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Development of Nuclear Energy in India and its Challenges in the Protection of Human Rights.

Ms. Bhaswati Talukdar

Assistant Professor, Law, University law college, Gauhati University

Abstract:
The development of nuclear energy in India signifies a critical component of the nation's energy strategy and its ambition for technological self-reliance. Since the establishment of the Atomic Energy Commission in 1948, India has been working with nuclear power for peaceful purposes, resulting in significant milestones such as the operationalization of the Kudankulam Nuclear Power Plant and advancements in thorium-based energy technologies. However, this advancement has raised complex challenges concerning human rights protection.

Key issues comprise the movement of communities due to the construction of nuclear facilities, often accompanied by insufficient rehabilitation and compensation, thereby encroaching on the rights to property and livelihood. Environmental issues and concerns, particularly the safe disposal of nuclear waste, affect the right to a healthy environment under Article 21 of the Indian Constitution. Furthermore, the lack of clearness in decision-making and suppression of anti-nuclear protests restrict liberty of expression and the right to public involvement. Workers and nearby residents face occupational health risks from radiation exposure, underscoring the need for strict safety protocols.

India's legal framework, administrated by the Atomic Energy Act, 1962, lacks vigorous provisions to address these human rights concerns, while regulatory bodies like the AERB face disapproval for inadequate independence. Balancing energy development with human rights requires a reinforced legal framework, enhanced transparency, fair rehabilitation policies, and emphasis on renewable alternatives. This paper discusses for a rights-based approach to ensure that the benefits of nuclear energy do not compromise the fundamental rights and well-being of individuals and communities.

1. Introduction

Key words: Nuclear energy, advantages and disadvantages Human rights violation, laws, judicial decisions, recommendations

1.1 Brief Overview of Nuclear Energy in India

Nuclear energy plays an integral role in diversifying India's energy sources. The Indian government has recognized nuclear power as a dependable and low-carbon source of electricity, essential for meeting its growing energy demands while addressing climate change. With fossil fuels depleting and the global shift towards cleaner energy sources, nuclear energy provides a sustainable solution. India has committed to dropping its carbon emissions and achieving 40% of its power capacity from non-fossil sources by 2030, as part of its commitment to the Paris Agreement.[1] In this context, nuclear power is envisioned as a critical player in attaining energy security and reducing greenhouse gas emissions.

[1] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 275.

While nuclear energy offers immense benefits and advantages its potential risks must not be miscalculated, especially when it comes to human rights. Nuclear accidents, such as the Chernobyl and Fukushima disasters, have shown the devastating and shocking impact such incidents can have on human health, the environment, and livelihoods. In India, the construction of nuclear power plants has often led to displacement and raised concerns about the safety of local populations, particularly in densely populated areas. Balancing the need for nuclear development with safeguarding human rights, especially the right to life (Article 21 of the Indian Constitution), is crucial. Ensuring transparency, environmental protection, public participation, and adequate compensation for affected communities are essential components of this balance.

1.2 Objective of the Article: An Analysis of India's Nuclear Laws and Their Intersection with Human Rights Protection

The primary objective of this article is to analyse and examine the current legal framework governing nuclear energy in India and its intersection with human rights. This includes an exploration of laws like the Atomic Energy Act, 1962 and the Civil Liability for Nuclear Damage Act, 2010, and how these regulations aim to safeguard human rights while encouraging nuclear development. The article will also examine how judicial interpretations have shaped the application of these laws, and how India's obligations under international treaties influence the balancing of nuclear growth with the protection of fundamental rights[2].

1.3. Research methodology.

This research employs a qualitative and doctrinal methodology, focusing on the critical analysis of constitutional provisions, national legislation such as the Atomic Energy Act, 1962, and relevant judicial decisions. It includes a review of secondary sources such as academic literature, government reports, policy documents, and case studies, particularly from nuclear project sites like Kudankulam and Jaitapur. A human rights lens is applied to assess how the development and regulation of nuclear energy intersect with fundamental rights under the Indian Constitution.

1.4. significance of the study.

This research is significant in illuminating the often-overlooked human rights implications of nuclear energy development in India. As the country advances its nuclear energy goals to meet growing power demands and climate commitments, it is essential to ensure that these efforts do not undermine constitutional rights, environmental justice, or public health. The study contributes to ongoing legal and policy debates by identifying gaps in current laws and recommending reforms for a more transparent, participatory, and rights-respecting nuclear governance framework. It aims to guide policymakers, legal scholars, and civil society toward a more equitable and sustainable energy future.

2. History of Nuclear Energy Development in India:

2.1 Key Milestones

India's nuclear energy program has its origins in the visionary leadership of Dr. Homi J. Bhabha, who is look upon as the father of India's nuclear program. The establishment of the Department of Atomic Energy (DAE) in 1948 marked the official beginning of India's nuclear journey. The primary goal was to harness atomic energy for peaceful purposes, including electricity generation, medical applications, and agricultural advancements[3].

[2] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 123
[3] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 309

In 1954, the Atomic Energy Commission (AEC) was formed to oversee and carry out atomic research and development. A major stride forward was the commissioning of the Apsara reactor in 1956, India's first nuclear reactor. Following this, in 1969, the Tarapur Atomic Power Station (TAPS) was established as India's first commercial nuclear power plant[4] .India also pursued nuclear weapons capability, leading to the Pokhran-I nuclear test in 1974, code-named "Smiling Buddha." This marked India's entry into the group of nations with nuclear weapons, although it resulted in international sanctions due to India's refusal to sign the Non-Proliferation Treaty (NPT)[5].

