A Strategy for Non-Strategic Disarmament: The Multilateral Prohibition of Low-Yield Nuclear Weapons

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Executive Summary

As a multi-polar world order emerges, strategic circumstances are becoming increasingly conducive to the proliferation of non-strategic nuclear weapons among nuclear-armed states. This study responds to the present imperative to include non-strategic nuclear weapons in multilateral arms control negotiations for continued progress toward nuclear non-proliferation and disarmament. After examining the possible alternatives, this study concludes that a multilateral arms control treaty led by a coalition of non-nuclear-armed states is the most effective mechanism for achieving this outcome and the most likely to succeed.

The study begins by outlining the obstacles to including non-strategic nuclear weapons in arms control negotiations. It argues that a redefinition of these weapons, applicable to all nuclear-armed states and delivery systems, is crucial to the future of arms control.

It achieves this by identifying low-yield nuclear weapons as a special category of non-strategic nuclear weapon which poses a unique threat to international security. Low-yield nuclear weapons can be defined as any nuclear weapon with a design yield below 5 kilotons; such weapons are exclusively developed and deployed for contingencies of a non-strategic character.

The study then undertakes a review of the historical development of low-yield nuclear weapons and gives an overview of their presence in modern nuclear arsenals. Through an analysis of the deterrence and war-fighting capabilities of low-yield nuclear weapons it is found that their utility is highly limited.

The probability of low-yield nuclear weapons being used is significantly greater than other classes of nuclear weapon owing to the battlefield contingencies for which they are designed and the vulnerable nature of their deployment in the field. Their continued development, particularly in emerging nuclear arsenals, constitutes a major threat to regional and global stability.

This study also canvasses the possible alternative approaches to non-strategic nuclear arms control including; improvements to command-and-control, coordination of declaratory policy, unilateral disarmament initiatives, and regulating delivery systems. While some of these options may be worth pursuing as concurrent policy ideas, they cannot substitute for the proposed treaty.

A multilateral treaty banning low-yield nuclear weapons removes several pathways to nuclear war while providing extra mechanisms for controlling escalation should they ever be used. By analysing the possible scenarios involving low-yield nuclear weapons it is shown that a treaty with minimal intrusive verification strengthens the security of each state party.

Furthermore, such a treaty would have a symbiotic relationship with existing disarmament initiatives and provide a norm-setting platform for future reductions in nuclear stockpiles.

The removal of low-yield nuclear weapons raises the nuclear threshold, helps avoid escalation and general nuclear war, all while retaining the stabilising benefits of nuclear deterrence.
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1 Introduction

As strategic rivalries deepen among nuclear-armed states (NASs) conventionally inferior parties are incentivised to explore the battlefield utility of nuclear weapons in order to strengthen their deterrents. This study traces the capabilities and trends associated with non-strategic nuclear weapons of low yields, the weapons being developed, and their utility in credible contingencies.

Non-strategic nuclear weapons (NSNWs), particularly low-yield and niche capability weapons, are retained by a number of countries in their nuclear arsenals yet receive surprisingly little scrutiny in the broader nuclear discourse. Currently, some NASs are increasing their low-yield arsenals, while others are orienting their present nuclear forces towards contingencies involving low-yield weapons. The development and deployment of low-yield nuclear weapons have a unique impact on deterrence and carry a disproportionate risk of nuclear conflict.

This study begins by discussing the definitional problems associated with NSNWs and the difficulty of including them in multilateral arms control negotiations. We then trace the historical evolution of low-yield NSNWs and their deployment and diversification across present day arsenals. Through an analysis of the battlefield utility of low-yield NSNWs the boundaries of their contribution to overall nuclear

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1 A nuclear-armed state (NAS) is a state that possesses nuclear weapons, whether its arsenal is emerging or developed. Any state that does not possess nuclear weapons is a non-nuclear-armed state (NNAS).
deterrence are established. Proponents argue that low-yield NSNWs are appropriate for a range of credible war-fighting contingencies unsuited to other forms of nuclear and conventional weaponry. By applying studies of the technical limitations of low-yield nuclear weapons, we find that any utility they have is highly limited and greatly outweighed by their inherent risks.

This study concludes that the elimination of low-yield nuclear weapons is both possible and desirable for international security, and that a multilateral arms control agreement establishing a minimum-yield threshold for nuclear weapons is the most effective mechanism for achieving this outcome. After evaluating and discarding all possible alternatives, we finish with a discussion of the manner in which such a treaty could be designed and implemented.

2 The Spectrum of Nuclear Weapons

a. Strategic and non-strategic nuclear weapons

The difference between a strategic and a non-strategic nuclear weapon is primarily the contingency for which the weapon is deployed. Strategic nuclear weapons are for deterrence by punishment, typically through counter-value targeting, while NSNWs

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2 The utility of nuclear weapons is usually divided into these two roles, see, for example, George H. Quester, “Substituting Conventional for Nuclear Weapons: Some Problems and Some Possibilities,” *Ethics*, Vol. 95, No. 3 (1985), pp. 619-640, 638.
are counter-force weapons aimed at degrading an adversary’s capacity for aggression.\(^3\) Low-yield nuclear weapons (LYWs) are a category of NSNW designed primarily for battlefield contingencies,\(^4\) and carry with them special risks outlined in this paper. Nuclear arms control agreements have hereto focused on higher yield weapons, while NSNWs have never been addressed. The inclusion of NSNWs in future arms control negotiations is critical if continued progress is to be made toward nuclear disarmament. As Dr Henry Kissinger testified before the U.S. Senate Foreign Relations Committee in May 2010:

[New START is] probably the last agreement on strategic arms that can be made without taking tactical nuclear weapons into account. It is also approaching the end of what can be achieved by bilateral negotiations between the United States and Russia. Growing existing arsenals and proliferation will soon impose a multilateral context.\(^5\)

As recently as June 2013, the Russian Foreign Minister, Sergei Lavrov, emphatically reinforced this view, saying that future nuclear arms reductions had to include all nuclear-armed states, and be pursued in a multilateral format.\(^6\)

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The above statement illuminates a paradox; NSNWs (or tactical nuclear weapons) have been defined by the U.S. Office of the Secretary of Defense as any nuclear weapon that is not part of the nuclear triad.7 This definition appears to be reflected in New START. As the counting rules for New START focus solely on American and Russian delivery systems, the nuclear arsenals of most other states would be considered NSNWs even though they predominantly view all their nuclear weapons as strategic.8 It is therefore unlikely that the inclusion of NSNWs in multilateral arms control negotiations will be possible without redefining NSNWs in a manner that is commonly accepted and applicable across all NASs and their delivery systems.

b. Yields

It is possible to categorise NSNWs based on yield. The yield of a nuclear weapon is the energy released in the explosion. It is usually measured using trinitrotoluene (TNT) equivalent; “one ton” is approximately the energy released in the detonation of one ton of TNT.9

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9 In the context of yield, a (metric) ton of TNT is defined as precisely 4.184 gigajoules (metric units used throughout this paper). See National Institute of Standards and Technology, “The NIST Reference on Constants, Units and Uncertainty,” (2000) <http://physics.nist.gov/cuu/Units/>. The term “ton” is used in a number of arms control treaties, see eg Treaty between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Underground Nuclear Weapon Tests, signed 3 July 1974, 1714 UNTS 29637 (entered into force 11 December 1990).
The simplest nuclear weapons are pure fission devices with design yields of approximately 10 to 20 kilotons.\(^{10}\) Each state that has developed nuclear weapons has begun with these “first nuclear weapons” (FNWs).\(^{11}\) Most NASs have gone on to develop fusion-boosted and thermonuclear weapons, often with smaller spatial dimensions for ease of delivery.

Advanced proliferation makes it possible to develop nuclear weapons with significantly lower yields than FNWs. For the purposes of this study, a low-yield weapon (LYW) is any nuclear weapon designed to have an explosive yield of less than about 5 kilotons (the process of establishing an exact minimum-yield threshold will be considered in Section 10).\(^{12}\) Many modern nuclear weapons have variable

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yield (dial-a-yield) settings. The term LYW includes variable yield weapons where at least one setting is less than the minimum-yield threshold.

Since the development of LYWs is only technologically feasible following the development of higher-yield weapons, it is safe to assume that any NAS will possess at least some weapons above the minimum-yield threshold. For the purposes of this study, a **full-spectrum-nuclear-armed state** (FSNAS) is a state that possesses nuclear weapons, some of which are below the minimum-yield threshold and some of which are above the minimum-yield threshold. A **limited-spectrum-nuclear-armed state** (LSNAS) is a state that possesses nuclear weapons but only at yields above the minimum-yield threshold.

### 3 History

After World War II ended the United States demobilised its armed forces. By the late 1940s, Washington no longer believed it could resist a Soviet invasion of Western Europe should one occur. In 1949, Top Secret U.S. strategic war-plans relied heavily on atomic bombing of Soviet industrial centres as deterrence to aggression in Western Europe. It was accepted that this would not in itself halt a Soviet attack, but

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that Soviet forces would soon suffer major shortages of fuel and supplies as a result of U.S. bombing. The United States would then remobilise, and embark upon the reconquest of Europe. It was assessed, however, that atomic bombing would not break the will of the Soviet people to resist, and that the Soviets would commit great reprisals against the inhabitants of occupied territory up to the very limits of their capability in response. It was also acknowledged that a nuclear bombardment by the United States would surrender moral credibility and “open the field and set the pattern for all adversaries to use any weapons of mass destruction”.

As the Soviet Union developed its own nuclear arsenal through the 1950s and 60s, the United States shifted its strategy for the defence of Europe. Washington attempted to compensate for perceived conventional inferiority by developing small tactical nuclear weapons designed for war-fighting. The idea was to have nuclear weapons powerful enough to halt a conventional assault by the Soviet Union, but not so powerful as to immediately threaten Soviet core interests or command and control, thus engaging in “limited” nuclear war.

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16 Ibid, p. 361.
18 Of course this presumed nuclear war could remain centrally directed once it had broken out. Ibid., pp. 318-319.
This led to the U.S. developing new LYWs, the most infamous of these being the W54 “Davy Crockett” with a yield of only 10-20 tons.19 This weapon, weighing just 23 kg, was carried by infantry platoons to be fired by recoilless rifle with a range of only about 2 km. The W54 was first deployed in West Germany in 1962 but the U.S. Army acknowledged it could not guarantee protection of these weapons and recommended their withdrawal.20 The W54’s role was subsumed by the W48 artillery shell with a minimum yield of around 70 tons.21 These weapons became ubiquitous in the NATO force posture and in September 1974 U.S. Secretary for Defense, James Schlesinger, testified before the U.S. Senate Foreign Relations Committee that “the average yield of the NATO stockpile is less than 4 kilotons.”22

In the 1970s the Soviet Union achieved rough parity with America’s nuclear forces. At least three kinds of nuclear-capable artillery projectiles were deployed by the Soviet Union during this decade, along with two nuclear capable mortars.23 By 1978,


21 Ibid.


23 According to Igor Sutyagin, these were: “the 3BV2 203-mm projectile, the 3BV3 152-mm projectile, and the 3BV4 240-mm nuclear mortar shell for the M-240 and 2S4 mortars.” See Igor Sutyagin, “Atomic Accounting: A New Estimate of Russia’s Non-Strategic Nuclear Forces,” Occasional Paper (London: Royal United Services Institute for Defence and Security Studies, Stephen Austin and Sons, November 2012) p. 56.
the Soviet Union was deploying short-range ballistic missiles of relatively low yield in Europe, giving them considerable variance in short-range tactical nuclear options.24

Russia,25 the U.S. and the U.K. have all deployed LYWs at sea for anti-submarine warfare. During the 1970s and 1980s, the U.S. deployed anti-submarine missiles with a range of 90 km and yields of up to 5 kilotons.26 The U.K. deployed the WE.177A which could operate as a nuclear depth bomb with a variable yield from 0.5 kilotons to 10 kilotons.27 The lowest yield settings were used for shallow coastal waters or where higher yields could threaten nearby shipping. The U.K. deployed this weapon system on aircraft carriers during the Falklands War.28

By the late 1970s Washington feared that Soviet LYWs made conventional war more likely, given the perceived conventional imbalance that still remained.29 The Carter administration responded by attempting to expand NATO’s conventional forces in Western Europe to a point where they could sustain high intensity conventional

24 Ibid, pp. 54-55, 60.
25 Russia currently deploys multiple non-strategic anti-submarine warfare nuclear weapon systems but their precise yields are not well known: Ibid, pp. 40-43.
warfare for at least several weeks.\(^{30}\) This “extended the fuse” to nuclear war and slightly reduced the saliency of LYWs by characterising them as a last “solemn warning before the apocalypse” rather than as a weapon of first resort.\(^{31}\) In this way, LYWs began to be portrayed as a tool for crisis management (escalation control) as much as an actual war-fighting instrument.\(^{32}\) When the Soviet Union collapsed, both the U.S. and Russia removed all forward deployed NSNWs (except aircraft-delivered bombs) from Europe, as one practical step to mark the end of the Cold War.\(^{33}\)

During the 1990s, some in the U.S. argued that LYWs remained necessary for contingencies involving rogue actors.\(^{34}\) In 1994, the U.S. Departments of Defense and Energy co-authored a major study titled “Precision Low-Yield Weapon Design” or PLYWD.\(^{35}\) The report recommended the development of new high-precision LYWs in order to hold at risk hard and deeply buried targets (HDBTs) and deter rogue states from pursuing weapons of mass destruction (WMD).\(^{36}\) The PLYWD study was

\(^{30}\) Hereto U.S. doctrine dictated that while nuclear weapons should only be used in response to an overwhelming conventional threat, the decision should not be left too long, so that intact American units could take advantage of the effect nuclear weapons were expected to cause, see Ibid, pp. 160-167.

