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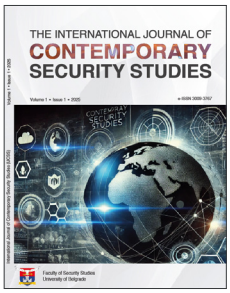

Review article

A Nuclear Policy Framework: Identifying Challenges and Ways to Solutions

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ABSTRACT

This article explores the possibility of restructuring current nuclear policy frameworks to address the evolving landscape of global politics and the challenges posed by nuclear proliferation. Currently, many nuclear treaties and arrangements are weakening due to inherent structural flaws. Disarmament efforts between major nuclear powers have been stalled, non-proliferation efforts have failed, and most Nuclear-Weapon Free Zones lack universal recognition, particularly from the United States. Meanwhile, central nuclear states are investing heavily in their nuclear modernization programmes. Despite this turbulent environment, policymakers and the public often appear relaxed, assuming that the non-use of nuclear weapons since 1945 guarantees their continued role as a deterrent rather than a weapon of war. While many perceptions regarding non-use of nuclear weapons seem logical, it is imprudent to ignore the current realities. Scholars like Herman Kahn have predicted a significant possibility of limited nuclear warfare in the future, and his arguments align closely with the current global nuclear scenario. This paper examines contemporary nuclear problems- such as its growing popularity and availability, and the policies and frameworks that have indirectly contributed to non-proliferation and disarmament. Finally, it also presents several solutions to address contemporary nuclear challenges, directly or indirectly. These include bringing unrecognised nuclear-armed states (for example, India and Israel) under the ambit of the Non-Proliferation Treaty, restructuring Nuclear-Weapon-Free-Zone agreements to reflect political realities, and adopting a ratio-based disarmament system. Together, these steps are among the solutions advanced in this research paper.

KEYWORDS

Nuclear disarmament; non-proliferation; nuclear-weapon-free-zone; nuclear policy; disarmament framework; conventional strategic deterrent; nuclear intelligence.

1. Introduction

The world is divided roughly into two sides regarding nuclear war. One believes nuclear war cannot be won, therefore must never be fought (Joint statement of President Ronald Reagan and Mikhail Gorbachev, November 21, 1985) (Jervis, 1989). The other side (scholars like Herman Kahn) believes that nuclear war is unthinkable but not impossible. A nuclear war does not have to be an all-out war; it can be a sub-limited nuclear war with limited annihilation (Kahn, 1962). Unfortunately, there is no time machine in this world that can reveal whether a nuclear war will really occur in the future. If we accept the first argument, it fails to explain the growing number of operational warheads and nuclear modernization programmes worldwide. It is not believable that

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the world needs almost 10,000 operational warheads solely as a deterrent. At this point, we should not worry about the future but about our precarious present (Cvetković & Martinović, 2021; Cvetković et al., 2021; Garba & Akaan, 2025; Janković et al., 2025; Kalanj, 2025; Onimisi, 2025; Petrović, 2025), which is dwindling with the demise of arms control treaties and arrangements. In this article, we focus solely on nuclear terror spread by states and not by non-state actors. However, the concept of nuclear terrorism has gained considerable attention in recent years. It is an exaggerated concern, as handling nuclear and other radiological weapons involves technical difficulties and a lack of availability. It makes nuclear and other radiological weapons less practical compared to other readily available means of instilling fear among the masses(Basrur, 2006). There is substantial evidence that terrorists have shown interest in acquiring nuclear weapon technology to use as a deterrent against states. Nevertheless, if humanity ever faces the threat of a nuclear war on Earth, it is most likely that the states would be the primary culprits.

Russia's invasion of Ukraine has reignited the longstanding debate on disarmament, raising a critical question: What lies ahead for nuclear disarmament after the dilution of the New START Treaty? Since the invention of nuclear weapons, every country in the world that was capable of acquiring such a weapon became fascinated with this weapon of mass destruction. Nuclear weapon technology spread across different continents despite controlling arrangements such as non-proliferation, disarmament, and Nuclear-Weapon-Free-Zone treaties. Many civil society organisations, NGOs, and individual activists have sought to build widespread opposition to nuclear weapons on ethical and environmental grounds. Although Treaties like the Partial Test Ban Treaty (PTBT), Threshold Test Ban Treaty (TTBT), and Nuclear Free Zone Treaties established a taboo around nuclear testing, two decades ago, North Korea tested nuclear weapons despite negative world opinion (Bennett, 2024). It seems the world is unlikely to give up on nukes anytime soon, since they remain the only strategic weapon that is capable of penetrating the deepest underground military assets of enemy nations and capable of standing against missile defence systems. Conventional weapons still lack these capabilities; therefore, nuclear weapons will exist until a similarly deadly and precise alternative emerges.

In the 1960s, U.S. President John F. Kennedy predicted that nuclear weapons would spread rapidly around the world: by 1970, there would be ten nuclear-armed countries instead of four, and by 1975 this number would rise to between fifteen and twenty. However, the reality has unfolded differently: there are currently only eight nuclear powers. Kennedy's predictions could have been more accurate had policymakers not implemented extensive measures to curb proliferation and negotiate arms control treaties. Some countries were diplomatically forced to abandon their nuclear-weapon programme, such as South Korea, South Africa, and Sweden (Sokolski, 2019). Other countries had clandestine programmes directly targeted by military action — examples include Syria, Iraq, and Iran. Change in geopolitics and the evolving nature of conflict have complicated the nuclear question. Nuclear technology proliferated rapidly in third-world countries, where it has been widely regarded as a symbol of political prestige and influence, and as a source of power to counter Western dominance (Basrur, 2006).

