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Sustainable Development in Global Nuclear Safety Governance with Legal Frameworks for Environmental Protection and Liability

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Abstract
The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1986) introduced crucial environmental legislation in the nuclear sector, focusing on protecting lives, property, and the environment from radioactive emissions. Later accords like the 1994 Convention on Nuclear Safety and the 1997 Joint Convention on the Safety of Spent Fuel and Radioactive Waste Management reinforced this environmental safeguard. These frameworks are examined in the context of public access to nuclear information, with notable gaps in laws granting the public rights to information and participation in nuclear decision-making. The Aarhus Convention (1998) is significant here, providing the public with rights to obtain environmental information, participate in decision-making, and seek legal remedies. The Espoo Convention and its 2003 Kiev Protocol further enhance public involvement, introducing the Strategic Environmental Assessment (SEA), which mandates environmental impact assessments for nuclear plans and ensures stakeholder consultation. The study also explores compensation for environmental harm caused by nuclear disasters, referencing various conventions like the EU Environmental Liability Directive and the Civil Liability Convention. It advocates for stronger implementation of international treaties, social responsibility in nuclear policies, and effective national regulations. The Indian regulatory landscape, particularly the Atomic Energy Regulatory Board (AERB) and the proposed Nuclear Regulatory Authority of India, is scrutinized. The paper underscores the importance of global collaboration to strengthen international laws on nuclear safety, waste management, liability, and compensation, promoting sustainable development while protecting the environment for future generations.

Keywords— Nuclear Convention, Public access, Environmental Liability

I. INTRODUCTION
Environmental concerns have always been at the forefront for both developed and developing societies due to globalization and industrialization of the world in the present age. Though the human intellect and efforts have significantly advanced, in most cases it goes beyond nature's limits, threatening the stability of civilization. For the last three centuries, scientific developments that have unlocked nuclear energy and managed genetic structures facilitated unprecedented development. However, with the rapid global pace of progress, localized pollution issues have escalated to a global scale, and hence, there is a need for collective international efforts to protect the environment for human sustenance. Energy is at the

center of development, and it plays a crucial role in poverty reduction, healthcare improvement, and overall progress. The increasing energy demand of the global population has led people to look into alternative sources for energy, of which nuclear energy is one possibility to solve the growing energy crisis. Although the promise of peaceful use is attached to nuclear energy, it entails great risks and can cause intense and irreparable damage to any ecosystem, which includes humans, plants, and animals. Radiation problems near nuclear plants, poor maintenance, and the unresolved problem of nuclear waste all make these more issues that fuel health concerns, ecological deterioration, and cultural disintegration. These regulations, though still in their infancy, aim to effectively protect the environment from the risks of nuclear activities. Early international nuclear law conventions, such as the Convention on Nuclear Safety (1994) and the Joint Convention on Radioactive Waste Management (1997), began prioritizing environmental protection, especially after disasters like Chernobyl. Public access to nuclear information has also improved, influenced by global agreements like the Stockholm Declaration (1972) and Aarhus Convention (1998), promoting transparency and stakeholder engagement.

Public involvement has become a critical component of the process, with conventions such as Espoo (1991) and Aarhus stressing environmental impact assessments and early stakeholder involvement in nuclear energy decisions. Preventing environmental damage caused by nuclear incidents remains the ultimate goal of nuclear law, which is supported by liability frameworks that hold operators accountable for safety measures. Compensation for nuclear damage, including environmental restoration, becomes essential when prevention fails. Legal frameworks, like the EU Environmental Liability Directive, are there to help judges decide what appropriate environmental restoration would be after nuclear disasters, reinforcing accountability and sustainable recovery.