\(^{31}\) Ibid, p. 291.

\(^{32}\) On the possibility of war-termination in the opening stages of nuclear conflict see, Desmond Ball, “Can Nuclear War be Controlled?” in James A. Scheur, ed., Nuclear Weapons Proliferation and Nuclear Risk (New York: St. Martin’s Press, 1984) pp. 3-53. See also, Ball, “Nuclear War at Sea”.


\(^{34}\) Dowler and Howard, “Countering the Threat of the Well-Armed Tyrant,” p. 34.


\(^{36}\) Much of the PLYWD study remains heavily redacted, however Hans Kristensen identifies this key phrase “The use of precision guidance could permit the Air Force to accomplish missions as effectively, or more effectively, with low-yield weapons” (emphasis added). See Hans Kristensen, “The
actively rejected by Congress which was concerned that nuclear weapons with yields intermediate between conventional and strategic weapons would blur the distinction between conventional and nuclear war. As such, the Congressional “National Defense Authorization for Fiscal Year 1994” (Spratt-Furse provision) prohibited the development of new “low-yield nuclear weapons” defined as nuclear weapons with design yields below 5 kilotons.

Toward the end of the 20th century LYWs began to spread to other NASs, as evidenced by India’s Pokhran-II and Pakistan’s Chagai nuclear tests in 1998. In a press interview Pakistan’s then principal scientific adviser to the president, Abdul Qadeer Khan, claimed that:

[O]ne was a big bomb which had a yield of about 30-35 kilotonne, which was twice as big as the one dropped on Hiroshima. The other four were small tactical weapons of low yield. Tipped on small missiles, they can be used in the battlefield against concentration of troops.


The following year both India and Pakistan claimed they had the ability to produce lower yield enhanced radiation weapons (ERWs or neutron bombs). In 1999, the director-general of Pakistan's Institute of Nuclear Sciences and Technology, Noor Muhammad Butt, was quoted as saying that Pakistan could build nuclear weapons “of any size or type, including neutron bombs,” while the chairman of India’s Atomic Energy Commission, Rajagopal Chidambaram, said the same. Chidambaram’s successor, Anil Kakodkar, stated in 2000 that the 1998 tests had proven India’s capacity to build nuclear weapons “from several kilotons to a couple of hundred kilotons range.”

After 9/11, the Bush administration became concerned that America’s nuclear arsenal would not deter rogue states from developing WMD, and consequently the 2001 Nuclear Posture Review (NPR) sought to revive American research into LYWs. In 2004, President Bush successfully lobbied Congress to overturn the ban on the

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40 See Section 6 for a description of ERW.


development of LYWs. Having won this victory, the Bush administration nevertheless decided not to pursue new low-yield nuclear earth penetrating weapons (EPWs). This was likely due to the effectiveness of America’s conventional forces in overthrowing Saddam Hussein, along with the questionable intelligence regarding WMD which precipitated the invasion. While the Bush administration chose not to pursue new nuclear weapons, it always conveyed a strong rhetoric in declaratory policy and kept negative security assurances (NSA) weak. This was viewed as one reason why the 2005 NPT Review Conference failed.

This appeared to change with the election of President Obama. In his 2009 Prague Speech on Nuclear Weapons, President Obama committed the United States to the vision of “peace and security of a world without nuclear weapons”. The subsequent 2010 NPR expressed two major declaratory shifts impacting LYWs. The first came in the form of a new NSA which states that:


The United States will not use or threaten to use nuclear weapons against non-nuclear weapons states that are party to the Nuclear Non-Proliferation Treaty (NPT) and in compliance with their nuclear nonproliferation obligations.\textsuperscript{48}

This expressly rules out a nuclear response to any attack from any non-nuclear-armed state (NNAS) which is in compliance with its NPT obligations, even if the attack was committed with chemical or biological agents. At the same time, the 2010 NPR announced the new Life Extension Program for America’s current arsenal in order to ensure the reliability of its existing nuclear forces, with the caveat that “Life Extension Programs...will not support new military missions or provide for new military capabilities.”\textsuperscript{49}

4 Current Situation

Most NASs now have a number of nuclear weapons with yields near or below the proposed minimum-yield threshold while others are looking to expand their low-yield nuclear options. This section provides a brief overview of each NAS and their known low-yield arsenals and postures.


\textsuperscript{49} Ibid, p. 39.
a. United States

The United States developed the B61 Mod 11 EPW during the 1990s; a gravity bomb earth-penetrator with a minimum variable yield setting of 300 tons. There are currently about 200 B61s deployed in Europe across six airbases in five NATO countries with a further 300 inactive in storage in the United States, a small number of which are reportedly on stand-by for deployment to the Pacific if directed by the president. The U.S. also has the B83 gravity bomb with a minimum variable yield setting in the low kiloton range. Approximately 100 of these weapons are deployed with hundreds more in storage at Minot and Whiteman Air Force Bases in Missouri. The Obama administration is currently developing the new B61 Mod 12 to improve accuracy and ease of delivery. The B61 Mod 12 will reportedly replace several other

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53 Ibid, p. 100.

54 Kristensen, “The B61 Life Extension Program.” See also Kile, Schell and Kristensen., “I. US Nuclear Forces”.

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B61 Models, which “will result in further reduction of the nuclear stockpile and the non-strategic nuclear arsenal”.\(^{55}\)

As of now, the United States has begun to reorient arms control efforts to include non-strategic nuclear weapons. On 19 June 2013, President Obama announced in a major speech that “we’ll work with our NATO allies to seek bold reductions in U.S. and Russian tactical weapons in Europe.”\(^{56}\) This comes after a 2012 NATO review that suggested “reducing its requirement for non-strategic nuclear weapons assigned to the Alliance in the context of reciprocal steps by Russia”.\(^{57}\)

b. Russian Federation

At the end of the Cold War Russia possessed a stockpile of low-yield artillery projectiles, surface-to-air missiles (SAMs), anti-submarine depth bombs and air-delivered warheads. The Russian low-yield arsenal is more varied and numerous than that retained by the United States and estimates as to its size and capabilities are hampered by “secrecy and a lack of transparency”.\(^{58}\) While it was previously thought that all Soviet low-yield nuclear artillery projectiles were dismantled by 2000,\(^{59}\) more recent estimates now dispute this, arguing that up to 18 nuclear artillery projectiles

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\(^{59}\) See footnote 33.
remain in the Russian arsenal with plans for their deployment.\textsuperscript{60} While this still represents near-total abolition, it is speculated that Russia is extending the life of its remaining nuclear artillery arsenal.\textsuperscript{61} Some Russian analysts have argued that Russia is seeking low-yield warheads that could be delivered by strategic launchers.\textsuperscript{62} Based on official Russian documents regarding nuclear use in regional engagements, the U.S. Defense Science Board concludes that “Russian strategies, doctrine, training, and new low yield weaponry are maturing in a manner that reinforces preparations for operations in a nuclear environment, even on their own soil”.\textsuperscript{63}

It is difficult to ascertain how many low-yield SAMs have been retained and adapted to more recent systems,\textsuperscript{64} however estimates currently range from 98 up to 400.\textsuperscript{65} As discussed later in Section 6, Russia also maintains a number of relatively low-yield missile defence interceptors which are gradually being phased out by non-nuclear variants.

In 2012, Russia also deployed a new liquid-fuelled submarine-launched ballistic missile (SLBM) which, according to its developer Makeyev State Rocket Center, is designed to carry up to “12 low-yield MIRV nuclear warheads,” though precisely

\textsuperscript{60} Sutyagin, “Atomic Accounting,” p. 53.
\textsuperscript{61} Ibid, p. 56.
\textsuperscript{64} Each SA-1 battery was thought to contain six 5-kiloton warheads: Sutyagin, “Atomic Accounting,” p. 22.
\textsuperscript{65} For the lower-end see Ibid., p. 23. For the higher estimates, see Kile et al “II. Russian nuclear forces,” p. 316; Kristensen and Norris, “Nonstrategic nuclear weapons, 2012,” p. 100.
what “low-yield” means is unspecified. Russia has also signalled an intention to refit cruise missiles with low-yield warheads, with Vice Admiral Oleg Burtsev stating in 2009 that: “There is no longer any need to equip missiles with powerful nuclear warheads. We can install low-yield warheads on existing cruise missiles”.

Estimates of Russia’s current stockpile of operational air-delivered non-strategic warheads vary dramatically between 334 up to 730. The proportion of these which are LYWs is unknown, however in 2009 the U.S. Department of Defense’s unclassified estimate of Russia’s total non-strategic arsenal numbered between 2,000 and 4,000, although recent open-source estimates come in lower at around 1,900.

c. United Kingdom

Since the late 1990s, the nuclear deterrent of the U.K. has consisted only of Trident submarines with SLBMs. Like the U.S. and Russia, the U.K. has traditionally drawn a distinction between strategic and non-strategic (or “sub-strategic”) weapons, with a British defence official stating that:

A sub-strategic strike would be the limited and highly selective use of nuclear weapons in a manner that fell demonstrably short of a strategic strike, but with a sufficient level of violence to convince an aggressor who had already miscalculated our resolve and attacked us that he should halt his aggression and withdraw or face the prospect of a devastating strategic strike.\textsuperscript{72}

The U.K. has about 160 operational nuclear warheads,\textsuperscript{73} and has hinted that Trident weapons have variable yields down to settings on the order of kilotons.\textsuperscript{74} According to Norris and Kristensen, the detonation of just the unboosted primary of a Trident warhead would produce a yield of 1 kiloton or less.\textsuperscript{75} In 2006, a former Permanent Secretary of the British Defence Ministry, Sir Michael Quinlan, stated that the existence of such a capability on some of the Trident missiles “is widely conjectured and not officially denied”.\textsuperscript{76}

In 2007, the Secretary of State for Defence, Des Browne, stated that the U.K. had stopped using the term “sub-strategic Trident” to avoid the implication that the U.K.

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was developing battlefield weapons.\textsuperscript{77} However, the U.K. has yet to rule out the use of nuclear weapons for non-strategic purposes in some circumstances, even against NNASs.\textsuperscript{78}

\textbf{d. France}

France maintains about 300 nuclear warheads in total, mostly on SLBMs and the rest on land-based and carrier-based aircraft.\textsuperscript{79} France claims that all of its weapons are strategic, even though its aircraft-delivered short-range cruise missiles would be classed as non-strategic by New START.\textsuperscript{80} In 2006, the Chief of the Defence Staff, Henri Bentégeat, referred to a minimum yield for new nuclear weapons to demonstrate that France was not pursuing a war-fighting strategy:

\begin{quote}
We have taken care to limit downwards the yield of the weapons we maintain so that nobody could ever forget that nuclear weapons are, by their very nature, different…It is important to me that this distinction continues to exist. Nuclear weapons must not, for us, become a battlefield weapon.\textsuperscript{81}
\end{quote}


\textsuperscript{80} Kristensen and Norris, “Nonstrategic Nuclear Weapons, 2012,” p. 98.

