

Nuclear Energy's Environmental Imperatives A Global Perspective: Imperatif Lingkungan Energi Nuklir Sebuah Perspektif Global

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This study explores the requirements and prospects of utilizing nuclear energy amid the global energy crisis, focusing on environmental considerations, regulatory frameworks, and sustainable deployment strategies. Drawing on multidisciplinary approaches and insights from renowned scientists, it examines the environmental impact assessment measures, international agreements, and development prospects associated with nuclear energy. The findings underscore the importance of stringent environmental standards and sustainable deployment strategies for ensuring the viability of nuclear energy as a crucial component of the global energy mix, offering valuable insights for policymakers and stakeholders in the energy sector.

Highlights:

- Comprehensive analysis of nuclear energy's environmental requirements.
- Examination of international agreements regulating atomic energy.
- Importance of sustainable deployment strategies amidst the global energy crisis.

Keywords: Atom Energy, Radiation Problems, Disaster, Harmful Emissions

Introduction

Many things are unknown to us about atomic energy, which has been perplexing the whole world from the beginning of the 20th century to the present. Atomic energy, an unparalleled source of electricity, has opened the doors of a new era for the world. At the time of the current energy crisis in the world, the source of cheap energy is important for all countries. It's no secret that the need for electricity is growing due to the fact that the population is increasing day by day, business is developing, energy processing technologies are covering our lives. Nuclear energy is important in meeting global energy demands for several reasons. First, it is a highly efficient energy source because a small amount of nuclear fuel produces a large amount of electricity[1]. This makes it a cost-effective option for large-scale power generation. However, if we look at the other side of the coin, nuclear energy emits very harmful radiation and poses a threat to the health and future of the population. In the following places, the importance of international environmental requirements for the placement of nuclear power facilities will be explained. Environmentally positive and negative aspects and consequences of the construction process of the NPP (nuclear power plant) expected to be built in the Republic of Uzbekistan are studied and recommendations are made[2].

Methods

Before a broad approach to the issue, it is necessary to form a little idea about the process of how nuclear energy is produced. Atomic energy is a form of energy produced during nuclear reactions. In many sources, atomic energy is referred to as nuclear energy. In general, atomic energy is the energy obtained from atoms. In practice, scientists consider two types of nuclear energy

production. The first type is the method of synthesis, i.e. the synthesis reaction, and the second is the method of division or decomposition. During a fusion reaction, two atoms combine to form a single atom. In the process of combining atoms, strong energy is generated in the form of heat. Most of the solar energy is produced as a result of the fusion reaction that takes place in the Sun. It is a type of nuclear energy[1].

Various scientists and politicians have emphasized that atomic energy is useful in the course of human life. Nevertheless, the dangers caused by atomic energy and the damage caused to the environment as a result of their catastrophic accidents have been shown by the unfortunate events related to NPPs in the past. In addition, it is not a secret to anyone that the desire to use atomic energy on a wide scale is bringing political processes to a climax in the international arena. Currently, the process of urbanization of cities in many countries (according to the analyzes of the United Nations Department of Economic and Social Affairs, by 2050, approximately 68% of the people on Earth will live in cities[2]) is necessary to provide them with energy. countries are forced to use different ways to provide. Ignorance of some issues related to the use of nuclear energy by the states poses a risk of causing serious environmental situations. The most important concern is the disposal of nuclear waste, because radioactive waste does not lose its danger for thousands of years. There are also safety concerns, as accidents such as Chernobyl and Fukushima have highlighted the potential dangers of nuclear power.

While nuclear power offers advantages such as low carbon emissions and reliable power generation, it also poses a number of environmental challenges. Some of the main issues related to nuclear energy include:

1. Nuclear Accidents

Despite strict safety measures, nuclear accidents are still possible. In the event of a major incident such as a reactor meltdown or containment breach, radioactive materials can be released, resulting in environmental contamination, health hazards, and long-term environmental damage. Everyone remembers the explosion at the Chernobyl nuclear power plant. As a result, millions of people were irradiated, hundreds of villages were displaced and rendered uninhabitable, the station was buried in thick concrete, but the environmental situation around it remains dangerous.[3]

2. Water Pollution

Nuclear power plants require large volumes of water for cooling. The heated water returned to the environment can cause pollution, which has negative effects on aquatic ecosystems and fish populations.

3. Non-Renewable Resource

Uranium, the primary fuel for nuclear power, is a finite resource. Although there are significant reserves of uranium globally, their extraction and processing contribute to carbon emissions and environmental degradation. Dependence on nuclear energy can lead to resource depletion if not managed sustainably.

