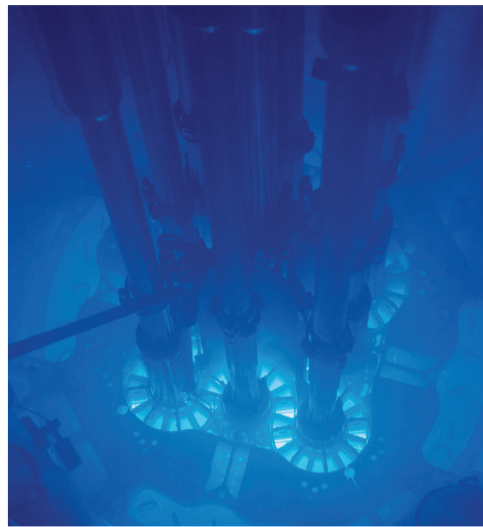


# Project on Nuclear Issues

A COLLECTION OF PAPERS FROM THE 2011 CONFERENCE SERIES





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Cover photos: *Left*—USS Alaska (SSBN 732) (Gold) navigates toward Naval Submarine Base Kings Bay, Ga. Jan. 11, 2012. The Ohio-class ballistic missile submarine returned to its southeast Georgia homeport after successfully completing sea trials, photo by James Kimber, U.S. Navy, <http://www.flickr.com/photos/submarinegroup/6679832613/>; *top right*—ascending through the cloud of fire and smoke, a ground-based interceptor launched on January 31, 2010 at Vandenberg Air Force Base, California, photo by Angelina Drake, U.S. Air Force, <http://www.vandenberg.af.mil/news/story.asp?id=123188302>; *bottom right*—samples from Idaho National Laboratory's Advanced Test Reactor (ATR) core is powered up, the fuel plates in glowing bright blue. The core is submerged in water for cooling, photo courtesy of Argonne National Laboratory, <http://www.flickr.com/photos/argonne/3954062594/>.

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# Contents

## Introduction      iv

1. **Our Own Worst Enemy: How Western Pressure Encourages Iran's Push for a Bomb**      1  
*Patrick Disney*
2. **Strengthening the International Atomic Energy Agency: A Double-Track Approach**      12  
*Sonia Drobysz*
3. **Why Do States Abandon Nuclear Weapons Activities: Understanding the Role of Alliance Coercion**      26  
*Gene Gerzhoy*
4. **Sustaining a U.S. Nuclear Deterrent after New START**      39  
*Thomas Karako*
5. **Cruise Missiles in Southern Asia: Strategic Implications for China, India, and Pakistan**      55  
*Kalyan Kemburi*
6. **Qualitative Considerations for the U.S. Nuclear Force at Lower Numbers vis-à-vis Peer and Near-Peer Adversaries**      71  
*Jeff Larsen, Justin Anderson, Darci Bloyer, Thomas Devine, Rebecca Davis Gibbons, and Christina Vaughan*
7. **The Duma/Senate Logjam Revisited: Actions and Reactions in Russian Treaty Ratification**      90  
*Anya Loukianova*
8. **Quantifying the Impact of Nuclear Weapons Enterprise Consolidation**      103  
*Carol Meyers*
9. **Reconceptualizing the Case for Nuclear Disarmament**      115  
*Jonathan Snider*
10. **The Enhanced Nuclear Detonation Safety Theme: An Introduction**      126  
*Raymond B. Wolfgang*
11. **Limiting Damage or Damaging Stability: Assessing Conventional Counterforce Strikes against Theater Nuclear Forces**      140  
*Tong Zhao*

# Introduction

Stephanie Spies

The Center for Strategic and International Studies launched the Project on Nuclear Issues (PONI) in 2003 in order to revitalize and strengthen a community of nuclear weapons experts whose training and background increasingly emphasize multidisciplinary expertise, especially among younger generations. In support of this goal, the PONI conference series was created to provide a forum for facilitating new and innovative thinking on how to address the evolving role of nuclear weapons in international security and to gather people from across the policy and technical communities to discuss key issues. The conference series continues to place a strong emphasis on featuring the ideas of rising experts in the field, who are uniquely positioned to advance new thinking and who represent the next generation of leaders from across the nuclear enterprise.

The 2011 conference series included events at the Nevada National Security Site in April, at the Center for Strategic and International Studies in July, and at the Lawrence Livermore National Laboratory in September, before concluding with a Capstone Conference at Offutt Air Force Base, home of the U.S. Strategic Command, in December. The papers included in this volume are a collection of some of the presentations delivered at the Capstone Conference. Spanning a wide range of technical and policy issues, these selected papers hope to further discussion in their respective areas, as well as contribute to the success of the greater nuclear community.

# Our Own Worst Enemy: How Western Pressure Encourages Iran's Push for a Bomb

Patrick Disney<sup>1</sup>

## Abstract

Western governments have expanded the campaign to pressure Iran's nuclear program, moving beyond sanctions and isolation, and resorting to sabotage, cyberattacks, and assassinations. This increased Western pressure carries the risk of hardening the Iranian position and allowing a consensus to emerge in Tehran in favor of a more provocative stance—potentially including nuclear weapons acquisition. To avoid this self-defeating outcome, Western policymakers must take care not to provide Iran with a pretext for weaponization, and to keep the path open for a diplomatic resolution to the confrontation with Iran.

Since Iran's large-scale nuclear program became known to the public in 2002, Western policymakers have sought to coerce Iran's leaders into forgoing nuclear weapons production. Living by the mantra that "all options are on the table," these Western governments have utilized nearly every tool at their disposal, from sanctions and pressure, to diplomatic carrots and covert actions. The overarching goal of these efforts has been to convince Iran's leaders that nuclear weapons are not worth the heavy cost they would have to pay for them. This coercive strategy is seen by many politicians as a middle-of-the-road sort of approach; it is confrontational without carrying an inordinate risk of escalation to military conflict. Perhaps without intending to, however, the Obama administration has backed itself into a corner in which its reliance on sanctions, sabotage, and covert actions to undermine Iranian nuclear progress actually makes escalation more likely.<sup>2</sup> By Washington's own admission, cyberattacks like the Stuxnet virus—which

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1. Patrick Disney is pursuing an M.A. in international relations at Yale University, after which he will serve as a Nonproliferation Graduate Fellow in the Nonproliferation and International Security Office of the National Nuclear Security Administration. This paper was made possible by a research grant provided by the Jackson Institute for Global Affairs at Yale University.

2. Suzanne Maloney, "Obama's Counterproductive New Iran Sanctions," *Foreign Affairs*, January 2012, <http://www.foreignaffairs.com/articles/137011/suzanne-maloney/obamas-counterproductive-new-iran-sanctions>; Gary Sick, "Who's Afraid of the Ayatollahs?" *Gary's Choices*, January 4, 2012, <http://garysick.tumblr.com/post/15320971562/whos-afraid-of-the-ayatollahs>;

was largely believed to have been orchestrated with the help of American intelligence agencies—are acts of war.<sup>3</sup> From Iran’s perspective, the ongoing campaigns to sabotage highly sensitive equipment, to surveil Iranian facilities with American spy drones, and to assassinate Iranian nuclear scientists represent a markedly aggressive approach by its Western adversaries. The Islamic Republic of Iran has demonstrated in the past that it is inclined to interpret even minor affronts as evidence of a Western cabal that threatens its existence; it should be self-evident, then, that a campaign of covert assassinations and sabotage would be interpreted by Iran’s leaders as full-fledged war.

A Western strategy that blurs the lines between peacetime and wartime gives Iran a justification to retaliate. Already, Iran has put on trial individuals it claims were agents of foreign governments on a mission to attack its vital national interests inside Iran.<sup>4</sup> It has escalated its threatening rhetoric by declaring a willingness to close the Strait of Hormuz as punishment for Western aggression, it allegedly plotted to murder the Saudi ambassador to the United States in Washington, and it has orchestrated numerous war games that have increased the level of military tension in the Persian Gulf region. If there is further escalation, it is increasingly likely that Iran will choose to retaliate directly against Western interests, whether through its networks in Iraq or Afghanistan, its proxies in Israel or Lebanon, or—most worrisome of all—by taking provocative steps on the nuclear program itself.

Thus, policies designed to delay Iran’s nuclear development represent a new frontier in the “cold war” between Iran and the West. By crossing this frontier, policymakers have greatly increased the risk that Iran will respond with escalations of its own, possibly by developing nuclear weapons. In the worst case scenario from the standpoint of nuclear proliferation, there is a real danger that Western nonproliferation policies might actually encourage an Iranian push for nuclear weapons. This danger requires a sober reassessment of the benefits and costs of such an aggressive strategy being pursued by Western leaders.

## Iran and the United States in a State of War

For more than 30 years, U.S. policymakers have deployed a wide variety of coercive tools to isolate Iran politically and economically in the hopes of changing the regime’s behavior. Since taking office in 2009, the administration of President Barack Obama has quietly shifted the central focus of America’s Iran strategy away from the long-standing reliance on economic sanctions and toward a greater emphasis on covert actions and sabotage. This was partly due to the threat of a U.S. military strike becoming less credible over time, and also as a consequence of ongoing Iranian progress toward a nuclear

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Vali Nasr, “Sanctions May Backfire,” *Atlantic Times*, February 2012.

3. David Sanger and Elisabeth Bumiller, “Pentagon to Consider Cyberattacks Acts of War,” *New York Times*, May 31, 2011, <http://www.nytimes.com/2011/06/01/us/politics/01cyber.html>.

4. Shirzad Bozorgmehr, “Official: Accused U.S.-Iranian Spy Must Be Tried in Iran,” CNN, December 21, 2011, [http://articles.cnn.com/2011-12-21/middleeast/world\\_meast\\_iran-accused-american\\_1\\_kazem-jalali-iranian-interests-section-iranian-tv?\\_s=PM:MIDDLEEAST](http://articles.cnn.com/2011-12-21/middleeast/world_meast_iran-accused-american_1_kazem-jalali-iranian-interests-section-iranian-tv?_s=PM:MIDDLEEAST).



weapons capability. Obama's approach has bought valuable time by exposing vulnerabilities and degrading Iran's technological capabilities, but it has also fundamentally altered the nature of the dispute.

It has become increasingly obvious in recent months that Iran and the West are now in a state of war, albeit a covert one. Several journalistic accounts have documented the widespread clandestine efforts under way by American, Israeli, and European intelligence agencies, whose missions are to insert faulty equipment into Iran's sensitive nuclear infrastructure.<sup>5</sup> These sabotage efforts have damaged key installations within Iran's system, including one highly publicized instance in which the Stuxnet virus reportedly disabled 1,000 centrifuges in the Natanz Enrichment Plant.<sup>6</sup> Additionally, it is considered an open secret that Western intelligence agencies have a number of assets on the ground in Iran whose mission is to gather information, encourage individuals to defect, and provide early warning of new developments in the nuclear program.<sup>7</sup> An explosion in November 2011, which many speculated was the work of the Israeli Mossad, destroyed a missile base belonging to the Islamic Revolutionary Guards Corps and killed the commander in charge of Iran's missile program.<sup>8</sup> And no fewer than six Iranian scientists working on segments of the nuclear program have been targeted by clandestine assassins in what Iran's UN envoy called "criminal acts of terrorism."<sup>9</sup> All these events occurred against a backdrop of sanctions, rhetorical threats, and arms sales to regional allies that typifies the West's approach toward Iran. And although the United States almost certainly exercises greater restraint than some other Western partners in its clandestine activities—American officials strongly condemned the assassination of yet another scientist in January—the Iranian government likely makes no such distinction.

For its part, Iran has already reacted to the West's tactical shift with escalations of its own, most notably including the plot to assassinate the Saudi ambassador uncovered in October. Just one month later, amid the uproar over the unprecedented detail included in the November report of the director-general of the International Atomic Energy Agency (IAEA), a group of Iranian students stormed the British Embassy in Tehran as state se-

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5. David Albright, *Peddling Peril: How the Secret Nuclear Trade Arms America's Enemies* (New York: Free Press, 2010); Catherine Collins and Douglas Frantz, *Fallout: The True Story of the CIA's Secret War on Nuclear Trafficking* (New York: Free Press, 2011); Eli Lake, "Operation Sabotage," *New Republic*, July 14, 2010, <http://www.tnr.com/article/world/75952/operation-sabotage>.

6. David Albright, Paul Brannan, and Christina Walrond. "Did Stuxnet Take Out 1,000 Centrifuges at the Natanz Enrichment Plant? Preliminary Assessment," Institute for Science and International Security, Washington, December 2010, [http://isis-online.org/uploads/isis-reports/documents/stuxnet\\_FEP\\_22Dec2010.pdf](http://isis-online.org/uploads/isis-reports/documents/stuxnet_FEP_22Dec2010.pdf).

7. Seymour Hersh, "Iran and the Bomb," *New Yorker*, June 6, 2011, [http://www.newyorker.com/reporting/2011/06/06/110606fa\\_fact\\_hersh](http://www.newyorker.com/reporting/2011/06/06/110606fa_fact_hersh).

8. Julian Borger and Saeed Kamali Dehghan, "Iranian Missile Architect Dies in Blast: But Was Explosion a Mossad Mission?" *Guardian* (London), November 14, 2011, <http://www.guardian.co.uk/world/2011/nov/14/iran-missile-death-mossad-mission>.

9. Ambassador Mohammad Khazaei, letter to UN secretary-general Ban Ki-moon, January 11, 2012.

curity personnel stood by idly. Iran also took credit for downing a secret U.S. spy drone, saying it took control of its aeronautics, and later refused President Obama's request to return the sensitive technology. And in the first few days of 2012, Iran threatened to close off the Strait of Hormuz and vowed to confront American aircraft carriers seeking to transit the waterway—a statement it backed up with a long-range missile test and major military exercises in the Persian Gulf.<sup>10</sup> Following the killing of Mostafa Ahmadi Roshan, the most recent Iranian nuclear scientist to be assassinated by unknown assailants, the hard-line daily newspaper *Kayhan* made the first overt call for retaliation for the campaign against Iran's scientists, saying, "We should retaliate against Israel for martyring of our young scientist."<sup>11</sup> Attempted bombings in February, reportedly aimed at Israeli diplomats in India, Georgia, and Thailand, suggest that Iran's plans for retaliation might already be under way.

Relations between Western governments and Iran have often been strained, but these recent events and the pattern of escalation they represent mark a turning point in their three-decade-long dispute. Both sides now seem to understand that a state of war exists between them. In the absence of unprecedented diplomatic progress, this "cold war" carries with it a real danger of spiraling out of control. Amid tensions surrounding the nuclear issue, American troops' withdrawals from Iraq and Afghanistan, and the constantly provocative rhetoric coming from Iran's leaders, even a minor confrontation could quickly ignite a conflagration in the region. In short, escalation is likely to breed further escalation.

## Escalation Breeds Escalation

Although Iran's leaders maintain that their religious convictions prohibit them from developing or using nuclear weapons, experts widely believe that a surprise attack similar to the Israeli strike on the Osirak reactor in Iraq would spur the Iranian government to retaliate by, among other things, expelling international inspectors and committing to obtaining nuclear weapons.<sup>12</sup> The U.S. Defense Department has declared that "since the Revolution, Iran's first priority has consistently remained the survival of the regime."<sup>13</sup> Just as Saddam Hussein redoubled his efforts to acquire a nuclear deterrent following the 1981 raid, so too would Iran likely drop all pretense of peaceful intentions and seek out nuclear weapons as a guarantor of the regime's survival. Though an attack remains

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10. Ramin Mostafavi, "Iran Test-Fires Missiles in Gulf Exercise," Reuters, January 2, 2012, <http://www.reuters.com/article/2012/01/02/us-iran-missile-idUSTRE80007E20120102>.

11. Rick Gladstone, "Iran Signals Revenge over Killing of Scientist," *New York Times*, January 12, 2012, <http://www.nytimes.com/2012/01/13/world/middleeast/iran-outrage-over-scientist-killing-deepens-as-it-signals-revenge.html>.

12. Barry Blechman and Daniel Brumberg, *Engagement, Coercion, and Iran's Nuclear Challenge: Report of a Joint Study Group on US-Iran Policy* (Washington, D.C.: Henry L. Stimson Center, 2010), 17, [http://www.usip.org/files/resources/Engagement\\_Coercion\\_and\\_Irans\\_Nuclear\\_Challenge.pdf](http://www.usip.org/files/resources/Engagement_Coercion_and_Irans_Nuclear_Challenge.pdf).

13. "Unclassified Report on Military Power of Iran, April 2010," U.S. Department of Defense, April 2010, <http://www.foxnews.com/projects/pdf/IranReportUnclassified.pdf>.

a distant possibility, it is more likely that Western governments will continue to expand punitive measures such as an oil embargo and covert actions like the Stuxnet virus. The question, then, is how will Iran respond to these aggressive moves? Based on its past experience, especially its history during the eight-year war against Iraq, the Iranian regime might seize upon what it views as Western aggression to use as a pretext for building nuclear weapons.

Following the Islamic Revolution that toppled the shah in 1979, Iran's new leader, Ayatollah Ruhollah Khomeini, declared unequivocally that his new government would forgo all weapons of mass destruction (WMD) based on Islamic conceptions of morality. According to Khomeini, the Muslim faith expressly forbids such weapons on the basis that they primarily harm innocents. The newly formed Islamic Republic of Iran then backed up this declaration by putting an end to the shah's robust plans to develop nuclear technology with the potential for producing weapons. The revolutionary regime stuck to its convictions on WMD until Saddam Hussein's Iraq used chemical weapons against Iranian troops in the bloody Iran-Iraq War. Faced with a near total lack of outrage on the matter from members of the international community, many of whom Khomeini accused of arming Saddam's Iraq in the first place, Iran's religious leaders reversed their previous position and restarted the country's chemical weapons program. Soon thereafter, Iran also restarted its nuclear program. With this process, Khomeini laid the foundation for a key principle within Iran known as "*maslahat-e nizam*," or "expediency of the system," whereby Iran's political-institutional needs might trump even Islamic law.<sup>14</sup>

The historical record suggests that Iran's commitments not to develop WMD in the early 1980s carried an implicit understanding that the religious prohibition on such weapons does not necessarily apply during a state of war. The current confrontation with the West, therefore, might offer Iran a convenient justification for pursuing nuclear weapons—and in the process allow Tehran's leaders to blame the West for their decision.

Why might Iran's leaders require such a convoluted justification for what many already assume is the true purpose of their nuclear program? In reality, a decision to pursue nuclear weapons is something that Iran's clerical rulers do not take lightly. Both the U.S. and Israeli intelligence communities have assessed that Iran has not yet made a decision to pursue a weapons program, and that it is merely keeping the option open in case its leaders decide to do so in the future.<sup>15</sup> Meanwhile, in the absence of such a decision, Iran's officials unanimously and repeatedly declare that their government has no interest in such destructive weapons. President Mahmoud Ahmadinejad, who frequently pushes the bounds of reason with his public bombast, has said that "those who have [nuclear] bombs are in graver danger than those who don't," and Iran's envoy to the IAEA has

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14. Nikki Keddie, *Modern Iran: Roots and Results of Revolution* (New Haven, Conn.: Yale University Press, 2003), 260.