\textsuperscript{81} There is no indication of what the value of this lower yield limit could be. Henri Bentégeat quoted in Serge Vinçon, “Rapport d’information fait au nom de la commission des Affaires étrangères, de la défense et des forces armées sur le rôle de la dissuasion nucléaire française aujourd’hui,” [‘Information report made on behalf of the Committee on Foreign Affairs, Defence and Armed Forces on the Role of the French nuclear deterrent today’] Sénateur, Document No. 36 (24 October 2006), p. 25 <http://www.senat.fr/rap/r06-036/r06-0361.pdf>. Translation by the authors.
The TN-75 with a yield of approximately 100 kilotons is France’s mainstay strategic warhead. France also deploys the Tête Nucléaire Aeroportée on cruise missiles and is developing the Tête Nucléaire Océanique for SLBMs, which are believed to have variable yields down to about 20 kilotons.\textsuperscript{82} Robert Norris points out that “[t]here are advocates within French military and civilian circles who believe it would be useful to have low-yield ‘mini-nukes’ to deter future proliferants or rogue nations.”\textsuperscript{83}

Despite having a unilateral minimum-yield threshold, some in France have advocated the pursuit of LYWs for use in a variety of contingencies.\textsuperscript{84} In 2006, the Minister for Defence, Michèle Alliot-Marie, said:

\begin{quote}
[A] potential adversary might think that, given [France’s] principles and its known respect for human rights, France would hesitate to use the entire yield of its nuclear arsenal against civil populations. The President of the Republic has underlined that our country has made its capabilities for action more flexible and henceforth has the possibility of targeting the decision centres of a potential aggressor, thereby avoiding the excessive general effects capable of making us hesitate.\textsuperscript{85}
\end{quote}

Like the U.K., “it is widely believed that the French have diversified their yield options in recent years. The option of exploding only the first-stage ‘primary’ of a

\footnotesize
\begin{itemize}
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warhead to reduce the yield may have been exploited” but any such adaptations, while speculated, have not been made public.  

**e. China**

While claiming to maintain a minimum nuclear deterrent posture and no-first-use policy, China is also increasing and modernising its nuclear arsenal to make it more survivable.  

China’s current nuclear stockpile is estimated to consist of around 200 operational warheads, with the majority being land-based ballistic missiles, air-delivered gravity bombs and SLBMs.  

According to Robert Norris, the yields of China’s warheads range from over 3 megatons down to “low-yield fission type [weapons] for tactical application”.  

In 1999, the Director of the Chinese Communist Party Information Office, Zhao Qizheng, claimed that China had the technology to build “neutron bombs”.  

Based in part on the low yields (a couple kilotons) of some of China’s nuclear tests in the 1980s and 1990s, it has also been claimed that China possesses low-yield artillery

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shells and atomic demolition mines.\textsuperscript{91} As with the other aspects of China’s nuclear arsenal, however, the accuracy of these estimates is hampered by the opacity of its nuclear program.\textsuperscript{92}

\textbf{f. Israel}

Israel maintains a policy of neither officially confirming nor denying that it possesses nuclear weapons.\textsuperscript{93} Seymour Hersh, an American journalist, asserts that Israel developed LYWs, including artillery shells and atomic demolition munitions, for use in the vicinity of its own territory or troops.\textsuperscript{94} It has also been claimed that Israel conducted at least one low-yield nuclear test in the 1970s, motivated by the desire to gain “confidence in advanced low-yield battlefield nuclear weapons”.\textsuperscript{95} However, claims that Israel produced NSNWs have “never been confirmed.”\textsuperscript{96}


\textsuperscript{92} Kristensen and Norris, “Nonstrategic Nuclear Weapons, 2012,” p. 103.


g. India

India conducted sub-kiloton explosions during the 1998 tests,\(^97\) but is not believed to currently possess LYWs. Instead, India maintains a minimum-deterrence posture with an estimated stockpile of 80-100 warheads.\(^98\) Thus far India has focused on improving its strategic missile capabilities and in April 2012 successfully test-fired a three-stage road-mobile missile “capable of reaching targets throughout most of China”.\(^99\)

While India has hereto focused on strengthening the credibility of its second strike options,\(^100\) Pakistan’s development of new LYWs is complicating India’s nuclear calculus, as is the increasing conventional superiority of China. It has been suggested that these strategic trends may cause India to diversify its nuclear arsenal in the future through the development of its own LYWs.\(^101\)

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\(^{100}\) On India’s effort to develop a nuclear triad, see Shyam Saran, “Is India’s Nuclear Deterrent Credible?” (Speech to India Habitat Centre, New Delhi, 24 April 2013) <http://krepon.armscontrolwonk.com/files/2013/05/Final-Is-Indias-Nuclear-Deterrent-Credible-rev1-2-1-3.pdf>.

h. Pakistan

Pakistan deploys nuclear weapons to counter India’s superior conventional forces and currently has the fastest growing arsenal of any NAS. In April 2011, Pakistan tested the new Nasr (Hattf-9) short-range (60 km) ballistic missile; a solid-fuel missile designed to carry a kiloton or sub-kiloton yield nuclear weapon. According to Khalid Ahmed Kidwai, Director of the Strategic Plans Division, “the test was a very important milestone in consolidating Pakistan’s strategic deterrence capability at all levels of the threat spectrum.” Pakistani officials say this capability was sought in response to India’s “Cold Start” doctrine which promotes rapid cross-border conventional retaliation for low-level provocations, and thus Pakistan maintains a nuclear-first-use doctrine against military incursions launched by India.

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Pakistan has also begun augmenting its enrichment of uranium with the production of weapons-grade plutonium.\textsuperscript{107} Plutonium requires less material than highly enriched uranium (HEU) to achieve the same yield, and some argue that this is primarily to expand Pakistan’s low-yield stockpile.\textsuperscript{108}

Pakistan’s reliance on nuclear weapons, in particular its focus on LYWs for battlefield use, constitutes a major threat to international security. While Pakistan’s nuclear arsenal is nominally controlled by the National Command Authority (NCA) chaired by the Prime Minister, in practice the NCA secretariat is dominated by the army.\textsuperscript{109} Being the only country where control over nuclear use is in the hands of the military; Pakistani doctrine dictates the pre-deployment of nuclear weapons to field commanders in a crisis, with a high likelihood of use should their army be threatened by Indian forces.\textsuperscript{110}

\textsuperscript{107} Pakistan’s new Khushab heavy water reactors (three complete with a fourth under construction) are believed to provide Pakistan with enough new fissile material to increase its “annual warhead production several-fold”. See Kile, Schell and Kristensen, “Pakistani Nuclear Forces,” p. 337.

\textsuperscript{108} India’s former joint intelligence committee chief, S.D. Pradham, claimed this will add to Pakistan’s “stockpile of low-yield weapons, which, they believe, will help them dominate any low-intensity conflict with India; see Sachin Parashar, “Pakistan Developing Tactical Nukes Aimed at India: Experts,” The Times of India (27 September 2012) <http://articles.timesofindia.indiatimes.com/2012-09-27/india/34126649_1_hans-m-kristensen-nuclear-weapons-scoot-attributes>. Kile, Schell and Kristensen, “Pakistani Nuclear Forces” p. 340.


5 Deterrence

The end of the Cold War shifted international attention away from major power conflict and toward the activities of so-called rogue states, regimes which attempt to circumvent international norms in order to commit hostile acts or proliferate WMD. Many believe the Cold War arsenal of strategic nuclear weapons is only suited to massive retaliation, not the new security environment where the objective is to deter proliferation. America’s nuclear weapons are too powerful, they argue, to deter the range of contingencies that are likely to emerge because existing weapons are of such destructive capacity that few U.S. presidents would contemplate their use. They would thus be “self-deterred” from employing nuclear weapons to destroy important targets.

Proponents of this view suggest self-deterrence will be exploited by potential adversaries in order to protect their rogue activities. With America’s current nuclear arsenal significant collateral damage would be unavoidable if used in a civilian populated environment, and thus HDBTs in urban areas which cannot be destroyed by


conventional means cannot credibly be held at risk.\textsuperscript{113} Thus if rogue actors build WMD facilities in places which cannot be destroyed conventionally, they will be immune from nuclear attack owing to the overwhelming consequences of such an action by the United States.

Some believe that leaders of rogue states have a distinctively narrow conception of the risks and costs associated with their actions.\textsuperscript{114} They argue that rogue states and non-state actors may accept the dire retaliation that will result from inflicting mass casualties, and thus may not be effectively deterred by a dread of punishment, particularly if it is a regime on the point of destruction with little to lose.\textsuperscript{115} The only way to deter such individuals, they argue, is for the United States to possess the capacity to deny these actors the ability to carry out their plans.\textsuperscript{116}

The development of new LYWs has been posited as one possible solution; NSNWs that are powerful enough to be used in contingencies where conventional weapons are ineffective (such as destroying HDBTs), but small enough not to cause unacceptable collateral damage.\textsuperscript{117} Advocates argue this increased usability is required if rogue

\begin{footnotesize}
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\item\textsuperscript{115} Although an operational priority of the intervening power would be to degrade the rogue state’s WMD capacity well before the point of regime collapse to avoid such a contingency.
\item\textsuperscript{116} See Frühling, “Bunker Busters’ and Intra-War Deterrence,” pp. 328-329.
\end{itemize}
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actors are going to be effectively deterred.\textsuperscript{118} In other words, if the yield is small enough, nuclear weapons may become a viable option for destroying important urban targets which strengthens the deterrent effect of the U.S. nuclear arsenal.

This is a very narrow band of destructive power, if it exists at all. In order for a U.S. president to contemplate a nuclear first strike, the seriousness of the threat need be proportional to the consequences of eradicating it. Proponents suggest that specially designed LYWs used for disrupting WMD programs do not violate proportionality as it is the “rogue state that escalated the confrontation to the non-conventional level”.\textsuperscript{119}

This is problematic for several reasons: Firstly, it is hypocritical to imply the possession of WMD is itself an escalation while the United States maintains a vast nuclear arsenal. Secondly, other than nuclear weapons, there is no non-conventional weapon that exists that is of disproportionate destructive power to America’s overwhelming conventional arsenal.\textsuperscript{120} The use of nuclear weapons, at any yield, is therefore “strategically, legally and morally unsuitable for pre-emptive or retaliatory counter-proliferation warfare.”\textsuperscript{121}

There are almost no circumstances where it will be widely accepted as proportional to employ LYW against chemical or biological targets (see Section 6). If the target is a nuclear weapons facility, the threat must still be so imminent and dire as to outweigh

\textsuperscript{118} Dowler and Howard, “Countering the Threat of the Well-Armed Tyrant”; Crouch, “Special Briefing on the Nuclear Posture Review”; Frühling, “‘Bunker Busters’ and Intra-War Deterrence.”

\textsuperscript{119} Frühling, “‘Bunker Busters’ and Intra-War Deterrence,” p. 335.

\textsuperscript{120} Indeed it is America’s conventional dominance that is a principal motivator for rogue states to acquire a nuclear deterrent. See George H. Quester, \textit{Nuclear First Strike: Consequences of a Broken Taboo} (Baltimore: John Hopkins University Press, 2006) p. 32.

the consequences of breaking the nuclear taboo in a first strike. In such a scenario the overwhelming priority would be to reliably destroy the target; the avoidance of collateral damage having been dismissed as the principal consideration.

In other words, if the immediacy of the threat is serious enough for the U.S. to employ nuclear weapons, then rogue actors are going to be just as deterred, or undeterred, by higher yield nuclear weapons as LYWs. It is a common belief that the United States will prevail over rogue adversaries unless the rogue regime employs WMD. 122 Even then it is difficult to envisage any scenario in which the United States will only stave off military defeat by employing nuclear weapons unless the United States has already suffered major nuclear attack; an eventuality suited to America’s present nuclear capabilities.

Another argument raised in favour of LYWs is that U.S. presidents understand that breaking the nuclear taboo has such grave consequences that LYWs will not make nuclear war more likely, but will limit the devastation in the event that nuclear weapons are ever used. 123 Unfortunately this defeats the logic of deterrence. In order for LYWs to act as a credible deterrent, a potential adversary must believe that the United States is prepared to launch a nuclear first strike, and that this is somehow more likely with America having LYWs than if the United States only had nuclear

122 Frühling, “‘Bunker Busters’ and Intra-War Deterrence,” p. 337.
weapons of higher yields. It is therefore not a good case to make that LYWs should be developed in order to make the U.S. nuclear arsenal more usable, but then argue or contend that this does not make it more usable.¹²⁴

It is also important to assess whether the steps taken to reduce an identified threat, create incentives for potential adversaries to engage in the very activity the United States would seek to deter. States pursue WMD as a means to deter the threat of military intervention by an adversary possessing conventional superiority.¹²⁵ In this respect the development of LYWs alone will not materially enhance the pay-offs inherent in WMD programs. Yet, in order for LYWs to be a credible deterrent there must be at least an implicit threat of use. Thus states are likely to take steps to insulate against this form of coercion should they perceive an enhanced nuclear threat.¹²⁶

If Saddam Hussein had possessed a nuclear deterrent, it is highly unlikely that he would have been overthrown in 2003. This lesson has been learned by North Korea and Iran.¹²⁷ In the same year, Moammar Qadhafi ended Libya’s WMD program and was subsequently overthrown after a NATO intervention in 2011. North Korea, by contrast, has conducted multiple nuclear tests, continues to antagonise the

¹²⁴ Dr Keith B. Payne argues exactly this: “The heart of the debate is not the Cold War adage that low-yield precision weapons are militarily more usable from the president’s perspective and thus more likely to be used, but that opponents may judge them to be more credible for deterrence when the stakes for the United States do not include survival.” See Keith B. Payne, “The Nuclear Posture Review: Setting the Record Straight,” The Washington Quarterly, Vol. 28, No. 3 (Summer 2005), pp. 135-151, 144-145.