Nuclear arms-control and disarmament treaties can be broadly categorised into four types: nuclear test-ban treaties, non-proliferation treaties, disarmament treaties, and Nuclear-Weapon-Free-Zone treaties. Most of these treaties have failed miserably, while most countries have voluntarily renounced nuclear testing. Since the 1990s, Nuclear testing has been renounced by major nuclear powers. The United States imposed a moratorium on testing in 1992, and the Comprehensive Test Ban Treaty (CTBT), signed in 1996 by the United States, Russia, and China, completely banned all types of nuclear explosions. However, unrecognised nuclear powers such as India, Pakistan, and North Korea have continued to conduct nuclear weapons tests even after that, despite widespread public protests against testing. The moratorium on nuclear tests by major nuclear powers is primarily driven by two factors: first, international condemnation and public protest because of the health and environmental effects of radioactive contamination. Second, there is no technical necessity for conducting nuclear testing, thanks to advances in computer simulations (Maloney, 2025). Major nuclear powers, including the U.S., Russia, and France, have conducted thousands of nuclear tests and accumulated extensive data regarding nuclear explosions. New scientific research, combined with historical test data, enables virtual experimentation through computer simulations to generate new insights and assess the reliability, safety, and security of these weapons. Therefore, nuclear testing has become obsolete for major powers unless motivated by specific political reasons.

The major Non-Proliferation Treaty (NPT) has failed to prevent proliferation despite various attempts. The last of the disarmament agreements, the New Start treaty between the USA and Russia, has been diluted by

geopolitical rivalries. Among Nuclear-Weapon-Free-Zone Treaties, only those established on global commons, such as the Antarctic Treaty, the Outer Space Treaty, and the Seabed Treaty, have been unanimously acknowledged. Most regional nuclear-weapon-free zones are not acknowledged due to political and security reasons. Hence, the ultimate goal should be to establish a new nuclear arrangement that realistically addresses the geopolitical realities of the 21st century and brings all nations to a single negotiation table to curb nuclear proliferation as well as reduce global nuclear threat. This article focuses on conceptual policy analysis that is based on historical accounts rather than empirical study. It synthesizes primary treaty texts, authoritative historical accounts, and scholarly literature to trace the successes and failures in nuclear arms control and proliferation dynamics. This article aims to identify patterns in the historical record and contemporary policy debates, identify gaps in existing arrangements, and propose feasible directions for policy reform. It does not present new quantitative datasets or original fieldwork; where empirical claims are made, they are supported by established secondary sources and official documents.

2. Growing appeal of nukes

The popularity and availability of nuclear technology seem prevalent globally despite the possibility of mass destruction, negative world opinion, and massive discouragement. It has some genuine reasons:

2.1. Nukes are too Good to abandon

Among the three weapons of mass destruction (WMD), chemical and biological weapons have been unanimously disbanded by most of the powerful countries. In contrast, nuclear weapons have remained in national arsenals. So, the reason behind abandoning the other two WMDs is not particularly based on ethical grounds. The effectiveness of chemical and biological weapons is heavily influenced by external variables, significantly diminishing their strategic advantage. For example, during the Iraq-Iran war, Iraqi chemical weapons backfired on its own troops when weapons were used in damp conditions in the southern border area. Mustard gas was used to dislodge Iranian troops, but when the wind shifted toward Iraqi positions, it harmed Iraqi forces and changed the outcome of the war(Central Intelligence Agency, 2010). Biological weapons can also have strategic disadvantages in this globalized world, where a local disease can quickly turn into a global epidemic. By contrast, nuclear warfare can be strategically planned and does not depend much on external variables (although blast damage can depend on factors such as weather, building construction materials, and the target's location) (Office of Technology Assessment, 1979). Nevertheless, damage caused by a nuclear weapon is almost inevitable, and the indirect effects of the blast can cause numerous casualties that are beyond assessment. Indirect effects include deaths from radiation and disease, contamination of water, air, and soil, and consequent crop failures that can lead to mass starvation. There is a chance that the attacked areas might lose their industrial civilization altogether. Therefore, a handful of nuclear weapons is enough to send an enemy country back to the pre-industrial era, thus eradicating its existence from the modern world.

2.2. Misuse of Atomic Assistance and South-South Cooperation

In 1955, U.S. President Eisenhower decided to share nuclear technology with the world for peaceful purposes. The U.S. 'Atoms for Peace' propaganda swept up all the developing countries with the hopes of clean, cheap nuclear energy, along with peace and prosperity. However, classified U.S. government reports warned that nuclear power was neither economically viable nor ready for export, and that it posed serious proliferation risks (Drogan, 2016). Therefore, misuse was inevitable; some countries legally purchased subcomponents from the suppliers and then built weapons indigenously under the guise of a civil nuclear programme. Notably, India built its nuclear device using a Canadian reactor and American nuclear fuel (Fuhrmann, 2012). The U.S., UK, and France offered training to Iranian nuclear scientists before the Islamic Revolution in 1979 (University of Calgary, 2003). Despite the risks of nuclear proliferation, major nuclear powers chose to spread the technology as a geopolitical gambit. Atomic assistance has been highly selective and highly discriminating in nature: states have utilized atomic aid to strengthen alliances, spread influence, and, at times, use it as a bargaining chip—for example, in exchanges involving oil with petroleum-producing nations. France supported Israel's programme

by transferring a reactor and reprocessing facility, while the Soviet Union supported the Chinese bomb programme. Beyond Cold War politics, countries of the Global South also cooperated to proliferate nuclear technology as a means of balancing regional political rivalries and defying Western geopolitical dominance. China assisted Pakistan to counterbalance the Indian nuclear programme. Pakistan, in turn, assisted in Libya, Iran, and North Korea (Lettow, 2010). The most recent example being North Korea's transfer of Plutonium reactors to Syria (Federation of American Scientists, 2008).

2.3. Change in Geopolitics and Failure of Disarmament

The beginning of the end of the Cold War was marked by the Intermediate-Range Nuclear Forces treaty (INF), which banned an entire category of missiles capable of launching nuclear warheads. This treaty ended in 2019 when the USA withdrew, alleging Russian noncompliance (NATO, 2019). Conventional arms control is also falling apart in the wake of the Russia-Ukraine war, as the North Atlantic Treaty Organization (NATO) and Russia officially withdrew from the Conventional Armed Forces in Europe (CFE) treaty, a key post-Cold War disarmament treaty. Russia suspended its active participation in the treaty since 2007, noting that the USA and its allies did not ratify the 1999 updated version of CFE (Faulconbridge & Kelly, 2023). Meanwhile, NATO has expanded, with recent members being Sweden and Finland. The membership of all three Scandinavian countries in NATO significantly heightens Russia's security concerns. This is underscored by Article 5 of the NATO treaty, which establishes the NATO alliance as a military alliance committed to mutual defence. The talks of universal nuclear disarmament also failed many times. When the New Start treaty was extended in 2021, the USA attempted to include China as a party, which was obviously unsuccessful (Parsie, 2024). In the second decade of the twenty-first century, global geopolitics has become increasingly tense. More countries in the Global South are actively engaging in an arms race, while rivalries reminiscent of the Cold War are reviving.