15. Douglas Birch, "US: Iran Has Not Yet Decided to Build Nuclear Bomb," Associated Press, January 8, 2012, <http://news.yahoo.com/us-iran-not-yet-decided-build-nuclear-bomb-140132073.html>; Amos Harel, "Israel: Iran still Mulling Whether to Build Nuclear Bomb," *Haaretz*, January 18, 2012, <http://www.haaretz.com/print-edition/news/israel-iran-still-mulling-whether-to-build-nuclear-bomb-1.407866>.

argued that it would be a “strategic mistake” for Iran to develop a nuclear arsenal—a view Supreme Leader Khamenei is reputed to share.<sup>16</sup>

Given the structural limitations of Iran’s political system, a number of difficult steps would have to be taken before Iran could become a nuclear-armed state. Most fundamentally, Iran would first need to develop the technical and industrial capabilities to produce weapons. Notwithstanding the many American politicians who speak of an Iranian nuclear weapons capability as a future danger that must be prevented, most expert assessments consider Iran to have already achieved the basic technological mastery needed to produce nuclear weapons. Thus, the 2007 U.S. National Intelligence Estimate concluded that Iran “has the scientific, technical and industrial capacity eventually to produce nuclear weapons if it decides to do so.”<sup>17</sup> In September 2009, the IAEA declared that Iran has the ability to make a nuclear bomb and has worked on a missile system that could serve as a nuclear delivery vehicle.<sup>18</sup> As was made clear in the November 2011 IAEA report, Iran shut down in 2003 the structured military program involving activities relevant to nuclear explosives, but since then some activities have continued on an ad hoc basis.<sup>19</sup> This assessment reinforces the conclusion that Iran’s program remains in something of a holding pattern, able to be directed toward weapons or toward nuclear energy with relative ease.

In order for Iran to produce nuclear bombs, the political leaders with authority over the military and industrial components of the nuclear program must first issue orders for weaponization. Such an order would almost certainly need to originate at the highest levels of Iran’s political system, including Khamenei himself. In the past, he has demonstrated that he is not inclined to dominate Iran’s decisionmaking structure, preferring instead to foster consensus among various competing factions. The absence of such a consensus in part accounts for the lackadaisical progress Iran seems to be making toward weaponization. It is thus safe to conclude that, without some consensus emerging among Iran’s political leadership in favor of either pursuing or forgoing nuclear weapons, the status quo is most likely to prevail for the indefinite future. A corollary to this conclusion, however, demonstrates the risk of the current Western approach to dealing

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16. Mahmoud Ahmadinejad, “Ahmadinejad: The Full Exclusive Interview,” *Euronews*, August 4, 2011, <http://www.euronews.net/2011/08/04/ahmadinejad---the-full-exclusive-interview/>; “Nuclear Arsenal Would Harm Iran’s Interests: Envoy,” *Global Security Newswire*, May 31, 2011, <http://www.nti.org/gsn/article/nuclear-arsenal-would-harm-irans-interests-envoy/>.

17. National Intelligence Council, *Iran: Nuclear Intentions and Capabilities*, National Intelligence Estimate (Washington, D.C.: National Intelligence Council, 2007), 7, [http://www.dni.gov/press\\_releases/20071203\\_release.pdf](http://www.dni.gov/press_releases/20071203_release.pdf).

18. Associated Press, “Iran Capable of Building Nuclear Bomb, Is Working on Missile to Carry Atomic Warhead: IAEA Report,” *NYDailyNews.com*, September 17, 2011, [http://articles.nydailynews.com/2009-09-17/news/17932943\\_1\\_iaea-un-s-nuclear-monitoring-agency-nuclear-blast](http://articles.nydailynews.com/2009-09-17/news/17932943_1_iaea-un-s-nuclear-monitoring-agency-nuclear-blast).

19. International Atomic Energy Agency, “Implementation of the NPT Safeguards Agreement and Relevant Provisions of Security Council Resolutions in the Islamic Republic of Iran,” GOV/2011/65 2011, September 2, 2011, 45, [http://www.isisnucleariran.org/assets/pdf/IAEA\\_Iran\\_2Sept2011.pdf](http://www.isisnucleariran.org/assets/pdf/IAEA_Iran_2Sept2011.pdf).

with Iran's nuclear development: If a consensus emerges in favor of weaponization, Iran should be expected to move forward rapidly with a weapons program, building upon the vast capabilities it has already achieved to build weapons in a relatively short period.

Fundamentally, Iran's decision whether or not to build a nuclear weapon will be based on a simple cost/benefit calculation made in Tehran. Iran's clerical leaders, valuing regime survival above all else, seem to have concluded that a dash for nuclear weapons would cause them more harm than benefit, as evidenced by their relatively stagnant progress toward actual weaponization work. Rather than set out on a crash course for the bomb, Tehran appears to have decided to build up its capabilities so that, if it chooses to, it could develop a nuclear weapon quickly. Viewed through this lens, Iran's progress toward weapons over the past half decade is more easily interpreted; the IAEA has documented various experiments with applications toward a weapons program, but has not managed to obtain clear evidence of a concerted push to violate Iran's basic requirement under the Nuclear Non-Proliferation Treaty not to develop nuclear bombs. Much like the runner in Zeno's paradox, Iran's nuclear development up to now has been like a man running along a track, heading toward the finish line. In order to reach his destination, the runner must first reach the halfway point, then he must reach the halfway point of the remaining distance, followed by yet another halfway point, and so on. The runner is always making progress toward his goal, but he never actually crosses the finish line. For as long as Iran's leaders view the costs of a breakout to be greater than its benefits, they can be expected to continue this strategy of incremental gains that take care to fall short of the West's redlines.

As has been argued above, however, Iran's leaders are most likely to reach a consensus in favor of weaponization in response to some external provocation such as an Israeli air strike. A clear provocation that holds the potential of destabilizing the country's Islamic regime would shift both the costs and the benefits of pursuing nuclear weapons. Having found themselves in a state of war with the West, Iran's leaders are no doubt already recalculating their assessment of the utility of a military program. The degree to which nuclear costs and benefits would be shifted by the conflict with the West will largely be determined within the context of Iran's larger foreign policy strategy, which its supreme leader has characterized as being a policy of responding to pressure with pressure. "Iran will respond with full force to any aggression or even threats in a way that will demolish the aggressors from within," the supreme leader said last November—a position he has since reiterated numerous times by declaring "We answer threats with threats."<sup>20</sup>

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20. Ramin Mostaghim and Patrick J. McDonnell, "Iran's Supreme Leader Warns Nations against Making Threats," *Los Angeles Times*, November 10, 2011, [http://latimesblogs.latimes.com/world\\_now/2011/11/irans-supreme-leader-blasts-worm-ridden-aggressors.html](http://latimesblogs.latimes.com/world_now/2011/11/irans-supreme-leader-blasts-worm-ridden-aggressors.html); Associated Press, "Iran's Warnings Reflect Tougher Military Doctrine," *Salon*, January 6, 2012, [http://www.salon.com/2012/01/06/irans\\_warnings\\_reflect\\_tougher\\_military\\_doctrine\\_2/](http://www.salon.com/2012/01/06/irans_warnings_reflect_tougher_military_doctrine_2/).



The central focus of Western sanctions, then, which seek to impose unbearable costs on Iran's economy in retaliation for its intransigence on the nuclear issue, is unlikely to succeed in this context. Indeed, if Iran's leaders are to be believed, a pressure strategy is more likely to cause Tehran to become more intransigent, not less. As Western pressure evolves from economic sanctions to the covert use of force, the risk of retaliatory escalation by Iran grows steadily. It is therefore possible that Iran's leaders, having already built up the capability to produce nuclear weapons quickly, could capitalize on the state of war between Iran and the West as a pretext for weaponization.

## What This Situation Means for Current Western Policy

This situation means that the West is sleepwalking toward disaster. The goal of Western policy toward Iran has been rooted in a faulty assumption, with grossly underestimated accounting of the risks of Iranian retaliation throughout. Despite President Obama's commitment to engage diplomatically with the Iranian leadership, the past three years have seen mere hours of face-to-face negotiations. The permanent five members of the UN Security Council plus Germany (known as the P5+1), which have formally led the efforts to engage with Iran on the nuclear issue, have followed the tactic of holding one high-profile meeting for long stretches of time, on which nearly the entire diplomatic strategy depends. Without concrete progress, the engagement track is essentially discarded, and the pressure track resurfaces as the primary approach.

In the absence of true diplomacy, the Western countries—led by France, the United Kingdom and the United States—have exerted significant efforts to impose severe penalties on Iran's economy, its financial system, and its petroleum industry. The U.S. Congress forced through an embargo of Iran's Central Bank over the objections of the White House, and toward the end of 2011 the European countries went forward with a plan to embargo European purchases of Iranian oil. The objective of this mounting pressure has been to force Iran's leaders back to the negotiating table, where it is hoped they would make concessions on the nuclear issue. But these escalating threats have actually made it more difficult for Iran's leaders, in the context of the country's domestic political environment, to accept the deal being offered. The West's strategy is self-defeating, largely because it hinges on an assumption that Iran must be coerced into abandoning its ambitions to obtain nuclear weapons—an ambition Iran itself denies having. As Scott Sagan has cogently acknowledged, “Nonproliferation policies to dissuade ambivalent actors not to do what they have no intention to do can backfire.”<sup>21</sup> Treating Iran as if it has already committed to weaponization over the objections of countless Iranian officials (and Western intelligence agencies to boot) runs the risk of triggering a “rally round the flag” effect in Iran, with serious potential for a backlash. Indeed, there has already been one.

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21. Scott Sagan, “The Causes of Nuclear Weapons Proliferation,” *Annual Review of Political Science* 14 (June 2011): 234. Also see Patrick Disney, “Kicking the Hornets’ Nest: Iran’s Nuclear Ambivalence and the West’s Counterproductive Nonproliferation Policies,” *Nonproliferation Review* 19 (July 2012).

Moreover, the West's campaign of sabotage actually runs counter to the goal of pressuring Tehran to make concessions. Having been ostensibly designed to buy time for a diplomatic solution, the West's covert efforts seek to delay Iran's actual acquisition of nuclear weapons—again, something Iran's leaders and all the available evidence suggests is not in the offing. These covert actions, although potentially delaying the timetable of weaponization in Iran, actually impose significant barriers to the emergence of a moderate consensus that could resolve the nuclear issue permanently. Inherent in any strategy that relies on assassinations and targeted bombings is a risk that Iran's hardliners will become empowered; and an increasingly hard-line government in Iran is far more likely to pursue an aggressive approach to its Western adversaries that eschews accommodation. Potentially, a consensus could emerge to retaliate violently. Even short of such an outcome, operational tactics that involve assassinating scientists and blowing up sensitive facilities in no way support Washington's goal of convincing Tehran to strike a diplomatic deal. Rather, the result of Western policies of escalation is likely to be an Iran far more aggressive than might otherwise have been the case.

## Recommendations

The focus of Western policy up to now has been on imposing pressure in order to give Iran's leaders a reason not to develop nuclear weapons. Equally important, however, and far too often overlooked, is the need to take care not to give Iran a reason to weaponize, which is exactly what current policy runs the risk of doing.

A good first step in rectifying this situation would be for Western leaders to eliminate the assumption that Iran is irreversibly committed to developing nuclear weapons as a basis for nonproliferation policies. An Iranian nuclear weapon is neither imminent nor inevitable; dealing with Iran as if it were is simply misaligned with reality and risks generating a self-fulfilling prophecy. Rather, Western policies need to be rooted in an understanding that Iranian political decisionmakers hold the key to whether the country develops a nuclear arsenal, and influencing their eventual decision is the ultimate goal of nonproliferation strategies.

Western leaders must be careful not to create a dynamic whereby Iran is treated as if it is weaponizing regardless of its actions and therefore has no reason *not* to weaponize. This is not to say that the international community must coddle Iran. But a clear distinction must be made between legitimate, legal instruments to prevent weapons proliferation and rote acts of unilateral aggression. So long as pressure alone is unlikely to succeed as a nonproliferation policy, it is likely to be counterproductive. The West must therefore maintain enough flexibility to break out of the cycle of mutual hostility that could lead to escalation. This means that, for Western policymakers, a readiness to reward good behavior is equally or more important than a willingness to punish bad behavior. Iran's leaders must be convinced that they stand to gain from forgoing nuclear weapons, and that sanctions can and will be lifted in exchange for cooperation on the nuclear issue.

In the present atmosphere of mistrust, convincing Iranian leaders that they stand to gain from cooperation will be difficult. On October 21, 2011, EU foreign policy chief Catherine Ashton sent a letter to the lead Iranian nuclear negotiator laying out an offer of diplomatic engagement to explore confidence-building measures, whereby Iran would commit to cease enrichment up to 20 percent uranium-235 and to turn over its existing stockpile of highly enriched uranium in return for a commitment by the P5+1 not to impose further sanctions. This proposal is similar to a previous offer dubbed “freeze for freeze,” which found few supporters in Tehran largely because it dealt with the wrong side of the sanctions equation. Neither the P5+1 nor Iran desires proof that the other is willing to keep things as they presently are; rather, both sides need to build confidence that positive actions on their part will be met with reciprocal and positive measures by the other. What is needed, then, is an “unfreeze for unfreeze” proposal. In this vein, Iran would agree to strengthen its cooperation with the IAEA, granting access to facilities or individuals heretofore closed off by Tehran, and in exchange the United States would agree to *remove* a certain set of penalties. Taking steps that benefit the other side, as opposed to merely avoiding further negative actions, can generate positive momentum that, though piecemeal, would contribute greatly to a renewed atmosphere of trust. Over time, this trust could be utilized to tackle larger issues.

Perhaps the most difficult part of this formulation would be convincing Washington to lift certain sanctions on Tehran preceding the complete resolution of all outstanding issues. Undoubtedly, the U.S. presidential campaign will pose a major obstacle for taking this important a step, but the United States and Europe over the past three decades have imposed more than enough sanctions of various types to explore such an approach without fear of losing any potential leverage.

Finally, any strategy utilizing covert acts of aggression such as cyberattacks, assassination, and sabotage must be cognizant of the danger of a violent Iranian response—or worse, all-out war. The gains provided by these types of covert actions are temporary; sabotaging Iran’s centrifuge production at best could delay its progress toward a weapons capability by a few weeks or months. However, the risks of emboldening its hard-liners could have far-reaching consequences, such as cementing its commitment to pursuing a nuclear deterrent. At the very least, these escalatory actions on the part of the West make it harder for a diplomatic solution to be reached. Given that the best possible outcome of Western covert actions is to delay rather than halt Iranian progress, Western leaders should seriously reconsider whether the risk of triggering Iran’s retaliation is worth setting its enrichment program back a few months.

This exploration suggests that it is far easier to give Iran a pretext to obtain nuclear weapons than it is to convince Iran to forgo them. This unfortunate conclusion, however, should not deter Western policymakers from taking the steps necessary to achieve their utmost objective of ensuring the peaceful nature of Iran’s nuclear program. Ultimately, the only long-term solution to this crisis will be to reintegrate Iran back into the international community. Both sides must commit to a process of reintegration, framed within a mechanism for engagement on all levels in pursuit of issues of mutual concern. Through a process of sustained engagement, over time both sides should be able to identify an end



state that will satisfy most of each other's demands. Iran must eventually be allowed to continue its nuclear development, including enrichment, while the West must insist on imposing sufficiently comprehensive safeguards to ensure the absence of weaponization work. Leaders in Washington and Tehran have declared their willingness to arrive at precisely this outcome; the challenge for all involved will be to take the actions required to bring it to fruition.

# Strengthening the International Atomic Energy Agency: A Double-Track Approach

Sonia Drobysz<sup>1</sup>

## Abstract

The International Atomic Energy Agency (IAEA), which plays a central and widely recognized role in helping to stop the spread of nuclear weapons, needs more support from its member states, as well as from other international organizations, groups, and initiatives within the nuclear nonproliferation regime. Indeed, although all call for a stronger agency and place high demands on the IAEA's services, they sometime seem to be reluctant to pay the necessary price. As the 2009 report of the International Commission on Nuclear Non-Proliferation and Disarmament noted, the "IAEA . . . has been insufficiently resourced, both in terms of authority and capabilities."<sup>2</sup> The blame is not only on external actors and on the agency's policymaking organs; its Secretariat has also shown signs of an aging bureaucracy. After exposing the challenges currently facing the IAEA, this paper builds on possible ways to overcome existing difficulties. Bearing in mind the ultimate goal of nonproliferation, a double-track approach to strengthen the IAEA is recommended. Although reforms should first be implemented at the internal level, efforts should also be directed toward external actors, which should reaffirm their support for the IAEA's work.

## Challenges Facing the IAEA

As is often the case with nuclear issues, the IAEA is confronting a dual situation. On the one hand, its workload is increasing, and this evolution indicates a broad consensus on the agency's ability to fulfill its missions and take on new ones. On the other hand,

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2. International Commission on Nuclear Non-Proliferation and Disarmament, *Eliminating Nuclear Threats: A Practical agenda for Global Policymakers* (Canberra: International Commission on Nuclear Non-Proliferation and Disarmament, 2009), 34–35, [http://icnnd.org/Reference/reports/ent/pdf/ICNND\\_Report-EliminatingNuclearThreats.pdf](http://icnnd.org/Reference/reports/ent/pdf/ICNND_Report-EliminatingNuclearThreats.pdf).

persistent internal and external difficulties remain that might affect the agency's contribution to nonproliferation objectives.

### *Central Role within the Nonproliferation Regime*

The IAEA's role within the nonproliferation regime today has multiple facets. Because it constitutes the biggest part of the organization's operational regular budget, the traditional function to control the peaceful uses of nuclear energy is at the core of the agency's work. However, safeguards—that is, measures to prevent the loss or diversion of materials, specialized equipment, or principal nuclear facilities—now cover a large part of the world's nuclear activities. In 2010, they were applied in 175 states.<sup>3</sup>

The implementation of safeguards has considerably expanded since the creation of the IAEA in 1957. Although the safeguards system was initially applied mainly by virtue of bilateral cooperation agreements concluded in the nuclear field and requiring assurances on the peaceful use of supplied items and material, it became regionalized with the adoption of the Tlatelolco Treaty on the denuclearization of Latin America, and then almost universalized with the Non-Proliferation Treaty (NPT) in 1968. According to article III of the NPT,

Each Non-Nuclear-Weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to be negotiated and concluded with the International Atomic Energy Agency in accordance with the Statute of the International Atomic Energy Agency and the Agency's safeguards system, for the exclusive purpose of verification of the fulfilment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices.<sup>4</sup>

Safeguards provide credible assurances to the international community that there are no nuclear material diversions to prohibited military ends and no undeclared material in states that are non-nuclear weapon states under the NPT.

The IAEA verifies states' nuclear material accountancy as well as design information related to nuclear facilities. It also applies containment and surveillance measures, and conducts frequent visits and inspections. NPT safeguards agreements providing for such modalities are concluded on the basis of document IAEA Information Circular 153 (INFCIRC/153), "The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons," and reproduced on a standard text of safeguards agreements concluded with member states. Because they cover *all* nuclear material in a state, they are referred to as "comprehensive safeguards agreements." Additionally, 115 states that are party to the NPT also have an Additional Protocol (AP) in force.<sup>5</sup> The AP system was adopted by

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3. See International Atomic Energy Agency (IAEA), *IAEA Annual Report 2010* (Vienna: IAEA, 2010), v.

4. "Treaty on the Non-Proliferation of Nuclear Weapons," <http://www.un.org/disarmament/WMD/Nuclear/NPTtext.shtml>.