India sustained its focus on nuclear development, culminating in the Pokhran-II tests in 1998 under Prime Minister Atal Bihari Vajpayee, further establishing India as a nuclear power. Despite these tests, India has consistently promoted the peaceful use of nuclear energy and expanded its civilian nuclear program under defence agreements with the International Atomic Energy Agency (IAEA)[6].The Indo-US Nuclear Deal signed in 2008 was another landmark in India's nuclear history, enabling India to involve in nuclear trade globally despite not being a signatory to the NPT[7].

2.2 Current Status of Nuclear Power Plants in India and Planned Future Expansions

As of April 2025, India operates 25 nuclear reactors across eight power plants, with a combined installed capacity of 8,880 MW, supplying around 3% of national electricity generation. The crucial operational nuclear power plants include the Tarapur, Rajasthan, Madras, Kakrapar, Narora, Kaiga, and Kudankulam Nuclear Power Stations. Of these, Kudankulam, located in Tamil Nadu, is the largest and most modern, with Russian collaboration under the Indo-Russian Agreement.

The Nuclear Power Corporation of India Limited (NPCIL) oversees the operation and maintenance and upkeep of these reactors. It is currently constructing several new reactors, including Kakrapar Unit 3 and Kudankulam Units 3 and 4. Additionally, plans are in place to build 12 new nuclear reactors with a total capacity of 9,000 MW over the next decade. The government is actively promoting the development and growth of fast breeder reactors and the thorium fuel cycle to make use of India's abundant thorium reserves[8].

India has also signed agreements with international partners, including Russia, France, and the United States, to enlarge its civilian nuclear infrastructure. These agreements have aided India secure nuclear fuel and technology for its reactors. One of the most ambitious future projects is the Jaitapur Nuclear Power Project in Maharashtra, which, when accomplished, will be the largest nuclear power plant in the world with a capacity of 9,900 MW[9].

2.3. Importance of Nuclear Energy for India's Energy Security and Economic Development

India's rising population and rapid economic growth have significantly increased its energy demands. Meeting these needs is critical to safeguarding energy security, economic growth, and reducing dependence on fossil fuels. Nuclear energy, with its capacity to provide reliable, large-scale, and low-carbon electricity, is seen as a vital constituent of India's energy mix[10].

.[4] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 511.
[5] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 178
[6] Department of Atomic Energy, *Annual Report 2022-23* (Govt of India 2023) 21
[7] C. Raja Mohan, *India and the Nuclear Age* (3rd edn HarperCollins 2019) 136.
[8] "Nuclear Power in India," *World Nuclear Association*, updated April 2025, https://world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx.
[9] Press Information Bureau, Government of India (2023), *Jaitapur Nuclear Power Project – Indo-French Civil Nuclear Cooperation*. Available at: https://pib.gov.in
[10] S.K Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 530.

Unlike renewable sources like wind and solar, nuclear energy can produce electricity continuously, regardless of weather conditions, making it a stable source of power. Moreover, nuclear power helps India decrease its dependence on coal, which still accounts for over 50% of its energy needs but contributes significantly to air pollution and carbon emissions[11]. With the government's goal of net-zero emissions by 2070, nuclear power is poised to play a crucial role in decreasing greenhouse gas emissions while ensuring continuous power supply for industries and households alike[12]

From an economic standpoint, nuclear energy is important for sustaining long-term growth. As part of the broader objective of transitioning to a low-carbon economy, India's nuclear ex Unlike renewable sources like wind and solar, nuclear energy can produce electricity continuously, regardless of weather conditions, making it a stable source of power. Moreover, nuclear power helps India decrease its dependence on coal, which still accounts for over 50% of its energy needs but contributes significantly to air pollution and carbon emissions which can attract foreign investments, foster technological innovation, and create skilled jobs in the nuclear sector[13] .It also helps India achieve its Sustainable Development Goals (SDGs), particularly those related to affordable and clean energy (SDG 7) and climate action (SDG 13)[14].

However, the development of nuclear energy must be done with careful attention to human rights and environmental concerns. The prospective for nuclear accidents, radioactive waste management, and displacement of communities near nuclear power plants pose significant risks that must be addressed within the legal framework to ensure that the benefits of nuclear energy are not achieved at the cost of human well-being[15].

3. Legal Framework Governing Nuclear Energy in India

3.1 The Atomic Energy Act, 1962: The Foundational Legislation for the Development, Control, and Use of Atomic Energy

The Atomic Energy Act, 1962 is the basis of India's legal framework for the development, regulation, and control of atomic energy. This act grants the central government the exclusive right to produce, develop, and utilize atomic energy for civilian and military purposes. It was enacted to ensure that nuclear energy, being a sensitive and potentially hazardous domain, remains under strict governmental control. The legislation allows the Department of Atomic Energy (DAE) to oversee the production, research, and use of atomic materials and energy. It also permits for the establishment of atomic research centres and regulatory bodies[16].

Under the Atomic Energy Act, the government is also accountable for securing nuclear materials, controlling the transportation of nuclear fuel, and managing the disposal of nuclear waste. It mandates the licensing of nuclear installations and operations, ensuring safety protocols and security measures are in place to prevent any unsanctioned use of nuclear materials[17] .The act plays a critical role in India's three-stage nuclear power development plan, which focuses on utilizing India's vast thorium reserves after using

[11] . Central Electricity Authority, *Monthly Executive Summary Report*, Government of India, June 2025. Retrieved from: https://cea.nic.in
[12] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 225
[13] C. Raja Mohan, *India and the Nuclear Age* (3rd edn HarperCollins 2019) 142
[14] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 319.
[15] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 535
[16] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 325.
[17] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 501

uranium and plutonium-based reactors. The act further provides provisions for penalizing any unauthorized handling of nuclear materials or technology[18].