The approach towards environmental protection in the nuclear energy sector is evolving and reflects an increased commitment to the harmonization of scientific progress with sustainable practices. Legal frameworks, public engagement, and compensation principles all contribute to mitigating the impact of nuclear activities on the environment. As societies evolve, so does the relationship between technological advancement and environmental conservation. Innovation increases living standards but has inherent risks associated with it. Environmental law is also important in regulating radioactive activities and ensuring a balance between development and ecological preservation. The 1986 Chernobyl disaster led to a global reevaluation of nuclear energy's environmental impact, and it resulted in international accords like the 1994 Convention on Nuclear Safety and the 1997 Joint Convention on Spent Fuel and Radioactive Waste Management. These accords emphasized environmental protection in nuclear activities. Access to nuclear information was necessary for transparency and informed decision-making. The early lack of public involvement indicated the need for reform. The Stockholm Declaration of 1972 and Rio Declaration of 1992 defined international environmental law, emphasizing openness and stakeholder participation. The Joint Convention of 1997 and Aarhus Convention of 1998 further entrenched public rights to information, decision-making, and legal redress against operators. Legislation like the Espoo Convention (1991) mandated environmental impact assessments (EIA) with public participation, while the Aarhus Convention ensured transparency and early public involvement in nuclear projects. Nuclear law also emphasized environmental safeguards, including emergency responses under the 1986 Convention on Nuclear Accidents and financial liability frameworks for damage prevention and compensation. Evolving nuclear laws are indeed testaments to the international will to harmonize human technological advancement with environmental stewardship, addressing transparency, public participation, and damage mitigation. The expanding legal framework manifests a necessity for sustainable development to meet energy demands.

II. Sustainable Development and Radioactive Waste

The concept of sustainable development has been raised to the front because of the environmental degradation created by fast-paced industrialization and over-exploitation of natural resources. During the 1970s, experts realized that economic development could not be used for the improvement of people's life without improving the health of their environment. Sustainable development, as defined in the 1987 "Our Common Future" report by the World Commission on Environment and Development, is meeting the needs of the present without compromising the ability of future generations to meet their own.

Radioactive waste, a dangerous source of pollution through civil and military activities, requires a special strategy for disposal as it is hazardous to the environment. This kind of waste originates from the nuclear fuel cycle as well as in the operation of nuclear reactors and contains low-, intermediate-, and high-level categories. The IAEA encourages rules that govern radioactive waste management and safety for both humans and the environment. Disposal methods include liquid waste evaporation, mixing residues with cement, and deep burial. Public concern about radioactive waste emphasizes the need for environmentally responsible disposal. Sustainable development is a key element of international environmental law, influencing global cooperation on issues like pollution, climate change, and resource conservation. Some of the notable legal frameworks include the 1972 Stockholm Conference, the 1985 Vienna Convention, and the 1992 Rio Declaration, all aimed at nudging the world toward sustainability in terms of environmental issues.

Intergenerational equity-the right of future generations to resources and a healthy environment-is integral to sustainable development. This principle, as incorporated under the India Public Trust Doctrine, is strengthened by international environmental law's precautionary and polluter-pays principles. These were held to be environmental and customary international law by the Supreme Court of India in Vellore Citizens Welfare Forum v. Union of India. The precautionary principle in India encompasses vagueness over environmental degradation causes, solutions, and, uniquely, the extent of damage. Sustainable development in India is constitutionally protected through Articles 48A and 51A(g), focusing on environmental protection. Indian courts have also protected the right to a healthy environment as a part of the right to life in Article 21. According to specific enactments like the Water (Prevention and Control of Pollution) Act, the Air (Prevention and Control of Pollution) Act, and the Environment (Protection) Act, sustainable practices must also come together with the use of nuclear energy, which is regulated under the Atomic Energy Act of 1962.

Finally, radioactive contamination incidents, such as the 1945 Trinity test, marked the beginning of a broader awareness of the destructive potential of radiation. These incidents have deeply influenced global environmental law and nuclear energy policies. The evolution of sustainable development, with a focus on intergenerational equity and environmental protection, underscores the need for balancing technological progress with safeguarding the planet for future generations.

III. Deleterious Incidents of Radioactive Contamination

Man-made radiation incidents have been recorded over the years and have been seen to unleash devastating power. The first major incident was the testing of the atomic bomb, codenamed 'Trinity,' in Alamogordo, New Mexico, on July 16, 1945. The explosion released radiance equivalent to thousands of suns, which became a turning point in the recognition of the power and dangers of nuclear energy, thus causing widespread fear and realization of its destructive capabilities.

The Fukushima nuclear plant disaster occurred on March 11, 2011, when the tsunami hit the plant, inflicting severe damage. Seawater pumps were unable to function to cool the reactors, resulting in the

danger of a meltdown in three of the four reactors. The tsunami also flooded the necessary pump rooms that control the cooling systems, which though emergency measures were taken, reactor pressures kept increasing. Despite the restoration of cooling systems, the situation resulted in evacuations and no-fly zones, which highlighted the vulnerability of nuclear power plants to natural disasters.