¹²⁶ Medalia, Nuclear Weapon Initiatives, pp. 21-22.

international community, and is not in imminent danger of American attack. Iran is certainly reducing the lead time required to build a nuclear weapon, and violating its legal obligations in doing so, but is presently having to pursue its nuclear program in an unstructured and haphazard way.\textsuperscript{128} Sanctions and sabotage are having a significant impact on Iran’s program;\textsuperscript{129} if the United States was to threaten nuclear attack then Iran would have every reason to expand dramatically its nuclear activities and cross the threshold to weaponisation.

Through the new NSA, the 2010 NPR implicitly acknowledges there is no credible circumstance in which the first use of nuclear weapons against a non-nuclear adversary could be proportional; the only conceivable nuclear first strike is against an adversary's nuclear facilities.\textsuperscript{130} The NSA’s wording was deliberately crafted to exclude North Korea and Iran in an attempt to create an incentive for bringing these countries back into compliance with the NPT.\textsuperscript{131} The value of such an incentive is questionable given both Iran and North Korea are mainly concerned about American conventional superiority, however the Obama administration has been quick to refute the claim that it is making implied nuclear threats.\textsuperscript{132}

\textsuperscript{128} Paine et al, “Countering Proliferation, or Compounding It?” pp. 33-34.
\textsuperscript{130} The new NSA effectively excludes any use or threat of use of nuclear weapons against a state that does not have nuclear weapons and is not in their pursuit.
\textsuperscript{132} Ibid.
So in order for LYWs to have a positive deterrent effect then all of the following need be true: The target cannot be held at risk with American conventional forces; adversaries must be convinced the U.S. is prepared to launch a nuclear attack with low-yield but not higher yield weapons; that this did not lower America’s overall nuclear threshold or provide incentives to other states to pursue a nuclear deterrent; and the avoidance of collateral damage remains a principal consideration in determining whether or not to strike. This is an incredible proposition.

6 Operations and War-Fighting

The utility of higher yield weapons is almost exclusively related to deterrence of potential adversaries. By contrast, the specific capabilities of LYWs for non-deterrence roles feature prominently in the literature. Writing in 1991, Thomas Dowler and Joseph Howard argued that the “existing U.S. nuclear arsenal had no deterrent effect on Saddam, and is unlikely to deter a future tyrant” from developing nuclear weapons or waging war (especially use of nuclear weapons against deployed U.S. troops in the region).\(^\text{133}\) Dowler and Howard were not alone in putting the case for LYW in this new post-Cold War security environment. They are right to point out

\(^{133}\) Dowler and Howard, “Countering the Threat of the Well-Armed Tyrant,” p. 34.
that, “[o]ur present nuclear forces were designed to deter a war with the Soviet Union, and, if deterrence failed, to defeat the U.S.S.R. in war.”  

Military strategists, weapons laboratories and academics have proposed a number of specific war-fighting capabilities for LYWs. They claim that LYWs are uniquely qualified to assist flexible responses to emerging security challenges, while minimising collateral damage.  

Many of the new capabilities embodied in LYWs are designed to counter non-nuclear threats.  

Most of the literature on this issue is a response to research conducted in the U.S. in connection with the 1991 Reed Report to the Strategic Air Command advocating the retargeting and even the “first use” of U.S. nuclear weapons to counter the threat from emerging nuclear arsenals in rogue states. It reportedly highlighted the “risk of failing to prepare nuclear responses to nuclear, chemical and biological threats from regional adversaries; included in the possible measures were the arming of expeditionary forces with low-yield, portable nuclear weapons.”  

134 Ibid, p. 36.  
135 Ibid. See also Crouch, “Special Briefing on the Nuclear Posture Review”; Bleek, “Nuclear Posture Review Released,” pp. 28-29; Frühling, “‘Bunker Busters’ and Intra-War Deterrence.”  
137 Named after former air force secretary Thomas C Reed.  
This section analyses each of the capabilities, uses and technical claims advanced for the deployment of LYWs. The credibility and practicality of their use is seen as a viable deterrent. Supporters argue that circumstances may call for the use of LYWs with niche capabilities. Prior to such use, a rational decision maker would have to reach the conclusion that the potential targets could only be defeated by using nuclear weapons (conventional force having proven inadequate).

a. Artillery and missiles

Several NASs have considered the use of LYWs against company-sized units, airfields, submarines, and similar counter-force targets. A surface or low-altitude burst using a 1 kiloton fission weapon would incapacitate tank crews over a radius of about 300 to 400 metres. For LYWs, the radius for incapacitation from irradiation is usually at least as big as the radius for incapacitation from the blast.

The radius for incapacitation by prompt radiation can be roughly doubled without increasing yield or fallout by resorting to enhanced radiation weapons (ERW or neutron bombs). An ERW is generally characterised as a fusion-fission nuclear

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weapon with a yield of less than about 10 kilotons (often 1 kiloton) that produces an order of magnitude more neutrons than a fission weapon of the same yield.\textsuperscript{142}

The effects of LYWs on concentrations of troops would be difficult to predict. From conventional testing, it is known that the shock wave from an explosion with a yield on the order of a few tons is strongly influenced by the local environment (e.g., buildings) in ways that are much less predictable than high-yield nuclear weapons.\textsuperscript{143}

Depending on weather conditions, significant fallout may extend several kilometres downwind from a 1 kiloton nuclear explosion,\textsuperscript{144} making collateral damage possible even in very sparsely populated areas.\textsuperscript{145}

The use of LYWs against an advancing land force is most likely to occur where the force poses a significant but not an existential threat. If the advancing land force belongs to an NAS, then this could signal a preparedness to initiate a limited nuclear war, although this strategy would be extremely risky for the reasons discussed in


\textsuperscript{143} Medalia, \textit{Nuclear Weapon Initiatives}, p. 7.


Section 5. In the face of an overwhelming invading force, a state could just as easily resort to a higher yield weapon.

The use of nuclear weapons by the United States during conventional conflict against even overwhelming armies under the control of NNASs is not widely advocated. Dowler and Howard perhaps put the case most strongly when they suggest that nuclear weapons could have been useful against airfields and other targets in Iraq in the first Gulf War. They express concern that Iraqi airfields had to be bombed repeatedly as Iraqi airfield maintenance personnel were able to quickly repair damage caused by American conventional weapons. The implication is that a single nuclear strike could replace many conventional bombings. Here they make reference to the use of local radiation and fallout (prolonged localised residual radioactivity) from an LYW near-surface burst for the purposes of rendering an asset or a small region of the battlefield inaccessible from the ground to all parties for a significant period after the bombing. Even if the collateral damage to civilians was likely to be minimal, the international opprobrium from use, particularly where the same effect could be achieved through repeated conventional bombing, would be grave and almost certainly outweigh any benefit.

146 See also Buchan et al, Future Roles of U.S. Nuclear Forces, p. 57.
147 Dowler and Howard, “Countering the Threat of the Well-Armed Tyrant.” Dennis Gormley explores the utility of LYWs for use against Iraqi mobile missile launchers in Gormley, “Silent Retreat”.
b. Earth penetrating weapons (EPW)\textsuperscript{149} for hard and deeply buried targets (HDBT)\textsuperscript{150}

In a 2001 report, the U.S. Departments of Defense and Energy concluded that,

potential adversary’s weapons of mass destruction (WMD), long-range missiles, modern air defenses, most sophisticated command and control systems, national leadership in wartime, and a variety of tactical arms are increasingly concealed and protected by networks of hard and deeply buried facilities.\textsuperscript{151}

The report goes on to argue that low-yield nuclear EPWs may have a significant role in tackling these emerging threats.

The notion that nuclear EPWs could be used against HDBTs reached a high watermark in the U.S. shortly after the December 2001 NPR.\textsuperscript{152} This appears to have been instrumental in the 2004 decision to rescind the 1994 ban on “research and development which could lead to the production by the United States of a new low-yield weapon.”\textsuperscript{153}

\textsuperscript{149} All known existing EPWs use impact momentum to penetrate the earth. Active penetrators, such as Deep Digger, which act like drills have been proposed but none have been completed, see Michael A Levi, “Fire in the Hole: Nuclear and Non-Nuclear Options for Counter-Proliferation” (Working Paper Number 31, Non-Proliferation Project, Global Policy Program, Carnegie Endowment for International Peace, Washington D.C., November 2002) p. 19.

\textsuperscript{150} For a detailed explanation of the types of HDBT, see Chapter 2 of National Research Council study: Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons: Division on Engineering and Physical Sciences, \textit{Effects of Nuclear Earth Penetrator and Other Weapons} (Washington: National Academies Press, 2005).


\textsuperscript{152} See Philipp C. Bleek, “Energy Department to Study Modifying Nuclear Weapons,” \textit{Arms Control Today}, Vol. 32, No. 3 (April 2002).

Typically, the surface-burst of an LYW would only have immediate effects (lethal radioactive fallout) over an area of several square kilometres. Even at very low yields, the amount and range of fallout from a nuclear explosion is not significantly reduced by detonating the device 10 metres underground. In concrete, rock and most soils, penetration with nuclear or conventional EPW to depths much greater than 10 metres, while maintaining the integrity of the warhead, is unattainable. Penetrating at higher speeds in order to achieve greater depth simply destroys the warhead on impact. In addressing the basic technical questions surrounding an EPW, Nelson concludes “the goal of a benign earth-penetrating nuclear weapon is physically impossible.”

Ground shock is the primary mechanism responsible for destroying buried targets and it is significantly enhanced by earth penetration. Ground-shock coupling is accomplished by burrowing the missile into the ground using gravity or rocket motors prior to detonation. A surface burst causes most of the energy of the weapon to be

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155 On the impossibility of containing fallout from a low-yield nuclear EPW, see Paine et al, “Countering Proliferation, or Compounding It?” p. 1; Medalia, Nuclear Weapon Initiatives, p. 47. The distribution of fallout would be similar to a surface burst and in most scenarios simulations show that fallout would be the primary cause of casualties, see National Research Council study: Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, Effects of Nuclear Earth Penetrator, p. 57.

156 Even using the optimal dimensions and the hardest steels available, penetration to 30 metres is impossible in almost all soils, see National Research Council study: Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, Effects of Nuclear Earth Penetrator, p. 24. Some studies are less ambitious about depths achievable, see, eg, David A Fulghum, “Standoff, Penetrating Nuclear Bombs Seen for B-2s,” Aviation Week, No. 146 (7 April 1997) p. 38. See also Michael May and Zachary Haldeman, “Effectiveness of Nuclear Weapons against Buried Biological Targets,” Science & Global Security, Vol. 12 (2004) pp. 91-113, 96.


reflected back into the air. Detonating below the surface, even at a depth of just a couple metres, significantly increases the amount of energy (seismic shock) deposited into the ground. A number of studies suggest that an LYW detonated a few metres below the surface has the same effect on a buried target as a surface burst with a yield about 20 times larger.159

Most studies conclude that a one kiloton (or even 100 ton) warhead detonated a few metres underground could damage a bunker up to a few tens of metres deeper underground.160 Of course, this assumes that delivery is so accurate that the weapon detonates practically directly above the target, when in fact most modern precision weapons have a circular error probable (weapon delivery accuracy) of at least 10 metres.161 Since an EPW can achieve the same effect on a HDBT target with lower yield, EPWs are lauded as inflicting minimal collateral damage.162 According to a 2005 National Research Council study, “[f]or urban targets, civilian casualties from a

159 Most of the benefit of ground-shock coupling is realised in the first few metres; burrowing deeper adds little, see National Research Council study: Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, Effects of Nuclear Earth Penetrator, p. 2; Nelson, “Low-Yield Earth-Penetrating Nuclear Weapons.” Some papers predict as much as a 50-fold improvement over a surface burst, see Fearay et al, “An Analysis of Weapons,” p. 315. These studies are usually based on extrapolation from testing using stemmed holes, whereas an EPW would leave an entry hole as it penetrates the soil and therefore might not be quite this effective at achieving ground-shock coupling, see May and Haldeman, “Effectiveness of Nuclear Weapons” (2004) p. 98; Buchan et al, Future Roles of U.S. Nuclear Forces, p. 66.