An ongoing global arms race characterizes the dangerous reality of today's world. Unlike the arms races of the World Wars, this contemporary competition is truly global in nature, encompassing nearly every region and continent. Nuclear weapons play a crucial role in this global competition. These weapons are not merely instruments of mass destruction; they also serve as powerful deterrents and symbols of national pride and political influence. They function as a diplomatic language among powerful nations, shaping geopolitical dynamics and influencing international relations. Nuclear weapons possess the power to unleash chaos on Earth by igniting a global war, yet, paradoxically, they also serve as instruments of deterrence that some argue can prevent large-scale catastrophes. It is now too late to encourage states to abandon this highly dangerous yet politically convenient weapon of mass destruction. However, the greater risks associated with these weapons may paradoxically lead to a deeper pursuit of global peace.

3. Rising possibility of sub-limited nuclear war

According to the SIPRI yearbook 2023, nine nuclear-weapon states together possess approximately 12,512 nuclear weapons, of which 9,576 are operationally available(SIPRI, 2023). The USA and Russia are running extensive programmes to dismantle retired warheads and to replace them with new-generation counterparts. The number of operational warheads all over the world is increasing due to the failure of existing nuclear arrangements. All eight nuclear-weapon-possessing states are investing substantially in nuclear modernizing programmes, which include warheads, delivery systems, and other related infrastructure that support precision, survivability, and safety (Acheson, 2022). An advanced nuclear stockpile, along with advanced space-based surveillance and reconnaissance, can be used to target critical targets (enemy forces, military installations, command and control centres, urban industrial centres, etc.). In the early 1960s, John F Kennedy's administration pursued this policy of targeting particular critical enemy targets, the destruction of which would diminish the enemy's retaliatory power without undermining their ability to live and function as a society. This policy is known as flexible deterrence. American technological development made this concept and policy feasible (Clodfelter & Zielinski, 2002).

Most of the nuclear-possessing nations can target challenging targets in their enemy nations. As the SIPRI yearbook 2023 notes, India's long-range missiles are capable of targeting the entire of China, as it emphasizes deterring China more in recent years (Kristensen & Korda, 2023). Christopher Clary and Vipin Narang, in their

article "India's Counterforce Temptations: Strategic Dilemmas, Doctrine, and Capabilities, argued that India may be shifting toward a counterforce strategy (Clary & Narang, 2019). This approach is particularly appropriate for technologically less developed countries, such as India and Pakistan, where arsenals do not become equally vulnerable: those with sufficient resources and technology can better secure their stockpiles (Lieber & Press, 2017). Nations with fewer resources to spend on nuclear modernization programmes face the danger of obliteration of their entire arsenal in a specific and calculated nuclear strike. Scholar Herman Kahn, in his book "Thinking about the Unthinkable, predicts that future wars- unlike the World Wars- are likely to be brief and primarily waged by military forces stationed at concentrated bases. Mass destruction of people and property is less likely to achieve any immediate military and strategic objective. Therefore, the revolutionary tide in technology is more likely to herald an era of controlled warfare, where nuclear weapons are not an annihilator of humanity but a tool to neutralize other nuclear arsenals. This weapon of mass destruction might destroy itself in future sub-limited warfare, leading to its own obsolescence.

4. Virtual Nuclear Capabilities and Unanticipated Agreements That Curbed Nuclear Proliferation & Armament

Historically, concepts like disarmament and non-proliferation were established to reduce the global stockpile of nuclear weapons; however, they have not been particularly successful in achieving this goal. Interestingly, some nuclear agreements that were not originally designed to reduce nuclear weapons have nevertheless contributed to this aim indirectly. Concepts such as nuclear alliances, virtual nuclear capability, and nuclear-modernization programmes have effectively discouraged many countries from pursuing nuclear weapons or have reduced the number of warheads, even among those with the technological, political, and financial capacity to develop and maintain them.

5. Nuclear Alliances

As geopolitics becomes increasingly complex, states are relying on the deterrent effect of nuclear weapons more than ever before. However, the concept of nuclear deterrence is highly subjective, resembling more of an art than a science. It was subject to the interpretation of individual countries, shaped by their perceptions of threat. The USA intends to protect its allies in the Euro-Atlantic and Indo-Pacific regions against nuclear threats (U.S. Department of Defence, 2002). This is the concept of extended deterrence, which worked well during the Cold War. NATO deployed U.S. nuclear weapons on European soil. U.S. nuclear weapons (air-delivered gravity bombs) are still deployed in Turkey, Italy, Belgium, and the Netherlands (Trachtenberg, 2012). All 32 NATO countries are under the U.S. nuclear umbrella. The USA is no longer the only country to provide a nuclear shield to its allies. Recently, Russia claimed to have included Belarus and seized Ukrainian territories under its nuclear umbrella (Erästö, 2023). We are witnessing a new surge of nuclear tug-of-war, in which protected allies expect their nuclear patrons to intervene in the event of a crisis. This type of alliance raises the chance of nuclear escalation as nuclear states can get dragged into allied conflicts that these states would generally prefer to avoid. On the contrary, these nuclear alliances contribute indirectly to non-proliferation by actively discouraging countries from pursuing nuclear capability despite possessing sufficient resources, manpower, technology, and security needs (Bradley, 2024). For example, countries in Indo-Pacific (Japan, South Korea, Australia) did not pursue nuclear weapons despite facing nuclear threats from China and North Korea. Conversely, the situation in the Middle East is opposite and has become very tense in recent years. If Iran possessed nuclear weapons, it might provoke its rich and industrialised neighbours (Saudi Arabia, Turkey, and other Gulf states) to seek their nuclear arsenals. Iran is also disparately seeking weapons as a deterrent against Israel's unconfirmed arsenal. In this context, Extended deterrence has the potential to solve the Middle East nuclear problem. Eight nuclear powers, with their substantial arsenals, can effectively dissuade a nuclear arms race in the Middle East, even discourage Iran from pursuing nuclear capabilities. Nuclear alliances should not be viewed solely with suspicion; they offer a constructive potential. Such alliances can enhance accountability, curb weapon proliferation, and encourage nations to forgo costly nuclear programs. Thus, nations can reallocate their scarce resources to other military initiatives that deliver tangible, lasting benefits.