5. This figure was current as of April 26, 2012. IAEA, "Conclusion of Additional Protocols:

the IAEA after discovery of the Iraqi clandestine nuclear weapons program, which was developed despite the IAEA's safeguards implementation in the state. The Iraqi crisis demonstrated the need to strengthen the safeguards system so that the IAEA could detect undeclared activities. Therefore, the model AP (doc. INFCIRC/540), which becomes legally binding for a given state only when brought into force by it, enables for broader access to information and increased physical access, called "complementary access." Under the AP, a state is required to provide information and give access to all parts of its nuclear fuel cycle—including, for instance, uranium mines, which were excluded from comprehensive safeguards agreements. Research-and-development activities related to the nuclear fuel cycle but not involving nuclear material also must be declared and verified. Broadened onsite rights allow inspectors to access any place on a site, and not just strategic points. Moreover, inspectors can collect environmental samples at locations beyond those prescribed in safeguards agreements.

States reaffirmed their support for the IAEA's work pursuant to the NPT during the 2010 Review Conference. The final document recognizes that the "IAEA safeguards are a fundamental component of the nuclear nonproliferation regime, play an indispensable role in the implementation of the Treaty and help to create an environment conducive to nuclear cooperation."<sup>6</sup>

Such traditional verification activities are also being extended to new missions. Discussions are currently ongoing between the United States, Russia, and the IAEA about how the agency could verify the plutonium management and disposition agreement, as amended by a 2010 protocol, concluded between the United States and Russia. The amendment undertakes to dispose of no less than 34 metric tons of plutonium. The agreement further provides that "each Party, in cooperation with the other Party, shall begin consultations with the IAEA at an early date and undertake all other necessary steps to conclude appropriate agreements with the IAEA to allow it to implement verification measures with respect to each Party's disposition program." The agency's role would thus not exactly be directed toward nondiversion, but rather non-reuse of nuclear material in nuclear weapons. Other potential roles in the field of disarmament are also being discussed, building on previous IAEA experience in states that formerly had, but have since abandoned, nuclear weapons programs—for instance, Iraq, South Africa, and Libya.<sup>7</sup>

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Status as of 26 April 2012," [http://www.iaea.org/OurWork/SV/Safeguards/documents/AP\\_status\\_list.pdf](http://www.iaea.org/OurWork/SV/Safeguards/documents/AP_status_list.pdf).

6. *2010 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, Final Document, Volume I, Part I, Review of the Operation of the Treaty, as Provided For in Its Article VIII (3), Taking into Account the Decisions and the Resolution Adopted by the 1995 Review and Extension Conference and the Final Document of the 2000 Review Conference*, doc. NPT/CONF.2010/50 (vol. I), § 11.

7. See, e.g., Tom Shea, "The Role of the IAEA in a World Reducing Stocks of Nuclear Weapons," paper presented during the Symposium on International Safeguards, Preparing for Future Verification Challenges, Session 33, Potential New Verification Roles in Support of Arms Control and Disarmament, November 4, 2010, <http://www.iaea.org/OurWork/SV/Safeguards/Symposium/2010/Documents/PapersRepository/333.pdf>.

The IAEA is also actively involved in nuclear security issues, to prevent and detect unauthorized, illicit trafficking in nuclear material and other radioactive substances.<sup>8</sup> The goal of the agency's activities in this field is to "support States, upon request, in their efforts to establish and maintain effective nuclear security through assistance in capacity building, guidance, human resource development, sustainability and risk reduction. The objective is also to assist adherence to and implementation of nuclear security related international legal instruments,"<sup>9</sup> such as United Nations Security Council resolutions, the Convention on the Physical Protection of Nuclear Material, and the International Convention for the Suppression of Acts of Nuclear Terrorism. The 2010 NPT Review Conference also emphasized "the important role of the IAEA in fostering international cooperation in nuclear security in establishing a comprehensive set of nuclear security guidelines, and in assisting Member States, upon request, in their efforts to enhance nuclear security."<sup>10</sup>

To fulfill these functions, the IAEA has developed unique expertise within the non-proliferation regime, which includes the active work of qualified and international staff members both at its headquarters in Vienna and in the field. A total of 2,338 professional and support staff members are dedicated to the organization's missions. Attention is paid to technical competence and to balanced geographical representation, as required by article VII.D of the agency's statute:

The paramount consideration in the recruitment and employment of the staff and in the determination of the conditions of service shall be to secure employees of the highest standards of efficiency, technical competence, and integrity. Subject to this consideration, due regard shall be paid to the contributions of members to the Agency and to the importance of recruiting the staff on as wide a geographical basis as possible.

Out of the IAEA's 151 member states, 105 were represented in its Secretariat in 2010.<sup>11</sup> It should nonetheless be noted that members of the Secretariat are not "representatives" of their states, but international civil servants. Thanks to its staff, the agency was thus able to cope with the expanding missions entrusted to it. However, the latter could be better performed if some institutional, legal, and political problems were overcome.

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8. Nuclear security is "the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear or other radioactive substances or their associated facilities." Nuclear Security Plan for 2010–2013, in GOV/2009/54–GC (53)/18, August 17, 2009, n. 2.

9. *Ibid.*, § 3.

10. *2010 NPT Review Conference Final Document*, vol. I, part I, § 28.

11. *Personnel, staffing of the Agency's Secretariat, Report by the Director General*, doc GOV/2011/49 – GC (55)/19, July 29, 2011, § 18.

## *Persistent Difficulties Affecting the IAEA's Contribution to Nonproliferation Efforts*

Despite wide recognition of its role within the regime, the IAEA still suffers from a lack of support from its member states, and sometimes also from other international organizations, groups, or initiatives. Moreover, the IAEA has sometimes shown symptoms of an aging bureaucracy. Indeed, a brief analysis of the IAEA's legal authority in the field of safeguards and an overview of its institutional organization reveal difficulties that could alter its ability to fulfill its mandate.

The first problem related to the IAEA's legal authority is the nonuniversality of its membership. A total of 14 NPT states still have not brought a comprehensive safeguards agreement into force, and the AP has not been accepted by all, though it is now in force in 114 states. In the first situation, states are in violation of their obligation pursuant to Article III of the NPT. In the second situation, when the tools provided for in the protocol are not being implemented in a given state, the IAEA is unable to reach a conclusion that all nuclear material remained committed to use in only peaceful activities. In both situations, limitation of the IAEA's action in favor of safeguards and nonproliferation objectives is not attributable to the organization itself, but rather to states that refuse to bring a safeguards agreement and/or an AP into force.

However, a second problem lies in the fact that there have also been cases where the IAEA's legal authority is there but not fully exercised. In this respect, the case of special inspection is relevant. NPT safeguards agreements provide that special inspections can be conducted "if the agency considers that information made available by the State, including explanations from the State and information obtained from routine inspections, is not adequate for the agency to fulfill its responsibilities under the Agreement."<sup>12</sup> Such inspections differ from routine inspections; they are considered "special" and they allow greater access when suspicion arises about the possibility of undeclared nuclear material or the diversion of nuclear material. Historically, they have been requested only twice, in Romania and North Korea. And yet there have been other cases where it could have been invoked. In Syria, the IAEA is yet to receive a satisfactory explanation about the presence of uranium particles found at the Dair Alzour site after the Israeli air strike in 2007. In May 2011, the IAEA's director-general reported, "the presence of a significant number of particles of anthropogenic natural uranium at the Dair Alzour site indicates a connection to nuclear related activities at the site and increases concerns about possible undeclared nuclear material at the site. The agency has not been able to determine the origin of the particles."<sup>13</sup> According to some, that situation constituted the "textbook definition of a case in which a special inspection is needed."<sup>14</sup> It was nonetheless never

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12. INFCIRC/153, § 73, b).

13. *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic, Report by the Director-General*, GOV/2011/30, May 24, 2011, § 21.

14. James M. Acton, Mark Fitzpatrick, and Pierre Goldschmidt, "The IAEA Should Call for a Special Inspection in Syria," *Proliferation Analysis* (Carnegie Endowment for International Peace), February 26, 2009, <http://www.carnegieendowment.org/2009/02/26/iaea-should-call-for-special-inspection-in-syria/4x2>.

requested by IAEA, leaving the external observer with a feeling that not all the available tools are being used.

A third problem is related to the ambiguity of the IAEA's legal authority in two different situations. The first one questions its mandate to investigate possible weaponization activities—that is, the range of possible nuclear activities, other than the acquisition of fissile material, necessary for the manufacture of a nuclear weapon or explosive device.<sup>15</sup> The last report on implementation of safeguards in Iran contains a long annex detailing the country's weaponization activities. But in that case, the IAEA benefits from “special legal authority,” granted by numerous United Nations Security Council resolutions and sometimes Iran's voluntary transparency. In other situations, however, the IAEA's right to look for “potential military dimensions” involving nuclear material is not clearly defined. Former director-general Mohammed ElBaradei explained that “the Agency's legal authority to investigate possible parallel weaponization activity is limited, absent some nexus linking the activity to nuclear material.”<sup>16</sup> Indeed, comprehensive safeguards agreements and, to a certain extent, APs focus exclusively on the detection of *nuclear material* diversion and do not clearly grant authority to investigate other nuclear-weapons-related research. A few commentators have been left wondering what was the “sufficient nexus” between materials monitoring and monitoring of other weapons-related research.<sup>17</sup> Without a clear answer to that question, or clarification by the IAEA's Board of Governors of the agency's rights, it seems that a gray area remains in its existing mandate.<sup>18</sup> The second legal ambiguity relates to the legal definition of noncompliance with safeguards agreement and, to a larger extent, noncompliance with the NPT. In light of the IAEA's practice, it is not possible to establish a clear list of situations that could be qualified as noncompliant. Consequently, there have been calls for clarification of what exactly constitutes noncompliance,<sup>19</sup> and where the standard of proof stands in such a situation.

Finally, the centrality of the IAEA's authority within the nonproliferation regime is being challenged. The growth and diversification of various initiatives, groups, institutions, global partnerships, and summits might lead to duplication or neglect of the agency's actions if no sufficient coordination is organized. The development of subregimes with conflicting incentives might undermine multilateralism and, consequently,

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15. International Commission on Nuclear Non-Proliferation and Disarmament, *Eliminating Nuclear Threats*, 85.

16. Mohamed ElBaradei, “Nuclear Non-Proliferation and Arms Control: Are We Making Progress?” remarks at the 2005 Carnegie International Non-Proliferation Conference, Washington, November 7, 2005, [www.iaea.org/NewsCenter/Statements/2005/ebsp2005n017.html](http://www.iaea.org/NewsCenter/Statements/2005/ebsp2005n017.html).

17. John Carlson, Russell Leslie, and Annette Berriman, “Nuclear Weaponisation Activities: What Is the Role of IAEA Safeguards?” Australian Safeguards and Non-Proliferation Office, Barton, no date, [http://www.dfat.gov.au/asno/publications/weaponisation\\_inmm072006.pdf](http://www.dfat.gov.au/asno/publications/weaponisation_inmm072006.pdf).

18. James Acton with Carter Newman, “IAEA Verification of Military Research and Development,” *Verification Matters*, no. 5 (July 2006), 47, <http://www.vertic.org/media/assets/Publications/VM5.pdf>.

19. See, e.g., Pierre Goldschmidt, “Exposing Nuclear Non-Compliance,” *Survival* 51, no. 1 (February–March 2009): 13–164.



the IAEA's effectiveness. In the field of nuclear security, for instance, while calls for a stronger regime have led to the creation of the World Institute for Nuclear Security, the Global Initiative to Combat Nuclear Terrorism, and the adoption of many resolutions by the UN Security Council, the IAEA's actions are still dependent on state requests. The agency does not have the authority to verify compliance with states' legal obligations and to impose reviews of existing national security systems.

At the same time, observing the IAEA's inner life sometimes begs questions about the necessity of preserving institutional multilateralism. Discussions within policymaking organs may be irrelevant, as they do not always focus on what falls within the organization's mandate. The politicization and polarization of the Board of Governors and the General Conference can lead to the introduction of political (as opposed to technical) items on the agenda and complicate the decisionmaking process. The denounced unbalanced character and nonuniversality of the NPT, beyond simple instrumentalization by a few, have crystallized various groups of states around repeated calls for further disarmament measures or assistance for peaceful uses of nuclear energy against stronger nonproliferation commitments.

The resulting fractionalization has hampered the IAEA's ability to operate flexibly and efficiently. Refusal by some states to bring an AP into force is one example of this. For instance, Brazil commented during the 2010 NPT Review Conference that

the additional protocol was not a part of that bargain. It was not fair to expect non-nuclear-weapon States, which had already undertaken unequivocal, credible and verifiable commitments to forswear nuclear weapons, to implement further enhanced verification measures, while the international community had yet to be presented with a time frame for achievement of a world free of nuclear weapons.<sup>20</sup>

Difficulties have also risen within the IAEA's Secretariat with respect to institutional practices and the continuity of expertise. On the first aspect, persistent tensions between the "need to know" (at the core of the safeguards confidentiality regime) and the "need to share" alter the evaluation process in the field of safeguards. With respect to the latter, there is a risk in both the short and longer terms of being understaffed with qualified personnel. A recent report by the director-general notes increasing difficulties in recruiting scientific and technical staff, and highlights the importance of gaining member states' support to help identify the right expertise.<sup>21</sup>

The lack of necessary resources extends not only to the IAEA's staff but also to its financial considerations. In this respect, the agency's program and budget for 2012–2013 states plainly that "demands for the agency's services are growing at a rate beyond what can realistically be funded through the regular budget. As a result, the agency is increasingly dependent on extra budgetary contributions, which are unpredictable, often tied to

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20. Antonio José Vallim Guerreiro, 2010 NPT Review Conference, Main Committee II, 1st meeting, May 10, 2010, doc. NPT/CONF.2010/MC.II/SR.1, § 36.

21. Personnel, staffing of the Agency's Secretariat, Report by the Director-General, doc GOV/2011/49 – GC (55)/19, 29 July 2011, § 28.



restrictive conditions and, thus, involve some risk for the programme.”<sup>22</sup> This is especially true in the field of security; the budget in this domain mainly comes from the “nuclear security fund,” which is exclusively dependent on unpredictable voluntary contributions subject to limitations on how they should be used.<sup>23</sup>

Thus, IAEA’s ability to fully fulfill its mandate within the nonproliferation regime is challenged by several external factors. However, such obstacles can be overcome.

## Combined Actions to Strengthen the IAEA

The IAEA has so far been able to carry out its mandate quite successfully. It is therefore important to tackle current threats to its effectiveness in order to consolidate and preserve its successful institutional, multilateral model. Indeed, the IAEA has an increasingly critical role to play in the detection and deterrence of nuclear proliferation.

A collaborative effort is needed to strengthen the IAEA, and it could be fashioned as a double-track approach. The first track includes an internal process, encompassing actions of both the Secretariat and member states to consolidate the agency’s mandate, implement it more effectively, and efficiently and improve institutional practices. The second track is an external process that comprises actions of the IAEA to engage others to bring in more support for the agency’s work and ensure that it has all the resources it needs.

### *Joint Efforts of the Secretariat and Member States at the Internal Level*

#### Functional Aspects

Changes and improvements are first required in the field of verification. They relate to the IAEA’s legal authority, as well as to safeguard implementation.

On the first aspect, the IAEA’s Secretariat can help tackle current obstacles to universalization of the AP and thereby support uniformity and maximization of the agency’s mandate. One of the reasons why some states refuse to bring an AP into force is a lack of understanding of the obligations that it involves.<sup>24</sup> The idea of “anytime/anywhere” access is commonly spread, whereas, pursuant to Article 4 of the AP, the IAEA shall, not mechanically or systematically seek to verify the information provided by the states. It has access to more locations, but only to locations identified in the AP. Moreover, before conducting a complementary access, written advance notice specifying the reasons for access and the activities to be carried out during access must be given.

Outreach activities to promote a better understanding of the AP as well as legal assistance to help implement its provisions should therefore be pursued. But a stronger

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22. IAEA, *The Agency’s Programme and Budget, 2012–2013* (Vienna: IAEA, 2012), 3.

23. Jack Boureston and Tanya Ogilvie-White, *Seeking Nuclear Security through Greater International Coordination*, Working Paper, International Institutions and Global Governance Program (New York: Council on Foreign Relations, 2010), 12, <http://www.cfr.org/international-law/seeking-nuclear-security-through-greater-international-coordination/p21709>.

24. John Carlson, “Is the Additional Protocol ‘Optional,’” *Trust and Verify*, issue 132 (January–March 2011): 6–9, <http://www.vertic.org/media/assets/TV/TV132.pdf>.

IAEA might also imply going beyond legal obligations, and accept extra voluntary measures in certain situations. The agency should, in that sense, further sensitize states to the importance of voluntarily sharing information that would be helpful to the agency, as recommended in Article VIII of the IAEA's Statute.

The IAEA's Board of Governors can also act in favor of a stronger verification mandate by clarifying the agency's authority to investigate weaponization activities. This does not necessarily mean that existing instruments should be amended. But it would help to provide a clear definition of what a "sufficient nexus" with nuclear material is, and to indicate when the IAEA would need additional powers to look for indicators of military activities.<sup>25</sup>

Both the IAEA's Board and the Secretariat should also agree on the need to fully use the agency's existing verification tools. Here, it should be noted that special inspections could still prove useful. As Andreas Persbo explains, "If the state is hiding something, it will have little incentive to invite inspectors to view the very secrets it wishes to protect. It could attempt to control the special inspection, by having an elaborate deception strategy in place." And yet, refusal to grant access for a special inspection will sound the alarm: "It may be desirable to call the inspection anyway. . . . The special inspection request represents 'the final offer' from the Agency, after which the issue will be raised with the UN Security Council and the General Assembly. This threat could, possibly, act as an incentive for the stalling state to cooperate with inspectors."<sup>26</sup>

A state's refusal to accept an inspection by the IAEA would be qualified as "non-compliance" with its safeguards agreement. In this respect, the different cases justifying a formal finding of "noncompliance" could be more precisely established. The IAEA's Board will always benefit from a certain margin of appreciation in deciding when, and based on what facts, a state should be found noncompliant. It is also the Board that decides when a state has been afforded "every reasonable opportunity to furnish any necessary reassurance," as required by the model safeguards agreement. But ambiguities and the risk of double standards being applied in verification could be minimized if criteria-based systems to the safeguards noncompliance process were applied and agreed upon. A pragmatic approach needs to be adopted in order to find a right balance between the two extremes. Mark Hibbs explains the complexities of the dilemma:

If the Board and Secretariat now set up an expert panel to draft a working definition of safeguards noncompliance, it may encourage all states in the future to report noncompliance without consideration of political agendas deterring them from meeting their responsibility to combat proliferation. But if noncompliance is too clearly defined, that might prevent the Board from making a finding in an unusual or unexpected case. Strictly defining noncompliance might also result in proliferators identifying a road map permitting them to cheat.<sup>27</sup>

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25. Acton with Newman, "IAEA Verification."

26. Andreas Persbo, "Special Inspections," *VERTIC Blog*, May 4, 2011, <http://www.vertic.org/pages/posts/special-inspections-73.php>.

27. Mark Hibbs, "The IAEA and Syria: A New Paradigm for Non-Compliance?" *Commen-*

The safeguards evaluation process itself is evolving, and recent positive developments within the IAEA's Department of Safeguards should be built upon in order to reach verification and nonproliferation objectives at minimum costs. Herman Nackaerts, the deputy director-general for safeguards, expressed the will "to move further away from an approach that is narrow, prescriptive, criteria-driven, and focused at the facility level—to one that is more objectives-driven, customized, and focused at the state level. This makes sense because we need to be guided by objectives rather than procedures: concerned with outcomes rather than processes."<sup>28</sup> The agency is, in that sense, working to develop a more qualitative approach to safeguards implementation. Full use of all information available to the agency (promoted under the concept "information-driven safeguards"), and further development of the state-level concept (considering safeguards activities from a state and not facility-by-facility perspective) is being promoted. Nuclear material accountancy remains a safeguards measure of fundamental importance, but a set of state factors—such as nuclear fuel cycle characteristics, the history of safeguards implementation in the state, and the level of cooperation with the agency—are also taken into account to adjust the inspection effort. However, while the IAEA is willing to differentiate between states, it cannot discriminate. Therefore, state factors must stay objective and measurable; the agency cannot, for instance, make any judgment on states' intentions. Thus, the line between differentiation and discrimination needs be drawn in order to avoid a politicization of safeguards evaluation.