160 See, eg, Paine et al, “Countering Proliferation, or Compounding It?” p. 9.

161 If the low-yield nuclear EPW makes contact with the surface more than a few tens of metres away from the point immediately above the target, then it will have no effect even on a shallow buried target. See National Research Council study: Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, Effects of Nuclear Earth Penetrator p. 41. For cases where the weapon misses the point immediately above the target by a distance that is smaller than the distance over which the weapon can have an effect, the degree and probability of damage to the target can be inferred, see Suzanne C Wright, “Damage Expectancy Uncertainties for Deeply Buried Targets” (Technical Report, Defense Nuclear Agency Doc DNA-TH-89-163, July 1991). The new B61-12 may have a circular error probable below ten metres, in line with improvements to the accuracy of conventional weapons, but it is not strictly speaking an EPW, see Kristensen, “The B61 Life-Extension Program” p. 2.

nuclear earth-penetrator weapon are reduced by a factor of 2 to 10 compared with those from a surface burst having 25 times the yield.\textsuperscript{163}

The conventional earth penetrating weapons in the U.S. arsenal penetrate to similar depths and have yields of up to several hundred kilograms.\textsuperscript{164} The Guided Bomb Unit GBU-28 was used successfully to destroy a bunker beneath several metres of concrete and steel in Iraq in 1991.\textsuperscript{165} Since then, the United States has developed a number of hard target laser-guided conventional high-explosive weapons. Since conventional EPWs are well tested for target depths of up to about 10 metres and higher yield nuclear EPW would be required to have effect at depths greater than a few tens of metres with reasonable confidence, low-yield nuclear EPWs could only be useful for targets in a fairly narrow range of depths, and even then only if the location and degree of hardening of the bunker were known with very high precision.

Assuming that higher yield nuclear weapons would be politically unacceptable, a state might also try using multiple conventional EPWs above the target and the surrounding area in the hopes of achieving a “functional kill” by destroying tunnels, access pathways and supporting technology (communications) for the bunker that are closer to the surface. Although this might require follow up to ensure that new tunnels were closed.

\textsuperscript{163} Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, \textit{Effects of Nuclear Earth Penetrator}, p. 2.

\textsuperscript{164} Some conventional systems have been developed that penetrate slightly deeper than the B61-11, see National Research Council study: Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, \textit{Effects of Nuclear Earth Penetrator}, pp. 99-102.

not constructed to the facility, it would not require the same degree of precision in intelligence on the position and layout of the structure.\textsuperscript{166}

Compared with a surface burst of the same yield, earth penetration to a realistic depth significantly increases the destructive power of a nuclear weapon (or a conventional weapon) against underground targets located beneath the blast site, even for target depths significantly greater than the penetration depth. However, for a given yield, earth penetration to realistic depths does nothing to contain fallout or reduce collateral damage.\textsuperscript{167}

c. Agent-defeat weapons

Following the First Gulf War, the United States identified that the inability to destroy facilities containing chemical and biological agents represented one of the “highest priority shortfalls in operational capability.”\textsuperscript{168} The use of conventional weapons against chemical and biological weapons facilities was considered to have an unacceptably high risk of serious collateral damage arising from the release of live agent.\textsuperscript{169} Writing in 2004, Jason Ellis and Geoffrey Kiefer declared that these


\textsuperscript{167} See National Research Council study: Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, \textit{Effects of Nuclear Earth Penetrator}.


“capability shortfalls have raised the prospect of a future requirement for tailored, low-yield nuclear weapons to resolve the agent defeat problem.”¹⁷⁰

A number of attempts have been made to model the effects of LYWs on chemical and biological warfare agents.¹⁷¹ Biological agent defeat is primarily accomplished by either neutron irradiation or incineration in the fireball.¹⁷² Particularly for underground targets, the effect of neutron irradiation can be more precisely calculated than the effect of the fireball.¹⁷³ All things being equal, the size of the fireball, the extent of collateral damage, and the amount of local fallout increase with yield in a non-linear fashion. By contrast, intensity and range of neutron irradiation can be enhanced without increasing yield by resorting to ERWs.¹⁷⁴

Neutralization might be achievable in an unhardened above ground facility.¹⁷⁵ However, there would be a number of outstanding difficulties with the use of nuclear weapons against biological warfare agents in a hardened or buried facility. Firstly, the

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¹⁷¹ Hans Kruger, “Radiation Neutralization of Stored Biological Warfare Agents with Low-Yield Warheads” (Lawrence Livermore National Laboratory Doc UCRL-ID-140193, 21 August 2000). See also Medalia, Nuclear Weapon Initiatives, p. 34.

¹⁷² Neutralisation by electromagnetic radiation (X-rays and gamma-rays) is surprisingly ineffective even at very close range, see Michael May and Zachary Haldeman, “Effectiveness of Nuclear Weapons Against Buried Biological Agents” (Center for International Security and Cooperation Report, Stanford, May 2003) p. 14. One study suggests that the decay of short-lived fission products may contribute: May and Haldeman, “Effectiveness of Nuclear Weapons” (2004), p. 104.


¹⁷⁴ Due to improvements in American precision-guided conventional munitions, there has been little interest in ERW since the 1980s, see Michael A. Levi and Michael E. O’Hanlon, The Future of Arms Control (Washington D.C.: Brookings Institution, 2005), p. 29.

neutralization of the contents of an underground bunker would require either a capability to penetrate the bunker with an EPW (LYW detonated inside the bunker) or a high yield device capable of completely destroying the bunker. Simply breaching or crushing the bunker is inadequate to neutralise its contents. A few metres of soil between the LYW and the agent could be adequate to shield the agent from neutron irradiation; the penetration depth and precision required would put many underground targets out of reach.  

Secondly, an ineffective attempt at neutralization could simply disperse the biological or chemical warfare agent. In the case of chemical and many biological agents sunlight, rain and dispersion would probably be adequate to render the agents inconsequential when compared with radioactive fallout. However, the dispersal of spore-forming biological agents could cause more civilian casualties in the surrounding region than either the prompt effects or the radioactive fallout from an LYW. Dry, powdered anthrax, in particular, can survive explosive shockwaves when disseminated using conventional explosives. This also makes the safe destruction of anthrax with conventional explosives extremely difficult, although this may be accomplished by using thermobaric or incendiary weapons (enhancing heat neutralization) or adding concentrated acid or bleach to conventional weapons

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176 See May and Haldeman, “Effectiveness of Nuclear Weapons.”


180 Kruger, “Radiation Neutralization.”
(chemical neutralization).\textsuperscript{181} There is no evidence that neutralization of chemical or biological warfare agents was considered during any previous test of an ERW so such use would involve significant technical uncertainties.

Thirdly, the plausibility of the scenario is questionable. It is unlikely that a potential adversary would concentrate enough doses of a biological agent in one location to justify the use of nuclear weapons. The adversary must also have placed the bunker at such a shallow depth that both the bunker and its contents could be destroyed with LYWs. Furthermore, a successful attack would require adequate intelligence about the position, layout, contents and purpose of a facility to warrant a precision strike. Indeed, the extraordinary accuracy required of intelligence for the success of precision low-yield nuclear strikes against HDBTs may be the single most important and enduring factor in rendering these weapons impotent.\textsuperscript{182} Even if the layout of the storage facility was known in detail and adequate penetration could be assured, it would be difficult to guarantee complete sterilization with kiloton or sub-kiloton nuclear weapons.\textsuperscript{183}

Finally, the greatest difficulties with destroying HDBTs remain: accuracy and penetration. In many hypothetical situations, only very high yield nuclear weapons would stand a good chance of destroying HDBTs.


\textsuperscript{183} May and Haldeman, “Effectiveness of Nuclear Weapons” (2004). According to Nelson, the “more sensible strategy” is to seal entrances until the territory can be captured: Nelson, “Nuclear 'Bunker Busters’ Would More Likely Disperse.”
d. Ballistic missile defence

The primary advantage of using nuclear-tipped interceptors to destroy offensive missiles in flight is that the interceptor does not need to be as accurate as a conventional interceptor in order to destroy the incoming missile. Where kinetic interception is impractical, a nuclear interceptor may be able to heat or irradiate a nuclear or biological warhead to the point that it is no longer functional, even if the explosion fails to destroy the missile itself. At present, Russia deploys 68 Gazelle interceptors around Moscow, each tipped with one NSNW “designed to detonate between altitudes of 5 to 30 kilometres above the defended area.” The precise yield of these warheads is not well known, but typical yields for low altitude interceptors are less than about 10 kilotons. The use of LYWs at altitudes of tens of kilometres would cause relatively minor damage to the defending territory, although it could produce some fallout and the electromagnetic pulse would disrupt satellite communications and radar systems. The effectiveness of nuclear interceptors has never been proven and a capability that requires launching nuclear missiles from the nation’s capital may not be the safest for Russia to possess. Igor Sutyagin notes that Russia is working on the new A-235 ballistic missile defence system, which is

184 Dowler and Howard, “Countering the Threat of the Well-Armed Tyrant.”
187 See Ibid., p. 18.
189 Ibid., pp. 67-68.
190 Buchan et al, Future Roles of U.S. Nuclear Forces, p. 81.
intended to improve accuracy to the point that all Russian interceptors can be non-nuclear.\textsuperscript{191} In 2001, the Bush administration had sufficient confidence in non-nuclear interceptors to withdraw from the ABM Treaty in order to be free to fully develop and deploy them.

e. Conclusion

Traditionally, nuclear weapons have been deterrent weapons of last resort. Treating them simply as more effective conventional weapons undermines the nuclear taboo and ultimately makes nuclear use more likely. This should only be done if the benefits of the unique war-fighting capabilities of these weapons justify the increased risk of nuclear use and of nuclear proliferation. Given the passive defence mechanisms (eg burying targets deeper) available to potential adversaries, any military advantage of these weapons is likely to be short lived compared with the damage their use would cause to non-proliferation norms. Even with plausible advances in earth penetration technologies and delivery accuracy, the benefits to be gained by possessing LYWs in an arsenal with higher yield nuclear weapons and advanced conventional weapons do not outweigh the drawbacks.\textsuperscript{192} There are few legitimate missions for which LYWs would be effective \textit{and} in which higher yield weapons would cause unacceptable collateral damage.

\begin{flushleft}
\begin{footnotesize}
\textsuperscript{191} Sutyagin, “Atomic Accounting,” p. 17.
\textsuperscript{192} See further, Levi and O’Hanlon, \textit{The Future of Arms Control}, p. 27.
\end{footnotesize}
\end{flushleft}
LYWs are more difficult to produce than higher yield weapons, therefore the decision to develop them must be for contingencies for which higher yield weapons prove unsuitable. The argument that LYWs may improve credible deterrence implies a more realistic threat of use. The attempt to blur the distinction between conventional and nuclear weapons can only serve to weaken the nuclear taboo and lower the thresholds to nuclear war.\[^{193}\] As Mark Fitzpatrick explains, “the more restraint and responsibility employed by the user of nuclear weapons, the more likely it is that such use will irreparably rupture the taboo by introducing shades of grey.”\[^{194}\] This means one must believe in the ability, and desirability, of engaging in the limited use of nuclear weapons, and have confidence that risks of escalation can be managed.

The only case in which non-escalation could be guaranteed is a low-yield nuclear strike against a non-nuclear adversary that is not in alliance with a nuclear power. Even then, a nuclear first strike against any NNAS carries with it serious consequences inimical to the broader foreign policy interests of the offending state. In part this is due to there being no strategic rivalries between an NAS and an NNAS in which the NAS has a conventional disadvantage and where the NAS has the technical

\[^{193}\text{If this were not so, no one would seek to build them as they would clearly have no deterrent value. See Elli Louka, “Nuclear Weapons, Justice and the Law,” (Cheltenham: Edward Elgar Publishing, 2011) pp. 19-20; Arkin and Norris, “Tinynukes for Mini Minds.”}\]

capacity to build strategically significant numbers of LYWs. No matter the circumstances of a nuclear first strike, widespread condemnation is likely to occur, irrespective of the perceived importance of the target or the lack of conventional alternatives.