3.2 The Civil Liability for Nuclear Damage Act, 2010: Compensation Mechanisms for Victims of Nuclear Accidents

The Civil Liability for Nuclear Damage Act, 2010 (CLND Act) was enacted in response to concerns about the lack of clear compensation mechanisms in the event of a nuclear accident in India. This legislation establishes a comprehensive framework for compensating victims of nuclear incidents. One of the key features of the CLND Act is the concept of strict liability, which places the onus of responsibility on the operator of the nuclear facility, typically the state-owned Nuclear Power Corporation of India Ltd. (NPCIL)[19].

The act limits the obligation of the nuclear operator to INR 1,500 crore (about USD 200 million), with the central government stepping in to provide additional compensation if necessary, up to a total cap of INR 2,000 crore[20] .The act also enables the operator to seek recourse against suppliers, a provision often referred to as the "supplier liability clause." This provision became an important point of contention during India's negotiations with international nuclear suppliers, particularly in the context of the Indo-US Nuclear Deal. Many suppliers were concerned about their potential exposure to accountabilities in the event of an accident[21].

The CLND Act line up India with international norms, such as the Convention on Supplementary Compensation for Nuclear Damage, though the domestic law introduces unique provisions like the supplier liability clause. It aims to ensure that victims of nuclear accidents are swiftly compensated and that operators and suppliers maintain high canons of safety and accountability[22].

3.3 Role of the Nuclear Power Corporation of India Ltd. (NPCIL) and the Atomic Energy Regulatory Board (AERB)

The Nuclear Power Corporation of India Ltd. (NPCIL) is a key player in India's nuclear sector. Established in 1987, it is a government-owned enterprise liable for the design, construction, operation, and maintenance of nuclear power plants. NPCIL operates under the administrative control of the Department of Atomic Energy. It is tasked with safeguarding the safe and efficient generation of nuclear energy and maintaining stringent safety protocols at all operational sites[23].

NPCIL's operational focus includes escalating nuclear power generation capacity through new plant construction and ensuring the smooth functioning of existing reactors. It is also responsible for emergency preparedness and response in case of any nuclear incidents. The corporation has faced challenges over the years, particularly in balancing the need for nuclear expansion with addressing environmental and public health concerns[24].

The Atomic Energy Regulatory Board (AERB), formed in 1983, is responsible for overseeing nuclear safety and regulatory functions. It ensures that nuclear power plants comply with safety standards and that workers and the public are protected and safeguarded from radiation hazards. AERB reviews and grants licenses for nuclear installations, conducts safety assessments, and formulates radiation protection

[18] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 229.
[19] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 236.
[20] Department of Atomic Energy, *Annual Report 2022-23* (Govt of India 2023) 42.
[21] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 332
[22] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 513
[23] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 240
[24] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 528

guidelines[25].It also works closely with NPCIL to conduct regular safety audits and enforce compliance with national and international safety standards.

The role of AERB in regulating India's nuclear sector is essential, as it serves as an independent regulatory body, despite being functionally tied to the Department of Atomic Energy. Critics, however, have called for greater independence for AERB to avoid potential conflicts of interest, given its current oversight relationship with the very department it regulates[26].

3.4 Overview of International Treaties Signed by India

India's approach and attitude towards international nuclear treaties has been shaped by its strategic needs and domestic priorities. Although India has developed a robust nuclear energy program, it has followed an independent path in relation to several international treaties, balancing its energy needs, security concerns, and commitment to peaceful nuclear use.

- Non-Proliferation Treaty (NPT): India has constantly refused to sign the NPT, citing its discriminatory nature, as the treaty creates a distinction between nuclear-weapon states and non-nuclear-weapon states. India upholds that nuclear disarmament should be universal and non-discriminatory. India's position on the NPT has led to international sanctions in the past but has also strengthened its position as a responsible nuclear state outside the NPT framework[27].
- Comprehensive Nuclear-Test-Ban Treaty (CTBT): India is also not a signatory to the CTBT, which targets to ban all nuclear explosions. While India supports the objective of global nuclear disarmament, it has expressed concerns over the treaty's verification mechanisms and the failure of nuclear-armed states to participate in meaningful disarmament[28] .India has, however, maintained a voluntary moratorium on nuclear testing since the Pokhran-II tests in 1998.
- Convention on Supplementary Compensation for Nuclear Damage (CSC): India became a signatory to the CSC in 2010, which arranges for a framework for establishing a global compensation regime in the event of a nuclear accident. This is aligned with India's domestic nuclear liability law, the CLND Act, and helps to ensure that in case of a nuclear disaster, compensation will be provided not only by domestic sources but also through international funds[29].

These treaties and agreements form the backbone of India's engagement with global nuclear governance, balancing its national sovereignty with international cooperation on nuclear safety and liability.

4. Human Rights Implications of Nuclear Energy

4.1 Right to Life (Article 21 of the Indian Constitution): The Potential Risk of Nuclear Accidents Affecting Public Safety

The Right to Life, as protected in Article 21 of the Indian Constitution, is a fundamental right that guarantees the protection of life and personal liberty. It has been expansively interpreted by the judiciary

[25] Atomic Energy Regulatory Board. (n.d.). *About us*. Government of India. Retrieved July 27, 2025, from https://www.aerb.gov.in/english/about-us

[26] H. O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 345

[27] K Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 540.