In the field of security, both the IAEA's Secretariat and its members could call for a stronger mandate. Jack Boureston and Tanya Ogilvie-White have argued that "the ideal scenario is that states would give an international body (preferably the IAEA) the authority to define, review, and monitor national nuclear security standards and to evaluate compliance."<sup>29</sup> The independent commission appointed by the IAEA director-general to formulate recommendations on the agency's role up through 2020 also supported this conclusion in its report.<sup>30</sup>

### Institutional Aspects

The evolution of the IAEA's missions needs be accompanied by improving institutional practices. On the one hand, the Secretariat should continue its current efforts to develop intradepartmental and interdepartmental communication, as well as collaborative analysis. This is essential for ensuring solid conclusions in the field of safeguards, for instance. The *Annual Report* for 2010, indeed, notes: "The Agency continued to further develop the State level concept for the planning, implementation and evaluation of

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*tary* (Carnegie Endowment for International Peace), June 17, 2011, <http://carnegieendowment.org/2011/06/17/iaea-and-syria-new-paradigm-for-noncompliance/270>.

28. Herman Nackaerts, "Preparing for Future Verification Challenge," statement at Symposium on International Safeguards, November 1, 2010, <http://www.iaea.org/newscenter/statements/ddgs/2010/nackaerts011110.html>.

29. Boureston and Ogilvie-White, "Seeking Nuclear Security," 11.

30. IAEA, *Reinforcing the Global Nuclear Order for Peace and Prosperity: The Role of the IAEA to 2020 and Beyond*, Report Prepared by an Independent Commission at the Request of the Director-General of the IAEA (Vienna: IAEA, 2008), 21–22.

safeguards activities for all States with comprehensive safeguards agreements in force. Key to this approach is the strengthening of collaborative analysis, involving multi-disciplinary teams throughout the entire safeguards process.”<sup>31</sup>

Better communication with the IAEA’s member states on how safeguards approaches, concepts, and evaluations are developed and later implemented is also important. At the same time, independence from member states guarantees reliable and credible conclusions. In this respect, while national intelligence documents transmitted to the agency may give key indicators on the nature of a state’s nuclear activities, such sources of information requires careful review and should be independently assessed. For instance, in his last report on safeguards implementation in Iran, the director-general took care to devote a section on the “credibility of information” provided by third parties on the possible military dimensions to the Iranian nuclear program.<sup>32</sup>

Conversely, there should be an effort on the part of the IAEA’s member states to improve institutional debates and related decisionmaking processes. Discussions should be depoliticized and focused on what falls within the IAEA’s mandate. Debates regarding the need for further disarmament measures or to condemn Israel for its nuclear policy should be moved to the NPT Review Conference or other political forums. This is not to say that they are of minor interest, but rather that the IAEA is not necessarily the appropriate body to deal with such issues.

Member states should also adopt a more constructive attitude by getting beyond the “support but don’t pay” approach. Although current budget constraints may impose more efficiency on the part of the IAEA’s Secretariat, they should not serve as an excuse for states to refuse to provide the minimum necessary resources for the agency’s work.

### *Collaborative Efforts at the External Level*

#### Engaging External Players

The IAEA should engage with other players within the nuclear nonproliferation regime in order to gather support for its own work, share best practices, and avoid duplication of activities. Further collaboration with and reliance on the State and Regional System of Accounting for Control of Nuclear Material (SSAC and RSAC) should first be encouraged. Such systems have to be established according to NPT safeguards agreements. Then the agency, “in its verification, shall take due account of the technical effectiveness of the state’s system.”<sup>33</sup> More safeguards activities could be effectively conducted at the national and regional levels to help the IAEA reduce its own onsite presence. The Safeguards Statement for 2010 indeed notes that “the performance of State and regional authorities and the effectiveness of SSACs and RSACs have a significant impact upon the

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31. IAEA, *IAEA Annual Report 2010*, 14–15.

32. See section B of the Annex “Possible Military Dimensions to Iran’s Nuclear Programme,” in *Implementation of the NPT Safeguards Agreement and Relevant Provisions of Security Council Resolutions in the Islamic Republic of Iran*, GOV/2011/65, November 8, 2011.

33. INFCIRC/153, § 7.

effectiveness and efficiency of safeguards implementation.”<sup>34</sup> However, this highlights a pressing need for effective, efficient, and independent SSAC and RSAC.

Collaboration with other verification organizations, acting in the field of nuclear or chemical nonproliferation—such as the Preparatory Commission for the Comprehensive Test Ban Treaty Organization or the Organization for the Prohibition of Chemical Weapons—should also be pursued. The reluctance of the IAEA’s member states to involve such organizations and conclude formal cooperation agreements has so far been based on political motives and a fear of potential breaches of confidentiality. Sharing instead of withholding information can nonetheless be vital. The international efforts to cope with the Fukushima nuclear catastrophe in Japan showed that the IAEA may need the active support of other UN agencies. In this case, the IAEA was provided with monitoring data from the Comprehensive Test Ban Treaty Organization’s global network of radionuclide monitoring stations and cooperated with other UN agencies to help mitigate the consequences of the disaster. Cooperation nonetheless had to be encouraged by UN secretary-general Ban Ki-moon and could have been more immediate. More interagency channels of communication should therefore be established.

The IAEA should also sensitize the nuclear industry to its actions aimed at detecting and preventing illicit trade in nuclear materials. The industry can, on a voluntary basis, share procurement data and actively support the agency’s work. Getting support from industrial players requires understanding their needs and constraints, and it would be interesting to further consider ways to make them see the benefit of a more active collaboration.

Finally, more cooperation between the IAEA and nongovernmental organizations would be useful. Existing rules on the consultative status of nongovernmental organizations vis-à-vis the IAEA encourage their access to meetings and information. They also provide that “subject to the relevant financial regulations, the director-general may request a nongovernmental organization to which consultative status has been granted and which has special competence in a particular field to undertake specific studies or investigations or to prepare specific papers.” Full use of such provisions would provide useful external expertise for the IAEA’s work.

Moreover, better communication between the IAEA and the public in a wider sense is essential. The IAEA’s activities in the field of nonproliferation are being broadcast with greater frequency by the media, at the risk of spreading inaccurate information. Greater levels of institutional transparency are therefore necessary; they would help promote a better understanding of what the IAEA does, thereby ensuring a wider support. Publication of the annual safeguards implementation report, which has traditionally remained confidential, is an option worthy of further exploration.

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34. IAEA, “Safeguards Statement for 2010 and Background to the Safeguards Statement,” no date, <http://www.iaea.org/OurWork/SV/Safeguards/es/es2010.html>.

## Getting Support from External Players

A stronger IAEA mandate also depends on the active cooperation of external players. Some obstacles to the universalization of the AP cannot be overcome by the agency itself and require incentives coming from a wider range of actors. Here the Nuclear Suppliers Group has a role to play. Making the AP a condition for the supply of nuclear material, technologies, and equipment—with no exceptions permitted—should still be actively sought. External players can thus sense promote full implementation of the existing instruments relevant to the agency's work.

The search for a better balance between nonproliferation and disarmament obligations would also help counter arguments that no new verification measures can be accepted as long as no new disarmament commitments are made. If nuclear weapon states accept the necessity to further implement their disarmament commitments, rejection of the AP on the basis of (non)reciprocity will lack potency. Some non-nuclear weapon states could no more argue that the nonproliferation and verification burden is only on them, because nuclear weapon states would also support the cost of irreversible, verifiable, and transparent disarmament. From this perspective, the Action Plan adopted by the 2010 NPT Review Conference provides concrete steps to be taken in the field of nuclear weapons disarmament but also nuclear testing and fissile material production.

The same kind of logic holds true for the balance between nonproliferation and the right to peaceful uses of nuclear energy, as recognized in Article IV of the NPT. As long as safeguards obligations are being complied with, access to equipment, materials, and scientific and technological information useful for peaceful nuclear applications should be ensured through international cooperation and the IAEA's assistance. Here again, the 2010 Action Plan should serve as a guide for supplier states. Action 51, calling on NPT states parties to facilitate transfers of nuclear technology and eliminate any undue constraints in this regard, is of particular relevance, as well as action 58, encouraging discussions, under the IAEA's auspices, on multilateral approaches to the nuclear fuel cycle.

Other forms of support for the IAEA's work involve recognition of its central coordinating role as a multilateral UN organization. Like-minded groups of action within the regime might be desirable in terms of effectiveness, but they might sometimes enter into conflict with the legitimacy of a truly multilateral organization. A proliferation of institutions, including ad hoc groups in the field of nonproliferation, should not lead to the establishment of an overly intrusive verification system that does not reflect the views of all groups of states within the regime. Such a system would undermine mutual trust by encouraging mutual defiance. The right balance should be found, and consideration of the possibility of democratizing some initiatives can only help. For instance, the International Commission on Non-Proliferation and Disarmament suggested that the Proliferation Security Initiative should evolve into a UN-neutral organization and clarify its internal processes.<sup>35</sup>

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35. International Commission on Nuclear Non-Proliferation and Disarmament, *Eliminating Nuclear Threats*, 97.



Finally, stronger backups should be put in place where necessary. Although trust and cooperation are the key and characterize the “normal approach” to international verification, firm actions need be taken in cases of noncompliance with nonproliferation obligations. In this respect, there are no doubts that the IAEA’s system and multilateral approaches have their limits. The agency cannot alone prevent or even deter proliferation, and it even sometimes needs extraordinary powers to detect proliferation. Coherent and strong responses should therefore be organized via strong UN Security Council resolutions. Pierre Goldschmidt suggested that the latter should maybe become more “generic.”<sup>36</sup> This means that, independent of any country-specific cases, they would provide for automatic actions in cases of noncompliance, such as extending the agency’s access rights, suspending technical cooperation, and the like. Though such systemization might be difficult because every case is different, a right balance should be found between allowing for flexibility and cooperation to correct misunderstandings on the one hand, and avoiding a double standard on the other. In that respect, the deterrent effect of IAEA verification will only be effective if the threat of collective action in cases of noncompliance itself is credible. To this end, strengthening the IAEA implies a strong will to firmly condemn states that try to defy or cheat it.

## Conclusion

For the last 55 years, the IAEA has done its best to fulfill its statutory objectives: promoting the peaceful uses of nuclear energy on the one hand, and providing credible assurances that they do not serve any proscribed military purpose on the other. In keeping with the Nobel Peace Prize it won in 2005, the organization has managed to cope with a constantly increasing workload.

The agency has nonetheless suffered from the structural flaws of the nonproliferation regime as well as from its own institutional weaknesses. Both are a constant threat to its effectiveness and efficiency and must be dealt with rapidly.

The IAEA itself has already started to tackle some of the current obstacles to the optimum exercise of its functions. However, strengthening the agency requires a collaborative effort from all the actors within the regime—the IAEA’s technical and political organs and its member states, but also other international organizations and organs, such as the UN Security Council, nongovernmental organizations, ad hoc cooperative groups, and private entities.

As Article II of the IAEA’s Statute reads, the agency “shall ensure, *so far as it is able*” that nuclear energy is not used to further military ends. This ability needs to be maximized, and joint actions to strengthen the IAEA’s legal authority, legitimacy, and expertise would certainly help.

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36. Pierre Goldschmidt, *Concrete Steps to Improve the Non-Proliferation Regime*, Carnegie Paper 100 (Washington, D.C.: Carnegie Endowment for International Peace, 2009), [http://carnegieendowment.org/files/improve\\_nonpro\\_regime.pdf](http://carnegieendowment.org/files/improve_nonpro_regime.pdf).

# Why Do States Abandon Nuclear Weapons Activities: Understanding the Role of Alliance Coercion

Gene Gerzhoy<sup>1</sup>

## Abstract

Among the more than 30 states that pursued nuclear weapons, only 10 successfully acquired nuclear weapons, and 1 of those disarmed. Why did the remaining states abandon their activities and forswear nuclear armament? Explanations that focus on international norms, domestic politics, and security threats have failed to resolve this puzzling variation in armament outcomes. This paper argues that an overlooked but critical cause of nuclear abandonment is coercion applied by the aspiring states' great power allies. Client states that rely on great power patrons to support their national security or domestic political survival are vulnerable to threats by patrons that alliance benefits will be curtailed or withdrawn. These benefits include security guarantees, arms transfers, economic aid, integration into alliance institutions, and support for favored policies. By testing the role of alliance coercion against the historical record, this paper seeks to improve our understanding of the causes of nuclear abandonment.

## Introduction

On December 6, 2011, Saudi Arabia's Prince Turki Al-Faisal declared that his country might acquire nuclear weapons in response to Iran, if the latter were to acquire nuclear weapons of its own.<sup>2</sup> The open discussion of Saudi Arabia's nuclear status should prompt political scientists and policymakers alike to examine whether Iranian nuclear acquisition will induce indigenous nuclear armament by other states in the region, including Egypt and Turkey. Secretary of State Hillary Clinton previously suggested that

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2. Associated Press, "Prince Hints Saudi Arabia May Join Nuclear Arms Race," *New York Times*, December 6, 2011, <http://www.nytimes.com/2011/12/07/world/middleeast/saudi-arabia-may-seek-nuclear-weapons-prince-says.html>.



the United States could avert the spread of nuclear weapons to Iran's neighbors by extending the U.S. "nuclear umbrella" to threatened allies.<sup>3</sup> However, similar guarantees did not prevent interest in nuclear armaments from arising among a number of U.S. allies, including South Korea, Taiwan, West Germany, and Australia.

Since the invention of the atomic bomb in 1945, 10 states have successfully acquired nuclear weapons. Of those, South Africa has disarmed, leaving only 9 extant nuclear powers.<sup>4</sup> Yet 25 states abandoned activities meant to facilitate nuclear weapons acquisition.<sup>5</sup> That variation in outcomes is puzzling on its face. But this empirical puzzle is only magnified by the usefulness that political scientists attribute to nuclear weapons. A state armed with nuclear weapons has access to unparalleled deterrent capabilities. If that state builds deliverable nuclear bombs that can survive a preliminary nuclear strike by its opponents, it can guarantee its security even when facing overwhelming conventional forces. In a world without recourse to higher political authority, nuclear deterrence is the closest thing states can possess to an assurance of survival. Why, then, have so many states that sought nuclear weapons abandoned their nuclear weapons activities and forsworn being armed in this way?<sup>6</sup> Answering this question is the central aim of this paper.

I argue that a critical but overlooked cause of nuclear abandonment is coercive pressure applied by the aspiring state's great power ally. Alliance with a great power patron confers benefits that are a boon to the client state's national security and domestic stability. These benefits include promises of defense against external attack, arms transfers, economic aid, support for favored policies, and integration into alliance decision making institutions. Yet the same benefits also generate coercive leverage for the patron, because of the threat that they could be curtailed or withdrawn.

Alliance coercion does not always succeed in compelling nuclear abandonment. To explain the conditions under which alliance coercion works, this paper points to two variables. The first variable is the degree to which the target state relies on its great power patron to guarantee its national security and domestic political stability. All other things being equal, states that rely heavily on great power allies to support their security will be more vulnerable to coercive pressure. The second variable is the credibility of the patron's threat to curtail the benefits that have been extended. Great powers that cannot

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3. Mark Landler and David E. Sanger, "Clinton Speaks of Shielding Mideast from Iran," *New York Times*, July 22, 2009, <http://www.nytimes.com/2009/07/23/world/asia/23diplo.html>.

4. Ukraine, Kazakhstan, and Belarus also relinquished nuclear weapons after the dissolution of the Soviet Union.

5. Harald Müller and Andreas Schmidt, "The Little-Known Story of De-Proliferation: Why States Give Up Nuclear Weapon Activities," in *Forecasting Nuclear Proliferation in the 21st Century: The Role of Theory*, edited by William C. Potter and Gaukhar Mukhatzhanova (Stanford, Calif.: Stanford University Press, 2010). See also Sonali Singh and Christopher R. Way, "The Correlates of Nuclear Proliferation: A Quantitative Test," *Journal of Conflict Resolution* 48, no. 6 (December 2004): 895–885.

6. For a previous work examining nuclear reversal, see Ariel E. Levite, "Never Say Never Again: Nuclear Reversal Revisited," *International Security* 27, no. 3 (March 2002): 59–88. Levite's "reversal" (the purposeful undoing of nuclear weapons activities) is what I call "abandonment."

withdraw benefits without hindering their own core interests will not be able to leverage their coercive power persuasively. By contrast, if the security or domestic political stability of the target state is peripheral to the patron’s interests, then coercive threats to undermine these goals will be credible.

In this paper, I detail this empirical puzzle of nuclear abandonment and summarize past attempts at its resolution. I also describe the preliminary research design that I plan to employ to test my hypotheses against competing claims in pursuing a full dissertation on this topic.

## Defining the Outcome Variable: Nuclear Abandonment

I define “nuclear abandonment” as either of the following: (1) when a state engaged in nuclear weapons activities ceases those activities; (2) when a state with nuclear weapons dismantles or relinquishes those weapons. There are two ways for a state’s behavior to be characterized as a “nuclear weapons activity”; the first is if a state engages in the development of technologies—such as bomb designs or components—whose only conceivable use is for weapons development. A number of nuclear technologies, however, are useful both for weapons development and peaceful energy. For instance, enrichment technologies can be used to produce fissile materials for bombs or fuel for power plants. To distinguish between nuclear activities intended for weapons and those intended for energy, I look to other evidence of a state’s motivations, such as private statements by decision makers or archival evidence indicating an intention to construct nuclear arms. If there is evidence that dual-use research is intended even in part for the development of a nuclear weapon or a nuclear weapons *option*, then I define that behavior as a nuclear weapons activity.<sup>7</sup>

This paper also distinguishes between “nonpursuit” and “abandonment.” Nonpursuit requires a state to abstain from activities that are intended to produce nuclear weapons in the first place. By contrast, abandonment requires the state to already have engaged in such activities, or to have acquired nuclear weapons by some other means (e.g., the post-Soviet successor states, which inherited their nuclear arsenals). The difference is critical because it narrows the universe of cases that are relevant for this study. I do not seek to explain nonacquisition as a general phenomenon, but rather the abandonment of previously initiated nuclear weapons activities. Table 1 illustrates the universe of cases with regard to nuclear weapons exploration, pursuit, acquisition, and abandonment.

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7. My definition follows Müller and Schmidt’s, as well as Ariel Levite’s. Müller and Schmidt, “Little-Known Story”; Levite, “Never Say Never Again.”

