

CRIMINAL LIABILITY FOR RADIOACTIVE CONTAMINATION WITH CESIUM-137 AS A GUARANTEE OF HUMAN RIGHTS PROTECTION

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ABSTRACT

Indonesia is experiencing a serious environmental problem, namely radioactive cesium-137 contamination, which is suspected to be caused by waste-processing activities carried out by PT Peter Metal Technology in Cikande, Banten. Radioactive cesium 137 has a very dangerous impact on both humans and the environment, and the negative effects of radioactive contamination can last for a very long time. The cesium-137 contamination incident indicates possible weaknesses in governmental supervision of waste-processing and sustainable environmental preservation. Thus, the issues to be discussed in this study are the responsibility of the corporation or party that caused the cesium-137 contamination to the community affected by cesium-137 and the role of the government in tackling environmental pollution to ensure the protection of the human rights of the community. This study uses a normative juridical research method with a legislative and conceptual approach. The purpose of this study is to analyze corporate responsibility for environmental pollution caused by corporate activities and to analyze the government's responsibility for environmental pollution. The results of this study indicate that corporations must be held responsible for the occurrence of cesium 137 radioactive contamination, whereby such responsibility is limited not only to the law but also to the restoration of the impact caused by their actions. Furthermore, the government must increase its supervisory capacity, improve coordination between institutions, and ensure victims' access to compensation and transparent public information.

Keywords: Corporate Accountability; Protection of Human Rights; Radioactive Cesium-137.

INTRODUCTION

Radioactive cesium-137 is a particularly hazardous isotope, characterized by its high radiation power over extended periods, which poses significant risks to human health and the environment. Radioactive cesium-137 contamination in humans and animals has been shown to cause inflammatory damage, cancer, and necrosis in organs, which can lead to pancreatitis, functional deficits, diabetes, organ deformities, and congenital defects due to genetic mutations

from radiation exposure. The high rate of absorption of these radioactive substances by the pancreas, salivary glands, and large intestine is the reason for this phenomenon.¹

An incident involving cesium-137 radioactive contamination occurred in the city of Goiânia, Brazil, in 1987. This incident is widely regarded as one of the most serious radiological accidents in history, resulting in four fatalities and direct radiation exposure to 249 individuals. The propagation of contamination was initiated by the rupture of a radioactive source, which manifested as a fine, soluble powder with facile dispersibility.² A comparable incident transpired in Japan on March 11, 2011, when a natural disaster led to the impairment of the reactors at Fukushima Daiichi. This incident resulted in radiation levels remaining in the area for a period of ten years, from 2011 to 2021, and these levels are believed to persist to the present day.³ The disasters that occurred in Brazil and Japan demonstrate the enormous negative impact of cesium-137 contamination on human health, the environment, and the sustainability of the global ecosystem. Cesium-137 can spread widely in the air, soil, and water and accumulate directly in the food chain.

The issue of cesium-137 radioactive contamination is not only a global concern but has also materialized as a national problem experienced by Indonesia. On August 19, 2025, the Food and Drug Administration (FDA) disclosed the detection of cesium-137 contamination in frozen shrimp products from PT Bahari Makmur Sejati. Subsequently, on September 18, 2025, the FDA published a list of products from PT Natural Java Spice that were listed on the red list of products detained without physical inspection. The products on the red list were spices that were declared to be chemically contaminated.⁴ Radioactive cesium-137 contamination has been traced to scrap metal processing activities at PT Peter Metal Technology's Modern Cikande Industrial Park, which is suspected of being an iron smelting company utilizing cesium-137. The processing company that handles contaminated shrimp is located three kilometers from the factory.⁵ In the aftermath of the cesium-137 radioactive contamination incident, a total of nine workers in Cikande, Banten, were found to have been exposed to cesium-137 radionuclides. This finding was confirmed through whole-body counting examinations conducted by the Ministry of Health. The presence of radioactive cesium-137 contamination suggests deficiencies in the management of radioactive waste, as well as inadequate oversight of entities involved in iron processing or other sectors that utilize radioactive cesium-137, potentially causing harm to surrounding communities, companies, and the environment.

The case of cesium-137 radioactive contamination experienced by Indonesia poses a direct threat to the fulfillment of human rights, to a clean, healthy, and sustainable environment as stipulated in Article 65 paragraph (1) of Law Number 32 of 2009 concerning Environmental Protection and Management, and also in international human rights law which can be found in UDHR, ICCPR, and ICESCR, and other human rights convention. The delay in detecting radioactive cesium-137 contamination in Indonesia following the FDA's rejection of products

¹Panchamoorthy Saravanan et al., "A Comprehensive Review of Eco Toxicity of Cesium 137 Deterioration of Radionuclides Pollution," *Environmental Science and Pollution Research* 32, no. 26 (2025): 15519, <https://doi.org/10.1007/s11356-025-36651-6>.

²Paulo Barretto and Evaldo Simões da Fonseca, "Radiation Sciences The Cesium-137 Radiological Accident in Goiânia, Brazil : Conditions and Results of the Airborne Radiometric Survey," *Brazilian Journal of Radiation Sciences* 11, no. 2 (2023): 2, <https://doi.org/10.15392/2319-0612.2023.2231>.

³Shin ichi Hayama et al., "Time Dependence of 137Cesium Contamination in Wild Japanese Monkeys after the Fukushima Daiichi Nuclear Accident," *Environmental Science and Pollution Research* 29, no. 58 (2022): 88366, <https://doi.org/10.1007/s11356-022-23707-0>.

⁴Robertus Andrianto, Damiana, and CNBC Indonesia, "Kronologi AS Temukan Kontaminasi Cesium-137 Di Udang Dan Cengkih Indonesia," 2025, Diakses Pada Tanggal 22 Oktober 2025, Pukul 12.15 WIB., <https://www.cnbcindonesia.com/news/20251002130023-4-672248/kronologi-as-temukan-kontaminasi-cesium-137-di-udang-dan-cengkih-indonesia>.

⁵Heru Haetami et al., "Membongkar Ancaman Paparan Radiasi Cesium-137 Di Cikande," 2025, Diakses Pada Tanggal 22 Oktober 2025, Pukul 12.40 WIB., <https://kbr.id/articles/ragam/membongkar-ancaman-paparan-radiasi-cesium-137-di-cikande>.

shipped from Indonesia indicates a general negligence in monitoring products exported internationally. This practice constitutes a violation of the regulation that stipulates the prohibition of the exportation of goods that pose a threat to the protection of human health and safety, animals, fish, plants, and the environment, Government Regulation Number 29 of 2021 concerning the Implementation of Trade, Article 10, paragraph (3), letter a.