[28]Kazi, R. (2014, December 24). *India is a de facto member of the Comprehensive Test Ban Treaty*. Manohar Parrikar Institute for Defence Studies and Analyses. Retrieved July 27, 2025, from https://www.idsa.in/issuebrief/india-is-a-de-facto-member-of-the-comprehensive-test-ban-treaty newindianexpress.com+11en.wikipedia.org+11en.wikipedia.org+11idsa.in+2idsa.in+2idsa.in+2

[29]Department of Atomic Energy. (n.d.). *Frequently Asked Questions on the CLND Act, 2010 and related issues* (Q&A 5 and 6). Government of India. Retrieved July 27, 2025, from https://dae.gov.in/frequently-asked-questions-and-answers-on-clnd-act-2010-and-related-issues

to include the right to live with human dignity, the right to a healthy environment, and the right to livelihood. Nuclear energy development, while contributing to national growth, poses potential risks to this fundamental right due to the inherent dangers of nuclear accidents, as witnessed in catastrophic incidents like Chernobyl (1986) and Fukushima (2011)[30].

In India, concerns over the Kudankulam Nuclear Power Plant and the possibility of accidents affecting surrounding communities have raised significant human rights concerns. Nuclear accidents, even though rare, have the potential to cause extensive harm, resulting in loss of life, severe injuries, and displacement. The judiciary has often had to balance the state's responsibility to develop nuclear energy with the need to safeguard citizens' right to life. The Indian Supreme Court, in cases like M.C. Mehta v. Union of India the judiciary has underscored that any industrial activity, including nuclear energy production, must prioritize human safety over economic or developmental interests. The court highlighted the precautionary principle and absolute liability doctrines, which mandate that industries must take proactive measures to prevent accidents, especially in high-risk sectors like nuclear energy[31].

4.2 Right to Health: Exposure to Radiation, Particularly for Those Living Near Nuclear Facilities, and Long-Term Health Concerns

The Right to Health, as a vital aspect of Article 21, extends to ensuring that individuals are protected from harmful radiation exposure. Nuclear facilities, while serving the nation's energy needs, are potential sources of radiation, which can have serious long-term health effects, particularly for individuals living in vicinity to nuclear plants[32]. Protracted or accidental exposure to radiation can lead to numerous health issues, including cancer, genetic mutations, and damage to the immune system.

For example, concerns have been raised regarding the Tarapur Atomic Power Station, where residents in nearby villages have reported higher occurrences of cancer and other health issues, allegedly due to radioactive discharges. Although the Atomic Energy Regulatory Board (AERB) has set strict safety standards for radiation levels, lapses in safety protocols can pose severe health risks.

Judicial involvements have also played a role in addressing health concerns related to nuclear energy. In the landmark case of RLEK v. State of Uttar Pradesh, the Supreme Court stressed that sustaining high safety standards in hazardous industries like nuclear power is imperative to protect public health[33] .The court emphasized that the state is obliged to ensure that human health is not compromised in the pursuit of energy development.

4.3 Right to a Healthy Environment: Environmental Degradation from Nuclear Activities, Radioactive Waste Management, and Potential Nuclear Disasters

The Right to a Healthy Environment has been recognized as part of the Right to Life under Article 21 of the Constitution. The development and growth of nuclear energy, while providing significant benefits, also raises serious environmental concerns, particularly in the areas of radioactive waste management, environmental degradation from uranium mining, and the potential and possibility for nuclear disasters. In the Bhopal Gas Tragedy and other environmental disasters, Indian courts have held that the state must adopt rigorous measures to prevent environmental harm, including from hazardous industries like nuclear power[34].

[30]H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 279
[31] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 274.
[32] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 589.
[33] Rlek v State of Uttar Pradesh, (1988) 1 SCC 797.
[34] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 319

Radioactive waste from nuclear reactors, if not properly and adequately managed, can contaminate soil, water, and air, affecting ecosystems and human health for generations. India's nuclear waste management policies are governed and regulated by stringent protocols, but concerns remain regarding long-term storage and disposal, particularly in light of India's plan to expand its nuclear power capacity[35] .The Kudankulam protests highlighted the environmental risks posed by nuclear plants, with local populations raising concerns and worries over the plant's potential impact on marine life and the livelihood of fishing communities

Judicial intervention in nuclear environmental matters and issues has often emphasized the polluter pays principle and the need for rigorous environmental impact assessments (EIA). The Supreme Court, in Vellore Citizens Welfare Forum v. Union of India, reinforced the duty of the state to ensure that any industrial activity, including nuclear energy development, must not jeopardize the environment[36].

In such instances, the judiciary has sometimes acted as a safeguard for these communities protecting their rights. In Samata v. State of Andhra Pradesh, the Supreme Court underscored and highlighted the need to protect tribal and local communities from exploitation in the name of development[37] .This principle has been reiterated and echoed in nuclear-related cases, where the judiciary has emphasized the importance of conducting proper EIAs and ensuring that the rights of displaced populations are upheld.

5. India's Participation in International Nuclear Safety Regimes and Human Rights Frameworks

India's nuclear energy program is intensely integrated into the global nuclear governance framework, yet its human rights compliance remains an area of apprehension. India has not signed the Non-Proliferation Treaty (NPT), citing the discriminatory nature of the treaty, but it has actively engaged with the global nuclear community through agreements such as the Convention on Nuclear Safety (CNS) and the Convention on Supplementary Compensation for Nuclear Damage (CSC)[38]. These conventions aim to provide for a global framework for t enhancing nuclear safety and establishing a compensation fund for victims of nuclear accidents across borders.

India is a participant of the International Atomic Energy Agency (IAEA), which sets global safety standards for nuclear energy and plays a noteworthy role in promoting the safe, secure, and peaceful use of nuclear energy. The IAEA Safety Standards are designed to protect both human health and the environment by minimalizing radiation risks[39]. India's compliance with IAEA guidelines has been vital in boosting international trust in its nuclear program, particularly after the India-U.S. Civil Nuclear Agreement (2008), which cemented the way for increased international cooperation in nuclear technology and trade. However, the domestic application of these international guidelines, predominantly in ensuring transparency and addressing human rights concerns, remains a constant challenge.