Hiroshima and Nagasaki, the cities that were devastated by nuclear warfare during World War II, epitomized the horrific effects of atomic bombs. Hiroshima was hit on August 6, 1945, killing more than 150,000 people and destroying everything within a 15-kilometer radius. Three days later, Nagasaki faced the same tragic fate, killing about 49,000 people. This event also had long-term radiation effects, including genetic damage passed to subsequent generations, and thus it created an awareness of the long-term consequences of nuclear war.

The third major incident in nuclear history is the Three Mile Island accident that occurred on March 28, 1979, near Pittsburgh, Pennsylvania. A partial meltdown at the TMI-2 reactor was contained after five days, averted catastrophic radiation release, but small amounts of radiation were indeed emitted which led to health impacts such as birth defects and mental retardation. The long-term effects of nuclear accidents were demonstrated when large amounts of radioactive water were channeled into containment buildings which needed decontamination efforts to be made for more extended periods.

The 1986 Chernobyl disaster in Ukraine released radioactive contamination over four million people. It had immediate deaths, followed by mass evacuations. Radioactive particles went through groundwater and surface waters contaminating ecosystems in Europe. The disaster created international efforts to ensure that similar catastrophes never happen again; hence, a global cooperation towards nuclear safety.

There were also a large number of minor radiation incidents, some of which were caused by human mistakes or equipment failure. For example, in 2006 a worker in Fleurus, Belgium, received a high dose from cobalt-60, resulting in severe effects on his health. One more such incident was the radiation exposure that occurred at Stamboliysky, Bulgaria, and Mexico City in 1962 due to mishandling of radioactive materials. A failure of the software of a medical device resulted in death through radiation exposure in the Therac-25 accident in 1985, which revealed that nuclear technology may be dangerous if it is not applied in the proper context.

Radiation incidents also took place in India, questioning its safety standards of nuclear facilities. In 2003, the Kalpakkam Reprocessing Plant exposed six workers to radiation and was indefinitely shut down. The coolant system leaks occurred at the Madras Atomic Power Station in 1991 and 1999. In 2009, the Kaiga Generating Station reported a tritium uptake incident, while Jadugoda, with its uranium processing plant, reported incidents in 2006 and 2008. Furthermore, the Mayapuri radiation incident in Delhi in 2010, where Cobalt-60 was mishandled, led to serious health effects and necessitates better disposal and safety measures.

These incidents underscore the critical importance of strict regulations, safety protocols, and international cooperation to prevent and manage nuclear accidents. Whether by accident or deliberate cause, the devastating effects of radiation exposure call for a concerted effort to safeguard both humanity and the environment. Lessons from previous incidents are crucial in moulding future efforts to improve safety measures, emergency strategies, and regulatory frameworks in the nuclear industry to avoid disasters of a similar nature.

IV. Global Legal Landscape in Nuclear Energy Governance, Non-Proliferation, and International Responsibility

The global legal framework governing nuclear energy is shaped by a complex array of treaties and conventions that are designed to regulate its use and ensure safety, security, and environmental

responsibility. The world became highly concerned with nuclear energy after the catastrophic use of nuclear weapons during World War II, particularly the bombings of Hiroshima and Nagasaki in 1945. This brought about much interest in nuclear weapons, and countries began to race to utilize nuclear technology for military and civilian purposes. Whereas its utilization for civil, medical, and industrial purposes increased fast, the negative environmental impact potential of nuclear energy made it urgent to manage responsibly and regulate properly. To overcome these concerns, there has been a strong international consensus on the necessity of eliminating nuclear weapons from military arsenals and ensuring that nuclear energy is utilized solely for peaceful purposes.

Four major areas comprise nuclear energy legal frameworks: non-proliferation, nuclear safety, waste management, and liability for damages. Major treaties relating to non-proliferation include the 1963 Partial Test Ban Treaty (PTBT), the 1970 Non-Proliferation Treaty (NPT), and the 1996 Comprehensive Nuclear Test Ban Treaty (CTBT). PTBT limited nuclear tests into the atmosphere, underwater, and space, towards disarmament. The NPT promotes disarmament, prevents nuclear proliferation, and ensures peaceful nuclear use but suffers from challenges of enforcement and regional security. The CTBT bans all nuclear explosions but has yet to come into force because the relevant states have not ratified it.