The government of Indonesia has demonstrated a pattern of negligence that poses a significant threat to human life and the integrity of the environment. This constitutes a violation of human rights because the state has an obligation to protect its citizens. Consequently, accountability is required from the parties responsible for the cesium-137 contamination. Such accountability serves two main purposes: first, to provide compensation to victims for their losses; and second, to deter future misconduct by encouraging more careful management of cesium-137. Environmental laws acknowledge corporations as legal entities, necessitating their accountability for losses incurred by their operations. Consequently, this study will examine corporate accountability for cesium-137 contamination as a means of ensuring the protection of human rights as international law have recognized corporate human rights responsibility as stated in the UN Guiding Principles on business and Human Rights.

A preliminary investigation into cesium-137 contamination and corporate criminal liability for environmental pollution was conducted by B. Setiawan, et al. and published under the title "Proposed Management of 137 Cesium Contaminated Soil: Case Study in South Tangerang City." This investigation analyzes the decontamination process that was implemented on soil contaminated with cesium-137 in the Tangerang area. The decontamination process was successful in reducing the radiation level to 0.3-0.75 Sv/h.⁶ A study titled *The Criminalization of Environmental Harm: A Study of the Most Serious Environmental Offenses Prosecuted by the U.S. Federal Government, 1985-2010* was authored by Erik W. Johnson et al. The study's objective is to discuss corporate responsibility for environmental pollution caused by corporate activities in the United States. It analyzes how law enforcement against corporations based on environmental laws is strictly enforced against small corporations but is not applied equally to large corporations.⁷

The most recent study was conducted by Mujiono and Fanny Tanu Wijaya and was entitled *Formulasi Korporasi sebagai Subjek Hukum Pidana dalam Regulasi Lingkungan Hidup di Indonesia*. This study explores the notion of corporations as legal subjects in the context of environmental criminal law, emphasizing the imperative for corporations to be held accountable for the environmental pollution stemming from their activities. Nevertheless, there remain discrepancies between the written regulations and the application of legal principles to corporate entities.⁸ The extant literature on the subject has largely focused on the deleterious effects

⁶B. Setiawan et al., "Proposed Managements of 137Cesium Contaminated Soil: Case Study in South Tangerang City," *Atom Indonesia* 47, no. 1 (2021): 65, <https://doi.org/10.17146/aij.2021.1055>. BAPETEN found contamination of 137Cs while testing environmental radiation monitoring equipment in an area in South Tangerang City. The area, therefore, needs to be cleaned up by performing decontamination followed by the activity of treating the contaminated soil. The decontamination works were carried out by excavating the contaminated soil on the surface to a depth of more than 1.5 m, and then the soils were put into the 100L drum. Decontamination work resulted in a significant reduction dose exposure in the area to (formula-presented

⁷Erik W. Johnson, Jennifer Schwartz, and Alana R. Inlow, "The Criminalization of Environmental Harm: A Study of the Most Serious Environmental Offenses Prosecuted by the U.S. Federal Government, 1985-2010," *Environmental Sociology* 6, no. 3 (2020): 319, <https://doi.org/10.1080/23251042.2020.1748269>.

⁸Mujiono and Fanny Tanuwijaya, "Formulasi Korporasi Sebagai Subjek Hukum Pidana Dalam Regulasi Lingkungan Hidup Di Indonesia," *Lentera Hukum* 6, no. 1 (2019): 67, <https://doi.org/10.19184/ejrh.v6i1.9590>, and the environment has provided free various needs for humans, which is an absolute requirement so that humans can maintain their lives. Environmental problems are essentially human ecological problems and environmental problems arise as a result of environmental pollution. This is an element of many negligence errors committed by companies or legal entities that operate, including the element of deliberate and negligent use of environmental law through Law No. 32 of 2009, concerning Environmental Protection stated in Article 116 UUPPLH. Corporate liability in environmental crime is the subject of discussion in cases with the decision register number No.1405K / Pid.Sus / 2013, namely PT. KARAWANG PRIMA SEJAHTERA (PT. KPSS

of radioactive cesium-137, the potential criminal liability for environmental contamination in the United States, and the corporate liability in Indonesia, where such liability has not been consistently enforced. This study will discuss the legal review of criminal liability for radioactive contamination as a basis for providing a normative foundation for the enforcement of criminal law in the environmental field, as a guarantee of human rights against the dangers of radiation in the future. The following issues will be discussed in this study: 1) what form of legal protection is provided by the Indonesian government to ensure the protection of communities affected by radioactive cesium-137 as a guarantee of human rights. 2) corporate responsibility for cesium-137 contamination caused by corporate activities must be addressed.

The objective of this study is to examine the form of criminal liability for corporations or entities that cause radioactive cesium-137 contamination, which poses a threat to human health and sustainable environmental ecosystems. This is of paramount importance in ensuring the community's well-being and safeguarding its right to a conducive and salubrious living environment. Moreover, there is absolute liability giving rise to a new principle of criminal liability that can be imposed on perpetrators (including corporations) without the need to prove the perpetrator's fault. In addition to protecting the community, this study aims to demonstrate that criminal punishment serves as a mechanism for imposing sanctions, thereby ensuring that corporations refrain from criminal acts and adhere to existing regulations in their daily operations.

METHOD

This study employs a normative legal research method by examining relevant statutes and regulations to establish a legal framework for analysing the identified issues.⁹ The subject to be deliberated in this case pertains to the question of criminal liability for cesium-137 contamination, with a view to ensuring the protection of human rights. The methods employed in this study encompass the statute approach and the conceptual approach. The statute approach involves the examination of pertinent laws and regulations, while the conceptual approach utilizes the perspectives or doctrines of legal experts to formulate solutions to the legal issues under discussion.¹⁰ The legal materials employed in this study encompass both primary and secondary sources. Primary legal materials are constituted by legislation, while secondary legal materials consist of scientific publications, including journals, books, and news articles relevant to the legal issues to be discussed.