The Vienna Declaration on Nuclear Safety (2015), adopted under the auspices of the IAEA, reiterated and reaffirmed the global commitment to solidification of nuclear safety post-Fukushima and emphasized the importance of preventing accidents and moderating and mitigating consequences to protect both people and the environment[40] .India has expressed support for these international principles, but converting them

[35] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 602.
[36] Vellore Citizens Welfare Forum v. Union of India, (1996) 5 SCC 647.
[37] Samata v. State of Andhra Pradesh, (1997) 8 SCC 191.
[38] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 351
[39] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 325
[40] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 670

into effective domestic policies and ensuring compliance remains a difficult issue due to the unique overwhelming challenges of balancing energy security, national security, and human rights.

5.1 Recommendations by International Bodies Such as the IAEA and Their Human Rights Guidelines

The IAEA has constantly emphasized the importance of nuclear safety, radiation protection, and environmental safety measure in its recommendations to participant states. The IAEA's Basic Safety Standards (BSS) are intended to ensure the guard of people and the environment from the harmful effects of ionizing radiation. These standards, while primarily technical, have strong human rights implications, especially concerning the right to health and the right to a safe environment. The BSS comprises measures for radiation protection for workers in the a

Moreover, the IAEA has advocated for solider emergency preparedness and response measures, which are fundamental in mitigating the human rights impacts of nuclear accidents. The Fukushima disaster highlighted the need for robust emergency response frameworks, comprising evacuation plans, medical response to radiation exposure, and effective communication with affected populations. These measures are critical and significant in protecting the right to life and the right to health, as recognized under international human rights law[41].

The IAEA Action Plan on Nuclear Safety (2011), developed in the aftermath of Fukushima, calls for member states to improve nuclear safety regulations, enhance transparency, and ensure that nuclear facilities meet the highest safety standards. The Action Plan includes provisions for improving peer reviews, sharing safety information, and promoting public participation in nuclear governance. The IAEA also encourages states to adopt best practices in nuclear waste management, recognizing that improper disposal of radioactive waste poses serious long-term risks to both human health and the environment[42].

Despite India's collaboration with international bodies like the IAEA, it faces constant and ongoing challenges in completely implementing these guidelines at the domestic level. Ensuring public participation, transparency, and accountability in nuclear decision-making are critical and vital in areas where India needs to strengthen its governance framework to align with international human rights norms.

In summary, India’s nuclear regulatory structure must evolve to line up with international standards, particularly in terms of transparency, human rights protections, and environmental safeguards. Comparing India’s nuclear governance to other countries like the U.S., Japan, and European nations highlights the gaps that requires to be addressed. By strengthening public participation and ensuring compensation for affected population, India can better balance its nuclear ambitions with human rights concerns. Adopting and applying the recommendations of international bodies such as the IAEA can help and assist India achieve this balance while promoting the safe and peaceful usage of nuclear energy.

6. Case Studies

6.1 Tarapur Nuclear Power Plant: Issues Related to Radiation Exposure, Health Impacts, and Compensation

The Tarapur Nuclear Power Plant (TAPP), established in 1969, is India’s oldest nuclear power facility. It has long been a subject of concern and apprehension regarding radiation exposure and its health effects on nearby communities. Studies conducted over the years have raised fears about the levels of radiation and the lack of all-inclusive and comprehensive health monitoring for plant workers and nearby

[41] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 678.
[42] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 330.

residents[43] . Despite efforts to update and modernize the plant and ensure better safety measures, there have been several reports of radiation leakages, which have raised questions about the effectiveness of India's regulatory framework.

The issue of compensation for affected populations remains argumentative. Unlike The United States' Price-Anderson Act, which arrange for a robust compensation mechanism for nuclear disasters, India's Civil Liability for Nuclear Damage Act (CLNDA), 2010, has been criticized for limiting liability to operators and placing inadequate financial burdens on suppliers[44] .The affected residents of the Tarapur region have repeatedly expressed concerns over the long-term health implications of radiation exposure, including cancer risks, genetic disorders, and other illnesses. However, there has been little clarity in reporting these health outcomes or in offering compensation to affected people.[45]

6.2 Kudankulam Nuclear Power Plant: Public Protests Over Environmental Concerns and Human Rights Violations

The Kudankulam Nuclear Power Plant (KNPP) in Tamil Nadu is a more contemporary example of the challenges in balancing nuclear energy with human rights. KNPP became operational in 2013, but since the early manufacture phases in the 1980s, it has been the epicentre of one of India's largest anti-nuclear movements[46]. Local communities, supported by environmentalists and human rights activists, have protested and demonstrated against the project, citing environmental degradation, displacement, and health concerns as key issues. The protests gained momentum after the Fukushima disaster had happened in Japan in 2011, with people fearing that a similar catastrophe could happen at Kudankulam also.[47]

Protestors and local fishing people argue that the plant poses a threat to marine biodiversity, local livelihoods, and public health. Their worries over radiation exposure and the potential for long-term environmental damage have basically been ignored by the government, which has framed the opposition as anti-development. In spite of these concerns, the judiciary has ruled in favour of the project on several occasions, citing the country's energy needs as vital[48].

The Supreme Court of India, in the G. Sundararajan v. Union of India case (2013), held that while nuclear power is indispensable for development, the government must necessarily ensure stringent safety protocols and environmental assessments[49]. However, critics contend that the lack of transparency and public participation in these assessments encroach upon the right to life (Article 21) and the right to a healthy environment.

