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International experience of legal regulation of nuclear energy use and its development in other countries

This article provides an overview of the global experience in legal regulation in the field of nuclear energy. It focuses on the evolution of legislative approaches in leading foreign countries, analyzing both international legal initiatives and national legislation. The article also considers modern challenges related to nuclear safety, liability, and the development of new technologies aimed at environmental sustainability. The purpose of the study is to analyze various approaches to legal regulation of the nuclear industry, assess the effectiveness of current mechanisms, and identify key trends and principles that contribute to safe and sustainable nuclear energy development at the national and international levels. This forms the basis for recommendations on developing a national regulatory framework based on best international practices and the recommendations of the IAEA. Additionally, we can identify ways to harmonize national legislation with international standards and obligations. The methodological foundation is a comparative analysis of legal institutions, norms, and approaches to nuclear energy regulation in various countries. Through the comparative legal method, the study highlights differences in legislative systems, regulations, and enforcement practices among leading nuclear states. This also allows us to identify common trends and effective regulatory models. As a result, the study identifies key features of global experience in legal regulation of nuclear energy use and outlines main trends in its development abroad. Foreign experience provides us with valuable lessons and examples that can be effectively applied in our national legal framework to ensure the safe, sustainable, and socially acceptable use of nuclear energy.

Keywords: nuclear energy, legal regulation in the field of atomic energy use, nuclear energy, nuclear safety.

Introduction

The modern world is undergoing significant changes in the energy sector, posing new challenges for countries seeking to ensure energy and economic security. Against the backdrop of global climate change, efforts to reduce greenhouse gas emissions, and the digital transformation of the energy market, nuclear energy has once again gained strategic importance as a stable, reliable, and low-carbon energy source. This issue is particularly relevant to the Republic of Kazakhstan, where nuclear power generation is not only a matter of energy security but also a strategic challenge that could ensure energy independence, environmental sustainability, and technological modernization. In this context, nuclear energy is not simply a technical or industrial resource; it is an essential element of national survival, strategic autonomy, and a tool for economic balancing.

The relevance of the research stems from the need to study relevant aspects and features of the legal regulation of nuclear energy. In today's world, there is a growing demand for nuclear power as a clean and reliable source of energy, but its widespread development requires proper legal regulation to prevent threats to nuclear safety and proliferation of nuclear weapons. For Kazakhstan, which is just beginning to implement its nuclear program, it is crucial to study and adopt the best international practices in legal regulation. This is essential for the successful and safe implementation of nuclear technology. However, replicating foreign models should not be an end in itself. It is important to consider the historical, political, economic, and cultural background of a country, as well as its unique legal system, when making decisions.

Based on this goal, the author identified the following specific research objectives: to identify the problems of nuclear safety guarantees and their solutions, areas of cooperation in this area in international and national dimensions; to consider the legal regulation of nuclear energy in certain foreign countries (USA, Canada, EU); to analyze current trends in the development of legal regulation and their relationship with energy and climate policy; to systematize the best practices of building regulatory bodies and legal regimes for countries starting the development of nuclear energy; to formulate proposals on the use of foreign experience

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in order to improve national legislation; to identify priorities for the development of legislation in the field of safety of nuclear energy use in the light of the prospects of the Republic of Kazakhstan.

The issues of the current state and trends of legal regulation in the field of the use of atomic energy at the international level, described in the work of V.V. Romanova, are the peculiarities of the legal regime of individual atomic energy facilities [1]. S.A. Lobanov, A.U. Nazarova, P.I. Chuvakhin [2] emphasize the problems in the effectiveness of international legal norms, various models of legal regulation of the nuclear industry in the USA and France, their advantages and disadvantages. In the works of M.S. Lizikova [3], Yu.V. Chernyakhovskaya, D.L. Korolkova [4], Sarah E. Boslaugh [5], R.A. Kurbanova [6] discusses issues of legal regulation of the nuclear industry in the United States and problems in the field of nuclear energy affecting energy and national security. V.A. Bogonenko [7, 8], considering the legal regulation of nuclear energy in France, notes a system that ensures a high level of safety and transparency, which is extremely important for a country in which nuclear energy occupies a dominant position in the energy industry. R.A. Kurbanov [9] notes the national system of EU requirements for nuclear safety.

Thus, these studies support the strategic priorities of state policy for the development of nuclear energy in foreign countries, considering the recommendations of international organizations, such as the IAEA, OECD/NEA and Euratom, and the practices of leading countries (USA, Canada, France). This makes it possible to develop a strategy as part of a decentralized, flexible and secure energy system. The priorities of nuclear safety and the integration of national legal systems into the global legal framework have been identified. This allows for the harmonization of domestic policies with the requirements of the international nuclear market, contributing to the strengthening of the energy independence of Kazakhstan.