6. Virtual Nuclear Capable States or VNCS

Some states possess latent nuclear capabilities, meaning they have access to sufficient quantities of weapon-usable fissile material or the ability to produce it, as well as the necessary technology and skilled personnel. These are called Virtual Nuclear Capabilities (VNCs), which means they are capable of making nuclear weapons in a matter of a few months or a year. Theoretically, any nation with civil nuclear power plants, a sufficient industrial infrastructure, and scientifically skilled people can be considered a VNC, even if it has never had any military nuclear ambitions (Horvath, 1998). In 1988, the U.S. Department of Defence published a report, "*Discriminate Deterrence: Report of the Commission on Integrated Long-Term Strategy," which* estimated that almost 40 states would be capable of manufacturing a nuclear device by 2000. Out of this list, five or six countries could make a nuclear weapon in a few months. These states are Belgium, Germany, Japan, Italy, and the Netherlands(Wohlstetter, 1988). In this context, India, Pakistan, and North Korea all fell into this category at one point. Sweden and South Africa dismantled their nuclear programmes only halfway, which means they can reconstitute them quickly if the need arises.

Virtual capability to develop nuclear weapons has provided many countries with a sense of security: if push comes to shove, they can produce such weapons within a small timeframe. This logic is rooted in the modern nature of inter-state warfare, which has evolved through multiple layers as technology and society have advanced. The progression follows a sequence roughly like this: cyber war, information war, trade war, traditional military mobilization, and, as a last resort, nuclear confrontation. If a state is virtually capable of building nuclear weapons, it is much more likely do so within the time it takes for these preliminary stages to unfold. This reasoning may also explain why Russian forces are persistently attacking and occupying Ukrainian nuclear power plants. Russia may be wary of a nuclear-armed Ukraine, which operates four nuclear power plants with 15 reactors, generating half of the country's electricity (Holt & Nikitin, 2024). Warfare surrounding nuclear plants can prove to be environmentally disastrous. However, the rationale of virtual nuclear capability has deterred many industrialized states from actively pursuing nuclear arsenals, preventing the world from descending into a 'nuclear jungle' dominated by widespread proliferation. Despite playing an active role in non-proliferation, VNCs often obstruct disarmament. They frequently refuse to grant the IAEA full access to nuclear sites and related information, arguing that if nuclear-armed states are indifferent to disarmament, non-nuclear states should not have to bear the burden of intrusive inspections. This breeds a cycle of distrust between nuclear states and VNCs and creates an environment in which nuclear-armed states constantly fear nuclear hedging by VNCs.

7. Nuclear Modernization Programmes & Arms Control

"*The deterrence value of a nuclear weapon depends on its accuracy, reliability, and the adversary's perception of its credibility*."

George P. Shultz, former U.S. Secretary of State

Scholars like Thomas C. Shelling and Bernard Brodie also advocated the fact that quantity does not determine effectiveness when it comes to nuclear weapons because, unlike conventional arms, they cannot be used repeatedly without catastrophic consequences. A 2014 study conducted by Michael J. Mills revealed that even a regional conflict between India and Pakistan, involving nuclear weapons, can trigger nuclear winter if each side decides to detonate 50 weapons of 15 kilotons each(Mills et al.,2025). Thus, even with fewer weapons, effective deterrence can be established if accuracy, reliability, and credibility are ensured. A huge arsenal is meaningless if it is not rationally deployed and strategically delivered. In recent years, nuclear-armed states have increasingly recognized this principle. The SIPRI report (2023) shows that the number of nuclear warheads in the world is decreasing as Russia and the USA are dismantling retired warheads while simultaneously investing heavily in extensive and costly modernization programs. China is modernizing its relatively small arsenal to increase survivability, reliability, safety, and penetration ability (Acheson, 2022).

Nuclear modernization programmes can offer three key benefits. First, as arsenals become more modern, countries are more likely to prefer a counterforce strategy. In the future, targeting cities would be a foolish move, given that nuclear forces are increasingly becoming vulnerable all over the world. Therefore, people are more likely to escape the blast effect of a nuclear catastrophe, although they will still face significant aftereffects.

Second, modernization can reduce the overall number of weapons. Experts such as Kingston Reif and Alicia Sanders-Zakre suggest that 1000 strategically deployed U.S. warheads are enough to provide a strong deterrent for both the U.S. and its allies globally. Therefore, if the U.S. were to adopt this strategy, it could put pressure on Russia and China to reconsider their expanding arsenals (Reif & Zakre, 2019). Third, U.S. nuclear modernization can influence states such as Russia and China to participate in arms-control negotiations out of fear of a more capable U.S. nuclear arsenal (Costlow, 2021).

Possible solutions

8. NPT for the Twenty-First Century

The NPT has failed terribly in preventing the proliferation of nuclear weapon technology for several reasons. One is the intelligence failure in detecting and curbing the nuclear-proliferation black market. The Pakistani A. Q. Khan network contributed a great deal to spreading sensitive nuclear technology and fissile materials in countries such as Libya, North Korea, and Iran (Kerr & Nikitin, 2012). The International Atomic Energy Agency (IAEA) has repeatedly demonstrated its inability to detect nuclear developments effectively and to ensure compliance. This is the high time NPT recognises certain nuclear-armed states as Nuclear Weapon States (NWS). The U.S. Nuclear Posture Review (2022) also postulates that the U.S. will continue to pursue engagement with other nuclear-armed states with realistic expectations, understanding, and shared responsibility to reduce nuclear risks. Countries such as India and Israel possess substantial nuclear arsenals and the capacity to export sensitive technologies. However, Israel follows an approach of secrecy, vowing that 'it would not be the first nation to introduce nuclear weapons in the Middle East'. Meanwhile, India has long sought membership in the Nuclear Suppliers Group (NSG); recognition as an NPT Nuclear-Weapon State would automatically grant it entry. The rationale behind the expanding NWS status to India includes the following:

1. The budget and multilateral cooperation of the IAEA will increase, bolstering its surveillance and detection abilities.
2. This cooperation would integrate India into the global non-proliferation framework, thereby increasing transparency and legitimacy of its strategic weapons programme.
3. As an immediate neighbour of Pakistan, India is better positioned to monitor potentially dangerous activities related to the nuclear black market. It may help prevent the proliferation of nuclear materials to terrorist groups such as Al-Qaeda.
4. Unlike North Korea or Iran, India has never violated the NPT principles. While North Korea and Iran both signed the NPT to acquire nuclear fuel, they later violated its conditions by pursuing secret nuclear programmes. In contrast, India has pursued its own nuclear development programme and has neither transferred its technology nor leaked its secrets (Bhat, 2020).
5. The Indo-U.S. civil nuclear deal, or 123 agreement of 2008, has already placed Indian civilian nuclear facilities under IAEA supervision. Through this agreement, India shoulders rights and responsibilities similar to those of NPT member states, even without signing the treaty (Curtis, 2010).

9. Inspiration from the Washington Naval Conference

After World War I, the U.S. announced a bold proposal to reverse global naval expansion. During the Washington Naval Conference of 1921-22, the Five-Power Treaty was established, which fixed a naval-tonnage ratio among the major naval powers at the time. According to this treaty, the fixed tonnage ratio for capital ships (battleships and cruisers) among the five major naval powers was as follows: Great Britain and the United States, 5; Japan, 3; France and Italy, 1.75, resulting in a ratio of 5:5:3 (Kuehn, 2022). Additionally, the submarine strength of the U.S. and Britain was fixed at 100,000 tons each, while Japan, Italy, and France were limited to 60,000 tons each (Andrade, 1969). This proposal effectively halted ten years of naval construction. It was a daring move even for the U.S., as it involved scrapping a large portion of the American fleet and mid-construction cancellation of all ships that were a part of the U.S. Navy expansion programme initiated in 1916 (Munson, 2017). The Washington naval conference was widely regarded as a diplomatic success because all major naval powers believed they had secured the best deal for themselves while safeguarding their security interests. It halted the

arms race to some extent, easing additional economic burden on post-World War I societies. However, it failed to resolve underlying mutual suspicions among naval powers or the race for domination, ultimately triggering a new wave of the arms race, including the construction of a large number of cruisers. Despite these shortcomings, this conference marked a historic achievement as one of the first successful arms-control treaties, bringing together nations from three continents to sit at a negotiation table, reach unanimous agreements, and take collective action on an issue of global significance.

The post-World War I era was dominated by sea power, during which technological development made battleships heavier, faster, and better-armed (Zhai, 2019). In contrast, the present era is defined by nuclear capabilities, where nuclear-modernization programmes have enhanced precision, permeability, and survivability of nuclear weapons. The horrors of World War I may have forced major powers to reach an agreement and establish a successful arrangement. However, we cannot afford to wait for a third world war to negotiate an agreement regarding the most powerful weapon of all time. The ratio-based system of the Five-Power Treaty could really provide a valuable model for addressing the modern nuclear-disarmament problem. China has consistently refused to participate in New START treaty negotiations, primarily due to the vast disparity between the U.S. and Russian nuclear arsenal compared to that of China, and because other capable nuclear powers like France and the United Kingdom are excluded from the trilateral arms-control framework. To address this, all nuclear-armed states should be categorized into two groups- Nuclear Weapon States (NWS): U.S., UK, Russia, China, and France- and de facto nuclear weapon states (DFNWS): India, Israel, Pakistan, and North Korea. The NWS should first commit to a disarmament treaty that is based on a ratio system after thoroughly examining its relative nuclear capabilities. Once this framework is in place, the DFNWS could join a disarmament treaty, which will also be based on a separate ratio system, with assurance that their vital security interests will be assured even after joining the treaty.

10. Limited Nuclear-Weapon Free Zones

In the 1960s, a powerful and ambitious global movement emerged against militarization and against the deployment and testing of nuclear weapons by the major nuclear powers. Nations across Asia, Africa, and Latin America choose not to be a part of the global nuclear arms race and established Nuclear-Weapon-Free-Zones (NWFZs) in certain regions. At the onset of the Cuban crisis, the Brazilian representative to the UN General Assembly first proposed a Latin American nuclear-weapon-free zone (U.S. Department of State archive). This led to the creation of one of the first NWFZs through the Treaty of Tlatelolco, which established the foundational framework for later NWFZ treaties. The Treaty of Rarotonga (The South Pacific Nuclear-Weapon-Free-Zone) and the Treaty of Pelindaba (the African Nuclear-Weapon-Free-Zone) were established in response to French nuclear tests in those regions. (Ogunbanwo, 1996), while the Treaty of Bangkok (the Southeast Asia Nuclear-Weapon-Free Zone) was created in response to American militarization in the Philippines (Centre for Arms Control and Non-Proliferation).

Unfortunately, the strong anti-nuclear sentiment in the developing world soon faded in the face of harsh geopolitical realities. Most recognised nuclear powers do not fully acknowledge all of these nuclear-free treaty zones. Only the Treaty of Tlatelolco enjoys recognition from all five recognised nuclear-weapon states: the United States, Russia, China, the UK, and France- because this treaty does not bar transit of nuclear material, the dumping of nuclear waste, or peaceful nuclear explosion in the zone (Mendenhall, 2020). In contrast, the other four treaties bar nuclear manufacturing, testing, storage, transit, waste dumping, and peaceful nuclear explosion, which led to their non-recognition by the United States. The proposed Arctic NWFZ is also becoming unfeasible due to the full integration of Scandinavian countries into NATO. It means most of the Arctic region now falls under the defence umbrella of either the U.S. or Russia. Nuclear-armed submarines of both nations often patrol Arctic waters, although neither has stationed intercontinental ballistic missiles or nuclear-armed bombers in this region (Wallace & Staples, 2010). It seems that, as long as geopolitical rivalry persists, controlling the storage and transit of nuclear materials- especially nuclear-armed submarines- remains nearly impossible in some strategic regions of the world, such as the Strait of Malacca, the Indian Ocean, and the Arctic. The rigid idea of a "pristinely pure" anti-nuclear environment has become increasingly obsolete as more states started to acquire nuclear weapons. Unrecognised nuclear powers such as India, Pakistan, Israel, and North Korea do not even fall within the ambit of these treaties, and are therefore not obligated to ratify the protocols. While NWFZs have the potential to enhance arms control, they will be effective only if they consider