ANALYSIS AND DISCUSSION

Legal Protection for Communities Affected by Radioactive Cesium-137 as a Guarantee of Human Rights

The issue of cesium-137 contamination in Cikande, Banten must be addressed beyond the confines of environmental health concerns. It is imperative to recognize that this matter encompasses human rights, particularly the right to life, the right to health, and the right to a good and healthy environment. Violations of citizens' constitutional rights to a safe and healthy environment are guaranteed in Article 28H paragraph (1) of the 1945 Constitution. The definition of "a good and healthy environment" signifies an environment conducive to optimal,

⁹Kornelius Benuf and Muhammad Azhar, "Metodologi Penelitian Hukum Sebagai Instrumen Mengurai Masalah Hukum Kontemporer," *Jurnal Gema Keadilan* 7, no. 1 (2020): 24, <https://doi.org/10.14710/gk.2020.7504>.

¹⁰Peter Mahmud Marzuki, *Penelitian Hukum*, 15th ed. (Jakarta: Kencana, 2021), 133, 135.

harmonious, and balanced human development.¹¹ The existence of such guarantees endows individuals with the capacity to insist that the government prioritize and perpetually enhance the quality and salubrity of the environment. This encompasses the state's responsibility to consistently foster a conducive and healthful living environment for its citizens. From a human rights perspective, the state is obligated not only to respect the rights of its citizens (obligation to respect), but also to protect and fulfill those rights. Consequently, the state is obligated to proactively mitigate environmental hazards that have the potential to adversely impact the community, including the risks posed by radiation. In this context, the handling of radiation victims can be categorized as a form of human rights violation because the state has failed to carry out its obligations.

Legal protection is necessary for the community affected by the contamination in Cikande. The concept of legal protection serves as a means to uphold justice when individuals face legal issues. Providing legal protection to the community helps safeguard human rights when those rights are violated by others. This legal protection helps ensure that the community can fully enjoy its rights as guaranteed by existing laws.¹² The term "legal protection" is a broad one, encompassing a variety of legal measures that are provided to law enforcement officials. The purpose of these measures is to ensure their physical and mental security in the face of various threats and disturbances from different parties.¹³ The fundamental purpose of legal protection is to assure the public that they will receive protection in accordance with the prevailing applicable laws and regulations.

The realization of human rights, as defined in legal frameworks, is contingent upon the harmonious interplay among three fundamental values.¹⁴ This condition is applicable to all categories of human rights, including the right to a clean, healthy, and sustainable environment, which is defined as the human right to inhabit an environment that fosters well-being and a dignified life.¹⁵ Of the three fundamental values, justice is the most significant legal objective because :

1. The concept of justice involves respecting, recognizing, and treating all individuals fairly, while considering their distinct characteristics and circumstances.;¹⁶
2. Human rights are established to guarantee certainty of justice.

The idea that human beings have a right to a healthy environment was first articulated in the Stockholm Declaration (1972), which states that every human being has a fundamental right to live in an environment that allows for a dignified and prosperous life.¹⁷ This principle is reinforced by the Rio Declaration (1992), which establishes a link between sustainable development, intergenerational justice, and the right to a healthy environment.¹⁸ Moreover, the

¹¹Rosmidah Hasibuan, "Pengaturan Hak Atas Lingkungan Hidup Terhadap Kesehatan," *Jurnal Ilmiah "Advokasi"* 6, no. 2 (2018): 93, <https://jurnal.ulb.ac.id/index.php/advokasi/article/view/252>.

¹²Bagas Adam Arifin, "Tanggung Jawab Korporasi Atas Dampak Pencemaran Lingkungan Akibat Aktivitas Pembangkit Listrik Tenaga Panas Bumi," *Jurist-Diction* 4, no. 1 (2021): 53, <https://doi.org/10.20473/jd.v4i1.24292>.

¹³Satjipto Raharjo, *Ilmu Hukum*, VIII (Bandung: Citra Aditya Bakti, 2014).

¹⁴Andang Binawan and Maria Grasia Sari Soetopo, "Implementasi Hak Atas Lingkungan Hidup Yang Bersih, Sehat, Dan Berkelanjutan Dalam Konteks Hukum Indonesia," *Jurnal Hukum Lingkungan Indonesia* 9, no. 1 (2023): 121–56, <https://doi.org/10.38011/jhli.v9i1.499>.

¹⁵Fajri Fadhilah, "Hak Atas Lingkungan Hidup Yang Baik Dan Sehat Dalam Konteks Mutu Udara Jakarta," *Indonesian Center for Environmental Law*, 2018, 3, <https://walhijakarta.org/wp-content/uploads/2023/05/Brief-ICEL-Hak-Atas-Lingkungan-Hidup-yang-Baik-dan-Sehat-dalam-Konteks-Mutu-Udara-Jakarta.pdf>.

¹⁶Bernadus Wibowo Suliantoro and Caritas Woro Murdiati Runggandini, "Konsep Keadilan Sosial Dalam Kebhinekaan Menurut Pemikiran Karen J. Warren," *Jurnal Etika Sosial* 23, no. 1 (2018): 40, <http://ejournal.atmajaya.ac.id/index.php/respons/article/download/467/160>.

¹⁷Melissa J Durkee, "CONFERENCE: THE 1972 STOCKHOLM DECLARATION AT FIFTY: REFLECTING ON A HALF-CENTURY OF INTERNATIONAL ENVIRONMENTAL LAW/International Environmental Law at Its Semicentennial: The Stockholm Legacy/Hosted by the Dean Rusk International Law Center and the Georg," *Georgia Journal of International & Comparative Law* 50, no. 3 (2022): 748–53, <https://digitalcommons.law.uga.edu/cgi/viewcontent.cgi?article=2552&context=gjicl>.

¹⁸Ibid

United Nations Human Rights Council formally acknowledged the right to a clean, healthy, and sustainable environment as a universal human right through Resolution 48/13 (2021).¹⁹ The United Nations General Assembly, through Resolution 76/300 (2022), has reaffirmed this as an international legal right that is morally and politically binding on all member states.²⁰ In 2025, the International Court of Justice (ICJ) issued an Advisory Opinion on Climate Change and Human Rights, asserting that the right to a healthy environment had evolved into a component of customary international law.²¹

According to the Law on Human Rights (Law No. 39 of 1999), in the chapter on basic principles, it is stated that every individual has the right to utilize all national legal remedies and international forums for all human rights violations guaranteed by Indonesian law and international human rights law that has been accepted by Indonesia. Those who seek to uphold human rights and fundamental freedoms are obligated to utilize all available legal remedies at the national level (exhaustion of local remedies) prior to seeking recourse through regional or international bodies, unless they have received no response from national forums. Therefore, it is crucial to implement initiatives aimed at strengthening national institutions, thereby establishing them as conduits for safeguarding of human rights within the Indonesian context. This obligation is incumbent upon the government, as stipulated in the Law on Human Rights.²²

In the context of the cesium-137 case, the government's responsibility extends beyond the technical aspects of waste cleanup to include protecting citizens from health threats, providing transparent information, and ensuring access to justice for affected communities. To comprehend the scope of human rights protection in the context of the environment, the NIC (need, interest, capability) theory proposed by Chalabi (2023) offers a pertinent analytical framework.²³ This theory suggests that environmental rights can be protected through three perspectives: individual, collective, and global.