For nuclear safety, the CPPNM in 1979 addresses topics of theft, sabotage, and trafficking; its scope is expanded by the amendment of 2005. The 1994 Convention on Nuclear Safety addresses international standards with respect to nuclear power plant safety through their design, construction, and operation. There is peer review as well as monitoring.

Regarding liability, the 1963 Vienna Convention on Civil Liability for Nuclear Damage holds operators strictly liable for accidents, providing compensation for victims. The 1997 Protocol expanded liability to include environmental and economic damages and raised compensation limits. These frameworks collectively address the critical aspects of nuclear energy governance.

To complete this, there is the Convention on Supplementary Compensation for Nuclear Damage from 1997, which intended to establish an international nuclear liability regime that completes regional conventions existing already, as in the cases of the Vienna and Paris Conventions. The CSC provides legal certainty and prompt compensation in case of a nuclear accident through the obligation for member states to make common laws at the national level. However, the CSC has yet to come into force because of lack of ratifications and requires minimum number of states to cross the threshold for entering into force. The development of these international regimes of liability highlights an increasing sense of commitment toward securing financial protection, legal certainty, and prompt compensation in the aftermath of nuclear accidents. The Vienna Convention, its 1997 Protocol, and the CSC together constitute a strong framework that holds nuclear operators liable for accidents and provides compensation to victims. These legal instruments are essential in ensuring that the global use of nuclear energy is responsible, safe, and sustainable.

The international legal framework for nuclear energy is comprised of a variety of treaties and conventions that address the major issues of non-proliferation, safety, waste management, and liability. While there has been considerable progress in regulating nuclear energy and promoting its peaceful use, challenges remain in achieving universal compliance, ensuring nuclear disarmament, and addressing the potential environmental and safety risks associated with nuclear energy. International cooperation and the further strengthening of existing legal frameworks will be necessary for the responsible and safe use of nuclear energy in the benefit of humankind.

V. ATOMIC ENERGY LAWS IN INDIA

India's journey has been quite noteworthy in the nuclear energy world, with developments in both the military and civilian sectors. This developing nation, India, developed a thriving, largely indigenous nuclear power program. The uses of nuclear energy stretch from electricity generation to advancements in agriculture and medicine. However, the potential dangers posed by nuclear energy have prompted India to enact laws and regulations to control and manage its development safely. The legislative framework governing atomic energy in India is a complex system that focuses on safety, security, and the responsible use of nuclear energy. Laws and regulations have been formulated, and several are still in the process of enactment, to ensure the safe handling and disposal of nuclear materials. Below is an overview of the main legislations that regulate nuclear energy in India:

A. Atomic Energy Act, 1962

Earlier legislation has been replaced by The Atomic Energy Act of 1962, reflecting the rapid developments in nuclear energy. It forms the backbone of the nuclear regulatory framework in India. Section 2(a) clarifies "atomic energy," and Section 2(2) deals with the workings of minerals related to atomic energy. The Act gives wide powers to the central government in matters concerning atomic energy activities such as the production, development, and disposal of Section 3. Under Section 4, there is a duty to report the presence of uranium or thorium. Sections 7 and 9 detail governmental powers to acquire information and to conduct exploration activities. The Act further grants powers to compulsorily acquire land under Sections 10 and 11, and Section 14 gives the government powers to make rules for effective control, including conditions of licensing. It also incorporates provisions for health and safety requirements under Section 17. There are provisions related to the penal provisions of offense under Section 24, that distinguish between a serious and a minor offense. However, one of the critical criticisms of this Act is its failure to include adequate provisions on civil liability in case of accidents and the dearth of enough deterrents for potential hazards.