the realities of modern geopolitical rivalry and the ongoing arms race. Implementing targeted restrictions on the type and quantity of nuclear assets, together with a reliable monitoring system and transparent verification practices, could significantly strengthen the arms-control potential of NWFZs (Moreno, 2007).

11. Evolution of Nuclear Intelligence

The nuclear arms race between the USA and the USSR stimulated advancements in technological intelligence ability, enabling the monitoring and analysis of large and sophisticated strategic nuclear forces. These capabilities include advanced reconnaissance aircraft such as the U-2 as well as reconnaissance satellites (Graham & Hansan, 2007). However, nuclear proliferation in the 21st century is different. It presents unique challenges that have rendered high-end monitoring technology largely ineffective. Smaller countries that pursue clandestine nuclear weapon programmes often lack the extensive and sophisticated infrastructure of larger nations, allowing them to mask dual-purpose facilities as legitimate civilian nuclear activities. Therefore, the intelligence capability that was developed to monitor the USSR's nuclear activities is inadequate for monitoring these covert operations. Nations have quickly adapted to this game of cat-and-mouse with the IAEA, which uses satellite imagery and rapid communications. Historically, countries such as South Africa and India demonstrated their ability in concealing and deceiving the international community regarding their nuclear activities. Tehran deeply buried and sanitized its nuclear infrastructure. At the same time, Syria concealed its reactor inside an ordinary-looking building that showed no indicators of ongoing nuclear activities, such as external cables or a cooling tower (Hansen, 2011).

It appears that technology has taken a backseat in preventing nuclear proliferation, especially when it involves non-state actors such as the A. Q. Khan network. Despite rapid advancements in Signal Intelligence (SIGINT), Overhead Imagery Intelligence (IMINT), and Electronic Intelligence (ELINT), HUMINT operations may remain the most feasible option for nuclear intelligence in the foreseeable future. The Washington Naval Conference serves as an inspiring example in this context. The U.S. Office of Naval Intelligence played a vital role at this conference by collecting information on foreign naval capabilities. At that time, inadequate surveillance and reconnaissance capabilities compelled intelligence officers to rely heavily on human intelligence. They primarily depended on open-source intelligence collection, but they also cultivated a network of personal sources to obtain valuable insights into Japanese naval affairs. Simple methods were used, such as engaging with Japanese friends, foreign technical experts, or travellers who may have passed through a sensitive area. Personal sources, which provided information out of friendship or after consuming too much alcohol, or information traded from foreign intelligence services (Munson, 2017). In the modern era, technologically empowered HUMINT has the potential to mitigate proliferation challenges by gaining a comprehensive understanding of adversaries' capabilities and intentions (Gioe, 2017). Inclusion of powerful nations such as India and Israel in the NPT as 'permanent members' would increase this capability, particularly since Israel has already demonstrated its ability to neutralize clandestine nuclear programmes in Syria, Iraq, and Iran(Yadlin, 2018).

12. Non-Nuclear Deterrent

In the 2022 U.S. Nuclear Posture Review, the Department of Defence (DoD) stated its intent to explore non-nuclear or conventional weapon capabilities to use as an effective deterrent for the United States and its allies. Non-nuclear or conventional weapons must meet certain criteria to be an effective deterrent: they should possess strategic range (i.e., intercontinental capability), precision, and destructive potential. The Advent of nuclear weapons marked a revolution in military affairs; however, another transformation is currently occurring, giving conventional weapons superiority over nuclear options in many respects. Advanced surveillance and reconnaissance systems, cruise and ballistic missiles of intercontinental range, precision-guided warheads, and stealth technology now enable strikes across the globe with non-nuclear weapons (Mazarr, 1991). However, non-nuclear strategic weapons are not yet suitable as a deterrent for one primary reason: they are more susceptible to countermeasures than nuclear weapons. For example, if a conventional missile is launched at a country, it can potentially be intercepted by an advanced missile defence system. In contrast, if a nuclear missile is launched, no defence system can fully protect against the catastrophic effects of a nuclear explosion and the resulting radiation, which would inevitably impact the defending nation. Therefore, currently, non-nuclear

weapon systems remain underdeveloped and are not yet capable of replacing nuclear weapons as a reliable deterrent. Here, we have to place our faith in science and human ingenuity, trusting that one day a revolution in conventional weapon technology will replace nuclear weapons entirely, rendering the knowledge of this radioactive weapon completely obsolete. This new capability would retain all the critical attributes that are present in nuclear weapons- such as deep penetration, global-strike ability, high destructive power, and survivability against counter-defence systems-while eliminating harmful indirect effects of nuclear weapons, including radiation, diseases, and radioactive contamination.