6.3 Bhopal Gas Tragedy as a Cautionary Tale for India's Industrial Safety and Its Potential Parallels with Nuclear Risks

The Bhopal Gas Tragedy of 1984 remains one of the most horrible industrial disasters in human history, serving as a grey reminder of the possible risks associated with large-scale industrial activities in India[50]. The leak of methyl isocyanate gas from the Union Carbide plant in Bhopal caused thousands of deaths and long-term health problems for survivors. The aftermath of Bhopal gas tragedy highlights important

[43] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 332
[44] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 682.
[45] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 362.
[46] Ho Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 370
[47] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 338.
[48] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 690
[49] Ho Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 372
[50] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 340

failures in safety regulations, corporate accountability, and victim compensation, all of which reverberate with concerns over India's management of nuclear energy.

The Bhopal disaster has been raised as a deterrent tale in deliberations about nuclear safety in India. While nuclear energy is frequently hyped as clean and efficient, critics argue that the regulatory fiascos and weak enforcement mechanisms evident in Bhopal could easily be reverberated in a nuclear disaster. The Civil Liability for Nuclear Damage Act, 2010, which places limits on compensation and releases suppliers of much liability, is seen as deficient to handle a nuclear catastrophe of analogous magnitude to Bhopal[51].

Thus, the catastrophe serves as a threatening about the consequences of placing economic development over human rights and environmental safety. Bhopal's legacy calls for sturdier regulatory frameworks, superior transparency, and vigorous compensation mechanisms to prevent similar tragedies in the nuclear sector.

6.4 The Jaitapur Nuclear Power Project.

In Maharashtra, local farmers and fishermen have opposed the construction, fearing displacement and loss of livelihood. The Environmental Impact Assessment (EIA) for the project has been criticized by the locals and the activists for downplaying the potential risks, especially in a seismically active region[52]. These cases demonstrate and highlight the challenges faced by marginalized communities when the state is balancing national energy interests with the protection of their rights.

7. Judicial Approach and Constitutional Interpretation

The Indian judiciary has always played a critical role in determining the intersection of nuclear energy advancement and human rights. The Supreme Court of India has delivered numerous landmark judgments emphasizing the importance of protecting the environment and public health while balancing the needs and necessities of development. In M.C. Mehta v. Union of India (1987), the Court rightfully expanded the scope of Article 21 of the Constitution, which guarantees the right to life, to include the right to a healthy environment[53].In this case, the Supreme Court laid down the principle of absolute liability, holding that industries involved in hazardous activities have an absolute obligation to ensure that no harm comes to the public, regardless of fault or negligence. This doctrine has been functional in cases involving nuclear energy, particularly in the context of potential accidents and radiation exposure[54]. The judiciary's active role in balancing environmental protection with developmental goals has led to the enforcement of stricter safety and compensation mechanisms in India's nuclear sector.

The judiciary has also recognized the probable risks associated with nuclear energy, predominantly in cases such as G. Sundararajan v. Union of India (2013), where the Supreme Court ruled in favour of continuing the Kudankulam Nuclear Power Plant but imposed stringent safety measures and environmental assessments[55]. The judgment mirrored and reflected the Court's approach to balancing the requirement for nuclear energy with the protection of human rights, including the right to life and the right to a healthy environment.

Public Interest Litigation (PIL) has become an important tool in addressing nuclear safety issues and human rights violations in India. Activists and concerned citizens have used PIL to challenge nuclear projects, claim and demand greater transparency, and safeguard that public health and environmental

[51] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 695
[52] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 621.
[53] M.C. Mehta v. Union of India, (1987) 1 SCC 395
[54] M.C. Mehta v. Union of India, (1987) 1 SCC 395
[55] G. Sundararajan v. Union of India 2013 8 SCR 631

concerns are addressed. The Kudankulam case is a major example of how PIL has been used to bring nuclear safety issues to the front. Environmentalist G. Sundararajan filed a PIL against the government, raising apprehensions about the environmental and human rights impacts of the plant[56].

PILs have also been contributory in raising awareness about the rights of marginalized communities, such as those moved by nuclear projects or exposed to radiation. The judiciary has retorted by requiring sterner environmental clearances, improved safety protocols, and compensation for affected populations. However, the efficacy of PILs is often restricted by the government's prioritization of energy security over human rights and environmental safety[57].

8. Challenges in Balancing Nuclear Energy and Human Rights in India.

8.1 Lack of Transparency and Public Participation in Nuclear Policy Decisions

One of the primary challenges in the governance of nuclear energy in India is the lack of transparency and public participation in decision-making processes. Nuclear policy and plant constructions are often shrouded in secrecy, with limited public consultation or engagement, particularly in projects deemed vital to national security. This absence of transparency is partly ascribed to the Atomic Energy Act, 1962, which grants the government broad powers to control all matters related to atomic energy, including its development and regulation. While this may be necessary for national security reasons, it often comes at the expense of public scrutiny and participation[58].

For instance, the building of the Kudankulam Nuclear Power Plant in Tamil Nadu was met with strong opposition from local communities, who claimed they were not adequately informed or consulted about the risks associated with the plant[59].The lack of proper channels for public talk led to prolonged protests and legal battles, raising concerns over whether the government adequately considered the health, safety, and environmental impacts of nuclear projects on local inhabitants. The Environmental Impact Assessments (EIA), required for such projects, are often criticized for being rushed or superficial and artificial, and public hearings are frequently perceived as formalities rather than genuine engagements.

The Indian judiciary has accentuated the importance of transparency and public participation in environmental matters. In the case of T.N. Godavarman Thirumulpad v. Union of India, the Supreme Court highlighted that public participation in decision-making processes involving environmental concerns is essential for upholding the precautionary principle and ensuring accountability[60]. However, in the context of nuclear energy, balancing national security interests with transparency remains a persistent tenacious challenge.

