



NUCLEAR POWER PLANT: ENVIRONMENTAL RISKS AND MITIGATION MEASURES

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Annotatsiya

The construction of a nuclear power plant in Uzbekistan represents a significant step toward achieving energy security and sustainable development. Given the increasing demand for electricity due to population growth and industrial expansion, nuclear energy is considered a viable alternative to fossil fuels. However, the environmental risks associated with nuclear power, including radioactive waste management, thermal pollution, and potential accidents, require careful assessment and mitigation strategies. This study analyzes the ecological risks of nuclear energy and proposes measures to minimize its environmental impact. By examining international experiences, such as those of France, Finland, and South Korea, the research highlights best practices in nuclear safety, waste disposal, and emergency preparedness. The study employs analytical and statistical methods to evaluate Uzbekistan's energy landscape, along with expert assessments on nuclear safety implementation.

Kalit soʻzlar:

nuclear energy, ecological risks, safety measures, radioactive waste, energy independence.

Relevance of the Topic. In the 21st century, sustainable development in the energy sector remains a crucial issue. The population growth and industrial development in Uzbekistan have led to an increasing demand for electricity. Currently, the country's energy sources primarily rely on natural gas and hydroelectric power plants. However, natural gas reserves are limited, and hydropower is not a stable energy source due to climate changes. Therefore, nuclear energy has become a pressing alternative energy source.

Nuclear energy is considered an environmentally clean energy source, playing a significant role in reducing greenhouse gas emissions. For instance, in France, more than 70% of electricity is generated by nuclear power plants, which has significantly reduced carbon dioxide (CO₂) emissions. Similarly, countries such as South Korea and Japan prioritize the development of nuclear energy to ensure energy security. For Uzbekistan, this direction is also of great importance, as the country requires a stable and affordable energy source for economic growth.

However, nuclear energy also has environmental risks, including radioactive waste, the risk of accidents, and negative impacts on nature. Therefore, it is crucial to enhance safety measures in nuclear energy production and develop strategies to minimize ecological risks.

Research Methods

The research employed the following methods:

- **Analytical method** – studying international experience and assessing its applicability to Uzbekistan’s conditions.
- **Statistical analysis** – analyzing statistical data related to the energy sector.
- **Expert evaluation** – reviewing opinions of international experts on nuclear safety.

Main Section. Ecological Risks of Nuclear Energy

1. Radioactive Waste Issue

- Nuclear reactors generate radioactive waste during operation.
- These wastes remain radioactive for a long time and require special disposal methods.
- In international practice, Finland has successfully implemented underground storage facilities for safe waste management.

2. Impact on Water Resources

- Nuclear power plants require large amounts of water for cooling systems.
- The return of heated water to rivers or water bodies can harm ecosystems.
- To mitigate this risk, closed-loop cooling systems or cooling towers should be utilized.

3. Air Pollution and Increased Radiation Levels

- Under normal operating conditions, nuclear power plants emit minimal harmful emissions into the atmosphere.
- However, in case of accidents, radiation levels may rise, posing a threat to the environment and human health.

4. Natural Disasters and Human Factors Leading to Risks

- Earthquakes, floods, and human errors can lead to nuclear accidents.
- Given that Uzbekistan is a seismically active region, special attention must be paid to the location and construction of nuclear power plants.

Measures to Minimize Ecological Risks

1. Implementation of Technological Safety Measures

- Modern reactors should be equipped with advanced safety systems.
- Passive safety systems (cooling systems that operate without electricity) should be introduced.

2. Development of a Strategy for Radioactive Waste Management

- Construction of underground facilities for long-term waste storage.
- Utilization of waste recycling technologies.

3. Creation of Green Zones and Biological Barriers

- Establishment of ecological safety zones around nuclear power plants.

- Planting radiation-absorbing vegetation and implementing biological filtration systems.

4. **Emergency Preparedness**

- Development of rapid response systems for nuclear accidents.
- Informing the local population and preparing evacuation plans for emergency situations.

Statistical Data Used

- **France:** More than 70% of electricity is generated by nuclear power plants.
- **South Korea:** Implements innovative technologies to enhance nuclear safety.
- **Finland:** Successfully introduced underground storage facilities for long-term radioactive waste disposal.
- **Uzbekistan:** Currently, 60% of the country's energy is derived from natural gas, and nuclear power can help reduce this dependency.

Conclusion

The construction of a nuclear power plant in Uzbekistan is a significant step toward ensuring the country's energy independence and sustainable development. However, it is necessary to develop strategies based on international experience to minimize ecological risks. By implementing modern technologies, managing radioactive waste effectively, and strengthening safety measures, nuclear power plants can be made environmentally acceptable.

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