**Table 1. Nuclear Weapons Activities and Abandonment**

Explored; Did Not Pursue	Pursued; Did Not Acquire	Acquired; Disarmed	Acquired
Algeria	Argentina <sup>a</sup>	South Africa	China
Australia	Brazil		France
Canada*	Iran <sup>b</sup>		India
Egypt*	Iraq <sup>c</sup>		Israel <sup>d</sup>
Indonesia*	Kazakhstan <sup>†e</sup>		North Korea
Italy*	Libya		Pakistan <sup>f</sup>
Nigeria*	South Korea		Russia
Norway*	Syria <sup>‡g</sup>		United Kingdom
Romania	Ukraine <sup>†h</sup>		United States
Spain*			
Sweden			
Switzerland			
Taiwan <sup>i</sup>			
Postwar Germany*			
Yugoslavia <sup>j</sup>			

Note: With exceptions (noted with superscripts a–j above, and listed below), the entries on this list come from Harald Müller and Andreas Schmidt, “The Little-Known Story of De-Proliferation: Why States Give Up Nuclear Weapon Activities,” in *Forecasting Nuclear Proliferation in the 21st Century: The Role of Theory*, edited by William C. Potter and Gaukhar Mukhatzhanova (Stanford, Calif.: Stanford University Press, 2010).

\*States included on Müller and Schmidt’s coding, but not on that of Sonali Singh and Christopher R. Way, “The Correlates of Nuclear Proliferation: A Quantitative Test,” *Journal of Conflict Resolution* 48, no. 6 (December 2004): 895–885..

†States I include that are in neither coding.

<sup>a</sup>Jacques E. C. Hymans, *The Psychology of Nuclear Proliferation: Identity, Emotions, and Foreign Policy* (Cambridge: Cambridge University Press, 2006).

<sup>b</sup>Iran pursued nuclear weapons under the shah; the Islamic Revolution interrupted these activities. Iran’s most recent attempt at nuclear weapons acquisition has yet to be resolved.

<sup>c</sup>Iraq’s nonacquisition was not a choice, but a consequence of a deliberate military intervention. That distinguishes it from the other states on this list, which made decision to cease nuclear pursuits.

<sup>d</sup>Avner Cohen, *Israel and the Bomb* (New York: Columbia University Press, 1998).

<sup>e</sup>William C. Potter, *The Politics of Nuclear Renunciation: The Cases of Belarus, Kazakhstan, and Ukraine*, Occasional Paper 22 (Washington, D.C.: Henry L. Stimson Center, 1995).

<sup>f</sup>Samina Ahmed, “Pakistan’s Nuclear Weapons Program: Turning Points and Nuclear Choices,” *International Security* 23, no. 4 (1999).

<sup>g</sup>Avner Cohen and Leonard S. Spector, “Israel’s Airstrike at Syria’s Nuclear Reactor: Implications for the Nonproliferation Regime,” *Arms Control Today* 38, no. 6 (August 2008).

<sup>h</sup>Potter, *Politics of Nuclear Renunciation*.

<sup>i</sup>Taiwan pursued engaged in nuclear weapons activities twice, according to Singh and Way, “Correlates.” The first instance was in 1967, and the second was in 1987.

<sup>j</sup>Yugoslavia pursued nuclear weapons twice also, once from 1953 to 1963 and the second time from 1982 to 1987. See Dong-Joon Jo and Erik Gartzke, “Determinants of Nuclear Weapons Proliferation,” *Journal of Conflict Resolution* 51, no. 1 (February 2007): 176–194, esp. n. 17.

## Alliance Coercion: The Argument in Brief

My theory of nuclear abandonment is based on a cost/benefit calculation by the aspiring nuclear state. Nuclear abandonment occurs when the expected costs of continued nuclear armament activities exceed the expected benefits of nuclear armament. Alliance coercion works by raising the expected costs of nuclear armament, tipping the target state's calculus in such a way as to discourage continued nuclear weapons activities. I define coercion as a threat to impose costs on a target state if its leaders do not agree to the coercer's demand. My theory takes as given that there is a coercive attempt aimed at the aspiring nuclear state by its great power ally, an assumption I verify in the empirical analysis that follows.

The magnitude of the coercive costs I am studying corresponds to the alliance benefits that the patron threatens to withdraw or curtail. I assume that decision makers in the target state have two primary interests that the alliance strongly affects: their state's security from external threats, and their political survival in the face of domestic opposition. Following Kenneth Waltz, I assume that the former is a prerequisite for all other goals, because a country that cannot guarantee its survival as a political entity with sovereign authority over its territory cannot pursue any other goals.<sup>8</sup> Political survival is a goal because state leaders are ultimately politicians, which means that they strive to remain in office.<sup>9</sup>

The principal costs that patrons threaten to impose on client states are the withdrawal of alliance benefits. I theorize five benefits associated with an alliance. First, military alliances confer security guarantees. That means that patrons promise to defend their clients from military attacks. If a patron credibly threatens to withdraw such guarantees in response to continued nuclear weapons activities, and if the client cannot defend itself without the military contribution of its ally, then the security benefits of nuclear armament no longer outweigh the threatened costs.

Second, great power patrons provide arms and other military matériel to their clients. These transfers provide clients with technology to which they otherwise do not have access, thereby reducing the cost of fielding a military by offsetting the client's military expenditures. They also benefit military establishments, which have a corporate interest in acquiring new technologies and growing their budget. Curtailing these benefits affects both national security and political survival. The latter is especially affected if military establishments play a critical role in underpinning the political leadership's authority.

Third, great powers integrate their clients into the decision making structures of the alliance. Alliance decisions can determine the fate of the target state's national security, so access to the institutions that produce alliance policies is a valued interest for client states.

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8. Kenneth N. Waltz, *Theory of International Politics* (Reading, Mass.: Addison-Wesley, 1979).

9. Bruce Bueno de Mesquita et al., *The Logic of Political Survival* (Cambridge, Mass.: MIT Press, 2003).

Fourth, great powers transfer economic aid to their client states. Although economic interests are not usually as fundamental to a state as national security interests, the sudden withdrawal of aid at a time of economic stress can lead to financial crises.<sup>10</sup> Such crises can reduce the leadership's popularity or ability to distribute wealth, thus threatening its political survival.

The fifth benefit comes in the form of policy concessions by the patron. If a client state's political leaders make promises to their constituents that depend in part on the support of the country's great power allies, then their patron can hold these promises hostage. For instance, West Germany's reconciliation with East Germany depended in part on the acquiescence of the United States.

I argue that "nuclear umbrellas"—promises that a patron will respond with nuclear force to attacks on its client—are by themselves insufficient to discourage nuclear armament. The international system is anarchic, meaning that it lacks a centralized authority to resolve disputes and deter aggression. Without a centralized authority, states must resort to self-defense if they are to survive. This "self-help" logic means that a patron's nuclear umbrella is a second-best option to indigenous nuclear capacity. Although a guarantee contributes to a client's security against foreign attack, there is always the risk that the patron will renege on its deterrence promises if shielding its client raises the risk of devastating attacks on the patron's homeland. It was precisely these fears that prompted France and the United Kingdom to acquire their own nuclear deterrents. Underscoring the weak effect of U.S. nuclear guarantees were the many other U.S. allies that sought nuclear weapons: West Germany, Italy, Australia, Canada, Norway, and South Korea.

Nuclear guarantees are not wholly without benefit to client states, however. A state that has an extended nuclear deterrence guarantee will be less likely to resist coercive attempts by its great power patron, because the alternative to armament will not necessarily be defenselessness from attack by a conventionally superior or nuclear-armed adversary. As such, nuclear guarantees increase the likelihood of coercive success by reducing the opportunity cost of nuclear abandonment. Nevertheless, without coercion, I do not expect nuclear guarantees to mollify armament temptations on their own.

To explain the credibility of threats, I consider whether or not the withdrawal of alliance benefits threatens the patron's core security interests. If reneging on a defensive pact or curtailing the benefits associated with an alliance does not hinder the patron's core interests, then the threat to do so will be credible.<sup>11</sup> However, I expect great powers to be opportunistic in their approach to alliance coercion and to utilize whatever sources of leverage are available. If the client's national security is a critical interest, the patron will shift toward targeting the client's political leaders. The credibility of threats is there-

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10. Charles Lipson, "International Cooperation in Economic and Security Affairs," *World Politics* 37, no. 1 (1984): 1–23.

11. Glenn H. Snyder, *Alliance Politics* (Ithaca, N.Y.: Cornell University Press, 1997); Jeremy Pressman, *Warring Friends: Alliance Restraint in International Politics* (Ithaca, N.Y.: Cornell University Press, 2008).

fore more important for determining the kind of coercive threat employed, rather than the overall likelihood that coercion succeeds.

## Past Research on Abandonment

Existing international relations theory has yet to provide adequate explanations for nuclear abandonment, though some theories perform better than others in explaining variation in armament outcomes. I divide the literature into three categories: explanations centered on nonproliferation norms, domestic political explanations, and explanations that focus on external security threats. In this section, I describe the conceptual and empirical limitations of existing theories, emphasizing the need for further empirical testing.

### *The Nuclear Non-Proliferation Treaty*

Many researchers point to the role of global nuclear nonproliferation norms in motivating nuclear abandonment. Specifically, scholars claim that the main effect of the Nuclear Non-Proliferation Treaty (NPT) was to establish a global expectation that nuclear weapons activities were no longer a socially acceptable behavior for members of the international community. According to Scott Sagan, before the advent of the NPT, nuclear armament was considered by statesmen to be a mark of prestige and status. But a countervailing norm emerged after the UN General Assembly's unanimous approval in 1961 of the Irish Resolution, which proposed a ban on nuclear weapons acquisition. According to this argument, the subsequent entry into force of the NPT in 1970 represented a near-universal rejection of the "status norm" and an acclamation of the "nonproliferation norm."

Testing the normative argument is difficult because it requires evidence of a state's motivations. To circumvent this difficulty, analysts have turned to quantitative analyses examining the timing of states' decisions. Thus, Harald Müller and Andreas Schmidt compare the behaviors of states whose independence came after the Irish Resolution with those that were independent countries before.<sup>12</sup> They find that countries "born" after the resolution were much less likely to engage in nuclear weapons activities.<sup>13</sup> They also find that since the advent of the NPT, nearly 70 percent of states that have engaged in nuclear weapons activities have given up those activities and that "less than 15 percent of the economically capable states have started nuclear weapons programs."<sup>14</sup>

Müller and Schmidt draw conclusions about state *motivations* from the data about the timing of state *behaviors*. The problem with this logical leap is that other, competing hypotheses can also explain the timing of the global shift to nonproliferation. Specifically, realist scholars argue that the NPT is an agreement between the great powers, forced upon the lesser powers by diplomatic, economic, and security pressure.<sup>15</sup> This claim

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12. Müller and Schmidt, "Little-Known Story."

13. Ibid., 147–8.

14. Ibid., 148.

15. Zachary S. Davis, "The Realist Nuclear Regime," *Security Studies* 2, no. 3–4 (1993):



shares nothing with the normative logic, but it still plausibly explains why abandonment is chronologically correlated with the NPT. Until we test the superpower coercion hypothesis, evidence for the normative hypothesis is suspect.

### *Domestic Politics*

Domestic hypotheses place causal emphasis for armament decisions on internal political processes. With regard to nuclear weapons decisions, three important mechanisms fall under this heading: bureaucratic politics, the economic preferences of the state's ruling coalition, and the identity conception of the state's leadership.

The first domestic political hypothesis argues that state bureaucracies that push for weapons research and armament heavily influence nuclear decisions.<sup>16</sup> The model identifies two kinds of bureaucracies as the typical actors: militaries, for which nuclear weapons research generates prestige, funding, and powerful weapons; and scientific establishments, which care less about weapons and more about the funding and prestige associated with developing them.<sup>17</sup> If these bureaucracies are powerful, then nuclear armament proceeds even without the explicit authorization of state leaders. However, if these bureaucracies are weakened, then states will reverse parochially motivated decisions to arm.

This model presents several conceptual and empirical difficulties. Most important, scientific and military bureaucracies are not uniform in their policy preferences. There is as much reason to assume that militaries will oppose nuclear armament as favor it, since nuclear weapons lack battlefield usefulness and are not geared toward the offense.<sup>18</sup> Historically, some militaries favored nuclear armament (e.g., Argentina and Brazil), while other military establishments resisted armament out of concern that funds for nuclear research would come out of conventional defense outlays (e.g., Israel and South Africa).<sup>19</sup> Similarly, while some scientists favor nuclear weapons development for the prestige and funding associated with it, others resist investments in military research out of moral or practical concerns. In Israel, for example, leading scientists actively resisted David

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79–99; John J. Mearsheimer, “The False Promise of International Institutions,” in *Theories of War and Peace: An International Security Reader*, edited by Michael E. Brown (Cambridge, Mass.: MIT Press, 1998), 329–383.

16. Scott D. Sagan, “Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb,” *International Security* 21, no. 3 (1997): 54–86. For more on the military's “offensive bias,” see Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars* (Ithaca, N.Y.: Cornell University Press, 1984); and Jack L. Snyder, *The Ideology of the Offensive: Military Decision Making and the Disasters of 1914* (Ithaca, N.Y.: Cornell University Press, 1984). For the possibility that nuclear weapons can act as a shield for territorial revisionism, see S. Paul Kapur, “India and Pakistan's Unstable Peace: Why Nuclear South Asia Is Not Like Cold War Europe,” *International Security* 30, no. 2 (2005): 127–152.

17. It is also plausible that researchers are motivated by the prospect of novel scientific discoveries; in other words, scientists want to develop nuclear weapons to prove that they can. Thank you to Mark Jansson for the suggestion.

18. Posen, *Sources*; and Snyder, *Ideology*.

19. Cohen, *Israel*.

Ben Gurion's quest for the bomb, and were eventually replaced with less resistant colleagues.<sup>20</sup>

The second domestic hypothesis examines the economic interests of a state's ruling coalition. Etel Solingen argues that the model of economic development that each state's coalition adopts determines these interests.<sup>21</sup> Ruling coalitions favoring export-oriented and globally integrated economic strategies will be more vulnerable to isolation from international markets. States governed by such coalitions will therefore be less likely to incur the costs of isolation by pursuing or acquiring nuclear weapons. By contrast, those coalitions that favor import-substitution industrialization or other autarkic growth strategies have less to fear from international isolation and are therefore less likely to restrain nuclear ambitions.

The validity of Solingen's explanation depends on the type of costs that international isolation entails. If those costs are economic—for example, if they come in the form of trade sanctions or economic embargoes—then globalizing coalitions will be hurt by isolation more than inward-looking coalitions. However, if the costs of isolation have little to do with economic interests—for example, if they take the form of alliance coercion—then the coalition's economic interests will not determine the state's susceptibility to isolation. In this instance, both globalizing and inward-looking coalitions will be susceptible to alliance coercion, and Solingen's central variable will be less relevant for determinations of vulnerability.

Solingen also assumes that the domestic variables her theory privileges are themselves insulated from international effects. However, if great power pressure affects the composition of a state's coalition—for example, by toppling an unfavorable regime, or encouraging the rise of a friendly government—then the "independent" variables she hypothesizes are actually themselves outcomes of superpower pressure. Because the assumptions of her thesis depend so heavily on the precise impact of great power pressure, it is necessary to rigorously test her theory against the one I advance in the present study.

Third, Jacques Hymans argues that the key to understanding nuclear armament decisions is the National Identity Conception (NIC) of the state's individual leader. An NIC is a set of ideas about the state's essential character; these ideas drive leaders either toward or away from nuclear weapons activities.<sup>22</sup> The argument assumes that nuclear armament is a "leap in the dark"—a revolutionary decision that can only be undertaken by leaders with resolute commitments to nuclear acquisition. Specifically, leaders with a combined "oppositional nationalist" NIC possess this resolve, while other leaders do not. An "oppositional" NIC produces heightened fear of other states and a tendency to

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20. Ibid.

21. Etel Solingen, "The Political Economy of Nuclear Restraint," *International Security* 19, no. 2 (1994); Etel Solingen, *Nuclear Logics: Contrasting Paths in East Asia and the Middle East* (Princeton, N.J.: Princeton University Press, 2007); Etel Solingen, "Domestic Models of Political Survival: Why Some Do and Others Don't (Proliferate)," in *Forecasting Nuclear Proliferation in the 21st Century: The Role of Theory*, edited by William C. Potter and Gaukhar Mukhatzhanova (Stanford, Calif.: Stanford University Press, 2010).

22. Hymans, *Psychology*.



ward elevated threat perceptions; a “nationalist” NIC engenders pride, or a sense that the state deserves prestige and power, and will use it effectively. Other NICs do not produce this heady mix of fear and pride, and it is that unique combination that motivates nuclear weapons pursuits.

Hymans’s claim depends to a great extent on his untested assumption that armament is a “revolutionary decision” that most leaders naturally avoid. Although nuclear armament is a risky activity whose precise consequences can never be known with full certainty, this can also be said of many other national security decisions, including security alignment, covert operations, and war. Yet states regularly engage in these behaviors. The assumption that armament represents a revolutionary decision should be scrutinized, especially given that the dangers associated with nuclear weapons activities vary considerably from case to case. My theory contends that nuclear weapons activities *are* dangerous, but only because of the costs that great powers threaten to impose on nuclear aspirants. Testing this claim is critical for assessing a key underlying assumption of Hymans’s theory.

### *Threat Variation Hypotheses*

Threat variation hypotheses base their logic on the claim that nuclear armament is primarily a balancing response to a threatening security environment. Applying this logic, T. V. Paul has argued that the cause of nuclear abandonment is a change in the external threat motivating nuclear weapons activities.<sup>23</sup> Quantitative analyses have also indicated strong correlations between threat variables and nuclear outcomes, though some qualitative studies have been less conclusive.<sup>24</sup> This discrepancy is probably due in part to different measurements of threat. Whereas quantitative studies rely on easily observed objective indicators, such as the frequency of militarized disputes, qualitative studies focus on threat perception, which may vary even as dispute intensity remains constant. Also, as argued by others, perceptions are a necessary link between objective “threats” and the balancing motivation they engender.<sup>25</sup>

Several threats are relevant to the pursuit of nuclear armament. The argument is that if any of these threats declines or disappears, then the impetus for nuclear armament will decline commensurately. The first type of threat decline is a change in a rival’s nuclear capabilities or pursuits. This hypothesis is based on the idea that states acquire nuclear weapons in response to the nuclear pursuits of their rivals.<sup>26</sup> The second type of

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23. T. V. Paul, *Power versus Prudence: Why Nations Forgo Nuclear Weapons* (Montreal: McGill-Queen’s University Press, 2000).

24. Singh and Way, “Correlates”; Dong-Joon Jo and Erik Gartzke, “Determinants of Nuclear Weapons Proliferation,” *Journal of Conflict Resolution* 51, no. 1 (February 2007): 167–194; Hymans, *Psychology*; Solingen, *Nuclear Logics*; James J. Walsh, “Bombs Unbuilt: Power, Ideas, and Institutions in International Politics,” Ph.D. thesis, Massachusetts Institute of Technology, 2001.

25. Stephen M. Walt, *The Origins of Alliances*, Cornell Studies in Security Affairs (Ithaca, N.Y.: Cornell University Press, 1987).

26. Sagan, “Why Do States Build Nuclear Weapons?” States may pursue nuclear weapons

threat decline can be observed in terms of the conventional capabilities of rivals. Nuclear weapons are not only useful for deterring nuclear threats but also for deterring conventional attacks on a state's homeland. This is particularly true if the conventional balance is not in a state's favor, in which case nuclear weapons can fill the military gap.<sup>27</sup> Third, states also factor the quality of mutual relations into their perceptions of military threat. Ultimately, states ask the question "Will I be attacked?" and not only the question "How well can I resist an attack if it comes?" If nuclear armament is motivated by disputes with a regional rival, and those disputes begin to dissipate, then the motivation for armament will also dissipate.