A nuclear first strike against an NNAS, at any yield, is likely to intensify interest in nuclear weapons among NNASs. This is true for weak states, states with capable conventional forces, and even states allied to nuclear powers which receive extended nuclear deterrence guarantees. Weak states will seek nuclear weapons to deter any similar intervention; while conventionally capable NNASs may seek to expand into the nuclear field, particularly if the objectives of a prior nuclear first strike are viewed as having been met. Recipients of extended nuclear deterrence guarantees that are contending with lowering nuclear thresholds are more likely to seek to enhance their deterrent credibility by developing their own nuclear arsenal.

The development of LYWs will also have a negative impact on nuclear proliferation even if they are not used in an actual attack. As eminent American physicists point out:

Actions by the U.S. to deploy new designs of nuclear warheads for new military missions would also strike at the heart of the current worldwide effort to prevent the proliferation of nuclear weapons…Attaching false hopes to low-yield nuclear weapons for destroying

195 It is worth noting that Pakistan actually does have a negative security assurance which applies only to NNAS. See Kerr and Nikitin, "Pakistan’s Nuclear Weapons," pp. 12-13.
196 Quester, Nuclear First Strike, p. 114.
buried targets is no reason to undermine the so-far-successful efforts to limit the proliferation of nuclear weapons.\textsuperscript{198}

Moreover, FNWs are of a significantly higher yield,\textsuperscript{199} and yet to retaliate with them against a low-yield strike would not violate proportionality given the lack of viable alternatives in meeting the threat. Even if the afflicted state did have LYWs, all out nuclear war may be considered the only viable option to degrade the aggressor’s capacity for future attacks. Therefore states that use LYWs cannot expect an adversary will be self-deterred from retaliating with higher yield weapons once subject to nuclear attack.\textsuperscript{200} Since the main reason to possess LYWs is to increase their usability and strengthen deterrence, NNASs will observe an enhanced saliency of nuclear weapons and respond accordingly.\textsuperscript{201}

Rivalries between NASs are more serious. If one state seeks LYWs to balance a conventionally superior rival then it increases both the risk of unauthorised use and the likelihood of escalation if deterrence fails. The state with an advantage in conventional forces may develop its own low-yield arsenal in response, making conventional war more likely as it will have increased confidence in its own nuclear


deterrent. Should they not seek parity the weaker state may increase provocative activities, calculating that their adversary will not risk nuclear attack by responding conventionally. Taking India and Pakistan as an example, this could mean an increase in the number of Mumbai-style attacks perpetrated by trained militants under the belief that the deployment of LYWs will deter a major conventional response. If India continued to show restraint, provocations may increase sufficiently to the point where public opinion in India becomes irresistible. In such case the existence of LYWs becomes a serious liability once conventional deterrence has failed, given the pre-delegation of these weapons in a crisis. It means India has a powerful incentive to launch a major pre-emptive strike against Pakistan’s strategic forces in order to degrade Pakistan’s strategic deterrent, and to then retaliate against deployed units carrying LYWs as they are identified.

The means of war termination in such a scenario is unclear. Even if a field commander detonated an LYW exclusively for demonstration purposes on their own territory, India may still view this as a first use of nuclear weapons by Pakistan and escalate. Unlike Pakistan’s strategic weapons, its new LYWs cannot separate the nuclear core from the trigger making them far more susceptible to theft. Moreover, in circumstances where LYWs have been pre-delegated to field commanders, the use

202 This influenced U.S. war-planning in the 1970s when the Soviet Union reached approximate nuclear parity and while it retained perceived conventional superiority. See Butfoy, “The Nuclear-Conventional Nexus,” pp. 317-322.

203 Indian declaratory policy is actually more draconian; it holds that in the event of nuclear attack against Indian military assets, retaliation will be of a counter-value nature, focusing on urban centres. See Liebl, “India and Pakistan: Competing,” pp. 156-157.


205 Sanger, Confront and Conceal, p. 61.
of a nuclear weapon in a politically constrained manner by one commander does not guarantee a similar action by others. More likely is that once the nuclear threshold has been breached, the uncertainty of communications and fog of war mean others will use them and do so in a militarily offensive manner. In the highly unlikely event that both sides use LYWs in a major conflict and restrain themselves at that level, the mutual devastation would still be unprecedented.  

The inability of political leaders to control the outbreak of a low-yield nuclear attack, direct ongoing operations, avoid escalation or bring hostilities to conclusion vexed NATO planners for decades. There was always an unavoidable paradox that in order for NSNWs to deter conventional attack they had to be placed at risk should such an attack occur. If deterrence fails, relatively junior officers facing overwhelming military aggression will be placed in a use-it-or-lose-it dilemma. U.S. doctrine during the Cold War dictated that while theatre-level weapons should only be employed in circumstances in which there was an irresistible conventional attack, the decision to use nuclear weapons should be made quickly as allied forces must remain intact in order to take advantage of nuclear use. It was also concluded that in the event of the battlefield use of nuclear weapons in Europe things would descend into chaos and anarchy in “very short order” at which point escalation to general nuclear war may be  

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206 In 1980, the United Nations Secretary General convened a panel of experts to simulate a tactical nuclear war in Europe involving 1,500 relatively low-yield nuclear artillery shells against exclusively military targets. They concluded that there would be a minimum of 5-6 million civilian deaths, 400,000 military deaths, and over 1 million from radiation and disease. See United Nations, General and Complete Disarmament: A Comprehensive Study on Nuclear Weapons: Report of the Secretary-General (London: F. Pinter, 1981).


“unavoidable”. It is hard to imagine nuclear powers in Asia today having substantially greater command and control of LYWs than did the superpowers during the Cold War.

In South Asia, the risk of unauthorised use is also substantial. NSNWs are necessarily highly mobile with many individuals responsible for their security. The risk of diversion of battlefield oriented LYWs increases exponentially when fielded, and if diverted during a crisis or conflict none need even become aware of the occurrence. It is also questionable whether unauthorised use of nuclear weapons would be distinguished from deliberate use if the target is the adversary of the state which “lost” the nuclear weapon and stood to benefit from the attack. It is therefore clear that the dangers of unauthorised use and diversion greatly outweigh any marginal benefit deployed LYWs may offer.


210 Kerr and Nikitin, “Pakistan’s Nuclear Weapons.”

211 In 2009, U.S. Intelligence intercepted communications that indicated the Taliban may have acquired a nuclear weapon from Pakistan. When the Obama administration pressed the Pakistanis they did not receive much cooperation. One senior U.S. intelligence official later recalled: “We didn’t know if the Pakistanis really know what was going on. And if they did discover something was missing, how could we even be certain they would level with us?” Quoted in Sanger, Confront and Conceal, Chapter 3. See also Miglani, “Pakistan Builds Low Yield Nuclear Capability.”

212 Quester, Nuclear First Strike, pp. 38-39.
8 Alternative Approaches for Non-Strategic Nuclear Arms Control

Historically, NSNWs have received little attention, even from arms control experts. This section canvasses two alternatives to focusing on yield for managing the risks associated with NSNWs in order to determine the most effective investment of political effort for reducing the risks associated with these weapons and advancing nuclear disarmament more broadly.

a. Declaratory policy

Some may argue it is preferable to coordinate declaratory policy rather than regulate yield. While stricter declaratory policy is important, it is impossible to verify statements such as “no first use”, the meaning and interpretation of which is often ambiguous, and the impact on peace and security largely depends on the credibility of the state making the declaration and the strategic circumstances in which it is made. India has a “no first use” policy, however it is unclear what this means in a battlefield scenario should Pakistan happen to use a nuclear weapon on its own soil. The strength of declaratory policy is its flexibility to evolving strategic circumstances;

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214 See footnote 203.
however, it is not effective where the objective is to entrench permanent prohibition.\textsuperscript{215}

\subsection*{Delivery systems}

In a multilateral context, focusing on non-strategic modes of delivery raises insurmountable obstacles given the geographic proximity of strategic rivals against whom NASs maintain a nuclear deterrent. For example, a treaty that places restrictions on land-based missiles with a range greater than 5,500 km (by analogy with New START) is decidedly unhelpful when it comes to managing strategic risk between India and Pakistan or China and India.

Moreover, it is highly unlikely that states such as China, India and Pakistan will agree to more restrictive limitations on their delivery systems unless the arsenals of the United States and Russia are similarly circumscribed. Unlike long-range strategic delivery systems such as ICBMs, non-strategic delivery vehicles can serve many conventional war-fighting purposes.\textsuperscript{216} The distinction between conventional and nuclear short-range missiles may make verification impractical and prejudice against those without versatile arsenals.\textsuperscript{217}

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{217} On the possibility of a Short-Range Nuclear Forces Treaty for India and Pakistan to tackle this problem, see Vladimir Dvorkin, “Antimissile Defences, Arms Control and Nuclear Proliferation”
\end{itemize}
\end{footnotesize}
9 Regulating LYWs

As mentioned previously, placing a yield limit on NSNWs has never been proposed and therefore possible alternatives for removing LYWs have not been greatly explored. However, there are a number of alternative approaches to formal treaties that have been posited for moving toward general nuclear disarmament, and these methods are evaluated in this section as if they were specifically applied to LYWs.218

a. Removing LYWs by example

History offers few examples whereby unilateral steps taken toward disarmament have impacted on whether other states pursue LYWs. When the U.S. legislature restricted LYWs in 1994, only difficult fiscal circumstances and a conducive strategic environment saw deep reductions in Russia’s non-strategic arsenal, which clearly began prior to the U.S. Defense Authorization Act 1994. Unilateral action is also inherently unstable, as demonstrated by the ban’s repeal ten years later. Prior to the leaking of the 2001 NPR, the Bush administration did indicate that it may take unilateral steps on tactical and non-deployed strategic warheads and wait for Russia to


218 The methods used are adapted from those posited by Bruno Tertrais on how France may join nuclear disarmament negotiations. See Tertrais, “French Perspectives on Nuclear Weapons and Nuclear Disarmament”, pp. 16-17.
reciprocate, after which these steps may be codified in the form of a treaty.\footnote{219} At the
time it was acknowledged that this would represent “a major shift in US arms-control
strategy” and that if no formal treaty resulted from unilateral efforts “the strategy
would not provide the stable framework offered by traditional arms-control
agreements.”\footnote{220}

Nor can it be argued that France’s declaration in 2006 that it has placed a floor on the
yield of its nuclear arsenal was linked to actions taken by any other state. The repeal
of the U.S. ban occurred prior to the French declaration and there is no evidence this
unilateral action had any effect on the nuclear posture of any other NAS.

\textbf{b. Removal of LYWs led by the major powers}

A combined effort by a group of NASs that included the U.S. and Russia to place a
minimum-yield threshold on nuclear weapons is certain to be more effective than any
unilateral declaration by any individual state. However, such an initiative is likely to
be perceived as being prejudicial against NASs with the greatest interest in LYWs.
The resulting resistance may degrade consensus to the point where the initiative
ultimately fails. For instance, it can be readily imagined that a country like China
would respond positively to a large chorus of NNASs calling for the banning of
nuclear weapons with design yields below 5 kilotons, but be less willing to pressure
states like Pakistan if it were viewed as an attempt by the U.S. to undermine
Pakistan’s national security.

\begin{footnotesize}
\footnote{219} Andrew Koch, “US Rethink Could Spawn ‘Mini-Nukes’,” \textit{HIS Janes Defense & Security
DocType=News&Id=2160327&Pubabbrev=JDW>.
\footnote{220} Ibid.
\end{footnotesize}
c. Banning LYWs through a multilateral arms control treaty

For several reasons the removal of LYWs as a threat to international security is most effectively achieved through a multilateral treaty which outlaws their development and retention, rather than other potential avenues toward this objective. Firstly, multilateral treaties have beneficial norm-setting effects which are not replicated by other mechanisms. For example, even though the Comprehensive Nuclear-Test-Ban Treaty (CTBT) has yet to enter into force, its existence and ratification by some 159 countries has created a powerful norm against nuclear testing,\textsuperscript{221} and even NASs that are yet to ratify the CTBT have now declared unilateral moratoriums.\textsuperscript{222} Moreover, these norms create benchmarks of legitimacy against which nuclear behaviour is judged by the international community and for which there are adverse consequences for their violation, even if not legally enforceable by the treaty itself.\textsuperscript{223}

Secondly, it would prove much easier for NNASs to lobby NASs to remove LYWs once the norm against them had been established and LYWs had been identified as being qualitatively different and effectively marginalised. NNASs would have no objection to a treaty outlawing a type of nuclear weapon and therefore the tabling of a treaty by an NNAS or states at the United Nations General Assembly is likely to achieve rapid and widespread support.


\textsuperscript{222} Excepting Israel and North Korea.

