Strategies for Non-Strategic Nuclear Weapons:

Low-Yield Programs and Policy Considerations

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Abstract

Advances in nuclear weapon technologies and the corresponding evolution in the threat landscape posed by non-allied nations over the past four years, and especially in the last few weeks, underscores the exigency of the United States in updating its stated national security policies. Here we review and suggest options for the 2022 Nuclear Posture Review (NPR) regarding the low-yield submarine-launched cruise missile (SLCM-N) and submarine-launched ballistic missile (SLBM) programs. The 2018 NPR called for programmatic changes to counteract the evolving threat environment and allow for greater deterrence flexibility[1]. These programs include modernization of existing technologies and creation of novel weapons systems. Of these changes, two new programs were started to develop low-yield, sea-based, non-strategic weapons. These options are designed to counter any perceived gaps in U.S. regional deterrence capabilities. We enumerate several general policy options likely to be considered by the Biden White House. Our proposed solution calls for maintenance of the W76-2 program and the continuance of the low-yield SLCM-N program; we present our **argument for low-yield synthesis** along the axes of technical considerations, tailored response capabilities, ensured support and defense of our allies, and prevention of escalation to war.

The Current Nuclear Landscape

The major national security threats facing the U.S. today come from two sources: renewed great power competition and the continued threat from aggressive, regional powers[2]. The Russian Federation (R.F.) and The People's Republic of China (P.R.C.) have become increasingly assertive in matters relating to security, diplomacy, and economics in an effort to degrade the rules-based international order and replace it with a framework more amenable to their own interests. The Democratic People's Republic of Korea (D.P.R.K.) and Iran also pose continuing threats to the U.S. and its allies by conducting increasingly aggressive campaigns of provocation and maligned influence in their respective regions.

These changing threats have led to a new threat environment posed by nuclear weapon states. Russia and China have evolved with the development of new weapon systems such as the hypersonic glide vehicle (HGV). An analysis of the nuclear weapon arsenal in terms of range and yield as shown in Figure 1, where part A demonstrates specific gaps that have opened in U.S. capabilities in the low-yield/low-range space. This space is typically associated with non-strategic or tactical weapons. We adopt the threshold for low-yield as 8 kilotons yield or less, where standard-yield will have yields exceeding this[3].

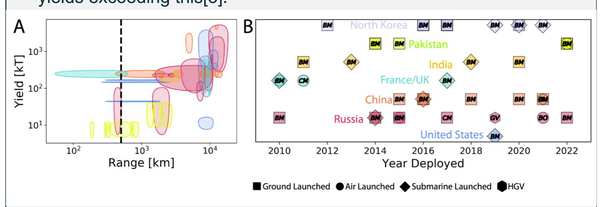

Fig. 1. Evolution of Threat Environment. (A) Plot of range [km] and Yield [kT] for nuclear weapon states. The dotted line corresponds to the separation between short-range and medium range weapons. (B) Timeline of nuclear weapon deployments since 2010 colored by nation with shapes indicating weapon system classification. The colors from (B) also correspond to the nations in (A).

Policy Options for the 2022 NPR

The purpose of a Nuclear Posture Review (NPR) is to develop and propagate declaratory nuclear policy for transparent and clear communication with other nuclear players. A successful U.S. NPR will help deter nuclear proliferation, maintain strategic deterrence and stability, reassure U.S. allies and partners, and sustain a safe, secure, and effective nuclear arsenal. To do this, there are four general options the Biden White House may take.

1. **Roll out the W76-2**: Follow in the precedent of the 2018 NPR and focus on development and rollout of the W76-2, while continuing to explore other low-yield options in order to strengthen extended deterrence and fill the missile gap[1].

1. **Rollback the W76-2**: Revert to the policies of the 2010 NPR and rollback low-yield weapons to avoid the interpretation that the U.S. is seeking out more "usable weapons"[4].

1. **Transition to New Low-Yield Options**: In order to avoid warhead ambiguity posed by the W76-1 (standard-yield) and W76-2 (low-yield) being launched on the same platform, transition to developing a low-yield SLCM-N and use it to replace the W76-2's role in low-yield deterrence[5].

1. **Low-Yield Synthesis**: Make both the W76-2 and the SLCM-N key players in the U.S. nuclear arsenal, thus maximizing the flexibility of options and best maintain extended deterrence capabilities, due to the SLCM-N avoiding warhead ambiguity and the SLBM being ready-made and with larger range and utility.

We argue that option 4, "Low-Yield Synthesis", is the best option to pursue for the 2022 NPR for low-yield weapons programs and policy.

