Analysis of Nuclear Law and Nuclear Power Plant Development Plans in Indonesia

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Article Info

Received: 2023-01-10
Revised: 2023-02-01
Accepted: 2023-03-20

Keywords:
indonesia; nuclear; nuclear law; nuclear power plant.

Abstract

This research discusses Nuclear Law Analysis and Nuclear Power Plant Development Plans in Indonesia. The nuclear legal framework is an essential infrastructure in developing nuclear power plants in a country. This research aims to determine the current legal framework for nuclear power in Indonesia and examine the strengthening of nuclear law, which is needed as infrastructure for developing nuclear power plants in Indonesia. This research is normative or dogmatic, using conceptual, statutory and comparative approaches. Data collection techniques include conducting literature studies and searching for primary and secondary legal materials in this research. The results of the study show that the nuclear legal framework in Indonesia has been realized through various ratifications of international electricity legal instruments and national regulations through the Nuclear Energy Law (UUK) as the legal basis and various derivative regulations covering almost all aspects of electricity. . laws, including the mandate to build nuclear power plants in Indonesia. However, considering that UUK is over 20 years old and reflects the Fukushima Daichi nuclear accident, Indonesia's nuclear legal framework as nuclear power plant infrastructure needs to be strengthened. This strengthening covers the four pillars of nuclear law, namely safety, security, safeguards and liabilities, which can encourage the construction of the first nuclear power plant in Indonesia for energy independence and realizing net zero emissions with strict safety and security standards to achieve this goal. Protect citizens and the environment.

I. Introduction

Nuclear Power Plants (NPPs), since the first reactors became operational in the 1950s, have played an essential role in providing low-carbon, affordable and reliable electricity to communities worldwide, thanks to their low life cycle emissions. About 10% (ten per cent) of global electricity and about 25% (twenty-five per cent) of low-carbon electricity is generated by nuclear power plants, which are currently used in 32 countries (Leon & Lindberg, 2022). According to data from the International Atomic Energy Agency (IAEA), currently, there are 415 (four hundred and fifteen) NPP reactors in operation and 57 (fifty-seven) NPP reactors under construction throughout the world (Donovan & Watson, 2022). Nuclear energy has a better impact on limiting carbon emissions in some countries than renewable energy. Therefore, taking into account safety aspects, atomic energy must be considered and redeveloped seriously (Wang et al., 2023).

Indonesia targets nuclear power plants to be commercially operational by 2032, which is part of the Government's plan to switch to renewable energy (Uly & Ika, 2023). Although using nuclear energy for nuclear power plants has a significant positive impact on human life, it can also have a negative impact if an accident occurs (Fuadi & Ichsan, 2022). Therefore, nuclear law is needed as a very effective tool to control its development and respond to the impacts and risks it causes (Ge, 2022a). The accident at the Chornobyl nuclear power plant became the most dramatic example of the reactive nature of the development of international nuclear law with the emergence of the nuclear safety framework (Burns, 2022). Nuclear law is a special regulation designed to regulate the actions of corporations and individuals involved in activities related to nuclear, ionizing radiation and exposure to natural radiation sources (Stoiber et al., 2003). Nuclear law is a special regulation designed to regulate the actions of corporations and individuals involved in activities related to nuclear, ionizing radiation and exposure to natural radiation sources (Grossi, 2022).

Previous studies on nuclear law have been carried out by many researchers, including Jiu Liu, who discovered that the nuclear legal system plays a vital role in encouraging and ensuring the development of the civil nuclear industry and the utilization of nuclear energy, which has long existed. Has increased since the 1940s. The construction of nuclear law as a new interdisciplinary relationship between nuclear science and technology and law must be followed up now. From the analysis of nuclear law as a new branch of the legal discipline, it is necessary to clarify this scientific discipline's meaning, objects, and characteristics and design it well for teachers and the curriculum so that the nuclear science discipline can function well. Law is more mature and realizing its value as a new interdisciplinary field in law (Liu, 2022).

Furthermore, Wuqing Du, Wei You, and Zhenqing Xu found that an updated legal system that fully integrates technological and institutional innovation is needed to deal with China's rapidly expanding commercial nuclear industry. More specifically, it is necessary to formulate a unified Atomic Energy Law and update inefficient regulations and documents to enhance the role of the law in areas such as nuclear site selection and disposal of low- and medium-level radioactive nuclear waste, licensing systems, and nuclear waste—emergency state. Legal harmony and balance are the keys. A new licensing system for nuclear site selection must be developed with dynamic assessment. The design of an appropriate legal system for nuclear emergency response must be led by the Ministry of Emergency Management and supported by various regulatory and nuclear facility management bodies (Du et al., 2022).