One question about threat hypotheses that remains unanswered is whether *declines* in threat perception are sufficient to motivate the abandonment of nuclear weapons activities. Though a less threatening environment may lessen the urgency of armament, it does not necessarily induce abandonment. The contention is that while threats ratchet up the motivation for nuclear armament, something else must bring it back down. A state with an improving security environment may still want to continue nuclear weapons activities as a hedge against the reemergence of threats. I argue that alliance coercion satisfies this role, producing pressure to abandon nuclear weapons activities. In the following section, I describe how my further research will test this theory against the competing claims I have described in this section.

## Method of Inquiry and Case Selection

### *Qualitative Historical Analysis*

My theory of alliance coercion must be tested against competing claims. To do so, I will utilize two kinds of historical analysis: process tracing, and an analysis of cross-case variation. Process tracing examines the decision making process, with close attention to the sequence of events leading to decisions. This method of analysis is well suited for explaining nuclear abandonment, because abandonment is the outcome of choices made by a policy elite. By tracing the links between each decision, I observe whether or not alliance coercion motivated armament outcomes, or whether other causes were decisive. In addition to analyses of individual cases, I use comparative case analysis. Specifically, I employ Mill's Method of Difference, whereby cases are compared because they differ on the outcome variable but match up on potential causal variables. By controlling for other causes, I can identify the characteristics on which the cases differ, hinting at a causal relationship between these variables and the outcome.

To test whether alliance coercion played a role in producing the abandonment of nuclear weapons activities, I will investigate the armament history of all the U.S. al-

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due to the fear of being blackmailed by nuclear-armed rivals: Richard K. Betts, *Nuclear Blackmail and Nuclear Balance* (Washington, D.C.: Brookings Institution Press, 1987).

27. John J. Mearsheimer, *Conventional Deterrence* (Ithaca, N.Y.: Cornell University Press, 1983).

lies that engaged in nuclear weapons activities.<sup>28</sup> United States–aligned states that abandoned nuclear weapons activities include Australia, Canada, Italy, Norway, Spain, Sweden, Taiwan, postwar Germany, and South Korea. Additionally, Kazakhstan and Ukraine were not formal allies, but sought to capture benefits from the United States after the collapse of the Soviet Union. Four allied states completed their nuclear weapons activities: France, the United Kingdom, Pakistan, and Israel. By systematically exploring the differences between these two groups, I will determine whether the historical record supports my hypotheses regarding the effect of alliance coercion on nuclear abandonment.

To explain other reasons why nuclear abandonment can occur, I examine cases where states not aligned with the United States abandoned nuclear weapons activities. By doing so, I delineate other causal mechanisms that could have produced pressure to reverse nuclear pursuits. Nonallied states that abandoned nuclear weapons activities included Algeria, Indonesia, Romania, Switzerland, Yugoslavia, Argentina, Brazil, Libya, and South Africa.

Evidence that would invalidate my hypothesis includes proof that the following occurred: (1) decision makers citing nonsecurity costs (e.g., economic sanctions) as their primary reasons for abandoning nuclear weapons pursuits; (2) decision makers referring to the advantages of a *nuclear* security guarantee as the primary inducement for nuclear abandonment; (3) decision makers citing the importance of international norms or agreements—and especially the NPT—as the most important reason to stop pursuit; (4) decision makers in countries that ultimately ceased their pursuit of nuclear weapons consistently dismissing the importance of coercive threats; or (5) decisions being closely correlated with and causally connected to any of the alternative causal mechanisms I described in the section above.

## Policy Implications

Explaining why states abandon nuclear weapons activities has critical consequences for the design of counter proliferation policy. U.S. policymakers have relied in the past on nuclear guarantees to mollify allies' temptation to arm. If the historical record validates the hypotheses in this study, it would show that promises of extended deterrence by themselves are insufficient to impede armament, and require a coordinated policy of coercion. Specifically, effective policy will require the United States to pressure its allies into nuclear abandonment.

Conclusions regarding the effect of alliance coercion on nuclear abandonment also have implications for counter proliferation strategies aimed at *nonallies*. Coercive attempts fail without leverage. To pressure nonallies, policymakers must identify third parties that possess such leverage, and induce them to compel nuclear abandonment by

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28. The United States was not the only superpower that constrained the nuclear choices of its clients. The Soviet Union was also keen on limiting its clients' armament ambitions. Archival evidence of the Soviet Union's relations with client states is restricted, so I limit my analysis to the United States and its allies for the time being.

their clients. To succeed, policymakers must identify the specific vulnerabilities that are likely to produce coercive success; only where those vulnerabilities are present will third parties succeed in compelling nuclear forbearance by their allies. Thus, China and Russia are far more likely than the United States to successfully compel nuclear abandonment by North Korea and Iran.

Alliance coercion is especially likely to contain nuclear proliferation because the United States has leverage over more potential nuclear aspirants than ever before. As the only remaining superpower, the United States has a large network of states that depend on it for alliance benefits. These benefits include balancing regional rivals, providing arms and aid, and undergirding domestic stability. Though the likelihood of stopping nuclear acquisition by nonallied states is low, the United States can still contain the dangerous reaction to these states' nuclear efforts by its allies. That will require close attention to the functioning of alliance coercion as opposed to falling back on appeals to international norms or even offers of extended nuclear deterrence guarantees.

## Conclusion

Although the fear of mutual assured destruction prevented the outbreak of nuclear war in the past, the rapid acquisition of nuclear weapons by additional states will raise the lethality of future conflicts and increase their likelihood. Though the construction of retaliatory capabilities deters nuclear conflict, new nuclear powers will have small stockpiles that are vulnerable to first strikes.<sup>29</sup> Without the fear of assured retaliation, new nuclear states will be tempted to launch preventive attacks on their rivals. As dangerous is the risk that new nuclear powers will lack the resources to construct effective command-and-control systems, raising the chance of accidental or unauthorized launches, along with the likelihood of nuclear theft by guerilla or terrorist groups.<sup>30</sup> Containing the spread of nuclear weapons is the surest way to prevent violent nuclear conflict.

By specifying the conditions under which alliance coercion is likely to produce the abandonment of nuclear weapons pursuits, my theory will permit an accurate test of the effectiveness of great power pressure in stemming nuclear proliferation. Effective empirical testing of coercion will allow a reassessment of current hypotheses about the inhibitors of nuclear proliferation, improve our understanding of past instances of nuclear abandonment, and generate better theories regarding this critical global phenomenon. And just as important, this project will strengthen our predictive capabilities, leading to better assessments of the likelihood of future nuclear proliferation, and of policymakers' ability to stymie it.

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29. Robert Jervis, *The Meaning of the Nuclear Revolution: Statecraft and the Prospect of Armageddon* (Ithaca, N.Y.: Cornell University Press, 1989); Scott D. Sagan and Kenneth N. Waltz, *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W. W. Norton, 2003).

30. Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, N.J.: Princeton University Press, 1995).

# Sustaining a U.S. Nuclear Deterrent after New START

Thomas Karako<sup>1</sup>

## Abstract

The provisions of the New START Implementation Act (NSIA), which were passed by the U.S. House of Representatives as part of the annual defense authorization bill in May 2011, represented an attempt by Congress to exercise more robust involvement in U.S. nuclear policy. The bill sought to implement the “grand bargain” that preceded the ratification of the New Strategic Arms Reduction Treaty (New START)—namely, that the treaty’s 7-year window of reductions to U.S. nuclear forces should be made in tandem with a 10-year modernization program of both the weapons themselves and their aging delivery systems. The context of this arrangement was growing concern about the ability of the United States to retain a sustainable nuclear deterrent for the indefinite future. Although the NSIA provisions were abandoned during conference with the Senate in December 2011, their underlying concerns remain unresolved, and the sustainability of the nuclear enterprise is certain to reappear as a future point of controversy.

## Introduction

As of September 30, 2009, the U.S. nuclear stockpile consisted of 5,113 warheads—the first public accounting of the stockpile in U.S. history.<sup>2</sup> This number represents an 84 percent reduction from the United States’ high of 31,255 in 1967, more than a 75 percent reduction since the fall of the Berlin Wall (22,217 in 1989), and approximately half the size of the stockpile since the beginning of the George W. Bush presidency (10,526 in 2001).<sup>3</sup> But even as the numbers of deployed warheads declined, the post–Cold War

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2. U.S. Department of Defense (DoD), “Fact Sheet: Increasing Transparency in the U.S. Nuclear Weapons Stockpile,” May 3, 2010.

3. William J. Perry et al., *America’s Strategic Posture: The Final Report of the Congressio-*

years also witnessed a considerable constriction of the physical facilities and personnel devoted to the civilian nuclear enterprise and military mission. The administrations of both George W. Bush and Barack Obama pledged to move beyond Cold War deterrence thinking and to reduce the role of nuclear weapons in U.S. national security strategy. Both administrations also pledged, however, to retain a nuclear deterrent for as long as nuclear weapons were needed. Despite a changing geopolitical environment and a greater reliance on conventional forces, the basic purpose of nuclear weapons has remained substantially constant even since before the end of the Cold War. In the words of former secretary of defense James Schlesinger,

We sometimes hear or read the query, “Why are we investing in these capabilities which will never be used?” This is a fallacy. A deterrent, if it is effective, is in “use” every day. The purpose in sustaining these capabilities is to be sufficiently impressive to avoid their “use”—in the sense of the actual need to deliver the weapons to targets.<sup>4</sup>

In recent years, a series of reports have documented how the shrinking post-Cold War U.S. nuclear infrastructure is plagued with serious physical and personnel issues, both military and civilian, along with a troubling lack of attention to important aspects of both the military’s nuclear mission and the domestic nuclear enterprise. The sustainability of the U.S. nuclear deterrent seems to face an uncertain future. That the military’s nuclear mission had come to be taken for granted was confirmed by two embarrassing incidents—first, when four nuclear weapon fuses were accidentally transported to Taiwan in 2006; and again in 2007, when actual nuclear weapons went missing for 36 hours after having been flown from North Dakota to Louisiana without authorization.<sup>5</sup>

These growing concerns culminated in the 2009 report of a congressionally mandated, bipartisan “blue ribbon” commission, headed by former secretaries of defense William Perry and James Schlesinger. This Congressional Commission on the Strategic Posture of the United States (commonly known as the Strategic Posture Commission) warned of an “atrophying” and “decrepit” nuclear enterprise, and the need to renew nuclear production capabilities and a wide range of deterrence skills.<sup>6</sup> The weapons themselves require costly and time-consuming life-extension programs to remain reliable, but the ability to perform these programs has fallen off dramatically. Facilities also need to be upgraded. The National Nuclear Security Administration (NNSA)—run plutonium pit production facility in Los Alamos, New Mexico, for example, sits atop a major

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*nal Commission on the Strategic Posture of the United States* (Washington, D.C.: U.S. Institute of Peace, 2009), 111.

4. Quoted by Taylor A. Bolz, ed., *In the Eyes of Experts: Analysis and Comments on America’s Strategic Posture* (Washington, D.C.: U.S. Institute of Peace, 2009), 12.

5. See, e.g., DoD, *Report of the Defense Science Board Task Force on Nuclear Deterrence Skills* (Washington, D.C.: U.S. Government Printing Office, 2008); and James Schlesinger et al., *Report of the Secretary of Defense Task Force on DoD Nuclear Weapons Management: Phase II: Review of the DoD Nuclear Mission* (Washington, DC: U.S. Government Printing Office, 2008).

6. Perry et al., *America’s Strategic Posture*.



earthquake fault line. And the uranium facility in Oak Ridge, Tennessee, dates back to the Manhattan Project. Both need to be replaced, at the cost of billions of dollars each.

Significant capital costs would also be required to replace or modernize the delivery vehicles for nuclear weapons, including strategic bombers, Minuteman III ballistic missiles, sea-launched Trident missiles, the aging Ohio-class nuclear submarines, and nuclear-capable cruise missiles. The need to upgrade the nuclear enterprise led Secretary of Defense Robert Gates to transfer \$8.3 billion in top-line budget authority from the Department of Defense to NNSA over five years—no casual act in a period of tightened budgets.

The condition of the U.S. nuclear enterprise was an important, but hitherto underappreciated, part of the ratification debate on New START, which was signed in April 2010. When New START was finally ratified by the Senate, it was only after the Obama administration had laid out a new plan to remedy some of the well-established problems with the nuclear enterprise. Although exacted as a political “grand bargain” by the Senate, the basic idea that nuclear cuts should proceed in tandem with nuclear modernization is firmly rooted, as discussed below, in the technical realities of the post-Cold War hedging strategy implemented by the Clinton administration.

The Senate’s approval of New START in December 2010, at the close of the 111th Congress, reflected those promises about the future of the U.S. nuclear arsenal and modernization of the U.S. strategic nuclear enterprise. Specifically, the connection was first made in a series of reports and letters exchanged between senators and the administration, and second in the Senate’s Resolution of Ratification, which specifically called for their implementation. The Obama administration committed to modernizing the nuclear arsenal, seeking \$7.6 billion in its fiscal year (FY) 2012 budget request for nuclear weapons activities and pledging a total of \$189 billion over the next decade for both weapons and delivery vehicles.

This commitment came in part in November 2010 in an updated “Section 1251 Report” (named for the section number of the FY 2010 defense act requiring it). Therein, the administration described the problems and acknowledged that its commitment was with full awareness of the fiscal restrictions facing the government: “Given the extremely tight budget environment facing the federal government, these [increased budget] requests to the Congress demonstrate the priority the Administration places on maintaining the safety, security, and effectiveness of the deterrent.”<sup>7</sup>

In short, commitment to the modernization of both weapons and delivery systems enabled cuts in the stockpile—cuts that, if enacted in the absence of modernization, could call into question the United States’ ability to meet its deterrence requirements. Subsequent administration statements after New START’s ratification, however, indicated that the administration was considering much deeper cuts quite irrespective of the promised modernization progress.

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7. “November 2010 Update to the National Defense Authorization Act of FY 2010 Section 1251 Report: New START Treaty Framework and Nuclear Force Structure Plans,” Scribd.com, November 2010, 2, <http://www.scribd.com/doc/43340875/1251>.

These facts set the stage for the 112th Congress, and thus shaped the discussion, oversight, hearings, and legislation of the House and Senate subcommittees on strategic forces. In early 2011, the armed services committees of both the Democratic-controlled Senate and the Republican-controlled House held hearings on the post–New START environment, on plans to implement the promised nuclear modernization, and on reports that the administration planned to make still-deeper cuts, below New START levels. Over the ensuing months, executive branch–congressional politics and budget disputes, along with the administration’s eagerness for deeper arms control reductions, began to draw that grand bargain into serious doubt. As a result, members of both the House and the Senate introduced two nearly identical bills called “the New START Implementation Act,” or NSIA (H.R. 1750 / S. 1097).

Reaffirming the importance of modernization outlined in the Senate’s resolution of ratification, the NSIA linked deeper reductions with nuclear modernization, both during the life of the treaty and beyond it, as well as paving the way for greater congressional oversight in future reductions to the nuclear stockpile. According to the provisions, the executive branch would be prohibited from unilaterally reducing, retiring, or dismantling weapons in the stockpile, except pursuant to law, in the form of either a treaty or statute. It would have altered the deference to unilateral executive branch preferences, which is perhaps appropriate with a much smaller and aging stockpile. The shrinking size of the stockpile cannot easily be reversed, and decisions to accelerate these reductions should therefore be made with care.

In the House, most of the NSIA provisions were incorporated into the annual national defense authorization act for FY 2012 (H.R. 1540), and were then passed by the House. Shortly after passage, however, the Obama administration threatened to veto the annual defense bill if it contained several of the NSIA provisions.<sup>8</sup> When the Senate passed its version of the defense authorization act for FY 2012, it lacked comparably robust provisions of the NSIA, but, of particular importance, did address some of the House’s concerns by establishing reporting requirements. Following a conference between the House and Senate in December 2011, the compromise bill dropped the more restrictive legislative mechanisms. In return, funding authorization for the nuclear modernization programs was increased, albeit slightly. The postconference compromise act was signed into law by President Obama on December 31, 2011.

Meanwhile, in the fall of 2011, the Department of Defense began to review deterrence requirements and nuclear employment guidance for the specific purpose of creating “options” for “deeper” and “dramatic” reductions below New START levels.<sup>9</sup> If,

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8. Executive Office of the President, “Statement of Administration Policy: H.R. 1540—National Defense Authorization Act for FY 2012,” May 24, 2011, [http://www.whitehouse.gov/sites/default/files/omb/legislative/sap/112/saphr1540r\\_20110524.pdf](http://www.whitehouse.gov/sites/default/files/omb/legislative/sap/112/saphr1540r_20110524.pdf).

9. Tom Donilon, “Keynote,” remarks at Carnegie International Nuclear Policy Conference, Washington, March 29, 2011, <http://carnegieendowment.org/2011/03/29/keynote-thomas-donilon/2s6j>; Ellen Tauscher, “European Contributions to Nuclear Disarmament and Conflict Resolution,” remarks at the 59th Pugwash Conference on Science and World Affairs, Berlin, July 1, 2011, <http://www.state.gov/t/us/167985.htm>; DoD, *Nuclear Posture Review Report: April*

as it currently appears, the modernization-for-cuts grand bargain of 2010 is not fully implemented, it could both adversely affect the future prospects for nuclear reductions and also undermine trust between the executive and legislative branches. Indeed, all the concerns that prompted the NSIA are likely to remain for years to come.

## The Role of Congress

In recent decades, Congress has tended to acquiesce to presidential leadership and preferences with respect to nuclear reductions. The size and shape of the U.S. nuclear force has historically been largely “a function of presidential choice.”<sup>10</sup> The 1991 Presidential Nuclear Initiatives, for example, were nonbinding political arrangements that resulted, in part, in the withdrawal of thousands of U.S. nuclear warheads from Europe, and the destruction of thousands more, without express statutory authorization from Congress, or the advice and consent of the Senate, to do so. In 2004, the George W. Bush administration directed that the nuclear stockpile again be cut dramatically—by half—a goal that was reportedly met by 2007.<sup>11</sup> Since the Cold War, congressional interest in U.S. nuclear policy has waned, but this need not remain so. The NSIA of 2011 was one attempt in the 112th Congress to reassert congressional involvement in shaping the future of U.S. nuclear policy.

The basis for more robust congressional involvement in U.S. nuclear policy is quite straightforward. At times, both chambers of Congress have exercised oversight over the credibility, force structure, and policy, including the nuclear force employment issues raised by a possible policy of a “no first use.” Quite separate from the role of the Senate in approving or rejecting arms control treaties, Congress played an important role in shaping nuclear policy and force structure during the Cold War. If it wishes to resume such a role, it has ample legislative and appropriation authority to do so.

Speaking to Congress’s relative inattention in recent years, the Strategic Posture Commission warned about the adverse effects from the “chronic unwillingness of the Congress to support the programs needed to maintain [nuclear] test readiness,” and warned in particular of “evidence that some allies interpret the apparent lack of test readiness as a symptom of reduced U.S. commitment to extended deterrence.”<sup>12</sup> More robust congressional attention and involvement would be consistent with the commission’s recommendation that “the practice and spirit of executive–legislative dialogue on nuclear strategy that helped pave the way for bipartisanship and continuity in policy should be renewed.”<sup>13</sup>

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2010 (Washington, DC: U.S. Government Printing Office, 2010), 12, <http://www.defense.gov/npr/docs/2010%20nuclear%20posture%20review%20report.pdf>.

10. Perry et al., *America’s Strategic Posture*, 23.

11. Jim Trebes, “Monitoring a Nuclear Weapon from the Inside,” *Science and Technology Review*, July–August 2008.

12. Perry et al., *America’s Strategic Posture*, 51.

13. *Ibid.*, 15–16.