Methods and materials

The methodological foundation of this research derives from the defined topic and the objectives, utilizing historical and dialectical approaches to analyze socio-legal phenomena scientifically. These methods make it possible to examine legal guarantees for nuclear safety in other countries from their social, legal, and institutional aspects. To address specific research questions, the study applies a methodological framework based on the dialectical relationship between the general, the specific, and the particular. Historical and legal methods are used to identify features and trends in globalization processes, their impact on nuclear safety, and the evolution of scientific perspectives and conceptual frameworks in the field. A comparative legal approach is used to compare the legal approaches to nuclear energy regulation in different countries with international standards. Through the use of structural and functional analysis, the trends and patterns in the legal regulation of nuclear energy abroad are systemized. The system-structural approach enables us to classify international legal standards for nuclear energy.

Discussion

The International Atomic Energy Agency's (IAEA) latest report on the status of nuclear reactors around the world as of December 31, 2022, indicates that there are currently 411 operating reactors and 58 additional reactors under construction [10]. This shows not only the significance of nuclear energy as a major trend of the 21st century, but also its continued development at a rapid pace with no signs of slowing down in the near future.

Nuclear power is a clean and efficient energy source that can help reduce carbon emissions and provide a stable and affordable source of electricity. It has the potential to play a significant role in achieving the United Nations' Sustainable Development Goals by 2030 and in combating climate change on a global scale.

The International Atomic Energy Agency (IAEA) and the International Energy Agency (IEA), among other organizations, regularly publish multi-year projections that suggest that the share of nuclear power in the energy mix will increase and remain at this level for the foreseeable future.

Many countries around the world have already gained positive experience in nuclear energy production. They have developed relevant legislation and identified management bodies in this field, as well as their powers and responsibilities. These countries have also developed ways to protect the environment and ensure nuclear safety, including the safe disposal of hazardous radioactive materials.

Given current geopolitical trends, nuclear and thermonuclear energy is becoming one of the most promising industries. In the near future, the number of nuclear power plants around the world will increase, and with it, the number of countries with the necessary knowledge and technology to operate them. This makes the international legal regulation of relations in this area particularly important in modern times [1; 23].

When analyzing global experience in the field of legal regulation of nuclear energy use, we refer to information collected by the World Nuclear Association regarding its development in other countries. As of January 1, 2025, the US leads the world in nuclear energy production with 779.2 billion kilowatt-hours (kWh), followed by significant progress in France (323.8 billion kWh), Japan (77.5 billion kWh), and China (406 billion kWh). Nuclear energy plays a significant role in the overall electricity mix in several countries, including France (64.8 %), Slovakia (61.3 %), Ukraine (50.7 %), Hungary (48.8 %), Belgium (41.2 %), and Switzerland (32.4 %) [11].

Let us explore the experience of legal regulation of nuclear energy in various countries that successfully utilize this type of energy and can provide their best practices for implementation in the Republic of Kazakhstan.

The safety of nuclear energy use is inextricably linked to environmental concerns, as anthropogenic interference with natural processes in the 20th and 21st centuries has taken a new form—nuclear pollution. In the past 30 years, several nuclear accidents have occurred, beginning with Chernobyl in 1986 and culminating in the disaster at the Fukushima-1 nuclear power plant in 2011. As a result, international organizations' recommendations in recent years have primarily focused on improving and strengthening nuclear and radiation safety measures.

The legal regulation of the use of nuclear energy in the United States is of particular interest for several reasons:

First, the United States holds a leading position in the world in the production of nuclear energy, which requires an extensive legislative framework governing all stages of the nuclear cycle—from uranium mining to the disposal of radioactive waste.

Secondly, the use of accident-resistant fuels that reduce the amount of nuclear fuel and waste used; innovative development of nuclear energy; clarity of licensing procedures; compliance with high standards of public health and safety [3].

Thirdly, the United States has a wealth of experience in public-private partnerships in the nuclear energy sector. Owing to these partnerships, the US nuclear power industry accounts for 30 % of the world's total nuclear power generation [4].

The U.S. National Energy Policy is developed and implemented by the Department of Energy, which is responsible for the implementation of national, economic, and energy security of the United States through the implementation of policies in the field of nuclear energy, fossil fuels, and alternative energy sources; responsible for the environmental impacts of energy projects. The key offices of this Ministry are the Nuclear Energy Department, the National Nuclear Safety Administration, the Environmental Management Department, the Uranium Disinfection and Neutralization Fund, the Radioactive Waste Production Department, the Nuclear Waste Technical Inspection Council, the Nuclear Reactor Safety Council, etc.