Then Stephen Burns discovered that law is a means and not an end in nuclear regulation. The development of the legal framework is an exciting journey that reflects a commitment to address the main problematic aspects of using nuclear energy for peaceful purposes through various approaches using binding treaties and conventions and non-binding codes and guidelines. Future improvements to the legal regime will be aided by seeking greater harmonization across the system. This requires a commitment to ensure that institutions at international and national levels are transparent and willing to engage in constructive interactions with stakeholders (Burns, 2022).

This research complements previous research which has yet to study nuclear law and nuclear power plant development plans in Indonesia. Nuclear law consists of four main components, namely: first, as a special legal rule, nuclear law is recognized as part of national law, which consists of various regulations needed to regulate the unique nature of technology; secondly, the regulation uses a risk-benefit measurement method to manage activities that cause harm or benefit to national development, society and the environment. Third, as it befits a legal regime, it provides regulations for the behaviour of rechtspersoon and natuurlijkepersoon, including commercial, academic, scientific and government entities. The fourth is radioactivity produced by fissionable material or ionizing radiation, which is the determining factor that indicates a special regime (Stoiber et al., 2003).

By these essential elements, nuclear law is a set of special regulations/provisions. If it is related to plans to build nuclear power plants in a country, nuclear law, embodied in the legal framework, is one of the 19 national infrastructures for building nuclear power plants based on IAEA guidelines that need to be fulfilled by countries. Country (Stoiber et al., 2003). This research was conducted based on the argument that international and national nuclear law has been regulated through various legal instruments. The nuclear legal framework in various laws and regulations in Indonesia, when related to constructing nuclear power plants, is one of the efforts to fulfil the national infrastructure for constructing nuclear power plants according to IAEA guidelines (Umah, 2021). This began with the creation of the State Committee for the Investigation of Radioactivity in 1954, tasked with investigating possible radioactivity that may have come from nuclear weapons tests in the Pacific Ocean (Sugiawan & Managi, 2019).

Indonesia already has three research reactors: the first atomic research reactor, Triga Mark II, in Bandung, the Kartini research reactor in Yogyakarta, and the 30 MW multi-purpose reactor in Serpong. Then, with the demand to meet the needs in the industrial era 4.0 to produce electricity using environmentally friendly energy sources, Indonesia plans to build a nuclear power plant (Maharani & Mellawati, 2019). However, the Government has not responded strongly to the discourse on building a nuclear power plant in Indonesia (Hariyadi, 2016). One of the reasons is concern that if a nuclear accident occurs, it will have a harmful impact, such as the Fukushima Daiichi nuclear disaster, which will have a long-term impact on Japan (Behling et al., 2019). The Fukushima Daiichi nuclear disaster has triggered a reassessment of nuclear energy policies in many countries; this then becomes an academic problem that is worth researching, namely how nuclear law currently exists in Indonesia and how to strengthen nuclear law, which is needed as infrastructure for building nuclear power plants in Indonesia.

2. Research Method

This research is normative or doctrinaire and uses conceptual, comparative, and statutory approaches (Marzuki, 2005). Legal materials are classified into two: firstly, primary legal materials in the form of International Conventions and statutory regulations relating to nuclear energy, and secondary legal materials in the form of experts' views or doctrines obtained from literature or legal articles from journals or proceedings laws or books and research results related to the issues raised (ND & Achmad Yulianto, 2007). Data collection techniques in normative research are conducting literature studies or searching for primary and secondary legal materials in this research. These legal materials are then selected, classified and analyzed prescriptively to provide an opinion on the results of the research that has been carried out. This opinion is then used as a prescription or assessment with which we can consider which is more appropriate from a legal point of view regarding the problem being researched based on the research results. (ND & Achmad Yulianto, 2007).

3. Results and Discussion

Nuclear Legal Framework: Ratification of Various International Instruments related to Nuclear and National Regulations related to Nuclear Energy in Indonesia

Nuclear law has one distinctive characteristic, namely a high level of "internationalization", meaning that every international legal instrument in the form of obligations, standards, guidelines and other international instruments needs to be considered in formulating national law. Various legal instruments and international obligations bind drafters of electricity laws. There needs to be harmonization with the national legal regime so that regulations can benefit stakeholders in using nuclear energy. It is also necessary to consider potential cross-border impacts between countries. The principle of international cooperation is one of the basic concepts of nuclear law (Aziz & Hasan, 2012). In making laws and regulations in the nuclear energy sector, it is also necessary to pay attention to the 3S+1L concept, namely safety, security, security and responsibility. The 3S+1L concept can help designers of legislative regulations to avoid gaps, overlaps and inconsistencies that can cause problems in interpretation and implementation (Aziz & Hasan, 2012).