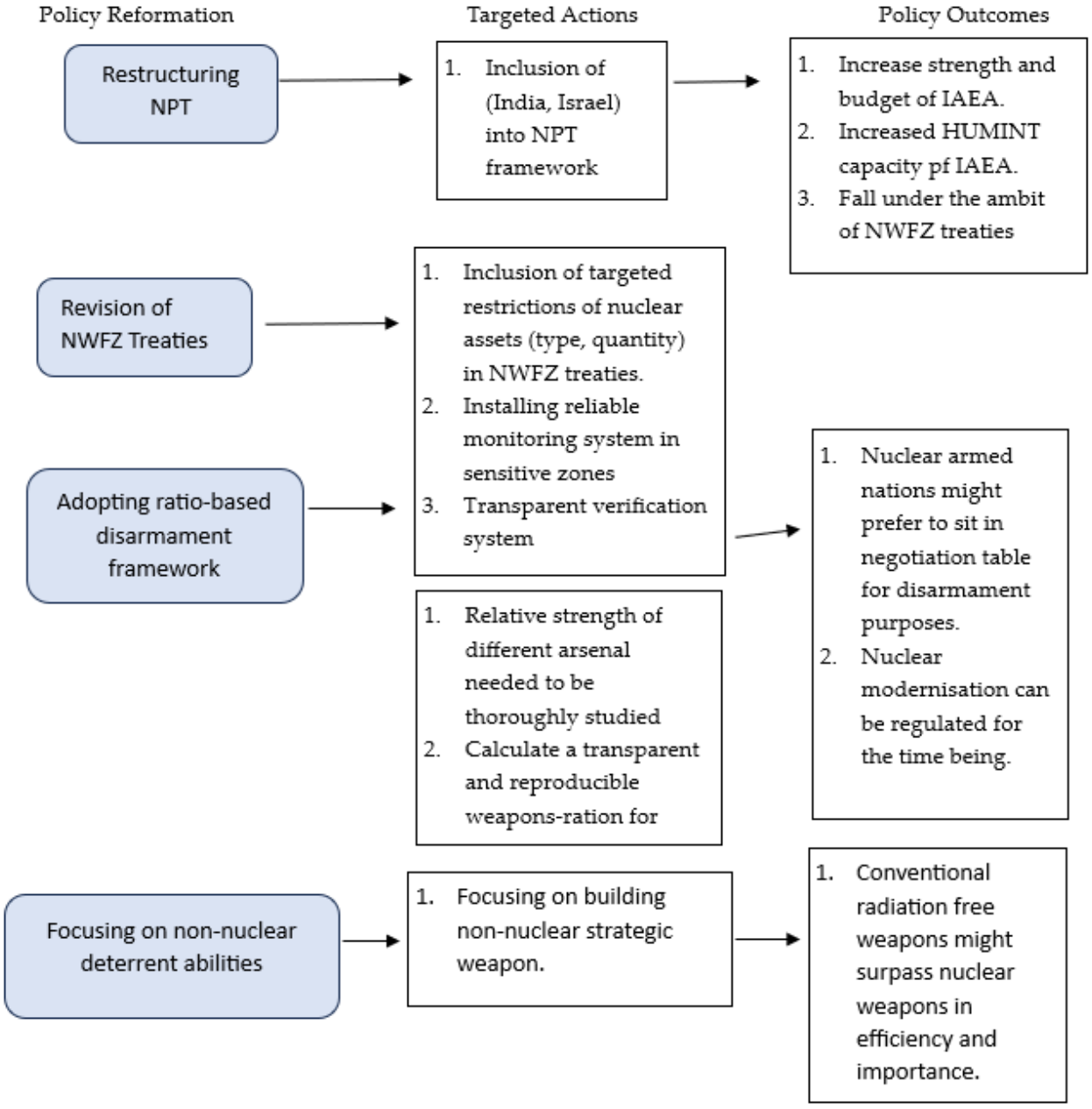

Figure 1. Nuclear Policy Framework. (Source: Self-developed)

13. Conclusion

अण्डपरिमाणात्।

Aṇḍa-parimāṇāt ।

ब्रह्मसूत्र, श्लोक 2.1.33

Badarayana, 400–450 CE

Translation: "Even the smallest particles, like atoms, have a purpose as determined by the divine will."

Every object, animate or inanimate, serves a purpose in the universe, regardless of whether we perceive that purpose as good or evil. Even nuclear weapons have served their purpose in human history, despite not being used in war since the Hiroshima and Nagasaki incidents in 1945. Like other wartime technologies such as GPS and the internet, nuclear technology- initially invented as a weapon- has also led to the development of a clean, cheap, reliable, and renewable energy source. It has also changed the tide of global politics. The 2018 Singapore Summit, a one-on-one meeting between the U.S. and North Korea regarding denuclearization of the Korean peninsula, exemplifies this. The summit delivered a massive diplomatic victory to Kim Jong Un. North Korea bagged a lucrative deal: the suspension of U.S. military exercises with Japan and South Korea in exchange for a vague commitment to denuclearization without a clear plan (Haenie et al., 2018). Such is the power of the 'nuclear card', which allows a smaller and relatively less significant country like North Korea to stand on equal footing with a global superpower on the international stage. For North Koreans, it was likely a moment of pride as their press quickly publicized the lopsided concessions. However, such events can negatively impact non-proliferation efforts in South Asia. If the United States were to withdraw its protective umbrella from countries like South Korea and Japan, these nations could pursue their own nuclear programme, since they possess the virtual capability to do so. Therefore, even if the chances of a conventional conflict escalating to a nuclear-scale conflict remain slim, the contribution of nuclear technology to modern society and politics is undeniable.

During the Cold War, the public and policymakers were far more concerned about the proliferation of nuclear weapons to additional states than they appear to be today. Driven by that fear, they were willing to take considerable risks, devise innovative ideas, and sign numerous treaties to curb nuclear proliferation and excessive nuclear armament. In recent times, however, public and political concern about this topic has appeared to ease. Current non-proliferation efforts primarily focus on the denuclearization of North Korea and Iran, largely due to perceptions that their nuclear behaviour is unpredictable. Meanwhile, disarmament by the major nuclear powers is often naively overlooked, based on the assumption that these states are thought to be more responsible and therefore will never resort to nuclear weapons. This shift in focus and the resulting policy fatigue can be attributed to several factors:

First, nuclear weapons have not been used in war since 1945; therefore, the world has, to some extent, forgotten the horrors of nuclear war and of escalatory events such as the Cuban Missile Crisis.

Second, major recognised nuclear powers have stopped full-scale testing of these weapons, so environmental protests related to such testing have also disappeared.

Third, advancements in conventional weapons technology have significantly increased accuracy and destructive power, enabling them to effectively strike some fixed targets that were previously vulnerable only to nuclear attacks (CIA, 1983). Consequently, nuclear weapons are increasingly viewed as tools of deterrence rather than instruments with tangible wartime utility.