1. Individual Level: Individuals affected by radiation are entitled to healthcare, compensation, and medical rehabilitation. In the case of cesium-137, nine workers who were exposed are entitled to long-term treatment, medical monitoring, and protection from the genetic effects of radiation.
2. Collective Level: The Cikande community has asserted its collective rights to environmental restoration, a sense of security, and the guarantee that its residential area is free from contamination.
3. Global Level: Given the implications of this case for international trade relations—specifically, the US FDA's decision to prohibit the importation of Indonesian products due to cesium-137 contamination—Indonesia bears an international responsibility to ensure that its industrial activities do not result in transboundary harm.

According to the principles of NIC Theory, the protection of human rights in the cesium-137 case is multifaceted, requiring cooperation among multiple sectors and agencies to prevent overlapping authority and to maintain effective public safety measures. The participation of BAPETEN, BPOM, and KLHK in this joint effort is essential to avoid jurisdictional conflicts and ensure the system's overall effectiveness. The right to a healthy environment serves as a foundation for realizing both the right to life and the right to health.

¹⁹United Nations Human Rights Council, *Resolution 48/13: The Human Right to a Clean, Healthy and Sustainable Environment*, Forty-eighth Session, October 8, 2021, [UN Doc. A/HRC/RES/48/13](https://www.unhcr.org/refugees/documents/43969696/unhcr-res-48-13).

²⁰United Nations General Assembly, *Resolution 76/300: The Human Right to a Clean, Healthy and Sustainable Environment*, Seventy-sixth Session, July 28, 2022, UN Doc. A/RES/76/300, <https://undocuments.org/en/A/RES/76/300>.

²¹International Court of Justice, *Advisory Opinion on Obligations of States in Respect of Climate Change*, July 23, 2025, General List No. 187, <https://www.icj-cij.org/en/case/187>.

²²Muladi, *Hak Asasi Manusia: Hakekat, Konsep, Dan Implikasinya Dalam Perspektif Hukum Dan Masyarakat* (Bandung: Refika Aditama, 2009), 268.

²³Azadeh Chalabi, "A New Theoretical Model of the Right to Environment and Its Practical Advantages," *Human Rights Law Review*, 23, no. 4 (2023): 1–19, <https://doi.org/10.1093/hrlr/ngad023>.

The state is obligated to guarantee that its policies and actions do not pose a threat to the well-being of its citizens. Failure to regulate the use of radioactive materials in the scrap industry or food exports can be categorized as omission liability, which is legal responsibility for negligence (*culpa in omittendo*). Several principles of international law serve as a foundational basis for the protection of the right to a healthy environment, particularly in the context of the cesium-137 contamination case in Indonesia:

a. Prevention Principle

This principle emphasizes the state's duty to prevent environmental harm proactively, rather than merely responding after a disaster occurs.²⁴ In the case of cesium-137, the government should have established a radiation screening system for imported scrap metal from the outset. This negligence constitutes a violation of the prevention principle.²⁵ Post-damage corrective measures, such as the suspension of scrap metal imports and the enhancement of radiation monitoring systems, constitute forms of compliance.

b. Precautionary Principle

This principle asserts that a lack of scientific certainty must not be used as an excuse to delay actions aimed at preventing possible environmental damage.²⁶ In the case of cesium-137, the evacuation of Cikande residents was executed a mere two months after the initial detection of contamination, even though the radiation levels were well-established to be exceedingly high.

c. Polluter Pays Principle

In accordance with this principle, the responsibility to cover the costs of cleanup and compensation for victims falls upon the polluting parties.²⁷ Within the context of cesium-137, this obligation should be shouldered by the corporations involved in the source of contamination, including both the industrial area managers and the importers of radioactive materials.

d. Access to Justice Principle

The principle of access to justice is predicated on the right of communities to access legal mechanisms to obtain remedies for environmental damage or loss they have suffered.²⁸ Affected residents have the right to sue polluters, either through civil class actions or citizen lawsuits. Within the framework of human rights, access to justice is included in the procedural right to obtain remedies.

From a protection standpoint, the state is responsible for promptly implementing measures such as evacuation, decontamination, and long-term health monitoring. At the same time, the community must be afforded access to information, education on emergency response, and legal safeguards for whistleblowers. Unfortunately, the government's response in the cesium-137 case has been largely reactive. Meaningful public participation is therefore crucial to ensure that environmental policymaking is not purely technocratic but genuinely upholds citizens' rights to take part in the decision-making process.

In the case of cesium-137, the government's response was characterized by a delay in disseminating information to the public, thereby impeding citizens' ability to implement

²⁴Phoebe N. Okowa, *The Prevention Principle in International Environmental Law* (Cambridge: Cambridge University Press, 2018), 1–25.

²⁵Saiful Kahfi and Firdaus, "Implementasi Prinsip Pencegahan Dalam Hukum Lingkungan Indonesia," *Jurnal Hukum Lingkungan Indonesia* 8, no. 1 (2021): 45–67.

²⁶Elizabeth Fisher, Judith Jones, and René von Schomberg, *Implementing the Precautionary Principle: Perspectives and Prospects* (Cheltenham: Edward Elgar Publishing Limited, 2006), 1–30.

²⁷Nicolas de Sadeleer, "The Polluter-Pays Principle in EU Law—Bold Case Law and Poor Harmonisation," in *EU Environmental Law and the Internal Market*, ed. Marjan Peeters and Rosa Uylenburg (Oxford: Oxford University Press, 2014), 279–304.