\textsuperscript{223} This includes, for instance, the suspension of nuclear supply for civilian power programs, see Crispin Rovere and Kalman A. Robertson, “Australia’s Uranium and India: Linking Exports to CTBT Ratification,” \textit{Security Challenges}, Vol. 9, No. 1 (Autumn 2013) pp. 51-61.
Finally, given that addressing NSNWs is now crucial to negotiating future reductions in strategic weapons, and that nuclear arms control must soon proceed in a multilateral framework, it is important that whatever mechanism is used to manage NSNWs be permanently applicable to all current and emerging arsenals. A universal treaty banning nuclear weapons below a designated yield is the most direct and effective means of achieving that outcome.

10 A Minimum-Yield Threshold Treaty

Now that the risks associated with the continued existence of LYWs have been canvassed and it has been established that a multilateral treaty is the best mechanism for achieving a prohibition, it is worth considering the possible structure and effects of such a treaty.

a. Establishing a minimum-yield threshold

An important detail is precisely what the yield limit of any new treaty should be. In order for a minimum-yield threshold to be supported by all NNASs, while still adding value to existing treaties, the limit needs to be set below the yield of an FNW. Setting the threshold above the yield of an FNW could be viewed by NNASs as an attempt by NASs to entrench their nuclear inferiority, thereby making universality unachievable. Furthermore, the continued existence of higher yield strategic weapons would blunt
any concerns that banning LYWs would threaten the deterrent value of nuclear weapons in international security. Also there is a yield limit above which it would be manifestly disproportionate to use nuclear weapons short of existential need, even against targets of major importance. In order to support international peace and security at all levels it is therefore necessary to set the nuclear threshold at low yields. The limit would ideally sit above most nuclear demolitions, depth bombs and artillery, but still permit strategic weapons with yields on the order of an FNW owing to increased accuracy and reliability of delivery systems. Thus the initial minimum threshold of LYWs would sit somewhere within this range, presumably around 5 kilotons. 224

A minimum-yield threshold of 5 kilotons would in no way undermine the nuclear assurances the United States extends to its allies in regions like Northeast Asia. The extended nuclear deterrence umbrella is provided for primarily by the legs of the American Triad, including long range bombers, strategic nuclear submarines (SSBNs) and ICBMs. 225 LYWs do not contribute to U.S. extended deterrence posture in this region, having already been removed from the Korean peninsula, Guam, Hawaii and Alaska. 226 Since the capabilities that provide the necessary assurances to allies are of

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224 While the increasing accuracy and reliability of delivery systems has reduced the yields of strategic warheads over time, it is highly unlikely that counter-value weapons will ever be reduced below 5 kilotons.


a fundamentally strategic character, banning nuclear weapons with a design yield below 5 kilotons would not affect these delivery systems.

Finally, setting the minimum-yield threshold at 5 kilotons has the additional advantage of already having precedents in the U.S. legislature due to the 1994 ban, and is the most commonly accepted yield limit defining an LYW.

b. Treaty provisions

The fundamental obligation in this treaty will be an undertaking never to develop, produce, stockpile or otherwise acquire or retain nuclear weapons designed to have a yield below the minimum-yield threshold or reasonably likely to have a yield below the threshold. There would be parallel obligations in relation to nuclear testing, use and threat of use. There would also be parallel obligations not to assist any entity with any of these activities.

A legal mechanism would be available to any state party against another state party that violates the treaty. The legal mechanism may be activated in relation to alleged acquisition, testing or use. A state that is harmed by the use or threat of use of an LYW may not be facing an imminent existential threat, and so the formal mechanism would provide an alternative to escalation if the nuclear threshold is crossed with LYWs. A country may be able to avoid massive escalation if the international community intervenes after allegations of an illegal nuclear attack. This alternative

227 This would include deliberately testing strategic weapons at low yield.

step entrenches the nuclear taboo in international law while maintaining strategic
deterrence as guarantor of ultimate security.

Resorting to the legal mechanism would not be a legal obligation where it could
interfere with the victim state’s right to self-defence under customary international
law. The legal mechanism would involve a formal complaint to the United Nations, possibly with an automatic Security Council procedure for establishing collective
measures which are in conformity with international law.

c. Impact of treaty and verification

Any new arms control treaty creates three types of risks. Firstly, there are risks which
exist even if all of the most relevant states (NASs with developed arsenals) ratify and
comply with the treaty. Some may argue that a treaty banning LYWs will make
nuclear war more likely to occur at higher yields; in other words, LYWs make it
possible to limit nuclear conflict. This is based on the assumption that escalation
control can be maintained with high credibility once the nuclear threshold is breached,
something that defies all operational understanding and experience. By maintaining
a clear separation between conventional and nuclear weapons, the proposed treaty
reduces the probability of nuclear war overall. Furthermore, the risk of unauthorised
use or diversion is dramatically reduced owing to governments retaining control of
strategic warheads. If the treaty achieves universality or near universality, it will
strengthen the security of every state party.

230 This point is made most forcefully by Robert McNamara himself. See Robert S. McNamara “The
Military Role of Nuclear Weapons: Perceptions and Misperceptions,” Foreign Affairs, Vol. 62, No. 1
Secondly, there is the risk that some states parties will be disadvantaged by accepting obligations, while other states refuse to ratify (i.e. a failure to achieve universality). This risk could be managed by making entry into force conditional on ratification by the United States and Russia, or even conditional on ratification by several NASs. Moreover, where a NAS that is not a party to the treaty contemplates the use of LYWs against a NAS that is a party to the treaty, the former will be forced to consider that any retaliation by the latter would probably involve higher yield nuclear weapons.  

Thirdly, there is the risk that a state party will violate the treaty and will not be caught until it has disadvantaged other parties or done significant harm to the treaty regime itself. As argued above, the possession of LYWs is unlikely to significantly enhance a state’s military or political power over other states.

The treaty has the greatest impact on the states that currently possess LYWs. Although ratification of the treaty affects the implied force posture of each NAS that ratifies the treaty, it requires little behavioural modification for most states. Mechanisms for verifying the removal of low-yield settings from variable yield weapons will depend on the electronics used in these weapons and may be separately negotiated between the states that possess them. The military significance of verification uncertainties is limited by the large residual nuclear force of more destructive strategic weapons held by these countries. Major shifts in the military

231 The Appendix evaluates the practical effect of the treaty in the event that some NASs are parties and others are not.
balance between NASs cannot be achieved by clandestine acquisition of LYWs. Even an unexpected attack with LYWs could be addressed by resorting to the legal mechanism or higher yield nuclear weapons.

Similarly, an NAS would not be able to significantly improve its military position relative to an NNAS or an emerging nuclear power by committing a clandestine violation of the treaty. Once the treaty enters into force, the surreptitious acquisition of LYWs could not contribute to deterrence. Ultimately, any benefit from illegal possession of LYWs can only be realised by making the violation public.  

Verification is likely to only be central to cases of alleged use or testing. Even if the state in violation decided to develop and use or test its LYWs, it would likely face strong international condemnation, as well as legal action under the treaty. North Korea’s 2006 nuclear test was detected successfully in the sub-kiloton range, despite the regime claiming it was of a much higher yield. Given the extraordinary nature of such an event, the political significance of verification uncertainties in the yield of the explosion and the design yield of the weapon (where a malfunction may have caused the low yield) are likely to be limited. There may be some complications where one party suspects that another party is planning to use LYWs and where that party

234 “In the end, increases in military power must be translated into political terms if the benefits are to be realized. To do so the violation must be revealed”: Abram Chayes, “An Enquiry into the Workings of Arms Control Agreements,” Harvard Law Review, Vol. 85, No. 5 (1972), pp. 905-969, 950.

235 If a state claimed to be a victim of a low-yield nuclear strike and the aggressor claimed that the weapon used was not an LYW then the treaty could provide for the victim state to open its affected territory for international investigation.

actively denies possessing LYWs. The Appendix discusses the ramifications of an undetected violation (i.e. the acquisition and unexpected use of LYWs) by an NAS.

This study has considered all of the possible conflicts between actors that are: party to the treaty and in compliance, party to the treaty and not in compliance, and not party to the treaty. It also covers states of varying nuclear status including; developed nuclear powers, emerging nuclear powers and NNASs (see table in the Appendix). A minimum-yield threshold treaty improves international peace and security overall. Furthermore it improves, on balance, the peace and security of every party to the treaty. In any case, it is clear that the risks of continued development of LYWs and of new arms races greatly outweigh the risk of accepting a treaty with minimal intrusive verification.

11 Relationship to Disarmament

A treaty banning LYWs would have a constructive relationship with existing arms control agreements such as the Nuclear Non-Proliferation Treaty (NPT) and the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The treaty may also play into future reductions negotiated between NASs.
The NPT is recognised as the most effective legal mechanism for reducing the motivation to acquire nuclear weapons.\textsuperscript{237} Since no new nuclear breakout is likely to occur with LYWs,\textsuperscript{238} a treaty banning LYWs does not subsume or replace the role of the NPT which has near universality. The NPT does not, however, cover any specific type of nuclear weapon or place definitions on the yields of such weapons. Thus, the NPT does not address the increasing variance of nuclear weapons and missions except implicitly through the Article VI obligation to negotiate in good faith toward disarmament.

The CTBT still requires ratification by a number of NASs before it enters into force. Since LYWs are technically complex there is a greater incentive to test these than for weapons designed at higher yields. In terms of the risk of undetected non-compliance with the CTBT, very low-yield, cavity-decoupled underground nuclear testing is the most commonly cited concern,\textsuperscript{239} and frequently raised as an argument against CTBT ratification.\textsuperscript{240} The banning of LYWs, with accompanying additional verification provisions, will remove one obstacle for the ratification of the CTBT by NASs, especially the U.S.\textsuperscript{241}


\textsuperscript{238} Due to the technical constraints discussed in Section 6 of this study.


\textsuperscript{241} China has indicated it will also ratify the CTBT after the U.S., see Emily Warren, Ting Xu and David Santoro, “Strategizing Test Ban Diplomacy: China's Play,” \textit{Bertelsmann Foundation and Pacific
A treaty which creates a minimum-yield threshold would be the first multilateral arms control agreement banning a particular type of nuclear weapon. Once the threshold is in place, it will serve as the benchmark for NASs seeking reductions in NSNWs through bilateral negotiation. In the future this may effectively raise the minimum-yield threshold, further separating the nexus between conventional and nuclear war.

A state need not be a member of either the NPT or the CTBT in order to be party to a treaty banning LYWs. It adds value to both treaties by contributing to the existing arms control equation, as well as providing a norm-setting platform in the form of a threshold against which future reductions in NSNWs may be benchmarked.

12 Conclusion: A Way Forward

LYWs are a special kind of NSNW with a range of strategic drawbacks; including the reality that possession of LYWs by some states makes the acquisition of LYWs by other states more likely and increases the overall probability of nuclear use. Efforts to develop LYWs signal to the world the contemplation of new nuclear missions, and potentially nuclear testing. Reliance on these weapons for counter-force operations harms prospects for global cooperation toward non-proliferation and disarmament
objectives. The contention that nuclear weapons are militarily useful encourages the proliferation of those weapons.

Outlawing nuclear weapons with a minimum design-yield below 5 kilotons removes several paths to nuclear conflict and positively influences the security, domestic and normative factors that determine the decisions of states to go nuclear. A multilateral treaty is the best mechanism for marginalising LYWs, thereby decreasing the probability of LYWs being used, either through accident or design, as well as controlling escalation in the event of a violation. Regardless of its nuclear status, each state receives a net benefit to its national security by ratifying the treaty outlawing LYWs. This is accomplished by reducing the chances of nuclear conflict and by providing decisions makers legal recourse to the international community in a relevant crisis situation.

The need to include NSNWs in arms control negotiations is a matter of increasing urgency for both international security and as an enabler for other arms control initiatives. The removal of LYWs raises the nuclear threshold, helps avoid escalation and general nuclear war, all while retaining the stabilising benefits of nuclear deterrence.