The Discrimination Problem

The discrimination problem arises when an adversary cannot tell what type of payload will be delivered by an incoming missile, forcing them to act under the assumption of the worst case-scenario[5]. This arises with the use of the W76-2. It is important that a state employing a nuclear weapon minimizes the risk of escalation that the discrimination problem can cause. A concern with the W76-2 is that under most conditions it cannot be distinguished from its standard-yield counterpart. The W76-2 is the only low-yield option currently available to the U.S. arsenal, having an expected yield of 8 kilotons. The Trident II D5 also carries two standard-yield warheads: the W76-1 and the W88[3]. No adversary can distinguish whether the Trident II D5 is carrying either of the two standard-yield warheads or the low-yield warhead prior to detonation[5]. When faced with this uncertainty, the target nation will have no choice but to interpret a launch of the Trident II D5 to contain standard-yield warheads, and thus respond proportionately with strategic forces; deploying the W76-2 on the Trident II D5 missiles greatly increases the risk of strategic forces being used, as described in Table 3 below. The SLCM-N could be developed to potentially avoid the heightened risk associated with the current deployment of W76-2 warheads on Trident II D5 missiles. The development of the SLCM-N could potentially reduce the risk of unintentional escalation and resolve this discrimination problem, if it were deployed on a delivery vehicle with no standard-yield counterpart, in accordance with its current development track. However, this does not discredit the larger role of the W76-2 to deterrence, as it is ready-made and provides a low-yield option with more range and penetrative power than the SLCM-N, and it should therefore be the larger component of the low-yield arsenal based on the current low-yield programs.

Target Interpretation	U.S. Launch	
	Low-Yield Launch	**High-Yield Launch**
Low-Yield Interpretation	Target nation responds with equivalent force and use of strategic forces is avoided. **Low-yield launch achieves its goal.**	Target nation incorrectly responds to a limited attack while the high-yield warhead causes devastation. **U.S. launch achieves it goal.**
High-Yield Interpretation	Target nation responds with its strategic force of which the U.S. responds with its strategic forces. **General thermonuclear war ensues.**	Target nation correctly responds to the high-yield attack under the principles of mutually-assured destruction. **General thermonuclear war ensues.**

Table 3. Possible Outcomes of a U.S. Trident II D5 Missile Launch.

Keeping Pace with Peace

The U.S. faces nations with varied levels of nuclear development. Developing and introducing the SLCM-N alongside the W76-2 provides greater ability to tailor responses to the heterogeneous nuclear threat landscape.The continued development of weapons programs by various states, primarily the R.F., the P.R.C., and the D.P.R.K., creates the potential for regional deterrence gaps. Both Russia and China are expanding their nuclear capabilities with Russia deploying the Avangard, a hypersonic glide vehicle, and China working on increasing its number of land-, sea-, and air-based nuclear weapons delivery systems, to support its pursuit of a nuclear triad[6][7]. The D.P.R.K. is also aiming to develop its nuclear capabilities and programs; in 2016, Kim Jong-un expressed that North Korea was successful in a hydrogen bomb test, though the veracity of this claim is unverified[8]. The development of non-strategic systems by other states does not obligate the U.S. to respond in kind. However, we assess that the potential for deterrence gaps exists and there are conceivable missions in which low-yield weapons would be preferred.

Considering U.S. Allies

Regional deterrence relies on the scalability and flexibility of the United State's nuclear posture. Russia is the most imposing threat to strategic stability and NATO allies. The 2018 NPR suggested that there was a deterrence "gap" that could be exploitable by Russia in the event of a low-yield nuclear conflict[9]. Collectively, NATO allies have yet to explicitly agree to the presence of said "gap," but still express concern in the U.S. ability to deter Russian low-yield, nuclear attacks. Developing the SLCM-N should help close this gap since it gives the U.S. a properly-scaled response option. This should be more palatable to our NATO allies, many of whom historically have much more substantial economic relations with Russia than the United States.

Given the ongoing contest for territory in East Asia and the South China Sea as well as the persistent U.S. goal of maintaining a global presence, deployment of SLCM-Ns on underwater craft is the most effective path forward to assure key allies, such as South Korea and Japan, and also dissuade North Korean military adventurism. South Korean opinion polls circa 2017 generally support the employment of U.S. tactical nuclear weapons in the region, in part because there was a lack of credibility regarding the U.S. nuclear umbrella in the Korean Peninsula at the time[10]. The South Korean public expressed the sentiment that the U.S. would not put Los Angeles at risk to save Seoul[11]. Versatile, reliable, and credible low-yield options like the W76-2 SLBM and the eventual SLCM-N will demonstrate the U.S.'s willingness to defend against conflicts at a variety of escalation levels. Extended nuclear deterrence to South Korea must be resilient and survivable in the case of not only potential nuclear attacks but also conventional attacks. As such, submarine-launched warheads are the best option for second-strike resiliency.

Japan also depends on a credible and robust United States nuclear umbrella, particularly in regards to extended deterrence related to China. The Japanese have active geopolitical disputes with China revolving around the Senkaku Islands, and Russia involving the Kuril Islands, which both sets of countries claim[12]. Despite the 2017 U.S.-Japan joint statement which reaffirmed U.S.commitments to defend Japan even with nuclear capabilities, the Japanese public has a low opinion of nuclear weapons and extended deterrence[13]. The Japanese government, however, does generally approve of the current nuclear arrangement with the United States[14][15]. A standard-yield-only posture would likely not be seen as credible to deter geopolitical disputes of that magnitude. However, the incorporation of low-yield weapons helps to meet the needs of Japan, in part by deterring varied levels of Chinese and Russian aggression towards the disputed territories.

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NOTE: This poster features highlights from a paper by the authors listed under the poster title (available as preprint: 10.31235/osf.io/w5b37). The figures and arguments are from that paper where additional explanation and figures can be found. This work was submitted to Naval War College Review in Jan. 2022, and is currently under peer-review.

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