## After New START

In Prague on April 5, 2009, President Barack Obama pledged substantial reductions in the U.S. nuclear arsenal, offering “America’s commitment to seek the peace and security of a world without nuclear weapons.” But he added that “this goal will not be reached quickly—perhaps not in my lifetime.”<sup>14</sup> A year later, as required by Congress, the administration released a new Nuclear Posture Review (NPR) in April 2010—the third NPR since 1994. It stated that “changes in the nuclear threat environment have altered the hierarchy of our nuclear concerns and strategic objectives.” The NPR added that these recent changes would enable the United States to move to “significantly lower nuclear force levels and with reduced reliance on nuclear weapons.”<sup>15</sup> At the signing ceremony for New START that same month, Obama reaffirmed his hope that the treaty would “set the stage” for further and “more significant cuts.”<sup>16</sup>

Although describing a vision of ultimate elimination, Obama affirmed in his 2009 Prague speech that as long as nuclear weapons existed in the world, the United States would retain a strong nuclear deterrent: “Make no mistake: As long as these weapons exist, the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense to our allies.”

The above-mentioned Strategic Posture Commission reached conclusions of similar balance in its final report, which was released a month after Obama’s Prague speech. It judged that “the United States will need to sustain a deterrent for the indefinite future.” Furthermore, with respect to the twin goals of eventual elimination and indefinite deterrence articulated by Obama in Prague, the commission observed that “conflicts or trade-offs” could arise, and therefore urged a careful balance:

A U.S. policy agenda that seems to stress unnecessarily our nuclear weapon posture could erode international cooperation to reduce nuclear dangers. Conversely, a policy agenda that emphasizes unilateral reductions could weaken the deterrence of foes and the assurance of allies. It is necessary to strike a balance in meeting these two imperatives.<sup>17</sup>

Although some have characterized the Prague vision as a radical departure from the past, former secretary of defense William Perry writes that it instead is merely “the most recent formulation of the ‘lead but hedge’ policy” articulated by the Clinton administration’s 1994 NPR, and reaffirmed again in large measure by the George W. Bush administration.<sup>18</sup> The Strategic Posture Commission expressed concerns about the complete

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14. Barack Obama, remarks at Hradcany Square, Prague, April 5, 2009.

15. DoD, *Nuclear Posture Review Report: April 2010*.

16. Barack Obama and Dmitry Medvedev, remarks at New START Treaty Signing Ceremony and Press Conference, Prague, April 8, 2010.

17. Perry et al., *America’s Strategic Posture*, 15.

18. Ibid., xi. See also Robert Gates, “Nuclear Weapons and Deterrence in the 21st Century,” speech at the Carnegie Endowment for International Peace, Washington, October 28, 2008: “President Clinton called his nuclear arms reductions part of a lead and hedge strategy: we’ll lead the way in reducing our arsenal, but we must always hedge against the dangerous and

elimination of nuclear weapons: “The conditions that might make possible the global elimination of nuclear weapons are not present today and their creation would require a fundamental transformation of the world political order.” The commission further noted that while the “nuclear deterrent of the United States need not play anything like the central role that it did for decades in U.S. military policy and national security strategy,” it nevertheless “remains crucial for some important problems.” Moreover, the road to deep reductions could incur numerous challenges, and these challenges had still yet to be explored. Deeper reductions in U.S. forces could, furthermore, have yet-unanticipated and unintended consequences for strategic stability and balanced nuclear postures; indeed, “the challenges of finding stabilizing, balanced postures will become only more pronounced as deeper reductions require the participation of additional states.”<sup>19</sup>

## The Stockpile and New START

The 5,113 weapons in the U.S. stockpile in 2009 included both deployed and nondeployed weapons (table 1). Only the former have previously been restricted by international treaties; nondeployed weapons, and thus the number of the total stockpile, have never been restricted by treaty. Of the 5,113 or so warheads in the stockpile in late 2009, the counting rules of the Moscow Treaty of 2002 would in principle have allowed up to 2,200 of them to be deployed at any time.<sup>20</sup> As of 2008, the deployed nuclear force levels of the United States were reportedly already below the 2,200 threshold, and represented the lowest levels of deployed weapons since the Eisenhower administration.<sup>21</sup>

New START was signed on April 8, 2010, and approved by the Senate on December 22, 2010, and it entered into force on February 5, 2011. Under the terms of the treaty, the United States and Russia will be limited to lower legal limits on delivery vehicles and deployed warheads within seven years from the date the treaty enters into force; specifically:

- A limit of 1,550 deployed strategic nuclear warheads. Each warhead on deployed intercontinental ballistic missiles (ICBMs) and deployed submarine-launched ballistic missiles (SLBMs) counts toward this limit, and each deployed heavy bomber equipped for nuclear armaments counts as one warhead toward this limit.
- A combined limit of 800 deployed and nondeployed ICBM launchers, SLBM launchers, and heavy bombers equipped for nuclear armaments.
- A separate limit of 700 deployed ICBMs, deployed SLBMs, and deployed heavy bombers equipped for nuclear armaments.

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unpredictable world. That is still true today and maybe even more so.”

19. Perry et al., *America's Strategic Posture*, 66–67.

20. The 2002 Moscow Treaty between the United States and Russia made no restrictions on the number of delivery systems and allowed each party to deploy up to a maximum of 1,700 to 2,200 nuclear weapons.

21. Perry et al., *America's Strategic Posture*, 5.

**Table 1. U.S. Stockpiled Weapons, Ends of Fiscal Years 1962–2009**

Year	No.	Year	No.	Year	No.	Year	No.
1962	25,540	1974	28,537	1986	23,317	1998	10,732
1963	28,133	1975	27,519	1987	23,575	1999	10,685
1964	29,463	1976	25,914	1988	23,205	2000	10,577
1965	31,139	1977	25,542	1989	22,217	2001	10,526
1966	31,175	1978	24,418	1990	21,392	2002	10,457
1967	31,255	1979	24,138	1991	19,008	2003	10,027
1968	29,561	1980	24,104	1992	13,708	2004	8,570
1969	27,552	1981	23,208	1993	11,511	2005	8,360
1970	26,008	1982	22,886	1994	10,979	2006	7,853
1971	25,830	1983	23,305	1995	10,904	2007	5,709
1972	26,516	1984	23,459	1996	11,011	2008	5,273
1973	27,835	1985	23,368	1997	10,903	2009	5,113

Source: U.S. Department of Defense, “Fact Sheet: Increasing Transparency in the U.S. Nuclear Weapons Stockpile.”

The pace at which the United States reduces its deployed forces to comply with New START had still not been determined as late as January 2012, but appears unlikely to begin even during FY 2013. Some have predicted that under current plans, the number of weapons in the U.S. stockpile could decline from the 5,113 warheads reported in 2009 to about 4,600 warheads in or around 2012.<sup>22</sup> The currently planned cuts to nondeployed weapons before the years 2021–2023 would probably consist of only a few hundred warheads; more significant cuts to the stockpile are contingent upon the implementation of a responsive nuclear infrastructure. The marginal cost of retaining such an additional number of warheads over that period (as opposed to retiring them) is relatively small, probably in the tens of millions of dollars.<sup>23</sup>

To be clear, however, of the nuclear weapons classified as “operationally deployed” for legal treaty purposes, most are not on alert and responsive to presidential orders. Ref-

22. Hans M. Kristensen et al., *From Counterforce to Minimum Deterrence: A New Nuclear Policy on the Path toward Eliminating Nuclear Weapons*, Occasional Paper 7 (Washington, DC: Federation of American Scientists and Natural Resources Defense Council, 2009), 13, [http://www.fas.org/pubs/\\_docs/OccasionalPaper7.pdf](http://www.fas.org/pubs/_docs/OccasionalPaper7.pdf).

23. General James Cartwright has suggested that “although the exact costs associated with maintaining additional warheads would depend on the mix of warhead types selected, a reasonable estimate is that retaining additional warheads would cost several tens of millions of dollars per year.” James Cartwright, vice chairman, Joint Chiefs of Staff, “Responses to December 1, 2010, questions from Senator Kyl,” December 6, 2010.



erencing the limit of 1,700 to 2,200 operationally deployed strategic nuclear weapons set by the 2002 Moscow Treaty, a 2008 report jointly issued by the secretaries of defense and of energy noted that the actual day-to-day number is “much smaller,” and that it could take “a few weeks to months” to bring up to day-to-day operational availability the full figure of deployed nuclear weapons.<sup>24</sup> Some nongovernmental experts estimate that, in recent years and under current alert postures and guidance, the force of operationally deployed strategic warheads on alert and available for immediate deterrence and defeat goals has been closer to 900.<sup>25</sup>

Data exchanged shortly after the ratification of New START confirmed that although the United States will need to make reductions in both deployed nuclear warheads and delivery vehicles in order to reach New START levels, Russia will need to make much more modest cuts, and only in the category of nondeployed delivery vehicles (see table 2). Specifically, the United States will need to reduce

- deployed delivery vehicles (ICBMs, SLBMs, and bombers) by 182 in order to reduce the number from 882 to meet the treaty’s limit of 700;
- the aggregate of deployed and nondeployed delivery vehicles by 324, to reduce the number from 1,124 to the treaty’s limit of 800; and
- deployed nuclear weapons from 1,800 by 250 to reach the treaty’s the limit of 1,550.

A data exchange after the treaty’s entry into force on February 5, 2011, also revealed that the Russian Federation will need to make almost no reductions in order to meet New START levels. According to the counting rules of the treaty, both Russia’s deployed delivery vehicles and its deployed warheads were already below New START levels. Russia will, however, need to make some modest reductions to its aggregate total of deployed and nondeployed delivery vehicles.

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24. “Strategic nuclear warheads available on a day-to-day basis provide a spectrum of targeting options for consideration during rapidly developing, high-stakes contingencies. This force, much smaller than the 1,700 to 2,200 ODSNW [operationally deployed strategic nuclear weapons], and routinely deployed and responsive to orders only from the President, serves immediate deterrence and defeat goals. However, should unexpected developments pose a more imminent threat, the projected day-to-day alert force could be increased relatively quickly (a few weeks to months) up to the baseline.” Samuel W. Bodman and Robert M. Gates, *National Security and Nuclear Weapons in the 21st Century*, Report for U.S. Department of Energy and U.S. Department of Defense (Washington, D.C.: U.S. Government Printing Office, 2008), 13, <http://www.defense.gov/news/nuclearweaponspolicy.pdf>.

25. Kristensen et al., *From Counterforce to Minimum Deterrence*, 12.

**Table 2. U.S. and Russian Deployed Warheads and Delivery Vehicles as of February 5, 2011**

Category	United States	Russian Federation	Allowed under New START	Number to Reduce (United States / Russia)
Deployed ICBMs, deployed SLBMs, and deployed heavy bombers	882	521	700	182 / N.A.
Warheads on deployed ICBMs, on deployed SLBMs, and nuclear warheads counted for deployed heavy bombers	1,800	1,537	1,550	250 / N.A.
Deployed and nondeployed launchers of ICBMs, deployed and nondeployed launchers of SLBMs, and deployed and nondeployed heavy bombers	1,124	865	800	324 / 65

Source: “New START Treaty Aggregate Numbers of Strategic Offensive Arms,” fact sheet, Bureau of Arms Control, Verification and Compliance, June 1, 2011, <http://www.state.gov/documents/organization/191792.pdf>.

## Why a Nondeployed Hedge?

Significantly, New START did not restrict or reduce the numbers of nondeployed nuclear warheads (nor, indeed, had previous arms control treaties). Since then, however, the Obama administration has indicated that post–New START negotiations may include them, thus reducing the total stockpile below current levels. On March 29, 2011, National Security Adviser Tom Donilon stated that the administration believes “the next agreement with Russia . . . should include both nondeployed and nonstrategic nuclear weapons.”<sup>26</sup> If implemented before the creation of a responsive nuclear infrastructure, however, deeper cuts could begin to call into question the United States’ extended deterrent commitments to allies.

The U.S. nuclear stockpile contains a substantial number of nondeployed weapons to “hedge” against technical and geopolitical uncertainties. If a systemic technical failure were to affect an entire class of warheads, or geopolitical events were to warrant an increased deployment of warheads, nondeployed warheads could be deployed and “uploaded” onto existing nuclear delivery systems (e.g., missiles, bombers, and submarines) to compensate. This long-established practice continues an approach utilized since the end of the Cold War to ensure that there will be a robust deterrent force without the need for nuclear explosive testing. The Clinton administration’s 1994 NPR articulated a “lead but hedge” strategy to making deep post–Cold War cuts in deployed forces while retaining substantial nondeployed forces.

26. Donilon, “Keynote.”

The strategy of stockpile hedging is a form of risk management. During the Cold War, the nondeployed stockpile was less important, because the United States maintained and continually used a robust production capability for nuclear warheads. This capability allowed the United States to produce nuclear warheads in large numbers in a short period of time. The number of deployed and nondeployed U.S. nuclear weapons has since been reduced dramatically, but the existence and basic rationale for the nondeployed stockpile remain.

Two basic relationships that govern the need for a nondeployed hedge and the size of the nuclear stockpile have remained unchanged since the end of the Cold War:

- the need to hedge against geopolitical and technical uncertainties (as noted in the 1994, 2001, and 2010 NPRs); and
- the relationship between the potential for hedge reductions and a responsive infrastructure (as noted in the “New Triad” of the 2001 NPR and reaffirmed in the 2010 version).

Factors unique to the United States make reductions in its nondeployed forces of greater significance as compared with those of Russia or other nuclear powers. As explained in the 2011 edition of the Department of Defense report *Nuclear Matters Handbook*,

There are two basic approaches to nuclear stockpile risk mitigation: the existence of a significant warhead production capability, the maintenance of warheads designated as hedge weapons, or some combination of the two. During the Cold War, the United States maintained a robust production capability to augment or decrease production, as required, depending on operational and geopolitical requirements. Today, the United States does not have an active nuclear weapon production capability and relies on the maintenance of a warhead hedge to reduce risk to acceptable levels.<sup>27</sup>

Elaborating on the role of a nondeployed hedge force for the United States, a September 2008 joint report by the Department of Defense and the Department of Energy notes that “the United States is now the *only* nuclear weapons state party to the NPT [Nuclear Non-Proliferation Treaty] that does not have the capability to produce a new nuclear warhead” (emphasis in the original).<sup>28</sup> Instead of a Stockpile Stewardship Program to maintain the existing stockpile by means of advanced modeling, simulation, experiments, and surveillance, Britain, France, Russia, and China retain the means to replace old nuclear warheads and create new ones. Whereas these other countries use production capability to serve as a kind of hedge, the United States remains heavily reli-

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27. Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs, *The Nuclear Matters Handbook: Expanded Edition* (Washington, D.C.: U.S. Government Printing Office, 2011), chap. 3, [http://www.acq.osd.mil/ncbdp/nm/nm\\_book\\_5\\_11/docs/NMHB2011.pdf](http://www.acq.osd.mil/ncbdp/nm/nm_book_5_11/docs/NMHB2011.pdf)?

28. Bodman and Gates, *National Security*, 19.

ant upon a large number of older nondeployed nuclear forces.<sup>29</sup> In the absence of even a modest or “trickle” production capability, a smaller hedge incurs greater risk than a larger one.<sup>30</sup> As *Nuclear Matters* further explains,

In the absence of a modernized nuclear infrastructure and the reestablishment of a fissile component production capability (with sufficient capacity), the decision to reduce the size of the hedge and dismantle additional weapons is final and cannot be reversed. Once the weapons are gone, the total stockpile number is permanently decreased until the United States can produce replacements—using a production process whose construction and deployment time to a first weapon could take two decades or longer.<sup>31</sup>

Indeed, over time, and even without reductions, the risks involved with the aging nondeployed force will naturally increase. The September 2008 report issued by the Department of Defense and Department of Energy adds that

the United States has not designed a new nuclear warhead since the 1980s and has not built a new warhead since the early 1990s. As a result, the nuclear weapons infrastructure has atrophied and existing U.S. nuclear weapons—most of which were designed 20 to 30 years ago—are being maintained well beyond the service life for which they were designed. Critical personnel, with experience in the design and testing of nuclear weapons, are also aging and retiring, and in the absence of a viable nuclear infrastructure, their expertise cannot be replaced.

In short, the post–Cold War moratorium on nuclear testing and the lack of a production capability means that “the process of *modernize* and *replace* became one of *retain* and *maintain*” (emphasis added).<sup>32</sup> For weapons that were originally designed to have a life span of perhaps only 20 years, “retain and maintain” strategies have their limits.

The nuclear arsenal has been annually certified as safe, secure, and reliable on the basis of the Stockpile Stewardship Program, through which NNSA conducts surveillance of warheads and ascertains the effects of aging. The “retain and maintain” path, however, is not without limitations, and as the stockpile ages, becomes smaller, and incorporates fewer weapon types, less flexibility translates into greater technical risk.<sup>33</sup> Delays further compound the risk: “The capability and credibility of the nation’s deterrent is particularly sensitive to technical problems that could render a warhead unacceptable.”<sup>34</sup> Experience has confirmed the need to hedge against technical risks. A study in the early 1980s sponsored by the Department of Energy suggested that “at times in the past, the

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29. Perry et al., *America’s Strategic Posture*, 14.

30. James M. Acton and Michael S. Gerson, eds., *Beyond New START: Advancing U.S. National Security through Arms Control With Russia* (Washington, D.C.: CSIS, 2011), vii, [http://csis.org/files/publication/110824\\_Acton\\_BeyondNewSTART\\_WEB.pdf](http://csis.org/files/publication/110824_Acton_BeyondNewSTART_WEB.pdf).

31. Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs, *Nuclear Matters Handbook*, chap. 3.

32. *Ibid.*, chap. 1.

33. Bodman and Gates, *National Security*, annex I.

34. *Ibid.*

warheads for a large part of the U.S. [ballistic missile submarine] force have been found to be badly deteriorated. At different times, a large fraction of the warheads either obviously or potentially would not work; they were obvious or potential duds.”<sup>35</sup>

The 2009 Strategic Posture Commission was more explicit. Although the commission judged that the United States must maintain a nuclear deterrent for “the indefinite future,”<sup>36</sup> it noted that the current approaches, although praiseworthy, had limits. In its view, “the Stockpile Stewardship Program and the Life Extension Program have been remarkably successful in refurbishing and modernizing the stockpile to meet these criteria, but cannot be counted on for the indefinite future.”<sup>37</sup> The commission added that challenges to the Stockpile Stewardship Program and Life Extension Program will increase with time.<sup>38</sup>

Regardless of the larger enterprise, the hedge force itself has a finite lifetime, and relying upon thousands of weapons is both unsustainable and undesirable for those who would prefer deeper reductions, on the part of both the United States and Russia. The indefinite reliance upon the reserve or hedge force “highlights the urgency of getting on with the task of restoring a responsive and capable nuclear weapons infrastructure.”<sup>39</sup> The report continues:

In the long term, the goal is for the United States to rely more on a revived nuclear infrastructure to respond to unforeseen events, and less on reserve warheads in the stockpile. However, until there is confidence in the infrastructure’s demonstrated capability to respond to unexpected developments by producing nuclear weapon components in sufficient quantities, especially plutonium pits, the United States will need to retain more reserve warheads than otherwise would be desired as a hedge against technical problems or adverse geopolitical changes.<sup>40</sup>

As noted by the 2010 NPR, the numbers of hedge weapons necessary could be diminished with the “implementation” of the major infrastructure identified by the NPR, including the new plutonium and uranium facilities.<sup>41</sup> The 2010 NPR’s identification of these needs was similar to the calls for a “responsive infrastructure” found in the 2001 NPR and the report of the Strategic Posture Commission.<sup>42</sup> Creating this responsive in-

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35. Jack W. Rosengren, *Some Little-Publicized Difficulties with a Nuclear Freeze*, RDA-TR-122116-001 (Marina del Rey, Calif.: R&D Associates, 1983), 13–20. See also Walter Pincus, “Scientists Bare Warhead Duds on ‘60s Polaris,” *Washington Post*, December 2, 1978.