The significant tragedies of the Three Mile Island Nuclear Power Plant in 1979 and Chornobyl in 1986 provided a warning about the safety and security of nuclear energy throughout the world and, at the same time, provided an opportunity for the international community to review and improve itself. International nuclear legal framework. In the early 1990s, secret nuclear activities carried out by certain parties to the Treaty on the Non-Proliferation of Nuclear Weapons were discovered, prompting the international community further to strengthen its comprehensive export security and control system. In 2001, the September 11 attacks raised severe concerns about nuclear terrorism in the international community. In 2011, the Fukushima Daiichi nuclear accident brought the issue of nuclear safety back into the spotlight of the international community. The international nuclear legal framework has been further developed and refined in response to new challenges (Ge, 2022b).

To pave the way for the expansion of nuclear power, ensuring nuclear safety is critical. A commitment to safety must be a universal priority, as the prospects for nuclear power plants anywhere will be affected by public outrage following a severe nuclear event. Therefore,

reviewing existing nuclear safety systems and assessing whether improvements should be made is essential. As emphasized in the IAEA Basic Safety Principles, operators must assume primary responsibility for safety, control the installation and be in the best position to ensure continued safety performance; they must have the engineering, financial and management capabilities to ensure that the installation operates as safely as it should—highest priority.

On the other hand, national regulatory bodies, in turn, reinforce operators' obligations to ensure safety by defining operator responsibilities and monitoring operator actions to ensure that these responsibilities are met. The Supervisory Body must be independent, capable, and have sufficient staff and funds to perform its functions. Each regulator must be firm, thorough (and fair) in ensuring that each operator fulfils its responsibilities (Meserve, 2022).

In connection with nuclear security, arrangements are made to:

1. Prevent the use of nuclear power for purposes incompatible with atomic principles for peace;
2. Actions to prevent, detect and respond to crimes and violations of nuclear security;
3. Minimize the impact and risk of radiology on society and the environment in the event of a nuclear crime case, And
4. Legal certainty, control of the use of technology, nuclear materials and radioactive substances for peaceful purposes

No single international instrument covers all provisions relevant to this issue. In particular, attention will be focused on multilateral agreements in the nuclear field negotiated under the auspices of the IAEA or related to the IAEA's responsibilities. However, other international instruments also provide essential support to the international framework. Several international instruments related to nuclear security include the following: 1. Treaty on the Non-Proliferation of Nuclear Weapons (Nugraheni, 2016). Regional nuclear non-proliferation and arms control agreements; Convention on the Physical Protection of Nuclear Material (CPPNM). The International Convention for the Suppression of Terrorist Bombings (from now on, the Terrorist Bombings Convention). United Nations Security Council resolution 1540 (United Nations, 2004). United Nations Security Council resolution 1373;(Nations, 2001) Convention on Suppression of Acts of Nuclear Terrorism (Nations, 2001). Code of Conduct on the Safety and Security of Radioactive Sources;(IAEA, 2004) Guidance on the Import and Export of Radioactive Sources.

The international legal framework regarding liability for nuclear losses is regulated in 2 (two) international conventions, namely the 1960 Paris Convention, complemented by the 1963 Brussels Additional Convention (IAEA, 2012a). And the Vienna Convention on Civil Liability for Nuclear Damage 1963. The Paris Convention and the 1963 Brussels Additional Convention are Conventions that have been agreed at regional level (open to OECD countries; open to other countries only if all Parties give their consent), while the Vienna Convention concerning Civil Liability for Nuclear Damage in 1963 which was later amended through the 1997 Protocol which revised the Vienna Convention, supplemented by the Convention on Additional Compensation for Nuclear Damage in 1997, and the 1988 Joint Protocol Concerning the Application of the Vienna Convention and the Paris Convention (Joint Protocol), is an international level convention that is open to all countries (Fuadi & Ichsan, 2022).