²⁸Jonas Ebbesson, "Access to Justice in Environmental Matters in the EU," in *EU Environmental Law*, ed. Marjan Peeters and Rosa Uylenburg (Oxford: Edward Elgar Publishing, 2012), 147–78.

timely protective measures. Moreover, there is currently no transparent mechanism in place to facilitate public participation in the decontamination or compensation process. Within the national legal system, the protection of the public from radiation is reflected in several legal instruments. However, the cesium-137 case demonstrates the existence of regulatory loopholes, as the contamination did not originate from an official nuclear facility but rather from waste produced by the scrap metal industry. This indicates a notable lacuna in the regulatory framework, as nuclear regulations do not fully address the risks posed by radiation in a non-nuclear industrial context. It is imperative to acknowledge that, from a scientific standpoint, these risks are equally grave.

Corporate Responsibility for Cesium-137 Radioactive Contamination of the Community

The discovery of cesium-137 radioactive contamination in a community environment is not an occurrence that can be considered arbitrary. Numerous factors influence the occurrence of such events. One such factor is the negligence of factories or companies, which in this case can also be referred to as corporations, in their responsibility to manage waste, namely radioactive waste. In accordance with Law No. 10 of 1999 concerning Nuclear Energy, the definition of radioactive waste encompasses radioactive substances, materials, and equipment that has been exposed to radioactive substances or has undergone radioactive decay due to the operation of nuclear installations, rendering it unsuitable for further utilization. Environmental issues are distinct cases, necessitating law enforcement's involvement of all relevant parties in monitoring and restoring the impact of environmental pollution, if it occurs. The public's concern over environmental issues stems from the fact that the most fundamental right threatened is the right to a healthy and sustainable environment. In environmental cases, particularly those involving pollution, if the perpetrator is proven guilty, they can be held criminally and civilly liable.²⁹

Accountability is not limited to individuals; it is also imposed on corporations. Conversely, when discussing corporations, several legal statutes exist that delineate their characteristics. For instance, Law No. 5 of 1997 on Psychotropic Substances stipulates: A corporation is defined as an organized group of people and/or wealth, irrespective of its legal status. According to Law No. 31 of 1999 on Eradicating Corruption, as amended by Law No. 21 of 1999 on Eradicating Corruption, the following statement is made: According to Law Number 31 of 1999 concerning Eradication of Corruption Crimes, as amended by Law Number 21 of 2001, a legal entity is defined as "a body that is not a natural person, such as a corporation, a foundation, a partnership, a company, or a government agency." The legislation also stipulates that assets, irrespective of their legal status, are subject to the same principles and provisions. A corporation is defined as an organized group of people and/or assets, irrespective of its legal status. According to the definitions of a corporation in these two legal documents, it can be concluded that there is a discrepancy in the scope of a corporation as a legal entity, specifically in the context of civil and criminal law. The term "corporation" is defined in civil law as a "legal entity," while in criminal law, the definition of a corporation encompasses not only legal entities but also non-legal entities. Consequently, the scope of corporations in criminal law is considerably broader than the legal concept found in civil law.³⁰

In the same manner that natural persons in a legal sense can be held legally accountable, corporations that possess the same status as legal entities can also be held legally accountable. In the realm of criminal law, the notion of "accountability" assumes a pivotal role, known as the doctrine of fault. In the Latin tradition, this concept is referred to as "Mens rea." The doctrine

²⁹Stefani Margareta and Widyawati Boediningsih, "Tanggung Gugat Korporasi Akibat Pencemaran Lingkungan Ditinjau Berdasarkan Undang-Undang Perlindungan Dan Pengelolaan Lingkungan Hidup" 0444 (2023): 1–13, <https://doi.org/10.58344/jhi.v1i2.10>.

³⁰Manullang Herlina and Pasaribu Riki Yanto, *Pertanggung Jawaban Pidana Korporasi*, (Medan : LPPM UHN Press, 2020).

of mens rea (evil intent) is implemented in such a way that an act does not result in a person being guilty unless that person is evil. In accordance with this principle, two conditions must be fulfilled to attain a conviction: the presence of a prohibited outward act, and the existence of malevolent intent.³¹ The capacity of corporations to be held criminally liable is predicated on the understanding that the transgressions perpetrated by these entities engender substantial detriment to society, the environment, and the state. In certain instances, corporations are utilized not only as instruments to perpetrate criminal acts but also as mechanisms to mask the proceeds of crime, thereby enabling corporations to derive profit from these illicit activities.³²

Several theories explain corporate legal liability, including:³³

1. The theory of strict liability is a doctrine of criminal law that attributes liability solely based on the explicit wording of the law, irrespective of the identity of the offender. In this legal framework, corporations are held liable for any physical acts committed by their directors, shareholders, agents, representatives, or employees. In the context of criminal law, the concept of strict liability signifies that the presence of malicious intent or the subjective element of “mens rea” is not required to be demonstrated regarding one or more components that reflect the unlawful nature or actus reus of an offense. This principle stands in contrast to other criminal offenses, where intent, negligence, or willfulness are typically considered as integral elements. Consequently, corporations must be held liable for the consequences that arise, without the need to prove fault or negligence.
2. The theory of vicarious liability underscores the accountability of corporate officers for the corporation’s unlawful actions as representatives. This theory posits that company superiors bear responsibility for the actions of their subordinates. This principle is rooted in the concept that an individual is held accountable for the actions of others when both parties are engaged in a joint entity or activity.
3. The theory of identification (direct corporate criminal liability) or the doctrine of direct criminal liability posits that a company can commit several offenses directly through individuals closely associated with the company and regarded as the company itself.
4. The Aggregation Model posits that criminal liability may be assigned to a legal entity under certain conditions. The model asserts that if an unlawful act is perpetrated by multiple individuals who fulfill the elements of the offense, and these elements are interconnected and not independent of one another, criminal liability may be imposed on the legal entity.
5. The corporate culture model, also known as the work culture model, refers to the explicit and implicit legal policies that influence the operation of a legal entity. In the context of criminal law, legal entities can be held criminally liable if there is evidence that an individual’s actions were based on the rational assumption that the legal entity authorizes or permits the commission of an unlawful act.

According to Law No. 32 of 2009 concerning Environmental Protection and Management, several sanctions can be imposed on violators. These sanctions include administrative sanctions, civil sanctions that will be imposed if dispute resolution through non-litigation fails, and criminal sanctions, which are the “ultimum remedium.” That is, criminal law is enforced as a last resort after the application of administrative law enforcement is deemed unsuccessful. As delineated in the general provisions of the Law No. 32 of 2009, “every person” is defined as an

³¹Novy Yandari Nurlaily and Agus Supriyo, “Pertanggungjawaban Korporasi Dalam Kasus Pencemaran Lingkungan Hidup,” *Media of Law and Sharia* 3, no. 3 (2022): 255–69, <https://doi.org/10.18196/mls.v3i3.14384>.