B. Atomic Energy (Working of The Mines, Minerals And Handling of Prescribed Substances) Rules, 1984

According to The Atomic Energy Act, 1962, the government has all rights to handle matters of uranium and thorium, which are prescribed substances of nuclear energy. The Atomic Energy (Working of Mines, Minerals and Handling of Prescribed Substances) Rules, 1984, govern the mining, use, and disposal of prescribed substances like thorium and uranium. Individual and organizational mines have to acquire licenses from the Atomic Energy Commission for mining, processing, or handling prescribed substances. They further detail the qualification of personnel undertaking such activities and provide for specific safety responsibilities that a licensee has toward radiation, environment, and worker health. Yet, the regulations have been viewed as having been too general without specific provisions about the environmentally safe handling, transport, and disposal of radioactive material. No particular mechanism has also been outlined on how non-compliance by the licensees and safety officers could be penalized.

B. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987

Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987, were made to govern the disposal of radioactive wastes, which are hazardous in nature and cause many environmental and health hazards. It is ensured through these rules that radioactive waste is disposed of only after prior sanction from the competent authority. The rules provide for methods, locations, and quantities of disposal to ensure safe and controlled disposal. The rules also require elaborate record-keeping and place obligations on authorized persons to ensure the safety of disposal, conduct environmental surveillance, and respond to

accidental releases. Though these provisions are detailed, the rules lack adequate punitive measures for non-compliance except suspension or cancellation of disposal authorization.

C. Atomic Energy (Radiation Protection) Rules, 2004

The Atomic Energy (Radiation Protection) Rules, 2004 superseded the old radiation protection rules of 1971 and were promulgated in an effort to strengthen regulations surrounding radiation safety. The rules require that no person construct any radiation installation or deal with radioactive materials without having received a license. The rules further consist of elaboration in details for licensure wherein environmental impact study reports and emergency response plans are required. The rules further define strict responsibilities for radiological safety officers, employers, and licensees focusing on limiting exposure to radiation and ensuring that effective surveillance of radiation is carried out. Rules have also called for safety measures to handle radioactive substances including providing emergency response plans on accident involving radioactive materials. Penalties under the Atomic Energy Act are provided for violations of the rules, thus helping enforce compliance.

D. Civil Liability for Nuclear Damage Act, 2010

Civil Liability for Nuclear Damage Act, 2010 is one of the most significant enactments in the nuclear energy sector in India. This Act provides for liability and compensation in the event of nuclear accidents. The legislation was framed to bring Indian nuclear liability laws in consonance with international conventions.

The Act defines "nuclear damage" broadly to include loss of life, personal injury, and property damage arising out of or resulting from a nuclear incident. The liability framework sets the nuclear operator primarily liable for damages caused by accidents within or originating from its facilities. The liability is capped at Rs. 500 crore, raising questions about whether it is adequate, especially in the case of catastrophic incidents. The liability of the government would be extra to the operators' ceiling in cases of extraordinary accidents. The additional liability is 300 million Special Drawing Rights (SDRs). The operators are required by the Act to arrange insurance or other financial security for potential damages and to provide a claims procedure for victims with provisions relating to claim by compensation and dispute settlement. However, the Act has been criticized for its low compensation levels, which do not provide adequate assurance for victims, especially in comparison to international standards. The Act also does not extend liability to suppliers of nuclear equipment and materials, a major flaw that limits the scope of liability and victim recourse.

E. Criticism of the Civil Liability for Nuclear Damage Act, 2010

The Civil Liability for Nuclear Damage Act has been a subject of scathing criticism as it provides extremely low compensation amounts and limited liability of operators. The three-tier liability of the Act-the liability of an operator is only up to Rs. 500 crore-creates a question on the adequacy of compensation against the victims if a large nuclear disaster were to occur. Even considering the fact that extra governmental liability and international compensation is added, the compensation amount still goes much below the scale needed for a nuclear disaster.

Suppliers are not part of the liability framework. The suppliers of the nuclear equipment and materials are immune to liability though they form a core part of the nuclear supply chain. This exclusion undermines the deterrent effect of the law, as suppliers have little incentive to ensure the safety of their products. In addition, the Act's focus on capping compensation could be seen as a subsidy to the

nuclear industry, which might be counterproductive to safety practices. A more effective nuclear liability law would put an emphasis on fast and proper compensation to victims but would keep the

entire chain of nuclear suppliers liable for standards in safety.