As a form of implementation of the 4 (four) main pillars of nuclear law consisting of safety,

security, security and responsibility, as well as compliance with the international legal framework related to nuclear energy, Indonesia has ratified various international legal instruments related to nuclear. Energy, including:

1. Ratification of the Agreement on the Prevention of the Spread of Nuclear Weapons through Law Number 8 of 1978, which was followed by a Bilateral Safeguards Agreement between the IAEA and Indonesia, and subsequently with additional protocols;
2. Ratification of CPPNM through Presidential Decree Number 49 of 1986;
3. Ratification of the Agreement on a Southeast Asia Region Free of Nuclear Weapons through Law of the Republic of Indonesia Number 9 of 1997;
4. Ratification of changes to the CPPNM through Presidential Regulation Number 46 of 2009 concerning Amendments to the Convention on the Physical Protection of Nuclear Material;
5. Ratification of the Convention on Early Notification of Nuclear Accidents through Presidential Decree Number 81 of 1993;
6. Ratification of the Convention on Assistance in Cases of Nuclear Accidents or Radiological Emergencies through Presidential Decree Number 82 of 1993;
7. Ratification of the Nuclear Safety Convention through Presidential Regulation of the Republic of Indonesia Number 106 of 2001;
8. Ratification of the International Convention for the Eradication of Terrorist Bombs through Law of the Republic of Indonesia Number 5 of 2006;
9. Ratification of the Convention for the Eradication of Acts of Nuclear Terrorism through Law of the Republic of Indonesia Number 10 of 2014.

Indonesia is not a party to the International Convention regarding responsibility for nuclear losses, but within the framework of national legislation, Indonesia has regulations regarding responsibility for nuclear losses in the event of a nuclear accident (Fuadi & Ichsan, 2022). Apart from the ratification of various international instruments related to nuclear energy carried out by Indonesia, the national legal framework for nuclear energy in Indonesia has been regulated through Law Number 10 of 1997 concerning Nuclear Energy (UUK). UUK replaces and revokes the Law on Basic Provisions on Atomic Energy (UU No. 31 of 1964/UU Atomic Energy). At that time, the Electricity Law was needed as a basis for the development of atomic energy in Indonesia. The UUPA was created by referring to the United States Atomic Energy Act of 1954 as a reference. Therefore, the political influence of United States law on the Atomic Energy Law is evident; in conditions like this, the Atomic Energy Law was born (Poernomo & et al., 2013).

UUK regulates the use of nuclear energy as being carried out for peaceful purposes reasonably and carefully and in the most significant interests of the welfare and prosperity of the people. This guarantees the safety, security, peace, and health of workers and the community as well as environmental protection. The rules contained in the UUK include electricity institutions, which are separated into Implementing Bodies and Supervisory Bodies, research and development, exploitation, supervision, management of radioactive waste, liability for nuclear losses, and criminal sanctions (Pemerintah Republik Indonesia, 1997).

UUK as the legal basis for nuclear energy in Indonesia is then followed up with various implementing regulations (Government Regulations (PP) and Presidential Regulations (Perpres)), including regulation of ionizing radiation safety and radioactive source safety through PP 33 of 2007, licensing for the use of sources and ionizing radiation material. Nuclear through PP 29 of 2008, radiation safety and security in the transport of radioactive substances through PP 58 of 2015, management of radioactive waste through PP 27 of 2002, licensing of nuclear installations and utilization of nuclear materials through PP 2 of 2014, licensing of the use of ionizing radiation sources and materials nuclear through PP 29 of 2008, limits on responsibility for nuclear losses through PP 46 of 2009, which then regulates further limits on liability for nuclear losses in Presidential Decree 74 of 2012 and various technical regulations. At the Nuclear Energy Regulatory Agency level. Based on these various national regulations, the existing laws and regulations related to nuclear energy cover almost all aspects of 3S+1L in nuclear law (Aziz & Hasan, 2012). However, considering developments in circumstances and time, as well as lessons learned from the Fukushima Daiichi nuclear accident in Japan, it is necessary to conduct further analysis regarding strengthening Indonesian nuclear law. It plans to build nuclear power plants that will be implemented.

Strengthening the Nuclear Legal Framework as One of the Infrastructure for Nuclear Power Plant Development in Indonesia

In connection with plans to build nuclear power plants in Indonesia, the implementation body will construct non-commercial nuclear reactors, which can collaborate with other government institutions and state universities. Meanwhile, commercial nuclear reactors are constructed by state-owned enterprises, cooperatives and the private sector. The GovernmentGovernment determines the construction of commercial nuclear reactors, in this case nuclear power plants, after consultation with the People's Representative Council of the Republic of Indonesia. Based on these provisions, according to UUK, the construction of nuclear power plants in Indonesia has been mandated by waiting first for the Government's decision/decision after consulting with the DPR. Furthermore, the Indonesian GovernmentGovernment is committed to transforming energy to reduce the greenhouse impact and achieve net zero emissions (NZE). To achieve this goal, the GovernmentGovernment encourages research and development of electricity generation technology with new and renewable energy sources by targeting an installed nuclear power generation capacity of 8 GW in 2035 and a renewable electricity generation capacity of 35 GW in 2060 at the national level energy mix (Executive Meeting Perizinan PLTN, 2023).