³²Warid Anjari, “Pertanggungjawaban Korporasi Sebagai Pelaku Tindak Pidana,” *Jurnal Ilmiah WIDYA Yustisia* 1, no. 2 (2016): 116–21, <https://www.neliti.com/publications/247176/pertanggungjawaban-korporasi-sebagai-pelaku-tindak-pidana>.

³³Diah Ratna Sari Hariyanto Satwika Narendra, Gde Made Swardhana, “Pertanggungjawaban Korporasi Berdasarkan Kesalahan Menurut Hukum Pidana,” *J-CEKI : Jurnal Cendekia Ilmiah* 3, no. 5 (2024): 5290–5303, <https://doi.org/10.56799/jceki.v3i5.5089>.

individual or business entity, whether incorporated or unincorporated, thereby encompassing corporations. In the context of environmental criminal law, the term “crimes committed by legal entities” refers to the actions of corporations that result in environmental damage. Such activities may include pollution, production waste, and other forms of harm to the environment.³⁴

The issue of cesium-137 radiation exposure in the Cikande industrial area has a direct impact on the community. Legal responsibility can be based on Article 98 paragraph (1) of the Law No. 32 of 2009, namely: Any individual who intentionally commits an act that results in the exceeding of ambient air quality standards, water quality standards, seawater quality standards, or environmental damage criteria is subject to criminal prosecution and, upon conviction, may be sentenced to a minimum of three years and a maximum of ten years’ imprisonment, in addition to a fine of at least Rp3,000,000,000.00 (three billion rupiah) and a maximum of Rp10,000,000,000.00 (ten billion rupiah). The individual may also be subject to Article 99, paragraph (1) of the Law No. 32 of 2009, which stipulates that: “Any individual whose negligence results in exceeding ambient air quality standards, water quality standards, seawater quality standards, or environmental damage criteria shall be subject to imprisonment for a minimum of one year and a maximum of three years, in addition to a fine of at least IDR 1,000,000,000 (one billion rupiah) and at most IDR 3,000,000,000 (three billion rupiah). The determination of the applicable article is determined by the mens rea or intent of the perpetrator, regardless of whether there is an element of intent or negligence.

Conversely, in instances where the perpetrator of an environmental crime is a corporation, the pertinent regulations concerning its liability are delineated in Articles 116–120 of the Environmental Protection and Management Law. Article 116(1) of the Environmental Protection and Management Law (EPML) establishes that in the event an environmental crime is perpetrated by, for, or on behalf of a business entity, criminal charges and penalties shall be imposed on the business entity and/or the individual who issued the directive to commit the crime or the individual who served as the leader of the criminal activity.

Article 118 of the Environmental Protection and Management Law also stipulates that in cases of environmental crimes perpetrated by a business entity, criminal sanctions shall be imposed on the business entity represented by an authorized representative in and out of court, in accordance with the prevailing laws and regulations, as the functional perpetrator. Accordingly, the formulation of Articles 116 and 118 of the Law No. 32 of 2009 delineates three categories of subjects amenable to prosecution and punishment, namely: (a) the business entity itself; (b) the individual who issued the directive or who functioned as the principal actor in the criminal act; and (c) the management.³⁵

The imposition of criminal sanctions on corporations whose actions result in the generation of radioactive waste can also be punished under Article 44, paragraph (2), in conjunction with Article 24, paragraph (1), of Law No. 10 of 1997 concerning Nuclear Energy, namely: Any individual who perpetrates an act in violation of Article 24, paragraph (1), specifically about producers of low-level and medium-level radioactive waste, who are obligated to collect, group, process, and temporarily store such waste before its transfer to the Implementing Agency, shall be subject to a maximum financial penalty amounting to Rp 100,000,000 (one hundred million rupiahs).

³⁴Safaruddin Harefa and Muhammad Alvin Nashir, “Pertanggungjawaban Pidana Korporasi Dalam Kasus Pelanggaran Lingkungan Hidup Di Indonesia,” *ADIL: Jurnal Hukum* 16, no. 1 (2025): 36–60, <https://doi.org/10.33476/ajl.v16i1.4966>. therefore the state must prioritize all forms of the legal system as the basis for running the country.

³⁵Muhari Agus Santoso, “Pertanggungjawaban Pidana Pencemaran Lingkungan Hidup Yang Dilakukan Oleh Korporasi,” *Jurnal Cakrawala Hukum* 7, no. 2 (2016): 216–28, <https://doi.org/10.26905/idjch.v7i2.1912>. multinational corporations have shown a massive accumulation of wealth and created a wide range of personalities. Whereas in the field of criminal law, which is heavily linked to accountability referred to in the Criminal Code (KUHP

In determining who among the management of a legal entity is responsible for criminal liability related to the environment and the management of radioactive waste, the Environmental Impact Assessment (EIA), permits (licenses), and division of duties within the legal entity (corporation) concerned must be examined. The investigation and the documents will yield data, information, and facts regarding the negative impacts caused by the business activities in question and the extent to which monitoring and control of these impacts have been carried out. A thorough examination of these documents reveals the rights and obligations of the company's management about monitoring, preventing, and controlling the negative impacts of the company's activities. Consequently, the investigation will ascertain whether the pollution and/or environmental damage was a result of intentional actions or negligence.³⁶

The imposition of criminal sanctions for cases of environmental pollution through exposure to cesium-137 radiation can only be determined after the investigation and proof of who will be held responsible on behalf of the corporation or the corporation itself has been completed. In instances where there is clear evidence of criminal acts involving environmental pollution, the judicial system is better equipped to determine an appropriate sentence. Furthermore, Article 119 of the Environmental Protection and Management Law stipulates that corporations may be subject to additional criminal penalties or disciplinary measures, including the following: a. Confiscation of profits derived from criminal activities; b. Closure of all or part of the business premises and/or operations; c. Remediation of the consequences of criminal acts; d. Performance of obligations that have been neglected without rights; e. Placement of the company under supervision for a period not exceeding three years. This necessitates that corporations undertake moral and environmental restitution for the impact they have exerted on the community.