8.2 Challenges of Ensuring Adequate Compensation for Victims of Nuclear Accidents, under the Civil Liability for Nuclear Damage Act, 2010

The Civil Liability for Nuclear Damage Act, 2010 (CLNDA), was enacted to provide compensation mechanisms for victims of nuclear accidents. However, ensuring adequate compensation remains a significant challenge. Under the Act, the liability cap for operators is set at ₹1,500 crore, and the liability of the government is limited to ₹2,000 crore, which has been criticized for being insufficient in the event of a major nuclear disaster[61]. The Bhopal Gas Tragedy, where victims faced long delays and inadequate

[56] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 342
[57] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 704
[58] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 601.
[59] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 322
[60] T.N. Godavarman Thirumulpad v. Union of India, (2002) 10 SCC 606.
[61] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 291.

compensation, has left a lasting impact on India's approach to industrial liability, raising concerns about whether the compensation structure under CLNDA can sufficiently address the scale of a nuclear disaster[62].

Moreover, the CLNDA places limited liability on foreign suppliers of nuclear materials and technology, raising concerns about holding foreign corporations answerable in the event of an accident. This provision has been controversial, with critics arguing that it undermines the principle of absolute liability, which the Indian judiciary has strongly endorsed in previous industrial disaster cases. In M.C. Mehta v. Union of India, the Supreme Court laid down the principle that industries engaging in fundamentally hazardous activities must take full responsibility for any harm caused, regardless of fault[63].

The legal challenges surrounding compensation are compounded by the complexity of attributing responsibility in nuclear accidents, especially in cases where multiple entities (domestic and foreign) are involved. There are also concerns over the speed of disbursement and the adequacy of support for long-term health issues that may arise from radiation exposure. Judicial oversight, as demonstrated in environmental cases, will be crucial in ensuring that victims of nuclear accidents are not denied their right to adequate, satisfactory and timely compensation[64].

8.3 Dilemmas Posed by National Security Interests and Environmental Protection

India's nuclear energy program is closely and intricately linked to its national security strategy; as nuclear energy development is intertwined with the country's nuclear weapons program. This creates a dilemma where national security interests are often prioritized over environmental protection and human rights considerations. Nuclear facilities are categorized as critical national infrastructure, meaning that discussions surrounding their environmental and human rights impacts are often secondary to their strategic importance[65]

This balancing act becomes mostly challenging in the context of nuclear weapons proliferation and India's refusal to sign the Non-Proliferation Treaty (NPT). While India maintains a commitment to the peaceful use of nuclear energy, the dual-use nature of nuclear technology (for both energy and weapons) complicates efforts to fully address environmental and human rights issues concerns. For example, in the Pokhran nuclear tests, environmental concerns were raised about the ecological impact of the tests on the surrounding desert region, but these concerns were largely overlooked in the interest of national security[66].

The judiciary, in cases like Vellore Citizens' Welfare Forum v. Union of India, has highlighted the need for sustainable development, where environmental protection is given equal weight to developmental goals[67]. However, in the context of nuclear energy, where national security is vital and of paramount importance achieving this balance remains a complex and continuing challenge.

8.4 Inequality in the Distribution of Risks and Benefits: Marginalized Communities Facing Greater Environmental Risks Without Equal Access to Energy Benefits

The issue of inequality in the dissemination of risks and benefits is a critical human rights challenge in the context of nuclear energy development. While nuclear energy provides considerable benefits in terms of energy security and economic development, the risks connected with nuclear accidents, radiation exposure, and environmental degradation often disproportionately affect marginalized and vulnerable

[62] H.O Agarwal, *Human Rights* (15th edn Central Law Publications 2012) 340
[63] M.C. Mehta v. Union of India, (1987) 1 SCC 395.
[64] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 612.
[65] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 299.
[66] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 641
[67] Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647.

communities[68]. These population may be located near nuclear power plants, uranium mines, or waste disposal sites, where the environmental and health risks are highest.

For example, in the Jaitapur Nuclear Power Project in Maharashtra, local farmers and fishermen have voiced concerns about being displaced and losing their livelihoods without receiving any significant benefit from the energy produced by the plant. Similar issues have been raised in the Kudankulam protests, where local communities have argued that they bear the environmental and health risks of the nuclear plant but receive diminutive benefit in terms of improved infrastructure or access to energy[69].

The Indian judiciary has often rightly intervened to protect the rights of marginalized communities in environmental cases. In Samata v. State of Andhra Pradesh, the Supreme Court has held that the rights of tribal communities must be protected from exploitation in the name of development and growth[70] .This principle applies to nuclear energy development as well, where the state must ensure that the benefits of nuclear energy are justifiably distributed and that vulnerable communities are not disproportionately burdened by its risks.

In summary, while nuclear energy plays a pivotal role in India's energy strategy and national security, its intersection with human rights poses significant challenges. Guaranteeing transparency, adequate compensation, balancing security with environmental protection, and addressing inequality are crucial areas that require continuous judicial oversight and policy reform. The legal and regulatory framework must essentially evolve to ensure that nuclear energy development is not only safe and secure but also equitable and respectful of human rights.

9. Recommendations for Strengthening Human Rights Protections against development of nuclear energy in India.

In light of the complexities and issues surrounding nuclear energy and its implications for human rights in India, it is important to establish inclusive and comprehensive measures that ensure the safety, health, and environmental well-being of affected populations. The following recommendations are proposed by the researcher to strengthen the legal frameworks and regulatory mechanisms, align with international standards, and reform compensation laws.

1. Need for Stronger Legal Frameworks Addressing the Right to Information, Public Participation, and Environmental Safeguards

The establishment of a strong legal framework that guarantees the right to information and propagates public participation in nuclear energy projects is essential.

