³

Renewable energy:
Energy which is produced from a relatively limitless supply of fuel. This energy is usually collected from the sun, wind, or water.¹⁴

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¹⁰ Ibid.
¹¹ Ibid.
¹² Ibid.
¹³ Ibid.
Radiation:
Particles which are emitted by a nucleus of an atom during the fission process. They are usually alpha, beta, and gamma rays, meaning that they are hazardous in direct exposure.\textsuperscript{15}

Geological repository:
An underground facility which is designed to permanently store and secure HLW.\textsuperscript{16}

Geological disposal:
The temporary disposal of HLW, or other radioactive wastes, in a geological repository until it is deemed no longer dangerous for regular waste disposal.

Reactors:
The facility in which uranium atoms are split during the fission process.\textsuperscript{17}

\textsuperscript{14} Ibid.
\textsuperscript{15} Ibid.
\textsuperscript{16} Ibid.
Nuclear Fuel:
Material which can be used during the fission process and will support a chain reaction to power a nuclear reactor, and as a result, generate energy.18

Background

Radioactive waste comes from the used up nuclear fuel, usually from reactors, processing plants, and research facilities. Additionally, such waste is produced when facilities and reactors, which were used to process nuclear fuel, are decommissioned.19 The byproduct, radioactive waste, falls into two categories: high-level waste and low-level waste. The first is typically removed directly from reactors while the latter can come “from medical, academic, industrial, and other commercial uses of radioactive materials” as well.20 Radioactive wastes are held in storage facilities until they are no long considered as such, which depends on the isotopes. In the United States, for example, the waste is sent to fuel pools. These are big pools of water, enclosed with concrete. The industry standard for cooling the radioactive waste is 10 years, after which it is moved to something called “dry cask” storage, in big steel containers. They provide sufficient protection for the public and do not require constant monitoring or security; as a result the waste can be kept there until it is no longer rendered as radioactive, allowing for its disposal.21 Currently, countries are responsible for their own waste, for ethical and legal reasons. All international waste is governed under the Nuclear-Non-Proliferation Treaty, or the NPT, and each nation, expect for India, Pakistan, Israel, and the DPRK should treat their waste in accordance with the agreement.22 The international community strongly agrees that the best way to dispose of HLW is through geological disposal.23 Additionally, the International Atomic Energy Agency (IAEA) created an international treaty in 1997, signed by most nations around the world, to regulate the

20 Ibid.
21 Ibid.
management and disposal of processed fuel, including HLW, and LLW. The treaty outlines that each country must use facilities and systems which are in line with the highest standards.\textsuperscript{24} Furthermore, Yukiya Amano, the Director-General of the IAEA encourages all nations to maintain tight control and supervision over the nuclear fuel from its creation until is to disposed of. He also called for MEDCs to share their expertise with LEDCs in the field, saying “I strongly encourage countries with existing nuclear power programs, and experience of the back end of the fuel cycle to share their experience with newcomer countries to ensure that best practice is implemented everywhere.”\textsuperscript{22} because “the volume of spent fuel will…continue to grow and it is essential that it is managed safely.”\textsuperscript{26} In comparison to the amount of other forms of waste, such as fossil fuels, radioactive waste is relatively small and is neither as hazardous nor hard to manage as that in other industries.\textsuperscript{27} In fact, the nuclear power industry is the only one which takes full responsibility for all of its waste.\textsuperscript{28} In terms of financials, the costs of the management and complete disposal of radioactive waste are only 5% of the total price of the electricity generated. However, this cost is usually factored into the total price of the electricity.\textsuperscript{29}

**Parties and Organizations Involved**

**International Atomic Energy Agency**

The IAEA is the largest international organization involved in the oversight of scientific and technical operations in the field of nuclear energy. It is also responsible for the development and implementation, through the UN, of policies which aim to make the world safer and more peaceful in accordance with the Sustainable Development Goals.\textsuperscript{30} The IAEA has pushed for the better regulation of nuclear fuel and waste and implemented a treaty to better regulate the management and disposal of such wastes.


\textsuperscript{26}Ibid.


\textsuperscript{28}Ibid.

\textsuperscript{29}Ibid.

\textsuperscript{30}“Overview,” *International Atomic Energy Agency*, https://www.iaea.org/about/overview/.
**Countries which generate nuclear energy**

The issue of nuclear waste is specifically targeted at nations which possess the ability to generate nuclear energy, as the waste is the byproduct. According to the European Nuclear Society, 31 countries operate a total of 442 nuclear power plants. In addition, 66 more are under construction.\(^{31}\)

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<th>Country</th>
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Nuclear Energy Agency

NEA is an intergovernmental organization which works with countries to improve cooperation between them on advanced nuclear technologies, safety, and law.  

The organization's mission statement is “to assist its member countries in maintaining and further developing, through international cooperation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes. To provide authoritative assessments and to forge common understandings on key issues as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.”

The NEA has 31 members: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

UN Resolutions/Important Documents

- Non-Proliferation of Nuclear Weapons Treaty (NPT) (INFCIRC/140)
- S/RES/1373
- S/RES/1540
- A/RES/49/75
- A/RES/48/75
- A/RES/68/53
- A/69/255
- A/RES/1665
- S/RES/1887

33 Ibid.
34 Ibid.
Timeline of Major Events

1957 – International Atomic Energy Agency (IAEA) founded.35

1960 – France conducts first nuclear tests.36

1961 – United Nation General Assembly approves Resolution 1665.37

1964 – China conducts first nuclear tests.38

1968 – Nuclear Non-Proliferation Treaty (NPT) signed.39

1970 – NPT goes into effect with 46 signatories.40

1988 – Board on Radioactive Waste Management studied and cooperated with the US government to find the effects of spent fuel and high-level waste, improve policy on the issue.41

1995 – Review Conference of NPT in New York.42

1995 – Nuclear Energy Agency (NEA) published a study on safety issues of HLW.43

2000 – NPT signatories agree to Review Conference in 2000.44

37 Ibid.
38 Ibid.
2003 – DPRK withdraws from NPT.45

2006 – DPRK conducts first nuclear tests.46

2009 – UN Security Council approves Resolution 1887.47

46 Ibid.
47 Ibid.
Possible Solutions

Improving Infrastructure
As the use of nuclear energy increases, as a form of sustainable energy, new infrastructure needs to be developed for the safe storage and transport of radioactive wastes to protect the environment. New developments need to be made in the capabilities and capacities of current disposal systems.

Deep Geological Disposal
Specialists in the area agree that the best long-term solution is the “placing of waste in a deep (500 meters 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 hope is that the waste will stay there for a long time and decay as to not pose a danger to future generations. Such a system would take a long time to implement universally.

Increased Financing
Costs are the single most important concern, aside from environmental ones, for radioactive waste disposal, as it is essential for countries to set aside an adequate budget in order to properly allocate resources and safely manage the disposal process.

Involvement of the Private Industry
Governments should help the private industry, potentially through subsidization, to develop methods to reduce the dangers of radioactive wastes.

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49 Ibid.
50 Ibid.
Bibliography