The government's strategic role encompasses the formulation of policies and regulations, the supervision of high-risk activities, the implementation of recovery measures, and the protection of citizens' rights to a good and healthy environment. Consequently, the cesium-137 radiation incident cannot be attributed exclusively to the corporation or party that caused the radiation leak. Instead, it also reflects the effectiveness of the government's role in carrying out its regulatory, supervisory, mitigation, and recovery functions. Consequently, the government's obligation in this matter is derived from its constitutional and statutory commitments to ensure the rights of all citizens to a conducive and salubrious environment. In the context of Indonesian environmental law, specifically Article 2 letter a of Law No. 32 of 2009 concerning Environmental Protection and Management, environmental protection and management are to be executed on the foundation of the principle of "state responsibility."

This suggests that the government/state not only functions as a supervisor but also bears institutional responsibilities. Moreover, Article 87 underscores the principle of environmental liability, stipulating that "Any individual or entity responsible for a business or activity that results in unlawful acts of pollution and/or environmental destruction, thereby causing harm to other individuals or the environment, is obligated to provide compensation and/or undertake specific remedial actions." Article 88 establishes the principle of strict liability for activities involving hazardous materials, including those associated with radiation. Consequently, in instances where cesium-137 contamination arises from industrial activities or the management of radioactive waste, corporate entities may be held accountable under the established regulations. Nevertheless, the government's role persists in instances of supervisory failure, inadequate regulations, or insufficient remedial measures.

³⁶Nuzul Qur'aini Mardiyah, "Pengaturan Pertanggungjawaban Korporasi Dalam Tindak Pidana Lingkungan Hidup / The Regulation Of Corporate Liability In Environmental Criminal Act," *Jurnal Hukum Dan Peradilan* 7, no. 3 (2018): 483, <https://doi.org/10.25216/jhp.7.3.2018.483-502>.

In addition to Law No. 32 of 2009, the government's responsibilities in the context of radiation are also specifically regulated in Law No. 10 of 1997 concerning Nuclear Energy. This law forms the basis for the establishment of the Nuclear Energy Supervisory Agency (BAPETEN) as a government institution tasked with supervising all activities involving the use of nuclear energy. Article 14 of the law stipulates that supervision shall be carried out through regulations, licensing, and inspections from the aspects of safety, security, and safeguards. Consequently, the government is legally obligated to ensure that all activities involving radioactive materials, including cesium-137, are carried out in accordance with stringent safety standards.

Moreover, Presidential Regulation No. 74 of 2012 concerning Nuclear Damage Liability stipulates that the government is liable in the event of a nuclear accident occurring at a government-owned facility or during the transportation of nuclear fuel to and from government facilities. This provision also stipulates that every operator or entrepreneur of a nuclear facility must possess financial guarantees or insurance to ensure the compensation of affected parties. Consequently, the government's role transcends that of a mere regulator and supervisor, as it can be held directly accountable for any activities involving radioactive materials that fall under its purview or jurisdiction.

This accountability mechanism is consistent with the international principle that the state holds ultimate responsibility for nuclear safety within its borders. This principle is firmly established in various international legal documents that designate the government as the primary entity responsible for ensuring safety, supervising nuclear operations, and establishing compensation mechanisms for any nuclear accidents that may occur.³⁷ An evaluation by the International Atomic Energy Agency (IAEA) also emphasizes the importance of strengthening BAPETEN's institutional capacity so that nuclear supervision in Indonesia is carried out in accordance with global safety and security standards.³⁸

The government's role in the cesium-137 case encompasses two functions, namely: Firstly, in its capacity as both a regulator and supervisor, the government is obligated to guarantee that all activities with the capacity to result in radiation, ranging from the production, utilization, transportation, storage, to the disposal of radioactive materials, are executed in accordance with safety standards, are duly authorized by appropriate permits, and are subject to sufficient supervision and monitoring systems. Failure in regulation or supervision can be interpreted as administrative negligence, which opens the door for the state to be held responsible. In the aftermath of the Fukushima incident in Japan, the judicial system determined that the government was to a certain extent culpable for its inadequate supervision of the nuclear facility operator. In the ruling, the government was deemed to have the capacity to prevent the accident but failed to use that authority effectively. This observation underscores the notion that, within contemporary legal frameworks, the government's inability to fulfill its supervisory duties can be interpreted as a form of state negligence that may incur legal liability.³⁹

Secondly, as the party responsible for recovery, the government is obligated to protect citizens' rights to a good and healthy environment (including the right to health), take mitigation measures, provide recovery facilities, set environmental recovery standards, and guarantee victims' access to compensation or damages. Given the long-term and intergenerational impacts of cesium-137, the government's response cannot be merely reactive; rather, it must be an ongoing, proactive measure. The article "The Lessons Learned from Japan's Mechanisms

³⁷Shinta Hadiyantina, Dewi Cahyandari, and Dhiana Puspitawati, "Bapeten Supervisory Authority in the Procedure of Transportation of Radioactive Substance Through the Sea," *Yustisia Jurnal Hukum* 8, no. 3 (2020): 447, <https://doi.org/10.20961/yustisia.v8i3.34678>.

³⁸Intan Soeparana and Joseph Tanega, "A Critical Assessment on Nuclear Security Measure in Indonesia," *Yuridika* 37, no. 2 (2022): 317–44, <https://doi.org/10.20473/ydk.v37i2.36279>. with the view of determining whether the existing regulations are sufficient to provide nuclear security measures that protect the general public, and (2

³⁹Legal Affairs, "Uclear Law Bulletin No. 93" 2014, no. 93 (2014).

to Compensate Victims of the Fukushima Daiichi Nuclear Accident” underscores the necessity of state involvement, alongside that of operators and an adequate litigation/alternative dispute resolution (ADR) system, to ensure that radiation victims receive appropriate compensation and rehabilitation.⁴⁰ A failure on the part of the government to fulfill these two functions could be construed as a transgression against the constitutional rights of citizens to a healthy environment, as delineated in Article 28H of the 1945 Constitution. While corporations or entities emitting radiation typically bear the primary legal liability, the public reserves the right to initiate legal action against the government through a citizen lawsuit in instances where government policies, permits, or oversight are deemed inadequate.⁴¹