- Right to Information: There should be greater transparency regarding nuclear projects. This includes compulsory disclosure of safety reports, environmental impact assessments (EIAs), and emergency preparedness schemes. Legislation analogous to the Right to Information Act, 2005, should be adapted explicitly for nuclear energy, requiring the Nuclear Power Corporation of India Ltd. (NPCIL) and the Atomic Energy Regulatory Board (AERB) to make information open to the public.
- Public Participation: Public consultations must be mandated at every stage of nuclear project development. Mechanisms for participatory decision-making can be institutionalized, ensuring that local communities have a voice in matters that affect their lives. The National Green Tribunal (NGT)

[68] P.S. Jaswal and Nishtha Jaswal, *Environmental Law* (4th edn Allahabad Law Agency 2016) 305.
[69] SK Kapoor, *International Law and Human Rights* (19th edn Central Law Agency 2020) 619
[70] Samata v. State of Andhra Pradesh, (1997) 8 SCC 191

has already set precedents for public hearings in environmental matters; this model should be extended to include nuclear projects.

- Environmental Safeguards: Incorporating strict environmental protections into the legal schedule will protect human rights. This comprises strict compliance with international standards set by organizations such as the International Atomic Energy Agency (IAEA) .

2. Improving Regulatory Mechanisms and the Role of the AERB in Ensuring Nuclear Safety

The Atomic Energy Regulatory Board (AERB) must be empowered to enhance its regulatory functions in the nuclear energy sector.

- Strengthening AERB's Authority: The AERB should be allowed greater autonomy from the government, allowing it to make impartial safety assessments and decisions. This autonomy is important for independent oversight, as government interests may sometimes conflict with safety apprehensions.
- Comprehensive Safety Protocols: The AERB should device comprehensive safety protocols founded on best practices from countries with advanced nuclear safety regulations. Regular safety drills, updates to emergency response plans, and robust inspection regimes must be compulsorily enforced to ensure the safety of nuclear facilities.
- Capacity Building: Training programs and workshops must be initiated for AERB personnel and other stakeholders involved in nuclear safety. This will prepare them with the latest knowledge and skills in nuclear safety management and risk calculation and assessment.

3. Advocating for Greater Alignment with International Human Rights and Environmental Standards

India's nuclear energy policies must necessarily align more closely with international human rights and environmental standards to ensure all-inclusive protections.

- Adoption of International Treaties: India should consider signing and ratifying relevant international treaties, such as the Comprehensive Nuclear-Test-Ban Treaty (CTBT), which provides guidelines on nuclear safety and non-proliferation. India should make efforts to remove the discriminatory provisions from the same and try to bring about a nuclear weapon free world.
- Integrating Human Rights Norms: The principles of human rights, as outlined in documents like the Universal Declaration of Human Rights (UDHR), should be integrated into national legislation governing nuclear energy. This will require the Indian government to create policies that explicitly address human rights in the context of nuclear activities.
- Collaboration with International Bodies: Active collaboration with international bodies like the IAEA can facilitate knowledge sharing on best practices for nuclear safety and human rights protections. This can also enhance India's reputation in the global nuclear community.

4. Proposing Reforms in Compensation Laws to Ensure Fair and Adequate Compensation for Victims of Nuclear Accidents

Compensation laws in India must be reformed to ensure that victims of nuclear accidents receive fair and adequate compensation.

- Review of the Civil Liability for Nuclear Damage Act, 2010: The existing liability cap under the Civil Liability for Nuclear Damage Act, 2010 should be reassessed. Current provisions, which cap liability at ₹1,500 crores (approximately $200 million), may not adequately compensate victims of a significant nuclear disaster.

- Victim-Centric Compensation Mechanisms: Legislation should establish victim-centric compensation mechanisms that are easy to navigate for victims and their families. This includes expedited claims processing and a clear, transparent formula for determining compensation based on health impacts, economic losses, and psychological trauma.
- Insurance and Risk Pooling: The establishment of a government-backed insurance scheme for nuclear operators can provide an additional layer of financial security for victims. Risk-pooling mechanisms can help distribute the financial burden of compensation across the industry.

5. Need for Balancing Energy Development with Constitutional Rights, Particularly the Right to Life and a Healthy Environment

The need to balance energy development with constitutional rights forms a critical component of the discussion on nuclear energy in India.

- Right to Life and Healthy Environment: The right to life under Article 21 of the Indian Constitution has been widely interpreted by the judiciary to include the right to a clean and healthy environment. Nuclear projects must therefore observe with this constitutional guarantee, necessitating the adoption of strict safety measures to prevent accidents and alleviate environmental dilapidation. The judiciary's growing interpretation of human rights imitates the need for a holistic and realistic approach to energy development that recognizes environmental sustainability as integral to human dignity.
- Sustainable Development Goals: India's commitment to the Sustainable Development Goals (SDGs) further highlights the significance of aligning energy policies with human rights protections. Policies must endorse not only economic growth but also environmental sustainability and social equity.
- Integrated Approach: An integrated attitude to energy development involves association among various stakeholders, including government bodies, regulatory agencies, civil society, and affected communities. By promoting cooperation and dialogue, India can grow a nuclear energy framework that respects human rights while addressing the persistent energy demands of the country.

Conclusion

The journey in the direction of a sustainable nuclear energy future in India requires a sensible approach that prioritizes human rights and environmental protections. While nuclear energy presents substantial opportunities for economic growth and energy security, it also positions challenges that must be addressed through robust legal frameworks, transparent policies, and active public engagement. By reiterating the obligation to uphold constitutional rights, particularly the right to life and a healthy environment, India can bridge and pave the way for a responsible and sustainable nuclear energy policy that benefits all its citizens.