Fourth, the counterintuitive academic discourse on nuclear stability has also contributed to this policy shift. Some scholars argue that nuclear-armed states are more prone to engage in low-level conflicts(Horowitz, 2019). For instance, the ongoing disputes between India, Pakistan, and China in Asia primarily manifest as border clashes, the fostering of terrorism, and cyber-attacks. Thus, more nuclear power might not be uniformly detrimental to peace; in some respects, it could potentially reduce the intensity of modern conflicts.

Despite the predominant belief that nuclear weapons will never be used in war, nine nuclear-armed states continue to modernize their nuclear arsenals. According to a 2023 report by the International Campaign to Abolish Nuclear Weapons (ICAN), these states spent a combined $91.4 billion on modernization efforts (Olsen, 2024). In light of current global instability, nuclear policy needs to be restructured to address existing loopholes

and weaknesses in the framework. To be politically acceptable, technologically feasible, and economically viable, a revised nuclear policy framework should incorporate several points:

First, it must acknowledge the possibility of nuclear war, even with the prevalence of low-level conflicts, given the present volatile nature of world politics and nuclear modernization efforts of some states.

Second, it should set realistic arms-control and disarmament goals that are acceptable to all major nuclear powers, ensuring that no nation feels its security is compromised. In this article, the analogy of the Washington conference serves as a major inspiration for future disarmament negotiations, in which the weapons ratio would be based on the operational capabilities of nuclear arsenals.

Third, the IAEA needs to address the challenge of states withdrawing from the NPT. To strengthen the IAEA's effectiveness, it is also important to recognize and enrol additional states, currently unrecognized as Nuclear Weapon States (NWS), such as India and Israel, into the NPT as NWS.

Fourth, diplomacy is very crucial when it comes to dealing with latent nuclear states such as Germany, Japan, South Korea, and Sweden; extended deterrence remains the most viable solution to prevent them from building their own arsenals. On the other hand, these VNCs should enable stringent inspections of civilian nuclear facilities to build confidence in the global community about the safe use of nuclear power.

In addition, *Nuclear-weapon-free zone (NWFZ) treaties should be revised and strengthened to prevent states from transporting or deploying nuclear materials in an unregulated manner anywhere in the world. At the same time, nations should collectively commit to developing robust non-nuclear deterrents to replace nuclear weapons in their arsenals.*

Nuclear-Supplier States need to adopt a criteria-based system to decide which countries receive enrichment and reprocessing related facilities and technologies (Lettow, 2010). The influence of alliance politics within the Nuclear Suppliers Group (NSG) has already negatively affected non-proliferation efforts. Therefore, nations with military ambitions or unclear intentions should be denied access to enrichment and reprocessing facilities. However, many countries initiate civil nuclear programmes with noble intentions, but these intentions can shift when faced with significant security threats, potentially leading to the weaponization of these programmes. For instance, Iran received atomic aid from the U.S. beginning in the 1950s. Even after the Islamic Revolution, Ayatollah Khomeini opposed nuclear weapons on religious grounds. However, the situation changed after the Iraq-Iran war in the 1980s, when Iran started to work towards its weapons programme (Fuhrmann, 2012). Pakistan also began a civilian nuclear programme in the 1950s but decided to build weapons following its humiliating defeat in the 1972 war with India. Therefore, nations possessing latent nuclear capabilities or existing civilian nuclear programs require close monitoring during periods of strategic threat or prolonged conflict, as these factors have historically triggered the development of nuclear weapons programs.

This rationale can also be applied to the present-day Russia-Ukraine war. Over the past three years, Russia has attacked two Ukrainian nuclear power plants- Chornobyl and Zaporizhzhia-despite the potential risk for a radiological disaster (Dolzikova, 2023). These assaults on nuclear infrastructure may be motivated by two factors: either Russia aims to dismantle Ukraine's energy supply or seeks to suppress Ukraine's ambition to develop nuclear weapons. The Ukrainian President has already voiced an opinion shared by many Ukrainians: the perceived choice between joining NATO and pursuing nuclear armament. Although the chances of Ukraine achieving a fully functional nuclear-weapons capability are slim due to a lack of international support and funding, alternatives such as so-called 'dirty bombs' made from radioactive waste remain a possibility (Davlikanova, 2024). Additionally, HUMINT might see a comeback in monitoring nuclear proliferation, as advanced technologies often prove insufficient in modern conflicts. For example, despite superior equipment and training, American soldiers faced significant challenges against less-equipped guerrilla fighting soldiers during the Vietnam War. Similarly, supreme-quality surveillance and reconnaissance capabilities consistently fail to detect low-profile proliferation activities. These factors need to be considered when establishing a nuclear framework for the present era. Given the changing tide of world politics, nuclear stability can no longer be taken for granted. Countries are engaged in a cat-and-mouse game, each trying to sabotage rival nuclear programs or destroy the adversary's nuclear facilities before completion of the weapon. Examples such as Israel's attack on a Syrian facility and America's cyber-attack on an Iranian facility raise concerns that Russia and Ukraine may be participating in the same game. The world needs to be more cautious and sceptical, for the nuclear clock is ticking faster than ever.

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14. Endnotes

[i] New Start or Strategic Arms Reduction Treaty is a arms control agreement between USA and Russia signed in 2011, extended till 2026. It limited the number of Intercontinental Ballistic Missile, Strategic bombers and Strategic warheads.

[ii] PTBT signed in 1963 banning nuclear weapon tests in the atmosphere, in outer space and under water

[iii] TTBT signed in 1974, enforced in 1990. It limits underground nuclear weapon test.

[iv] Five nuclear free zones treaties came into force- **Treaty of Tlatelolco (1967), Treaty of Rarotonga (1985), Treaty of Bangkok (1995), Treaty of Pelindaba (1996), Treaty of Semipalatinsk (2006).** These five treaties established nuclear free zones in Latin America, South Pacific, South Asia, Africa, Central Asia respectively.

[v] INF Treaty signed in 1987 by USA and USSR which required both countries to eliminate intermediate range missiles (500-5500 Km).

vi Hard targets refer to military and strategic assets (military installations, command and control centres, submarine bases, nuclear storage facilities). These high value targets are hardened and heavily fortified against attack.