The United States is one of the states of the so-called "nuclear club", which significantly affects federal legislation in the field of nuclear energy. First of all, such acts should include the Law on Atomic Energy, the Law on Private Ownership of Nuclear Materials, the Law on Environmental Protection, and the Law on Nuclear Waste Policy.

The Atomic Energy Act 1954 is a U.S. federal law governing both civilian and military applications of nuclear materials. It covers all aspects related to the development, sale and disposal of nuclear materials and facilities in the country.

Within the framework of this law, the Nuclear Energy Commission has been established with the aim of promoting the peaceful use of nuclear energy. The commission ensures compliance with general principles of safety and protection, as well as the protection of public health.

It is important to note that the Law defines the terms of nuclear cooperation between the United States and other countries, which must be respected. Among them, there are particularly important ones: all nuclear materials (for example, uranium, plutonium) and technologies are under the control of the federal government; any activity related to the use of nuclear materials (e.g., the construction and operation of nuclear power plants, nuclear fuel production, research) requires a license; protection of "Restricted Data", which relate to nuclear technologies. It is prohibited to transfer nuclear materials, technologies or information that can be used to create nuclear weapons without special permission; international cooperation requires the conclusion of special agreements (e.g., Section 123 Agreement), which guarantee that the transferred technologies will be used only for peaceful purposes and will not contribute to the creation of nuclear weapons [12].

The most generalized regulatory legal act in the field of environmental safety in the United States should be considered the National Environmental Policy Act (NEPA) of 1969, which was last supplemented in 2000. NEPA (as currently drafted) provides for the obligation of the US Federal Government to fulfill the following permanent tasks by all available means: to commit itself to preserving the environment for future generations; to provide all Americans with a safe, healthy, productive, aesthetically and culturally satisfying environment; ensure a wide range of useful uses of natural resources while ensuring environmental safety; ensure the safety of historical and cultural heritage while preserving the environment; direct their activities to preserve the natural balance between the population and renewable natural resources to ensure a high standard of living for the population; improve the quality of renewable natural resources and increase the efficiency of processing non-renewable resources [13].

The law defines three levels of activity. If the federal government has decided that a certain activity would not significantly affect the environment, then it belonged to the first level and is exempt from detailed environmental impact analysis. The second level of activity is the one that causes certain environmental consequences, and therefore, federal agencies must first carry out and give a brief environmental assessment of the proposed actions. If an activity could lead to significant environmental impacts, then it should be evaluated in more detail, including a description of the negative impacts, irreversible and alternative solutions, as well as short- and long-term benefits. Such activity belonges to the third level. The disadvantage of this three-level system is not the prohibition of actions that may harm the environment but the search for alternatives [5].

The Nuclear Waste Policy Act of 1982 is a federal law that establishes a comprehensive national program for the safe and permanent disposal of high-level radioactive waste. It establishes the conditions for the use of deep geological storage facilities for the safe storage and/or disposal of radioactive waste, the procedure for evaluating and selecting sites for these facilities, and the interaction between state and federal governments. The act also determines the schedule of key milestones that will be carried out by federal agencies. The Department of Energy (DOE) is responsible for placing, constructing, and operating a deep geological storage facility for high-level waste and spent nuclear fuel. The DOE has the right to use this facility only if it meets the established standards and requirements [14].

In 2001, the United States government developed a strategy to promote the development of nuclear energy with several key goals. These goals included ensuring energy security, promoting economic growth, and environmental sustainability. The main objectives of this strategy were ensuring energy security by reducing greenhouse gas emissions and ensuring long-term energy sustainability. Additionally, large-scale nuclear projects, such as the "Advanced Fuel Cycle" and the "Global Partnership for Nuclear Energy" were initiated.

The 2001 strategy aimed to revive nuclear energy in the United States to address various challenges related to energy security, environmental concerns, and economic factors. While not all goals were fully met, this policy set a foundation for the further development of the industry and increased the role of nuclear energy in the country's energy mix.

In 2005, the United States passed the Energy Policy Act, which became a significant piece of legislation aimed at addressing a variety of energy challenges in the country. The law included provisions for state guarantees for loans up to $18.5 billion for the construction of new nuclear power plants, which was intended to reduce financial risk for private investors and promote the development of new nuclear energy sources. Additionally, tax incentives were introduced for nuclear energy producers, making investments in the sector more attractive [15].