4. Environmental Hazards of Uranium Tailings

Uranium mining and processing produces waste known as tailings. These wastes contain radioactive and toxic elements that pose a threat to the environment and human health if not properly managed. Spills or accidental releases of waste can contaminate soil, groundwater, and surface water.

5. Nuclear Proliferation and Safety

The use of nuclear energy raises concerns about nuclear proliferation and safety. The diversion of nuclear materials for illegal purposes, accidents at nuclear facilities, or terrorist attacks pose significant environmental risks, including releases of harmful materials and radioactive contamination.

Several scientists have expressed their opinions on the use of atomic energy and its deployment. For example, I.I. Kryshev, L. A. Kuryndina and I. I. Lingelar developed the methodology of damage to the environment as a result of the use of nuclear energy [4]. G. Guidi, F. Gugliermetti and A.C. Violentas, comparing the effects of nuclear energy on the environment and its alternatives, if the external effects are taken into account and the environmental policy is made stricter, the economic competitiveness of nuclear energy can be significantly increased, R.M.Aleksakhin considers radioactive as the main environmental problems of the development of nuclear energy. that radiation accidents associated with waste and spent nuclear fuel processing, release of radionuclides into the environment[5]. A.I.M. Aly and R. Hussien studied the impact of various energy sources on the environment and mentioned in their research work the negative impact of nuclear energy on the environment and its consequences[6].

Addressing these environmental challenges requires strong regulatory frameworks, strong safety measures, an effective waste management strategy, and a commitment to transparency and public participation. Considering the long-term well-being of the environment and future generations, it is essential to continuously improve nuclear safety, minimize environmental risks and explore sustainable alternatives to meet energy needs[7].

An international legal convention on disasters that may occur as a result of atomic energy has been adopted. An example of them is the Vienna Convention of the International Atomic Energy Agency (IAEA) in 1963 (entered into force in 1977) [7]. Organization for Economic Co-operation and Development (OECD) 1960 Paris Convention on Third Party Liability in the Atomic Energy Sector (entered into force 1968) 1963 Brussels Supplementary Convention [8] Additional compensation for nuclear damage There are many international legal documents, such as the Convention on the Safe Transport of Radioactive Materials [10]. These documents are the most important documents that determine the international environmental requirements for the placement of NPPs[8].

Results and Discussion

One of the important aspects that underlines the importance of international environmental requirements for the deployment of nuclear energy is the potential risks associated with the release of radioactive materials into the environment. Given the wide-ranging impact of nuclear accidents such as Chernobyl and Fukushima, countries are required to adhere to strict global regulations aimed at preventing and managing nuclear disasters. These requirements ensure that appropriate safety protocols are in place, including regular inspections of nuclear facilities, emergency plans, and effective waste disposal practices. By complying with these international environmental requirements, countries can mitigate risks to the environment and human health associated with the deployment of nuclear power, promoting the sustainable and safe use of this energy source globally[9].

The International Atomic Energy Agency (IAEA) provides comprehensive guidelines and requirements for nuclear power plant (NPP) siting to ensure safety, environmental protection and sustainability. These requirements include a number of environmental, technical and social considerations. The main requirements of the IAEA, which should be taken into account when choosing a place, are discussed below[10].

1. It is Emphasized that Safety Rules must be Followed when Choosing a Place

It emphasizes the consideration of geological stability (eg seismic activity, volcanic activity),

hydrological conditions (eg floods, water supply) and meteorological factors (eg extreme weather conditions).

2. Environmental Impact Assessment (EIA)

A thorough assessment should be conducted to understand and mitigate potential impacts on the local environment and biodiversity. This includes assessing potential impacts on air, water and soil quality and local wildlife and ecosystems.

3. It should be Kept away from Areas Prone to Earthquakes

Tsunamis, floods, landslides and other significant natural hazards and the population density in the vicinity of the proposed area should be taken into account in order to minimize the risk to human health in the event of an accident.

4. Environmental Protection should be Considered

This includes assessing and controlling potential radiological impacts on the environment, including measures to manage and reduce radioactive emissions to air, water and soil, and non-radiological impacts such as thermal pollution from cooling systems, chemical emissions, noise and visual impacts. consideration should be given to environmental impact assessment and management[11].

5. Attention should be Paid to Sustainability and Protection of Natural Resources

This includes ensuring that the NPP has sufficient and reliable water resources for cooling purposes without significantly impacting local water supplies and ecosystems, and addressing existing land use and potential conflicts such as agriculture, residential areas and impact on protected natural areas should be considered [12].

6. It is Necessary to be Ready for Emergency Situations and Response Measures Against

it This should ensure that the NPP is open to emergency response teams and has the infrastructure for rapid evacuation if needed. It is also necessary to develop and implement emergency zoning and planning measures to protect the population and the environment.