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Collective governmental organisations of NNASs such as the Non-Proliferation and Disarmament Initiative (NPDI) are best placed to take leadership in building an international norm against LYWs and bringing a treaty before the United Nations for signature and ratification.\textsuperscript{243}

\textsuperscript{243} It is promising to note that the NPDI has already identified NSNWs as a significant impediment to non-proliferation and ongoing nuclear arms reductions, and submitted a joint working paper on NSNWs to the 2013 NPT PrepCom in Geneva. NPDI, “Non-Strategic Nuclear Weapons,” (Working Paper No. NPT/CONF.2015/PC.II/WP.3, Preparatory Committee for the 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, 6 March 2013). The NPT PrepCom Chairman’s factual summary “noted the discussions and proposals aimed at increasing mutual understanding on non-strategic nuclear forces.” in the context of efforts to reduce all types of nuclear weapons, including through multilateral measures, NPT PrepCom Doc NPT/CONF.2015/PC.II/CRP.2 (2 May 2013).
Glossary

**B61-11** (B61 Mod 11) – a modified version of a variable yield nuclear gravity bomb, the B61, deployed by the United States since 1997, designed to enhance ease of delivery, especially earth penetration capability

**Circular error probable** – an indicator of the accuracy of a weapon system; the radius of a circle, centred about the target area, whose boundary is expected to include the point of impact of 50% of missiles launched at or bombs dropped on the target


**EPW** – earth penetrating weapon (see footnote 149)

**ERW** – enhanced radiation warhead (neutron bomb, see footnote 142)

**FNW** – first nuclear weapon: a pure fission nuclear explosive device with a design yield of 5 to 20 kilotons, similar to the first nuclear weapons of the United States (Trinity, Little Boy, Fat Man, etc), Soviet Union, United Kingdom, France, China, India, Pakistan, South Africa and North Korea

**FSNAS** – Full-spectrum-nuclear-armed state: a state that possesses nuclear weapons, some of which are below the minimum-yield threshold and some of which are above the minimum-yield threshold

**HDBT** – hard and deeply buried target (see footnote 150)

**HEU** – highly enriched uranium: uranium containing 20% or more of the isotope $^{235}\text{U}$

**Higher yield weapon** – any nuclear weapon that is not an LYW; any nuclear weapon with a yield above the minimum yield threshold or a variable yield weapon with all settings above the minimum yield threshold

**ICBM** – intercontinental ballistic missile

**LEU** – low enriched uranium: uranium containing more than 0.7% (the proportion in natural uranium) of the isotope $^{235}\text{U}$ but less than 20% of the isotope $^{235}\text{U}$

**LSNAS** – limited-spectrum-nuclear-armed state: a state that possesses nuclear weapons but only at yields above the minimum-yield threshold

**LYW** – low-yield weapon: any nuclear weapon designed to have a yield below the minimum-yield threshold or a variable yield weapon with at least one setting below the minimum-yield threshold
Minimum-yield threshold – a value for yield (presumptively 5 kilotons) that separates LYW from higher-yield weapons, the process of establishing an exact minimum-yield threshold is explained in Section 10

NAS – nuclear-armed state: a state that possesses some nuclear weapons (assumed that at least some of these weapons are above the minimum-yield threshold)

NATO – North Atlantic Treaty Organization

NCA – National Command Authority of Pakistan


NNAS – Non-nuclear-armed state: a state that does not possess any nuclear weapons (as of May 2013, all NNAS are parties to the NPT except South Sudan).

NPDI – Non-Proliferation and Disarmament Initiative

NPR – Nuclear Posture Review

NPT – Treaty on the Non-Proliferation of Nuclear Weapons, opened for signature 1 July 1968, 729 UNTS 161 (entered into force 5 March 1970) (‘Nuclear Non-Proliferation Treaty’).

NSA – negative security assurance: a declaration by an NAS restricting the circumstances when they may use or threaten to use nuclear weapons against NNASs

NSNW – non-strategic nuclear weapon (see footnote 3)

PLYWD – Precision Low-Yield Weapon Design, a joint U.S. Department of Defense and Department of Energy study in 1994 (see footnote 35)

SAM – surface-to-air missile

SLBM – submarine-launched ballistic missile

SSBN – ballistic missile submarine (a submarine capable of carrying strategic nuclear ballistic missiles)

TNT – trinitrotoluene; the yield of a weapon is equal to the mass of TNT that would release the same amount of explosive energy, where it is assumed that one metric ton of TNT releases 4.184 gigajoules of energy

WMD – weapon of mass destruction; a non-conventional weapon including a nuclear, biological or chemical weapon
Appendix: Analysis of Dyads Created by Treaty

Definitions

- Full-spectrum-nuclear-armed state party (FSNASP): a FSNAS that is a party to the proposed Treaty and therefore in violation of its obligations under the Treaty (it is assumed in these examples that this non-compliance is not known unless and until the FSNASP uses LYW).
- Full-spectrum-nuclear-armed state not party (FSNASN): a FSNAS that is not a party to the Treaty.
- Limited-spectrum-nuclear-armed state party (LSNASP): a LSNAS that is a party to the Treaty.

Guide

In general, it is assumed that the “aggressor” has conventional and/or nuclear superiority over the “defender.”

The right most column represents the net effect of the treaty (positive +, negative -, or neutral 0) for each scenario.
<table>
<thead>
<tr>
<th>Aggressor</th>
<th>Defender</th>
<th>Scenario</th>
<th>Treaty effect</th>
<th>Ef</th>
</tr>
</thead>
</table>
| LSNASP    | LSNASP   | -Hostilities between two LSNASP  
-Possible large-scale conventional conflict already occurring | -Neither side has LYWs  
-Nuclear threshold clearly defined (decrease risk of miscalculation)  
-Only path available for a nuclear first strike is with a higher yield weapon  
-Decrease overall probability of a nuclear first strike  
-Greater centralised control of nuclear arsenal by leadership decreasing the likelihood of diversion, accident or unauthorised use.  
-If Defender believes that it must use a nuclear weapon, it will use a higher yield weapon, which causes more direct damage. The probability of immediate escalation conditioned on the event of a first strike with a higher yield weapon may be larger than the probability in the event of a first strike with an LYW.  
-In the event of a nuclear first strike, the probability of limited nuclear war is decreased and therefore the gravity of the risk (consequences) of a first strike is increased | + |
| LSNASP | NNAS | -LSNASP seeking to disarm an NNAS (eg suspected nuclear weaponisation activities) | -Attacker likely to use conventional weapons  
-Decrease probability of use of nuclear weapons  
-Decrease incentives for NNASs to seek nuclear weapons and strengthening of negative security assurances  
-As per Section 5 and 6 there are very few missions for which LYWs would be of material benefit.  
-If Attacker forms opinion that only way to accomplish goal is with use of nuclear weapon then it would use a higher yield weapon, increasing damage |
| LSNASP | FSNASP | -LSNASP and FSNASP engaged in conventional conflict. Each side assumes that resort to nuclear weapons unlikely since both are parties. FSNASP in fact uses LYWs  
-Rapid retaliation against an LYW may be unnecessary, although retaliation with higher yield weapons may be seen as justified  
-Use of LYWs would be a violation of international law  
-Legal recourse in Treaty could be used in place of nuclear retaliation/escalation  
-Demonstrates treaty does not require verification to be effective |
| LSNASP | FSNASN | -LSNASP and FSNASN engaged in conventional conflict. FSNASN uses LYWs as a first strike.  
-Easier to justify retaliation/escalation with higher yield weapons (LSNASP unlikely to lose nuclear deterrent in this respect)  
-No tacit understanding that LSNASP will use legal mechanism, so retaliation with higher yield weapon may be seen as justified (added incentive to ratify the treaty)  
-No opportunity for LSNASP to respond with LYWs (i.e. makes limited nuclear war less likely) |
<table>
<thead>
<tr>
<th>Aggressor</th>
<th>Defender</th>
<th>Scenario</th>
<th>Treaty effect</th>
<th>Ef</th>
</tr>
</thead>
</table>
| FSNASP   | NNAS     | -FSNASP uses LYWs against NNAS to disarm (eg suspected nuclear weaponisation activities) | -NNAS has legal recourse  
-Attack by FSNASP with LYWs likely to be condemned by international community  
-This attack could undermine negative security assurance unless evidence of threat from NNAS was clear  
-In cases of doubt about the yield of the weapon, there may be an expectation that the NNAS would open up its affected territory for international investigation (refusal to do so could support conclusions about proliferation activities in NNAS) | +  |
| LSNASP   | FSNASP   | -FSNASP uses LYWs against LSNASP as a first strike | -LSNASP maintains second strike capability at higher yields  
-Legal recourse (complaint mechanism) available if immediate nuclear retaliation not considered necessary  
-Use of higher yield weapons by LSNASP may be seen as justified, even without using the complaint mechanism | +  |
| FSNASP II | LSNASP II | - FSNASP with conventional superiority is winning war. LSNASP uses higher yield weapon (eg as a warning with minimal direct effect). FSNASP responds with LYWs. | - Unlikely that a state would resort to a lower yield weapon for a second strike in practice  
- If nuclear retaliation viewed as justified, international community likely to view non-compliance as better than compliance (i.e. treaty inhibiting justice)  
- Call into question value of treaty in preventing or limiting nuclear war |
|---|---|---|---|
| FSNASP | FSNASP | - Both sides use LYWs in contravention of the Treaty | - International community condemns first strike; second strike may be seen as proportionate despite violation of Treaty  
- Multiple instances of non-compliance call into question value of treaty  
- The Treaty could have a positive impact in this case if it provided that other states parties could use legal recourse (bring complaints) on an urgent third party basis |
| FSNASP | FSNASN | - FSNASP attacks FSNASN with LYWs (first use) | - Treaty unlikely to have much effect, despite breach (possible international condemnation)  
- Possible limited nuclear war  
- Nuclear response by FSNASN (including recourse to higher yield weapons) may be viewed as justified  
- FSNASN has no legal recourse under Treaty |
<table>
<thead>
<tr>
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<th>Scenario</th>
<th>Treaty effect</th>
<th>Ef</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSNASN</td>
<td>NNAS</td>
<td>-FSNASN uses LYWs against NNAS</td>
<td>-In the event that the Treaty is nearly universal among NAS, the international community is more likely to condemn the FSNASN (strengthen nuclear taboo) unless use of LYWs is viewed as the best way to achieve legitimate goal of preventing proliferation in NNAS</td>
<td>0</td>
</tr>
<tr>
<td>FSNASN I</td>
<td>LSNASP I</td>
<td></td>
<td>-See FSNASP I v LSNASP I above</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-If complaint mechanism is unavailable, use of higher yield weapons in a second strike by LSNASP may be seen as justified</td>
<td></td>
</tr>
<tr>
<td>FSNASN II</td>
<td>LSNASP II</td>
<td></td>
<td>-See FSNASP II v LSNASP II above</td>
<td>-</td>
</tr>
<tr>
<td>FSNASN</td>
<td>FSNASP</td>
<td>-FSNASN first uses LYWs</td>
<td>-Treaty decreases likelihood of use of LYW against a Party because Aggressor believes that Defender can only respond with higher yield weapons</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-International community less likely to condemn FSNASP if it retaliates with LYWs (non-compliance unpunished)</td>
<td>0  or +</td>
</tr>
<tr>
<td>FSNASN</td>
<td>FSNASN</td>
<td>-FSNASN v FSNASN – risk misinterpretation of conventional attack as LYWs</td>
<td>-Treaty has no effect</td>
<td>0</td>
</tr>
<tr>
<td>Aggressor</td>
<td>Defender</td>
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</tbody>
</table>
| NNAS      | NNAS     | -NNAS with conventional superiority has commenced conventional conflict with a LSNASP  
-LSNASP believes that it can only repel attack by using nuclear weapons (only effective and proportional response) | -Treaty has no effect | 0 |
| NNAS      | LSNASP   | -NNAS with conventional superiority has commenced conventional conflict with a LSNASP  
-LSNASP believes that it can only repel attack by using nuclear weapons (only effective and proportional response) | -Treaty does not impact on capability of NNAS to develop basic fission weapons  
-LSNASP can only use higher yield nuclear weapons, thereby causing more damage  
-If the costs of using higher yield weapons are known to be too high, then LSNASP nuclear weapons have lost their deterrent value | - |
| NNAS      | FSNASP   | -NNAS with conventional superiority has commenced conventional conflict with a FSNASP (believing that it does not have LYWs).  
-FSNASP uses LYWs | -NNAS has legal recourse (if it is a party to the Treaty) and likely international community will condemn violation and first use by FSNASP against NNAS | + |
| NNAS      | FSNASN   | -NNAS with conventional superiority has commenced conventional conflict with a FSNASN  
-FSNASN believes that it can only repel attack by using nuclear weapons | -Treaty has minimal effect | 0 |
<table>
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<tr>
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<th>Scenario</th>
<th>Treaty effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>NNAS benefiting from END or from alliance with an NAS</td>
<td>NAS</td>
<td></td>
<td>-Any use by either NAS would devolve into one of the categories above</td>
</tr>
<tr>
<td>3 NAS, 2 NNAS, 1 NAS and 2 NNAS, 3 NNAS, 4 states, etc</td>
<td>NAS and 1 NAS</td>
<td></td>
<td>-All devolve into above categories</td>
</tr>
</tbody>
</table>