This law has made several changes: 1. It divided the powers to regulate the wholesale supply market between the federal government and the states. 2. It created an organization responsible for the reliability of electricity production and distribution—the Electric Reliability Organization. Its tasks include setting standards for the reliability of electricity supply and the right to impose fines on wholesale suppliers who do not comply with these standards [2; 108].

Amendments were also made to other laws, particularly the Public Utility Regulatory Policies Act (PURPA). PURPA played a key role in the development of renewable energy and cogeneration in the United States. Owing to this law:

- conditions were created for the development of small and medium-sized clean energy projects;
- the share of renewable energy sources in the country's energy balance increased;
- the preconditions for further liberalization of the energy market emerged.

However, over time, PURPA became the subject of criticism, particularly from utilities, who believed that obligations to purchase electricity from independent generators increased their costs. Despite this, the

law remains an important element of the US energy policy and continues to influence the development of renewable energy [6].

An analysis of the US legislation on nuclear energy reveals that its use is subject to strict state control. Not only are the benefits of using nuclear power taken into account but so are the risks. Legal regulation is implemented through both an imperative approach (ensuring nuclear safety) and a dispositive approach (through treaties and agreements in the nuclear field). The legislation also establishes the supremacy of federal law in this area.

Canada is also a nuclear power nation. As of October 2023, there are 19 nuclear reactors operating in the country, located at four nuclear power plants. These reactors contribute significantly to the country's energy supply, particularly in the province of Ontario, where they play a crucial role in meeting the region's electricity needs.

The Canadian Nuclear Safety Commission (CNSC) is Canada's federal regulatory body responsible for ensuring safety in the field of nuclear energy and radiation protection. The CNSC was established in 2000 on the basis of the Nuclear Safety and Control Act, replacing the previous regulatory body, the Atomic Energy Control Board of Canada (AECB).

The Canadian Nuclear Safety Commission (CNSC) is an independent federal agency in Canada responsible for the regulation and control of all aspects related to the use of nuclear energy and radiation materials. This commission, established in 2000, plays a key role in ensuring the safety of society, workers and the environment from potential risks associated with nuclear activities.

The Commission's tasks include: monitoring the operation of nuclear power plants (NPP) and other nuclear facilities; regulation of the production, use, storage and transportation of nuclear materials; supervision of nuclear waste management, including its storage and disposal; the use of radiation sources in medicine, industry and science.

The Commission reports to the Parliament of Canada through the Minister of Natural Resources [16].

The legal regulation of the main issues of nuclear energy in Canada at the federal level is carried out according to the following laws: Transportation of Dangerous Goods Act, Nuclear Safety and Control Act, Radiation Protection Act, Nuclear Fuel Waste Act, Nuclear Liability Act, and others [17].

Let us take a closer look at the main provisions of Canada's nuclear legislation.

The Transportation of Dangerous Goods Act, passed in 1992, is binding on all provinces. This law establishes safety requirements, safety standards, and safety signs that define the prohibition of importing, offering for transportation, processing, or transportation of any dangerous goods. However, there are exceptions to this rule in cases where a person complies with all safety requirements and the rules applied to the goods. The goods must be accompanied by all necessary documents, and the vehicles must meet safety standards and display all necessary safety signs.

The law defines various types of hazardous materials and sets strict requirements for their packaging, transportation, and labeling. It also establishes financial responsibility for carriers in case of violations of safety regulations. The law requires carriers to check vehicles for compliance with safety standards, including opening them, inspecting them, and verifying the quantity of cargo and accompanying documents. In case of violations, carriers are held responsible under the law [18].

The Nuclear Safety and Control Act, passed in 1997, is a crucial document that governs the use of nuclear energy in Canada, ensuring safety, environmental protection, and compliance with international obligations. This law establishes a legal framework to regulate all aspects of nuclear activities, such as the production, use, storage, and transportation of radioactive materials. It also establishes the process of licensing and controlling these activities, which must be done in accordance with strict safety standards. Additionally, the law sets standards for acceptable radiation levels, as well as requirements for monitoring the radiation situation and ensuring compliance. It also defines the responsibilities of legal entities and individuals in case of violations of nuclear safety and security regulations [19].

The Nuclear Fuel Act of 2002 established the Nuclear Waste Management Organization, which operates without discrimination and receives remuneration. Each energy company that deposits funds into a trust fund with a financial institution annually becomes a member or shareholder of the organization. The organization's main goal is to conduct research on effective nuclear waste management methods. It also consults with the public, including indigenous communities, on these issues. After three months have passed since the end of each financial year, the organization submits a report on its expenses. Any violations of the organization's rules, such as late reporting to the minister, inappropriate expenses, or false entries in documents, can

lead to legal action. According to the law, non-profit organizations have the right to participate in the long-term storage of nuclear waste. They can perform advisory and monitoring functions [20].