A significant challenge in the cesium-137 case is establishing causality and identifying the source of contamination, which can hinder the accountability of the government or corporations. For instance, the “Evaluation of ambient dose equivalent rates influenced by vertical and horizontal distribution of radioactive cesium in soil in Fukushima Prefecture” demonstrates the intricacy of environmental variables, such as the distribution of radioactive elements in the soil, which complicates the forensic identification of the source of government or corporate actions.⁴² Consequently, the legal concept of “strict liability” (liability without the need to prove fault) assumes significant importance in ensuring the rights of victims are protected, even in circumstances where conventional proof is challenging to obtain. This assertion is further substantiated by extant literature in the domain of nuclear and radiation engineering, which demonstrates the inadequacy of fault-based liability as a governing principle in such contexts.⁴³

In the context of radiation cases, the conventional fault-based approach to liability has been deemed inadequate due to the complexity inherent in establishing a definitive causal relationship between specific actions and their subsequent health or environmental ramifications. Radiation, such as that emanating from the cesium-137 isotope, has a tendency to disseminate extensively and engender cumulative effects that manifest over an extended timeframe. Therefore, the principle of strict liability is a more effective approach to ensuring justice for victims.⁴⁴ In this case, any entity engaging in high-risk activities, including the state, can be held liable without the need to prove fault. The implementation of this principle enables affected communities to obtain compensation without encountering obstacles posed by complex scientific evidence.

The capacity of regulatory agencies such as BAPETEN to conduct integrated monitoring is limited; therefore, the establishment of strong legal and institutional mechanisms is a fundamental step to ensure that the government not only acts after a disaster occurs but is also able to prevent and minimize its impact through responsible governance. To address this gap, the government must enhance its oversight mechanisms through agencies such as the Nuclear Energy Regulatory Agency (BAPETEN). This will ensure that the management of radioactive sources, including cesium-137, adheres to international safety standards. To this end, a comprehensive set of preventive measures must be implemented, encompassing periodic

⁴⁰Suziana Masni Majid and Salawati Mat Basir, “The Lessons Learnt from Japan’s Mechanisms to Compensate Victims of the Fukushima Daiichi Nuclear Accident,” *International Journal of Asian Social Science* 9, no. 12 (2019): 752–64, <https://doi.org/10.18488/journal.1.2019.912.752.764>.

⁴¹Bachrul Amiq et al., “Environmental Damage: Community Lawsuit Against The Government Over Industrial Business Licenses,” *Law Reform: Jurnal Pembaharuan Hukum* 20, no. 1 (2024): 1–21, <https://doi.org/10.14710/lr.v20i1.61176>.

⁴²Alex Malins et al., “Evaluation of Ambient Dose Equivalent Rates Influenced by Vertical and Horizontal Distribution of Radioactive Cesium in Soil in Fukushima Prefecture,” *Journal of Environmental Radioactivity* Volume 151, no. 1 (January 2016): 38–49, <https://doi.org/10.1016/j.jenvrad.2015.09.014>.

⁴³Abdulrahman Ahmad N. Alhathi, Khalid Ali Y. Alshahrani, and Ali Muhammad M. Al-Darwbi, “The Legal Basis for Civil Liability in the Nuclear Field,” *International Journal of Religion* 5, no. 2 (2024): 360–66, <https://doi.org/10.61707/z49p3r72>. whether it is based on proven fault or presumed fault, to establish civil liability for nuclear damages.

⁴⁴Etheldreda E L T Wongkar, “Meninjau Kembali Strict Liability : Perkembangan Konseptual Dan Tantangannya Dalam Ajudikasi Lingkungan Di Indonesia,” *Jurnal Pro Natura* 1, no. 1 (2024): 1–18, <https://journal.ugm.ac.id/v3/Pro-Natura/article/view/13532/4547>.

inspections, the establishment of a system for reporting and tracking radioactive waste, and the enhancement of the technical capacity of supervisory officials.

In the event of a leak or contamination, the government is obligated to act expeditiously by implementing mitigation measures and ensuring transparency of information to the public. Such delays or inaccuracies in handling can be regarded as a transgression against the rights of citizens to environmental protection and health. Furthermore, the state is obligated to ensure universal access to legal redress through the mechanisms of litigation or citizen lawsuits. This is essential to ensure that government entities can be held accountable in instances of proven negligence. The updating of nuclear legal instruments to align with international standards will provide clarity regarding the state's responsibilities in cases of radioactive contamination.⁴⁵

CONCLUSION

The provision of legal protection for communities affected by cesium-137 can be regarded as a tangible realization of the human rights to life and a healthy environment. The right to a healthy environment is inextricably linked to the right to life and health. The state is obligated to implement measures that are designed to prevent, protect, and remediate environmental threats that pose a threat to the well-being of its citizens. The cesium-137 case exemplifies the deficiencies in the monitoring and coordination systems among institutions, the delays in handling victims, and the absence of public transparency. These violations not only contravene national law but also violate international standards, including the precautionary principle, the polluter pays principle, and the access to justice principle. Consequently, the protection of communities affected by cesium-137 should be regarded within the framework of human rights, rather than being perceived exclusively as a technical environmental concern. The state is obligated to fortify integrated regulations, establish equitable compensation mechanisms, ensure the right to information and justice, and formulate long-term policies for environmental and public health recovery. Legal protection afforded by the government to the public may take the form of preventive measures, including a thorough reassessment of corporate licensing mechanisms; repressive measures, through the imposition of criminal and administrative sanctions upon offenders; and curative measures, by providing compensation to affected communities.

Corporate accountability is not solely a legal matter; it also encompasses the responsibility to remedy the consequences of corporate actions. Moreover, the government's obligation in the cesium-137 contamination case extends beyond mere administrative or criminal environmental concerns. It encompasses a moral and constitutional duty to safeguard the well-being of the populace. To address these concerns, the government must take several actions. First, it must strengthen the application of the principle of strict liability. Second, it must increase its supervisory capacity. Third, it must improve inter-agency coordination mechanisms. Finally, it must ensure that victims have access to compensation and transparent public information. Absent these measures, the risk of cesium-137 or analogous radionuclide contamination could establish an unfavorable precedent for environmental governance and public safety in the future.

⁴⁵Gumilang Fuadi and Muchammad Ichsan, "Liability for Nuclear Damage : Perspectives of International Conventions , Indonesian Positive Law , and Islamic Law of Civilization . 1 In Addition to Its Use as a Weapon , Nuclear Energy Can Also Be Harnessed through Nuclear Reactors or Pembangkit Listrik," *Asy-Syir'ah Jurnal Ilmu Syari'ah Dan Hukum* 56, no. 2 (2022), <https://doi.org/10.14421/ajish.v56i2>.

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