The use of nuclear energy for nuclear power plants with high safety requirements has also been stated in the national long-term development plan for 2005–2025. The policy of utilizing nuclear energy for Indonesian nuclear power plants is also in line with the energy law, which has chosen nuclear energy as one of the energy sources controlled by the state and utilized for the greatest prosperity of the people. In line with national energy policy. (Government of the Republic of Indonesia, 2014) Regarding national energy policy, the Government plans to update the policy in the form of government regulations, which is targeted for completion in June 2024. In this update, nuclear will no longer be positioned as the primary energy source. The last resort will be on par with other renewable and new energy sources. The aim is to ensure the security of a sustainable national energy supply and effective and efficient use of energy (Adi, 2024).

A commitment to using nuclear power safely, securely and peacefully must be the basis for the decision to start a nuclear power generation program. To achieve this, a national infrastructure that is built sustainably and can support the nuclear power program throughout its life cycle is needed. This infrastructure must enable GovernmentGovernment, legal, regulatory, management, technology, human resources, industry and other stakeholders to collaborate to ensure nuclear power's safe and secure use. Building a responsible nuclear power generation program requires compliance with international legal instruments, internationally recognized nuclear safety regulations, guidelines, and safeguard requirements (International Atomic Energy Agency (IAEA), 2015). According to the guidelines issued by the IAEA, countries planning to build nuclear power plants, such as Indonesia, must prepare various supporting infrastructures. This IAEA Milestone Approach Guide helps countries considering or planning to build nuclear power plants (Moch, 2019).

Nineteen aspects of nuclear power plant development infrastructure need to be fulfilled based on IAEA guidelines, including the legal framework related to nuclear energy. The legal framework for nuclear power should define the responsibilities of all organizations necessary for the success of a nuclear power program. National legislation must comprehensively cover all aspects of nuclear law (Safety, Security, Protection and Responsibility for Nuclear Damage). Based on the 2009 IAEA Integrated NPP Infrastructure Review Mission in Indonesia, it was recommended that Indonesia undertake extensive preparatory work for most of the infrastructure issues that would enable the country to consider further nuclear power implementation. The results of the IAEA's study of aspects of the legal framework related to nuclear power in Indonesia have shown that the status is available and has been implemented (Suparman, 2020). However, this review was conducted before the Fukushima Daiichi nuclear disaster occurred. The impact of the Fukushima Daiichi nuclear disaster made many countries in the world review existing policies (Nam et al., 2021). Indonesia needs to strengthen regulations within the nuclear legal framework as one of the infrastructures for developing Indonesian nuclear power plants.

Strengthening Indonesia's nuclear energy legal framework is also necessary, considering that the UUK, the basis for nuclear energy law in Indonesia, is more than 20 years old since it was promulgated in 1997. The current UUK must clearly accommodate several nuclear energy regulations regulating this matter. Has been mandated internationally. Aspects of nuclear security and physical protection, safety and safeguards, nuclear emergency preparedness and response are several aspects that require further attention within the scope of UUK regulations (Poernomo et al., 2013). Regarding nuclear safety, the disaster that occurred at Fukushima Daiichi shows that natural variables and natural disasters must be considered in nuclear power plant safety. Indonesia has a geographical area similar to Japan, which is influenced by the movement of tectonic plates, making this country prone to earthquakes (Meiliasari et al., 2022). Learning from this experience, it is necessary to improve/strengthen nuclear safety aspects within the Indonesian nuclear legal framework by taking into account the anticipation of disasters caused by natural factors.

Regarding nuclear security and safeguards, UUK, as the basis for electricity law in Indonesia, does not fully regulate the main elements of nuclear security. The essential elements of nuclear security include 1. Physical protection regimes for nuclear and other radioactive materials and related facilities; 2. Provisions regarding authorization (permits), inspection and law enforcement actions relating to nuclear materials and nuclear facilities

(and other radioactive materials); 3. Actions to prevent, detect, and respond to incidents of theft or other illegal acquisition, illicit nuclear trade, or sabotage of related nuclear facilities; 4. Criminal acts for violations of applicable laws and regulations, with heavy sanctions, especially for evil acts; 5. National arrangements are necessary to implement international cooperation in protecting radioactive materials, recovering stolen or lost materials, and dealing with violators (Stoiber et al., 2010). Apart from that, the criminal provisions regulated in the UUK currently only regulate violations regarding permits for the use of nuclear energy permits for officers/workers working at nuclear facilities and related to radioactive waste management (Nugraheni, 2016). To strengthen the nuclear security regime, electricity provisions in Indonesia in the UUK and its derivative technical regulations must accommodate several essential elements in the nuclear security legal and regulatory framework (Stoiber et al., 2010).