It is worth noting that Canada has a well-developed nuclear power industry, which accounts for approximately 15 % of the country's electricity supply. With its vast energy potential, Canada is able to not only meet its own domestic needs but also play a significant role in the global energy market. Common features of nuclear energy development and production in Canada and the United States include reforms aimed at restructuring and liberalizing the electricity market and the partial privatization of the industry. The legal framework for nuclear energy in Canada includes federal laws governing the use of nuclear power, ensuring nuclear safety, management of nuclear waste, transportation of hazardous materials, and other related issues.

France is the largest producer of nuclear energy in Europe, has 18 commercial nuclear power plants with 56 operating reactors [7] (receives about 70 % of electricity), and ranks second in the world after the United States in terms of their number. Among the EU member states, France is one of the leading countries in the use of nuclear energy.

They have expertise in the fields of energy consumption, the construction and operation of nuclear power plants, as well as ensuring nuclear safety.

The French Institute of Radiation Protection and Nuclear Safety (Institut de Radioprotection et Sûreté Nucléaire, IRSN) is an independent body that conducts risk assessments and monitors compliance with safety standards throughout the entire life cycle of nuclear facilities. In addition to this, the IRSN plays a role in the development of regulations and standards related to radiation protection.

Agency for Nuclear Safety (Autorité de sureté nucléaire, ASN) is the regulatory body responsible for issuing licenses for the construction and operation of nuclear installations and monitoring compliance with safety requirements. In case of violations, ASN has the right to suspend the operation of nuclear facilities. ASN reports to the ministers of Environment, Industry, and Health, but major licensing decisions still require government approval.

In February 2023, the Ministry of Energy Transition announced the merger of ASN and IRSN, which, in their opinion, "will strengthen the independence of nuclear safety control within a single independent safety management unit to ensure a high level of safety requirements" [7].

Ministry of Ecology, Sustainable Development and Energy (Ministère de l'écologie, du Développement durable et de l'énergie) is responsible for the development of public policy in the field of energy, including the use of nuclear energy. The Ministry coordinates the activities of various departments and organizations dealing with nuclear safety issues.

France is one of the leading countries in the use of nuclear energy, and it has strict legal regulations in place to ensure safety, environmental protection, and compliance with international obligations in this area.

The law No. 2006-686 of June 13, 2006 "On transparency and safety in the nuclear field" ("Loi relative à la transparency et à la sécurité en matière nucléaire") defines the principles of accessibility of information to the public about the activities of enterprises related to the use of nuclear materials. It obliges government agencies and organizations working in this field to provide the public with information about their work, including information on radiation safety, environmental conditions, and radioactive waste management [8].

At the same time, the Law on Transparency and Safety in the Nuclear Field plays an important role. It:

- requires government agencies and companies operating in the nuclear industry to regularly publish reports and share information with the public about their activities. These reports include data on radiation monitoring, waste management, safety at facilities, and the environmental impact of nuclear power plants.

- establishes strict safety standards for all stages of handling nuclear material, from uranium extraction to waste disposal. It also regulates safety measures at nuclear power plants and other nuclear facilities.

- defines procedures for notifying the public about potential risks and incidents associated with the operation of nuclear installations. The public must be informed promptly about incidents and the measures taken to address them.

- provides for the establishment of a system for regular monitoring and inspections of nuclear facilities by independent experts, ensuring compliance with safety standards and preventing potential threats.

- establishes the responsibility of nuclear plant operators to ensure safety and take prompt action in case of emergencies, taking all necessary measures to minimize consequences and eliminate incidents.

- guarantees citizens' right to access information on nuclear safety and the environmental impact of nuclear facilities, allowing public organizations to request relevant data.

1. The Law on Safety in the Field of the Use of Nuclear Technologies provides for coordination between various government agencies and companies. It is aimed at increasing the level of openness and security in this area, as well as protecting the rights of citizens to access important information [21].

As a result, a significant portion of the regulations aimed at governing relations in the area of nuclear activities, including those that establish the consequences of these activities in relation to environmental protection objectives, is incorporated into the Environmental Code. This choice indicates that the principles of transparency and nuclear safety are recognized as fundamental principles of the legal framework for nuclear activities. The implementation of any form of nuclear activity, including the utilization of atomic energy, must not harm the public or the environment. Regulations governing relations in this area are an integral component of the overall legislation on environmental protection, intended to prevent accidents, the harmful effects of radioactive materials, and other adverse outcomes from such activities [17; 154].