Indian nuclear regulation framework has grown quite significantly in its years and involved various legislation for the use of nuclear energy safe and responsibly. Though the Atomic Energy Act, 1962 and the rules governing it cover quite a lot, gaps still persist. The atomic energy act in itself does not make provisions in terms of civil liability for the accident. This Civil Liability for Nuclear Damage Act, 2010, marks a significant stride toward nuclear accidents; however, it has many weaknesses in the level of compensation and the lack of liability to the suppliers. As India continues to expand its nuclear energy program, it will be very important that the regulatory framework evolves in a manner that places clear emphasis on safety, accountability, and fair compensation of the victims of nuclear accidents.

VI. CONCLUSION AND SUGGESTION

Traditional nuclear law, focused on the protection of people and property, has been broadened to include environmental considerations as a result of increased awareness and incidents like Chernobyl. Recent international legal developments demonstrate the increasing importance of environmental law in the nuclear field, including public access to nuclear information, participation in nuclear decision-making, and compensation for environmental damage caused by nuclear incidents. This emerging relationship needs to be jointly formed by nuclear law and environmental law experts. With respect to the advantages of the proper implementation of the best environmental legislation for nuclear activities around the globe, the next question would be: Can international law empower the national government to enforce its national environmental laws over the nuclear activities being carried out in another country? The answer lies in the concept of extraterritorial jurisdiction.

Recommendations:

i. Custom and treaties are the sources of international law, and the former develops through generally followed practices, while the latter are a legally binding agreement. Treaties need domestic implementation by the parties involved in each treaty.
ii. The national government should consider its social responsibility in implementing measures related to its nuclear energy policy efforts. A relevant nuclear operator needs to implement measures in good faith and in cooperation with governments.
iii. The government should formulate general principles on how to handle environmental pollution by radioactive materials, including decontamination and waste disposal standards. Areas for radioactive waste disposal should be designated with comprehensive plans prepared and unpermitted dumping prohibited.
iv. The government shall finance costs associated with measures to control contamination and ensure timely payments from nuclear operators to local governments for expenses incurred.
v. The social obligations should be in tandem with the financial responsibility of relevant nuclear operators.
vi. Periodic reviews of environmental laws on radioactive materials and considerations for nuclear reactor safety.
vii. Atomic Energy Regulatory Board (AERB) and proposed Nuclear Safety Regulatory Authority

viii. seeks to regulate the nuclear facilities and oversee safety. The legislative autonomy of the government is very crucial for effective regulation.
ix. International cooperation efforts, including nuclear cooperation agreements and participation in

x. international nuclear operator programs, demonstrate the commitment of India toward responsible development of nuclear technology.
xi. New international efforts focus on the reinforcement of international laws regarding nuclear safety, spent fuel and waste management, as well as liability and compensation for nuclear incidents.
xii. The India amendments to the rules on radiation protection dated 2004 reflect a commitment to enhanced environmental as well as human protection against radiation from radioactive installations.
xiii. Proposing the law on civil liability reflects India's commitment to reinforcing the liability regime in the event of nuclear damage.

REFERENCES

[1] C. Stoiber, A. Baer, N. Pelzer, and W. Tonhauser, Handbook on Nuclear Law. Vienna: International Atomic Energy Agency, 2003.
[2] J. M. Van Dyke, "The legal regime governing sea transport of ultrahazardous radioactive materials," Ocean Development & International Law, vol. 33, no. 1, pp. 77–108, 2002.
[3] P. L. Johnson, "The legal adviser of the IAEA: History, mission, processes, and key developments in the international nuclear legal framework," in Legal Advisers in International Organizations, Edward Elgar Publishing, 2023, pp. 259–287.
[4] N. G. Part, "Radiation protection and safety of radiation sources: International Basic Safety Standards," Interim Edition, 2011.
[5] P. J. Sands, "Environment, community and international law," Harv. Int'l. LJ, vol. 30, pp. 393, 1989.
[6] V. Bozhko and O. Kushch, "Comparative legal analysis of safe handling of liquid radioactive waste in Ukraine and most EU countries," in Liquid Radioactive Waste Treatment: Ukrainian Context, Cham: Springer Nature Switzerland, 2022, pp. 1–19.
[7] W. Keller and M. Modarres, "A historical overview of probabilistic risk assessment development and its use in the nuclear power industry: A tribute to the late Professor Norman Carl Rasmussen," Reliability Engineering & System Safety, vol. 89, no. 3, pp. 271–285, 2005.
[8] T. Zhunussova, M. Sneve, A. Liland, and Norwegian Radiation Protection Authority, "Radioactive waste management in Central Asia-12034," in Proc. Radioactive Waste Management (WM) Conference, Phoenix, AZ, USA, Feb.–Mar. 2012, pp. 1–10.
[9] G. Hecht, "A cosmogram for nuclear things," Isis, vol. 98, no. 1, pp. 100–108, 2007.
[10] D. Kauzlarich and R. C. Kramer, Crimes of the American Nuclear State: At Home and Abroad. UPNE, 1998.
[11] Vellore Citizens Welfare Forum v. Union of India, AIR 1996 SC 2715.
[12] World Nuclear Association, “Fukushima Daiichi Accident,” World Nuclear Association, Aug. 2023. [Online]. Available: https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-daiichi-accident.aspx.
[13] World Nuclear Association, “Three Mile Island | TMI 2 | Three Mile Island Accident,” World Nuclear Association, Mar. 2022. [Online]. Available: https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/three-mile-island-accident.aspx#:~:text=The%20accident%20to%20unit%202.