Regarding nuclear damage liability, Japan's nuclear damage liability system is not only a legal framework on paper but has also been tested in practice. Following a magnitude nine earthquake on Japan's east coast on March 11, 2011, a severe nuclear accident struck the Fukushima Daiichi power plant operated by Tokyo Electric Power Company (TEPCO) (Liu & Faure, 2016a). This accident shows that a country that has nuclear installations needs to prepare itself by establishing a clear and comprehensive legal framework in dealing with compensation that victims of nuclear accidents must pay. However, it is also essential that the legal framework allows governments and operators to adapt to the specific needs of nuclear accidents quickly. There are lessons to be learned from the experience of the Japanese Government and TEPCO in handling post-accident compensation claims. There are "five promises based on compensation empathy," namely: 1. ensuring fast and appropriate compensation payments; 2. Handle payments promptly and with care. 3. give sufficient attention to reconciliation proposals submitted by the Reconciliation Committee. 4. simplify document procedures; 5. take action to meet community requests (OECD, 2012).

The Dispute Reconciliation Committee for Nuclear Damage Compensation was created shortly after the accident. The committee has issued some guidelines for determining the scope of damages, which provide a broad range, including personal losses, property damage and even some pure economic losses. Although these guidelines are not legally binding, they will be a reference for damage compensation negotiations between victims and nuclear operators. They will facilitate smoother settlement negotiations between the parties (Liu & Faure, 2016b). Lessons learned from the Japanese Government in handling liability for nuclear losses resulting from the Fukushima Daichi nuclear accident are a consideration for strengthening Indonesia's nuclear loss liability regime. Liability for nuclear losses in Indonesian positive law is regulated in Chapter VII of the UUK (Pemerintah Republik Indonesia, 1997). Even though Indonesia does not participate in the International Convention regarding responsibility for nuclear damage, Indonesia has provisions governing nuclear accidents in the UUK (Poernomo et al., 2013).

In Indonesia's Positive Nuclear Law, the basic principle is the principle of absolute responsibility, which provides better protection to victims who experience nuclear losses. In the event of a nuclear accident, only the nuclear installation operator is responsible (Fuadi & Ichsan, 2022). Further regulations regarding liability for nuclear losses in Indonesian positive law are regulated through PP 46 of 2009 concerning Limitations of Liability for Nuclear Losses. In this Government Regulation, the limit of responsibility for nuclear losses, which

was initially set according to UUK, was set at a maximum of IDR 900,000,000,000.00 (nine hundred billion rupiahs), was changed to a maximum of IDR 4,000,000,000,000.00 (four trillion rupiahs). Furthermore, to implement the provisions of the UUK and PP, Presidential Decree 74 of 2012 concerning Responsibility for Nuclear Losses was stipulated. The Presidential Decree limits how much responsibility a nuclear installation entrepreneur will have and how much coverage/insurance is required if a nuclear loss occurs. The presidential regulation also classifies nuclear installations into fifteen categories, with respective limits of responsibility (Poernomo et al., 2013).

However, the accountability mechanism regulated in the Presidential Decree is only limited to an insurance mechanism or other financial guarantee for each nuclear installation for responsibility for nuclear losses and does not regulate the mechanism for how victims/third parties who suffer nuclear losses receive compensation. For the nuclear losses they suffered. Learning from the Fukushima Daichi nuclear accident, the Japanese Government's "Five promises based on empathy for compensation" are: 1. ensure prompt and appropriate payment of compensation; 2. Handle payments promptly and with care. 3. give sufficient attention to reconciliation proposals submitted by the Reconciliation Committee. 4. simplify document procedures; 5. take action to meet community requests (OECD, 2012). It can be a reference for strengthening the principles and mechanisms for compensating victims within the framework of Indonesian nuclear law. Strengthening the legal framework is an effort to clarify the mechanism for providing compensation to third parties who suffer losses due to nuclear accidents and provide more certain legal protection for victims who suffer losses due to nuclear accidents.