2. Health Code (Code de la santé publique): This code regulates public health issues during the operation of nuclear facilities. It includes standards for the protection of workers and the public from radiation, as well as measures to prevent accidents and eliminate their consequences [22].

3. Decree No. 2017-630 of April 25, 2017 on the establishment of safety rules for nuclear installations: This decree defines the requirements for the design, construction and operation of nuclear reactors, including rules for ensuring the physical protection of facilities and preventing unauthorized access.

4. Law No. 91-1381 of December 30, 1991 on Conducting Research and Experiments in the Field of Nuclear Weapons: This law governs activities related to research and development in the area of nuclear weapons. After signing the Comprehensive Nuclear-Test-Ban Treaty (CTBT), France has chosen not to conduct nuclear weapon tests, but it continues to conduct scientific research in this field.

5. Laws and regulations of the European Union: As a member of the EU, France is obligated to follow the directives and regulations set by the European Union regarding nuclear safety. One such directive is Council Directive 96/29/EURATOM, which was issued on May 13, 1996 and establishes basic standards to protect the health of workers and the general public from the risks associated with radioactive radiation.

The law No. 2006-739 of June 28, 2006, on the sustainable management of radioactive materials and waste, known as Program Act No. 2006-739, established the foundations of France's national policy on the sustainable management and financing of these materials and waste. This law regulates the handling of nuclear and radiation waste and organizes and finances activities and scientific research programs related to these subjects in accordance with its regulations. Many of the provisions in this law have since been incorporated into the Environmental Code [23].

The Law No. 2006-739 and Decree No. 2008-209 established rules for the management of spent nuclear fuel or radioactive waste. These rules:

1) prohibit the disposal of nuclear waste from abroad in France.

2) permit the production of nuclear waste only in accordance with international agreements, which include a schedule for its reception and processing, as well as the last date for shipping the resulting radioactive waste from France.

3) prohibit the storage of spent nuclear fuel in France except for purposes of processing, research, or transfer to other countries.

An analysis of these legislative acts reveals that they regulate some of the most significant aspects of nuclear energy. These include ensuring the safety of nuclear facilities, managing radioactive waste, and adapting to changes in the industry. The laws also aim to exclude outdated regulations and develop new ones, while modernizing existing ones.

Let us consider Sweden's approach to nuclear energy and its regulatory framework.

The country has ten nuclear power reactors, and three of these reactors are continuously being shut down. The remaining ten operating reactors include seven BWR ASEA-ATOM designs, and three PWR Westinghouse designs. Nuclear energy accounts for approximately 45 % of all electricity generated in Sweden each year on average. Swedish reactors have undergone and are undergoing modernization, as well as safety and capacity upgrades. Safety improvement measures related to reactor design and construction have also been implemented.

In June 2010, the Swedish Parliament lifted the ban on the construction of new nuclear power plants, allowing the construction and operation of a new reactor in case of a change in plans for the closure of an existing reactor. They also approved legislation to create conditions for the development of future generations of nuclear power.

The Swedish Radiation Safety Authority (SSM) is a regulatory body responsible for nuclear safety, radiation protection, and the non-proliferation of nuclear weapons in Sweden. It employs more than 300 specialists with expertise in various fields, including engineering, natural sciences, behavioral sciences, law, economics, and communications. The SSM's budget is approximately 400 million Swedish kronor annually. The SSM receives funding from fees and tax revenues. In case of an incident involving radioactive materials or radiation, the SSM coordinates expert assistance from the emergency response center and is responsible for organizing it. Additionally, the SSM plays a crucial role in coordinating national efforts in radiation measurement and analysis [24].

The main laws in the field of nuclear safety and radiation protection are: The Act on Nuclear Activities (1984: 3); The Radiation Protection Act (1988: 220); The Environmental Code (1998: 808); The Ordinance on the Financing of Residual Products of Nuclear Power (2006: 647); The Nuclear Liability Act (1968: 45). All acts are supplemented by a number of other additional regulations containing more detailed provisions on certain aspects of nuclear safety.

The Law on Nuclear Activities defines the term "nuclear activity" and states that such activities may only be carried out in accordance with a license issued in compliance with the legal requirements of this law and the Environmental Code. The license holder is responsible for ensuring the safe operation of each nuclear facility and the secure storage of nuclear waste. They must implement necessary security measures based on the nature of their activities and the conditions in which they operate. These measures include ensuring the safe management and disposal of radioactive waste, as well as the safe decommissioning and dismantling of facilities when nuclear activities are no longer carried out. Safety in nuclear activities is maintained by taking all necessary measures to prevent errors or malfunctions in nuclear equipment or any other situations that could lead to a radiation accident.