[14] World Nuclear Association, “Chernobyl Accident 1986,” World Nuclear Association, Apr. 2022. [Online]. Available: https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident.aspx.
[15] Stanford University, “Fleurus Belgium Nuclear Incident,” Winter 2017. [Online]. Available: http://large.stanford.edu/courses/2017/ph241/lowet1/.
[16] W. R. Johnston, “Mexico City orphaned source, 1962,” www.johnstonsarchive.net, Oct. 2008. [Online]. Available: https://www.johnstonsarchive.net/nuclear/radevents/1962MEX1.html.
[17] A. Fabio, “Killed by a Machine: The Therac-25,” Hackaday, Oct. 26, 2015. [Online]. Available: https://hackaday.com/2015/10/26/killed-by-a-machine-the-therac-25/#:~:text=For%20six%20unfortunate%20patients%20in.
[18] T. S. Subramanian, “The Kalpakkam `Incident’,” Frontline, Aug. 28, 2003. [Online]. Available: https://frontline.thehindu.com/other/article30218546.ece.
[19] The Hindu Newspaper. [Online]. Available: https://www.thehindu.com/opinion/editorial/Learning-from-Kaiga/article16850995.ece.
[20] The Times of India Newspaper. [Online]. Available: https://timesofindia.indiatimes.com/etimes/trending/when-delhi-faced-a-nuclear-crisis-and-was-exposed-to-hazardous-cobalt-60/articleshow/116946877.cms.
[21] A. Martin, S. Harbison, K. Beach, and P. Cole, An Introduction to Radiation Protection. CRC Press, 2018.
[22] M. B. Gerrard, Whose Backyard, Whose Risk: Fear and Fairness in Toxic and Nuclear Waste Siting. MIT Press, 1996.
[23] D. Kyne and B. Bolin, "Emerging environmental justice issues in nuclear power and radioactive contamination," Int. J. Environ. Res. Public Health, vol. 13, no. 7, p. 700, 2016.
[24] J. Davidovits, "Recent progresses in concretes for nuclear waste and uranium waste containment," Concrete International, vol. 16, no. 12, pp. 53–58, 1994.
[25] K. E. Sanders, R. B. Pope, Y. Y. Liu, and J. M. Shuler, "Interfaces among safety, security, and safeguards (3S)—conflicts and synergies," in Proc. INMM 56th Annu. Meeting, Indian Wells, CA, USA, vol. 17, pp. 150–155, 2015.
[26] A. Kiss and D. Shelton, Guide to International Environmental Law. Brill, 2007.
[27] J. S. Griffiths, J. Rutherford, F. M. D. Boydon, and M. Bacon, "Implications of recent legislation and strategy developments in UK—Impact on regulation of radioactive waste management at nuclear installations," WM Symposia, 2007.
[28] J. H. Cheong, H. T. Kim, T. W. Suk, and S. H. Park, "Development of regulatory framework for implementing radiological exemption/clearance based on ALARA principles and current practices in Korea," in WM Conf., 1999.
[29] R. Prăvălie and G. Bandoc, "Nuclear energy: Between global electricity demand, worldwide decarbonisation imperativeness, and planetary environmental implications," J. Environ. Manage., vol. 209, pp. 81–92, 2018.