4. Conclusion

Based on this study and analysis, it can be concluded as follows: First, the nuclear legal framework in Indonesia is realized by various ratifications of various international nuclear energy legal instruments and nuclear electricity regulations in national regulations. This ratification was carried out as a form of compliance by the Indonesian state with the international legal regime, which will give rise to the rights and obligations of the community regarding nuclear energy. Meanwhile, in national regulations, UUK is the legal basis for implementing nuclear energy in Indonesia, followed by various derivative technical regulations covering almost all elements of 3S+1L nuclear law (Safety, Security, Safeguards and Responsibility). UUK has also mandated the construction of nuclear power plants in Indonesia if it has obtained a government decision/decision after consulting with the DPR. The mandate to build nuclear power plants is also supported by various policies in Indonesia regarding long-term development plans. The national energy policy, Net Zero Emissions, includes the nuclear option as a power plant with strict safety standards.

Second, considering that the UUK is more than 20 (twenty) years old since it was promulgated and is based on lessons learned from the Fukushima Daichi nuclear accident, Indonesia's nuclear legal framework needs to be strengthened on the four main pillars of nuclear law. : safety, security, security and accountability. Anticipation of disasters caused by natural factors needs to be included to strengthen the pillars of safety. The essential elements of nuclear security include a physical protection regime, authorization (permit), inspection and law enforcement, preventive measures, detection, response to incidents of theft/other illegal takeover/illicit nuclear trade, and criminal provisions with severe

penalties for criminal offences that need to be enforced and emphasized strengthening security and safeguarding pillars. The principle of responsibility for nuclear losses and compensation mechanisms for victims also need to be strengthened to protect society and the environment in the event of a nuclear accident. Strengthening the nuclear legal framework can encourage the construction of Indonesia's first nuclear power plant for energy independence and realizing net zero emissions with strict security and safety standards to protect citizens and the environment.

References

Adi, A. C. (2024). *RPP Kebijakan Energi Nasional Ditargetkan Selesai Juni 2024*. Kementerian ESDM.

Aziz, F., & Hasan, Y. (2012). Kerangka Peraturan Perundang-Undangan Program Pembangunan Pltn. *Jurnal Forum Nuklir*, *6*(1), 94. https://doi.org/10.17146/jfn.2012.6.1.362

Behling, N., Williams, M. C., Behling, T. G., & Managi, S. (2019). Aftermath of Fukushima: Avoiding another major nuclear disaster. *Energy Policy*, *126*(May 2017), 411–420. https://doi.org/10.1016/j.enpol.2018.11.038

Burns, S. (2022). Milestones in Nuclear Law: A Journey in Nuclear Regulation. *Nuclear Law The Global Debate*.

Donovan, J., & Watson, N. (2022). *IAEA Joins Indonesia for G20 Event Highlighting Nuclear Power for Clean Energy Transition*. IAEA.Org.

Du, W., You, W., & Xu, Z. (2022). Review and Prospect of Legal Development in Commercial Nuclear Energy. *Energies*, *15*(12), 1–16. https://doi.org/10.3390/en15124310

Executive Meeting Perizinan PLTN. (2023). Bapeten.Go.Id.

Fuadi, G., & Ichsan, M. (2022). Liability for Nuclear Damage : Perspectives of International Conventions, Indonesian Positive Law, and Islamic Law. *Asy-Syir'ah: Jurnal Ilmu Syari'ah Dan Hukum*, *56*(2).

Ge, D. (2022a). Nuclear law: The global debate. *Nuclear Law: The Global Debate*, pp. 1–333. https://doi.org/10.1007/978-94-6265-495-2

Ge, D. (2022b). Nuclear Laws for Peaceful Uses of Nuclear Energy. *Nuclear Law The Global Debate*.

Grossi, R. M. (2022). Nuclear Law: The Global Debate. *Nuclear Law The Global Debate*, 1–27.

Hariyadi. (2016). Agenda-setting pembangunan pltn dan pencapaian ketahanan listrik (studi di jepara dan pangkal pinang). *Jurnal.Dpr. Go. Id*, pp. *2*, 127–142.

IAEA. (2004). Code of Conduct on the Safety and Security of Radioactive Sources. In *International Atomic Energy Agency* (pp. 1–16).

IAEA. (2012). Brussels Supplementary Convention on Nuclear Third Party Liability. *Compendium of International Legal Instrument*.

International Atomic Energy Agency (IAEA). (2015). Milestones in the Development of a National Infrastructure for Nuclear Power NG-G-3.1. In *IAEA Nuclear Energy Series: Vol. NG-G-3.1*.

Leon, S. B. y, & Lindberg, J. C. H. (2022). The Humanitarian Atom: The Role of Nuclear Power in Addressing the United Nations Sustainable Development Goals. *Nuclear Law The Global Debate*.

Liu, J. (2022). On the Creation of Nuclear Law as a New Inter-Discipline in Law. *2022 29th*

International Conference on Nuclear Engineering.