The Law on Nuclear Activities primarily addresses nuclear safety issues, while the Environmental Code deals with general aspects of environmental protection and potential consequences of hazardous activities. The Radiation Protection Act includes provisions for the protection of public health (including industrial workers), animals, and the environment, as well as the management of radioactive waste.

The Nuclear Liability Act implements Sweden's obligation to comply with the Paris Convention on Third-Party Liability in the Field of Nuclear Energy and the Brussels Convention additional to it [25].

We believe that some aspects of the legal regulation of the nuclear industry in Sweden could be adapted for the Republic of Kazakhstan. In particular, the experience of legislative regulation of funding for the management of nuclear waste and the creation of conditions for a generation change in nuclear reactors could be useful.

Analyzing the situation of nuclear energy in the European Union, we can see that there is an ambiguous attitude towards this energy source among European countries. For instance, Belgium, Switzerland, Austria, and Italy are opposed to nuclear energy development, while Germany has taken a radical change in its approach to nuclear power. On March 14, 2011, Chancellor Angela Merkel of Germany announced a review of her country's energy policy after the Fukushima nuclear disaster in Japan. This event led to a shift in Germany's approach towards nuclear energy, as the government established the Ethical Commission for Safe Energy Supply and recommended the country to move away from nuclear power by 2021 and shut down its reactors.

Angela Merkel's decision to phase out nuclear energy has been one of the most significant steps in global energy policy. This decision demonstrates how environmental concerns can influence national strategies and public opinion. The German experience also shows that transitioning to renewable energy requires significant investment, time, and infrastructure changes.

Currently, there is an "atomic renaissance" in the European Union, which means a revival of interest in nuclear energy as an important part of an energy strategy to achieve climate goals and ensure energy security. After a period of skepticism about nuclear energy following the Fukushima disaster in 2011, many European countries are once again considering it as a key low-carbon energy source.

The "nuclear renaissance" in the European Union (EU) reflects a growing recognition that nuclear energy can play an important role in the transition to a lower-carbon economy. While there are challenges such as high costs and public opposition, many EU countries are investing in nuclear energy as a key part of their strategy to achieve climate goals and ensure energy security.

Conclusion

The foreign experience of legal regulation in the field of nuclear energy is a set of legislative, administrative and international measures aimed at ensuring the safety, non-proliferation of nuclear materials and the development of nuclear energy for peaceful purposes. Different countries, depending on their economic, political, and environmental priorities, are developing unique approaches to regulating this area.

Thus, the experience of legal regulation of public relations in the field of nuclear energy accumulated in the USA, Canada and some European countries deserves attention and can be used for the following reasons: 1) a comprehensive system of laws and regulations that covers all aspects, from licensing and safety to waste management and liability for damage; 2) the practice of constant adjustment of regulatory legal acts; exclusion of outdated legal provisions or their modernization and development of new ones; 3) long-term nuclear waste management strategies have been developed, including the creation of deep geological storage facilities (for example, the Yucca Mountain project in the USA. Their experience can be used in the development of national programs for the management of radioactive waste, including technologies for their storage and disposal; 4) have extensive experience in licensing, which includes assessment of safety, environmental risks and compliance with technical standards. Their regulatory approaches, including independence and transparency, can be adapted to improve the effectiveness of national regulatory authorities; 5) The legal regulatory system provides for public participation in the decision-making process. Public hearings are held on key issues such as the construction of new facilities or the renewal of licenses; much attention is paid to the physical security of nuclear facilities and protection against cyber attacks. Strict security requirements are established, including protection against terrorist threats. This experience can help to increase public confidence in nuclear energy and reduce social tensions.

All of the above mechanisms of legal regulation in the field of nuclear energy contribute to improving the safety of this industry, diversifying sources of support, and reducing dependence on internal constraints. The Republic of Kazakhstan's comprehensive involvement in global initiatives is transforming the industry's development model towards an export-oriented and innovative one, ensuring financial stability, technical modernization, and long-term strategic sustainability.

Cooperation with international organizations and partners plays a crucial role in maintaining the stability of the nuclear energy sector in the face of high levels of external and internal uncertainty. This cooperation promotes the introduction of innovative solutions, enhances safety measures, provides access to preferential financial resources, and opens up opportunities for Kazakhstan to export its expertise.