7. Participation of the Public and Interested Parties should be Ensured

Engage with local communities, stakeholders and the public to inform the site selection process, potential impacts and safety measures, and address concerns and incorporate stakeholder and public input into the decision-making process for NPP construction. "Shish is necessary [13].

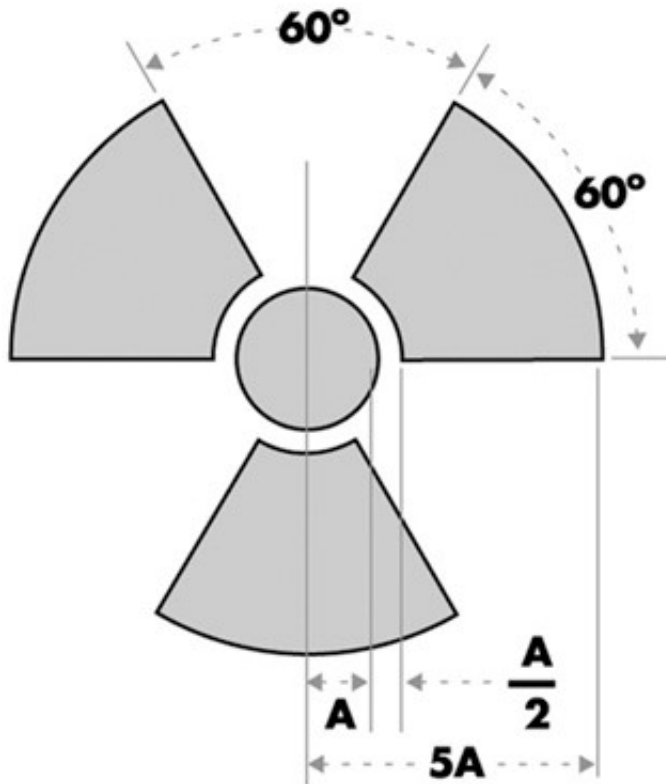
8. There must be Regulatory Compliance

In this, first of all, national regulations and international standards, including IAEA safety standards and instructions, regulations governing periodic inspections and assessments to ensure continuous compliance with environmental and safety requirements throughout the entire operation of the Nuclear Power Plant should be developed.

Another requirement is that the public insists that NPPs should be built as far away from residential areas as possible. Site Assessment for Nuclear Facilities [14] specifies the requirements for determining the information used in the facility assessment process and for assessing the specific hazards and safety-related features of the facility for the location of nuclear facilities. Also, it is part of international environmental law that the location of the NPP under construction should not harm the residents of the neighboring area[15].

The international standard radiation symbol is shown in the figure below when placing zones. This

must be visible on all signs denoting controlled areas for radiation safety purposes and on container labels indicating the presence of radioactive materials [16].



Cross-hatched area is to be magenta or purple. Background is to be yellow.

Figure 1. Radiation sign

Controlled areas are often specially designated to ensure radiation safety. Such areas are prominently marked with a radiation sign and "Caution, Radiation Protection", "Caution Radiation Area" or "Radiation Area".

Due to the reforms implemented in our country, society's life is improving. The construction works of NPP have also started in Uzbekistan. But every Uzbek citizen is worried about the question of how well its location meets environmental requirements and standards. In addition, it was reported that the neighboring Kazakhs oppose the construction of a nuclear power plant, which is expected to be built by Uzbekistan for the first time in Central Asia [17]. They said that the nuclear energy project, which is supposed to be built 50 km from the border of Kazakhstan, should be done in cooperation with neighboring countries. The IAEA safety rules state that NPPs in one country should not harm another country. However, based on official information, the government of Kazakhstan has not expressed its official attitude towards the NPP planned to be built by Uzbekistan. However, we believe that Uzbekistan should carry out evaluation and expertise on this issue and assess the level of risk to neighboring countries[18].

Conclusion

Taking into account the above circumstances, we can make the following conclusions and put forward some recommendations. Non-compliance with the rules for the use of nuclear energy causes the death of thousands of innocent people. This is shown by the NPP accidents that have occurred over the years. For this reason, we believe that it is necessary to establish a committee under the UN that conducts technical inspections of NPPs every 5 years by the IAEA. Also, it is

necessary to unite the countries with nuclear power plants into a single convention on the use of atomic energy. It is necessary to enshrine public opinion on the location of NPPs in the national legislation. Chapter 3 of the Law of the Republic of Uzbekistan "On the Use of Atomic Energy for Peaceful Purposes" does not contain any provision that determines the procedure for hearing and agreeing with the public opinion on the placement and construction of a nuclear device and (or) storage facility. On the one hand, this leads to violation of IAEA requirements.

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