Liu, J., & Faure, M. (2016a). Compensation for nuclear damage: a comparison among the international regime, Japan and China. *International Environmental Agreements: Politics, Law and Economics*, *16*(2), 165–187. https://doi.org/10.1007/s10784-014-9252-7

Liu, J., & Faure, M. (2016b). Compensation for nuclear damage: a comparison among the international regime, Japan and China. *International Environmental Agreements: Politics, Law and Economics*, *16*(2), 165–187. https://doi.org/10.1007/s10784-014-9252-7

Maharani, M. D. D., & Mellawati, J. (2019). Indeks Keberlanjutan Dimensi Peraturan Dalam Perencanaan Pembangunan PLTN Di Indonesia. *Jurnal Pengembangan Energi Nuklir*, *21*(1), 19. https://doi.org/10.17146/jpen.2019.21.1.5375

Marzuki, P. M. (2005). *Penelitian Hukum Edisi Revisi* (Revisi). Kencana.

Meiliasari, D. P., Panjaitan, B. S., Widana, I. D. K. K., Apriadi, R. K., & Cahyadi, D. (2022). Lesson Learned Dari Kecelakaan Reaktor Nuklir Fukushima Daiichi Untuk Meningkatkan Mitigasi Reaktor Serba Guna Gerrit Augustinus Siwabessy (RSG-GAS). *PENDIPA Journal of Science Education*, *6*(2), 493–500. https://doi.org/10.33369/pendipa.6.2.493-500

Meserve, R. (2022). Strengthening the Global Nuclear Safety Regime. *Nuclear Law The Global Debate*, pp. 75–84.

Moch, D. B. (2019). *The identification of responsibilities for the preparation of NPP development infrastructure in Indonesia.* 127–136.

Nam, H., Konishi, S., & Nam, K. W. (2021). Comparative analysis of decision making regarding nuclear policy after the Fukushima Dai-ichi Nuclear Power Plant Accident: Case study in Germany and Japan. *Technology in Society*, *67*(April), 101735. https://doi.org/10.1016/j.techsoc.2021.101735

Nations, U. (2001). United Nations Security Council resolution 1373. In the *United Nations*. https://doi.org/10.4324/9781315170657-71

ND, M. F., & Achmad Yulianto. (2007). *Dualisme Penelitian Hukum Normatif dan Empiris*. Fakultas Hukum Universitas Muhammadiyah Yogyakarta.

Nugraheni, M. W. (2016). Pentingnya Pengaturan Mengenai Keamanan Nuklir dalam Suatu Undang-Undang. *Seminar Keselamatan Nuklir*, 1–7.

OECD. (2012). *Japan's Compensation System for Nuclear Damage*.

Pemerintah Republik Indonesia. (1997). *Undang-Undang Nomor 10 Tahun 1997 tentang Ketenaganukliran*.

Poernomo, M., & et. al. (2013). Analisis Dan Evaluasi Peraturan Perundang-Undangan Tentang Ketenaganukliran. *Kemenkumham*, *1*(1).

Stoiber, C., Baer, A., Pelzer, N., & Tonhauser, W. (2003). *Handbook on Nuclear Law*. IAEA.

Stoiber, C., Cherf, A., Tonhauser, W., & Carmona, M. de L. V. (2010). *Handbook on Nuclear Law Implementing Legislation*. International Atomic Energy Agency.

Sugiawan, Y., & Managi, S. (2019). Public acceptance of nuclear power plants in Indonesia: Portraying the role of a multilevel governance system. *Energy Strategy Reviews*, *26*(October), 100427. https://doi.org/10.1016/j.esr.2019.100427

Suparman, S. (2020). *Nuclear Power Program in Indonesia: Potential and Challenges* (Issue February). BATAN.

Uly, Y. A., & Ika, A. (2023). *Pemerintah Targetkan Pembangkit Listrik Tenaga Nuklir Beroperasi Komersial 2032*. Kompas.Com.

Umah, A. (2021). *Sudah 50 Tahun RI Garap Nuklir, Tapi Tak Berani Punya PLTN*.

Cnbcindonesia.Com.

United Nations. (2004). *United Nations Security Council Resolution 1540*.

Wang, Q., Guo, J., Li, R., & Jiang, X. ting. (2023). Exploring the role of nuclear energy in the energy transition: A comparative perspective of the effects of coal, oil, natural gas, renewable energy, and nuclear power on economic growth and carbon emissions. *Environmental Research*, *221*(November 2022), 115290. https://doi.org/10.1016/j.envres.2023.115290