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А.К. Көкеев

Атом энергиясын пайдалану саласындағы құқықтық реттеудің әлемдік тәжірибесі және оның шет елдерде дамуы

Мақалада атом энергиясын пайдалану саласындағы құқықтық реттеудің әлемдік тәжірибесіне шолу берілген. Жетекші шет елдерде қолданылатын заңнамалық тәсілдердің эволюциясына ерекше назар аударылады. Автор халықаралық құқықтық бастамалар мен ұлттық заңнамалық актілерді де талдаған. Сонымен қатар, ядролық қауіпсіздікті қамтамасыз етуге, экологиялық тұрақтылыққа қол жеткізуге бағытталған жаңа ядролық технологиялардың жауапкершілігі мен дамуына байланысты заманауи сын-қатерлер қарастырылған. Зерттеудің мақсаты ядролық саланы құқықтық реттеудің әртүрлі тәсілдеріне жан-жақты талдау жүргізу. Қолданыстағы механизмдердің тиімділігін бағалау және ұлттық және халықаралық деңгейде атом энергетикасының тиімді, қауіпсіз және тұрақты дамуына ықпал ететін негізгі тенденцияларды, принциптер мен механизмдерді анықтау. Бұл бізге Атом энергиясы бойынша халықаралық агенттіктің (МАГАТЭ) үздік халықаралық тәжірибелері мен ұсынымдарына сүйене отырып, ұлттық нормативтік-құқықтық базаны құру бойынша ұсыныстарды тұжырымдауға мүмкіндік береді. Сондай-ақ ұлттық заңнаманы халықаралық стандарттар мен міндеттемелермен үйлестіру жолдарын анықтай аламыз. Жұмыстың әдіснамалық негізі әртүрлі елдердегі ядролық энергияны реттеудің құқықтық институттарын, нормалары мен тәсілдерін салыстыру. Салыстырмалы құқықтық әдіс жетекші ядролық мемлекеттердің заңнамалық жүйелеріндегі, нормативтік актілеріндегі және құқық қолдану практикасындағы айырмашылықтарды анықтауға, сондай-ақ реттеудің жалпы тенденциялары мен тиімді модельдерін анықтауға мүмкіндік береді. Зерттеу нәтижесінде атом энергиясын пайдалануды құқықтық реттеудің әлемдік тәжірибесінің негізгі ерекшеліктері және оның шет елдерде дамуының негізгі тенденциялары анықталды. Шетелдік тәжірибе бізге ядролық энергияны қауіпсіз, тұрақты және әлеуметтік тұрғыдан қолайлы пайдалануды қамтамасыз ету үшін ұлттық құқықтық жүйемізге тиімді енгізуге болатын құнды сабақтар мен модельдерді ұсынады.

Кілт сөздер: атом энергетикасы, атом энергиясын пайдалану саласындағы құқықтық реттеу, атом энергиясы, ядролық қауіпсіздік.

А.К. Кукеев

Мировой опыт правового регулирования в сфере использования ядерной энергии и его развитие в зарубежных странах

В данной статье представлен обзор мирового опыта правового регулирования в сфере использования ядерной энергии. Особое внимание уделяется эволюции законодательных подходов, применяемых в ведущих зарубежных странах. Анализируются как международные правовые инициативы, так и национальные законодательные акты. Кроме того, рассматриваются современные вызовы, связанные с обеспечением ядерной безопасности, вопросами ответственности и развитием новых ядерных технологий, направленных на достижение экологической устойчивости. Цель исследования — провести всесторонний анализ различных подходов к правовому регулированию ядерной отрасли, оценить эффективность существующих механизмов и выявить ключевые тенденции, принципы и механизмы, способствующие эффективному, безопасному и устойчивому развитию атомной энергетики на национальном и международном уровнях. Это позволяет сформулировать рекомендации по созданию национальной нормативно-правовой базы с учетом лучших международных практик и рекомендаций МАГАТЭ. Кроме того, можно определить пути гармонизации национального законодательства с международными стандартами и обязательствами. Методологическую основу исследования составляет сравнительный анализ правовых институтов, норм и подходов к регулированию использования ядерной энергии в различных странах. Применение сравнительно-правового метода позволяет выявить различия в законодательных системах, нормативных актах и правоприменительной практике ведущих ядерных государств, а также определить общие тенденции и эффективные модели регулирования. В результате проведенного исследования выделены ключевые особенности мирового опыта правового регулирования использования ядерной энергии и определены основные тенденции его развития в зарубежных странах. Зарубежный опыт представляет собой ценную базу знаний и практических решений, которые могут быть эффективно адаптированы в национальную правовую систему для обеспечения безопасного, устойчивого и социально приемлемого использования ядерной энергии.

Ключевые слова: ядерная энергетика, правовое регулирование в области использования атомной энергии, ядерная энергия, ядерная безопасность.

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