36. Perry et al., *America’s Strategic Posture*, 12.

37. *Ibid.*, xvii.

38. *Ibid.*, xii. The 2008 DoD–DoE report also expressed concern about the indefinite sustainability of the SSP and LEP approaches, noting that: “Successive efforts at extending the service life of the current inventory of warheads, however, can decrease confidence in the nuclear stockpile as the warheads deviate further from baseline designs which were originally validated using nuclear test data.” Bodman and Gates, *National Security*.

39. Bodman and Gates, *National Security*.

40. *Ibid.*

41. DoD, *Nuclear Posture Review Report: April 2010*, 30.

42. Perry et al., *America’s Strategic Posture*.

frastructure represents the *heart* of the grand bargain for New START, and keeping this bargain on track was the foremost purpose of the NSIA.

Implementing the responsive nuclear infrastructure promised before the ratification of New START would allow for further reductions in the total nuclear stockpile—deeper cuts than would otherwise be prudent.

One concern, however, is that the executive branch could choose to redefine U.S. deterrence requirements down—accepting greater technical risk, changed targeting strategies, or different assumptions about future geopolitical conditions in such a way as to render the need for a responsive infrastructure seemingly less urgent. The deterrence review begun in late 2011, and which is expected to be completed before the FY 2013 budget request, could do just this. Described as taking place for the express purpose of creating options for future nuclear reductions, the review will reportedly include “alternative approaches . . . to hedging.” Because the deterrence review has been expressly described as a means to identify possible deeper cuts, a redefinition of U.S. deterrence strategy could create substantial concern about the sustainability of the U.S. deterrent.<sup>43</sup>

## A Sustainable Nuclear Deterrent

All the relevant parties have been in remarkable agreement about the basic outlines of what the head of the NNSA, Tom D’Agostino, has called a “sustainable nuclear deterrent.”<sup>44</sup> The 2010 NPR, for example, stated that “to sustain a safe, secure, and effective U.S. nuclear stockpile as long as nuclear weapons exist, the United States must possess a modern physical infrastructure—comprised of the national security laboratories and a complex of supporting facilities.” The NPR emphasized that “these investments are essential to facilitating reductions while sustaining deterrence under New START and beyond.”<sup>45</sup>

In May 2010, shortly after the signing of New START, NNSA released its FY 2011 Stockpile Stewardship Management Plan report to Congress. This report identified numerous requirements for the new nuclear infrastructure, including the ability to undertake two or three simultaneous warhead life extension programs, instead of the current capability of one; the ability to produce 80 uranium canned subassemblies per year at Oak Ridge, as opposed to the current capacity of 40; and up to 80 plutonium pits per year at Los Alamos, versus the current rate of 10 to 20.<sup>46</sup> These new plutonium and uranium facilities were at the top of the list of the “essential investments” identified by the 2010

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43. James Miller, principal deputy undersecretary of defense for policy, testimony before the Senate Armed Services Strategic Forces Subcommittee, May 4, 2011.

44. Tom D’Agostino, “Charting a Sustainable Course for the National Nuclear Security Enterprise,” remarks at the First Annual Nuclear Deterrence Summit, Washington, December 2–5, 2008.

45. DoD, *Nuclear Posture Review Report: April 2010*.

46. National Nuclear Security Administration, *FY 2011 Stockpile Stewardship and Management Plan: Annex D* (Washington, D.C.: U.S. Government Printing Office, 2010), 5, [http://www.fas.org/programs/ssp/nukes/nuclearweapons/SSMP2011\\_annexD.pdf](http://www.fas.org/programs/ssp/nukes/nuclearweapons/SSMP2011_annexD.pdf).



NPR; indeed, the NPR committed to having them come online by 2021.

Indeed, the recommendations of what it would take to create a sustainable deterrent were, then, remarkably consistent across a broad, disparate, and bipartisan set of authorities. These include:

- the 2009 report of the bipartisan Strategic Posture Commission.
- the Obama administration’s 2010 NPR.
- NNSA’s 2010 Stockpile Stewardship and Management Plan report.
- the Senate’s December 2010 resolution of ratification to New START, requiring that the president certify that he would accelerate the new plutonium and uranium facilities to the extent possible, and continue to request full funding for their completion.
- an exchange of letters between President Obama and the top four Senate appropriators of both parties, in December 2010. The president’s letter stated: “I recognize that nuclear modernization requires investment for the long-term; . . . that is my commitment to the Congress—that my administration will pursue these programs and capabilities for as long as I am president.”
- the subsequent February 2, 2011, certifications by President Obama to the Senate: “I intend to (a) modernize or replace the triad of strategic nuclear delivery systems: a heavy bomber and air-launched cruise missile, an ICBM, and a nuclear-powered ballistic missile submarine (SSBN) and SLBM; and (b) maintain the United States rocket motor industrial base”; and further, that I intend to (a) accelerate, to the extent possible, the design and engineering phase of the [new plutonium and uranium facilities]; and (b) request full funding, including on a multi-year basis as appropriate, for the [buildings] . . . upon completion of the design and engineering phase for such facilities.”
- the update to the “Section 1251 Report,” delivered in November 2010, which stated that the construction for the new plutonium and uranium facilities would be complete by 2021, and would have full operational functionality by 2024.

Based on all these authorities and these numerous commitments, the NSIA identified each of these several metrics as discrete goals that should be met both during the reductions in deployed forces planned under New START and as baselines to be demonstrated before further nonrequired reductions were made in the nondeployed hedge stockpile. Notwithstanding all this background and the bill’s correspondence to their own stated goals and commitments, the administration threatened to veto the annual defense authorization act if it included the NSIA provisions.

The attempt to legislate the New START modernization bargain was, however, soon stymied by ordinary budgetary issues. As noted above, the Obama administration’s updated “Section 1251 Report” of November 2010 pledged a substantial level of funding for nuclear weapons activities by NNSA. Before New START was signed, the chairmen

and ranking members of the full Appropriations Committee in the Senate, and the Senate Energy and Water Subcommittee on Appropriations, exchanged letters with the president pledging full support for these funding levels in the future. Unfortunately, the appropriations committees in the House of Representatives did not exchange these letters, and when it came time to appropriate NNSA for FY 2012, the nuclear weapons activities account was cut by \$440 million (5.8 percent), from \$7.6 to \$7.1 billion.

More recent events further threaten the implementation of the New START modernization bargain. Following a department-wide strategic review of defense requirements, on January 3, 2012, President Obama and Defense Secretary Leon Panetta released an overview of a new strategic defense plan, which briefly suggested that “*it is possible that our deterrence goals can be achieved with a smaller nuclear force*, which would reduce the number of nuclear weapons in our inventory as well as their role in U.S. national security strategy” (emphasis in the original).<sup>47</sup>

On January 25, 2012, Panetta unveiled a more detailed overview of defense cuts proposed for the coming decade.<sup>48</sup> This document reaffirmed the coming FY’s protection of the nuclear Triad, but it noted that the Ohio-class nuclear submarine replacement force would be delayed, creating challenges for maintaining current at-sea presence requirements in the 2030s. The report also referenced the “ongoing” White House review of deterrence requirements, which “will address the potential for maintaining the nation’s deterrent with a different nuclear force. These statements have led some observers to be concerned that the administration’s pre–New START commitment to a 10-year, \$189 billion investment for a truly sustainable nuclear deterrent now stands in jeopardy, and that the FY 2013 request for weapons activities could be substantially reduced.

Although the legislative provisions were abandoned during conference with the Senate in December 2011, their underlying concerns remain unresolved, and the sustainability of the nuclear enterprise is certain to reappear as a point of controversy for FY 2013. Whether the post–New START path toward a sustainable nuclear deterrent will be implemented remains to be seen, but may depend upon congressional vigilance.

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47. DoD, *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense* (Washington, D.C.: U.S. Government Printing Office, 2012), [http://www.defense.gov/news/Defense\\_Strategic\\_Guidance.pdf](http://www.defense.gov/news/Defense_Strategic_Guidance.pdf).

48. DoD, *Defense Budget Priorities and Choices* (Washington, D.C.: U.S. Government Printing Office, 2012), [http://www.defense.gov/news/Defense\\_Budget\\_Priorities.pdf](http://www.defense.gov/news/Defense_Budget_Priorities.pdf).

# Cruise Missiles in Southern Asia: Strategic Implications for China, India, and Pakistan

Kalyan Kemburi<sup>1</sup>

## Abstract

The last two decades have witnessed the rise of cruise missiles as a coercive political tool and a versatile military weapon. Compared with other air delivery systems—aircraft and ballistic missiles—cruise missiles have certain unique technical characteristics: operational flexibility, precision, ability to penetrate air defenses, and affordability in development and deployment. These capabilities have attracted interest from military establishments the world over, including China, India, and Pakistan. This paper endeavors to analyze the capability and utility of cruise missiles to undertake deterrence missions and/or degrade missile defenses in these three countries.

In 2005, General Pervez Musharraf, then president of Pakistan, announced triumphantly the successful test firing of Pakistan's first cruise missile, Babur. Musharraf noted Babur's "biggest value is [that] it is not detectable . . . [and] cannot be intercepted."<sup>2</sup> This statement highlights the utility of the missile to undertake both first-use and second-strike missions: First, the stealth enables the missile to undertake a nuclear mission under a first-use policy;<sup>3</sup> and second, the missile is considered an offensive counter to the missile defense systems being deployed in the region.

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1. Kalyan M. Kemburi is an associate research fellow for the China Program of the S. Rajaratnam School of International Studies, Nanyang Technological University, Singapore. The author expresses his deepest gratitude to Dennis Gormley, Jing-dong Yuan, and Rajesh Basrur for their intellectual input and academic support.

2. Cited in Dennis M. Gormley, *Missile Contagion: Cruise Missile Proliferation and the Threat to International Security* (Westport, Conn.: Praeger Security International, 2010), 1.

3. The reason for specifically using the term "first use" not "first strike" is because the latter demands extensive targeting and delivery systems, which are presently difficult for Pakistan to muster due to financial and technological limitations. Under a first-use scenario, Islamabad would be responding with a nuclear use only after India has overwhelmed Pakistan with conventional forces. For more information on this issue, see Rajesh Rajagopalan, *Second Strike: Arguments about Nuclear War in South Asia* (New Delhi: Penguin Books, 2005).

With the advent and success of U.S. “cruise-missile diplomacy,”<sup>4</sup> beginning in the 1990s, cruise missiles emerged as a coercive political tool and a versatile military weapon. During the initial phase of the last two decades, cruise missiles were predominantly developed and deployed by a few advanced industrial countries, in particular the United States. These missiles were used for standoff precision strikes, with the stealth features enhancing the effectiveness of the weapon system.

However, the last decade had witnessed a new trend, as emerging industrial countries are showing increased propensity to develop cruise missiles. In addition to the effectiveness of cruise missiles in carrying out precision strikes, the new strategic rationale also emphasizes the ability of this weapon system to penetrate air defenses, and its affordability in development and deployment. Moreover, two recent incidents have attested to the effectiveness of cruise missiles: First, the failure of coalition missile defenses during the 2003 Operation Iraqi Freedom against the Iraqi cruise missile attacks.<sup>5</sup> Second, Hezbollah’s successful attack against an Israeli naval vessel in 2006 with an antiship cruise missile (ASCM).<sup>6</sup>

These incidents have raised the profile of cruise missiles among state and nonstate actors alike. Of particular concern is that most of the cruise missile aspirants are in zones of potential conflict: the Middle East, South Asia, the Korean Peninsula, and the Taiwan Strait. Compared with other delivery systems such as aircraft and ballistic missiles, cruise missiles are endowed with relatively better operational flexibility, including the ability to be launched from multiple platforms.

In spite of these wide-ranging implications, there has been little detailed analysis of cruise missiles. I am cognizant that not all the operational aspects of cruise missiles are deployed in all three countries that are this paper’s focus; however, in bringing these capabilities into this discussion, with the paper I hope to initiate a scholarly discussion on this important subject. What follows is a consideration of how the deployment of cruise missiles would affect the strategic calculus between China, India, and Pakistan, and an explanation of why the three countries should include this weapon system in any future strategic discussion and assessment.

## Cruise Missile Programs in China, India, and Pakistan

China, India, and Pakistan are currently in the process of developing and/or deploying several versions of land-, sea-, and air-launched land-attack cruise missiles (LACMs) of varying ranges. While the programs in China and India are mostly based on Soviet cruise

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4. David Tanks terms the United States’ employment of Tomahawk cruise missiles to punish or retaliate for violations of international norms and to fulfill national security objectives as “cruise-missile diplomacy.” See David Tanks, *Assessing the Cruise Missile Puzzle: How Great a Defense Challenge?* (Washington, D.C.: Institute for Foreign Policy Analysis, 2000), 7.

5. Dennis M. Gormley, “Missile Defense Myopia: Lessons from the Iraq War,” *Survival* 45, no. 4 (Winter 2003–2004): 61–86.

6. Frank Gardner, “Hezbollah Missile Threat Assessed,” BBC News, August 3, 2006, [http://news.bbc.co.uk/2/hi/middle\\_east/5242566.stm](http://news.bbc.co.uk/2/hi/middle_east/5242566.stm).

missile designs, drawing a flowchart for the cruise missile program in Pakistan is challenging. Reports indicate that the foundational technology for the cruise missile program in Pakistan may have been derived from South African missiles (possibly the Raptor-2, MUPSOW, and Torgos missiles) and from the indigenously developed targeting vehicle (the Nishan-Mk 2TJ). Additionally, cooperation with China, combined with technology scouted from unexploded Tomahawks that landed on Pakistani soil after being fired at Afghanistan in 1998,<sup>7</sup> could have helped Pakistan to perfect the technology.<sup>8</sup>

As with most military programs in these three countries, information pertaining to cruise missiles is also shrouded in ambiguity and secrecy, making it difficult to assess the precise scope and scale of these programs. As excellent historical analyses and detailed technical descriptions of these programs have been provided elsewhere, this section will only recapitulate the main issues.<sup>9</sup>

Having witnessed the prowess displayed by conventionally armed Tomahawks at striking targets with precision, military and defense industries in China have included conventionally armed surface-to-surface missiles and extended range cruise missiles as key projects in their developmental plans since the 1990s.<sup>10</sup> Among several cruise missiles that entered into service in China during the last fifteen years, the three models associated with the Hong Niao series LACMs warrant further attention.

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7. The United States fired these Tomahawks against suspected terrorist training camps in Afghanistan in 1998; some of them fell unexploded within the territory of Pakistan.

8. Usman Ansari, "Pakistan Eyes Launch Platforms, More Range for Missiles," *Defense News*, September 15, 2008.

9. For more information on cruise missiles in China, India, and Pakistan, see following sources. On cruise missiles in China: "C-602 (HN-1/-2/-3/YJ-62/X-600/DH-10/CJ-10/HN-2000)," *Jane's Strategic Weapon Systems*, June 1, 2010; "KD-63 (YJ-63), K/AKD-63," *Jane's Air-Launched Weapons*, April 26, 2010; Martin Andrew, "China's Conventional Cruise and Ballistic Missile Force Modernization and Deployment," *China Brief* 10, issue 1 (January 2010); and Michael S. Chase, "Chinese Land Attack Cruise Missile Developments and Their Implications for the United States," *China Brief* 8, issue 24 (December 2008). On cruise missiles in India: "BrahMos (PJ-10), 3M55 Yakhont," *Jane's Air-Launched Weapons*, March 28, 2011; "Sagarika," *Jane's Underwater Warfare Systems*, August 2010; Harsh V. Pant and Gopalaswamy Bharath, "India's Emerging Missile Capability: The Science and Politics of Agni-III," *Comparative Strategy* 27, issue 4 (2008): 382; Martin Sieff, "BrahMos-2 Tests Mark Major Progress on Indian Cruise Missile," *Space Daily*, March 6, 2008, [http://www.spacedaily.com/reports/BrahMos-2\\_Tests\\_Mark\\_Major\\_Progress\\_On\\_Indian\\_Cruise\\_Missile\\_999.html](http://www.spacedaily.com/reports/BrahMos-2_Tests_Mark_Major_Progress_On_Indian_Cruise_Missile_999.html); Sayan Majumdar, "The Brahmos Punch," *India Defence*, May 10, 2005, <http://indiadefence.com/brahmospunch.htm>; and T. S. Subramanian, "BrahMos success," *Frontline* 20, issue 5 (March 1–14, 2003), <http://www.flonnet.com/fl2005/stories/20030314002509400.htm>. On cruise missiles in Pakistan: Robert Hewson and Andrew Koch, "Pakistan Tests Cruise Missile," *Jane's Defense Weekly*, August 12–17, 2005; "Pakistan Stealth," *Aviation Week & Space Technology* 167, issue 9 (August 3, 2007); S. M. Hali, "Raad Roars!" *The Nation (AsiaNet)*, August 28, 2007; "Ansari, Pakistan Eyes Launch Platforms, More Range for Missiles," "Haft 8 (Raad)," *Jane's Strategic Weapon Systems*, August 24, 2011, and "Haft 7 (Babur)," *Jane's Strategic Weapon Systems*, August 24, 2011.

10. Mark A. Stokes, *China's Strategic Modernization: Implications for the United States* (Carlisle, Pa.: Strategic Studies Institute, U.S Army War College, 1999), 79.

The latest in this series the HN-3 entered into service in 2006 with a range of 3,000 kilometers.<sup>11</sup> It is further noted that the widely discussed DH-10 LACM, which was first displayed during the 60th Anniversary Parade in 2009, is based on the Hongniao 2 (HN-2) and reportedly started trials with the Second Artillery in 2004.<sup>12</sup> The 2008 Pentagon report on China's military power notes that DH-10 is nuclear capable; however, it is not certain whether the Second Artillery has utilized this option for the moment. Moreover, in 2010, *Jane's* reported that to differentiate between the conventionally armed DH-10 from the nuclear-tipped version, the Second Artillery uses two different canisters: circular-shaped (conventional) or octuple-shaped (nuclear).<sup>13</sup>

In India, the Brahmos is the most prominent and publicized LACM.<sup>14</sup> However, recent reports suggest that two more cruise missiles—Sagarika and Nirbhay—with ranges greater than Brahmos, are under various stages of development and testing. Brahmos, a ramjet-powered supersonic LACM, which could also be configured for ASCM missions, was reportedly derived from the Russian Yakhont ASCM. Although supersonic speeds enable Brahmos to evade most air defenses, its 290-kilometer range and 300-kilogram payload impose limitations either to achieve effectiveness as a viable nuclear deterrent or to undertake conventional strikes against counterforce and strategic targets. Reports indicate that Sagarika and Nirbhay could potentially overcome these limitations, although a lack of reliable information inhibits further analysis on this issue.

Sagarika is described as India's first submarine-launched nuclear-capable cruise missile with a range of approximately 1,300 kilometers (700 nautical miles).<sup>15</sup> In February 2010, the chief of India's Defense Research and Development Organization reported that an 800-kilometer-range cruise missile called Nirbhay is also under development.<sup>16</sup> Later speculation suggested that this missile might be under development specifically for conventional strike missions.<sup>17</sup>

Pakistan surprised the international community, and India in particular, with its announcement of a successful test of the land based Babur LACM in 2005. Babur is a subsonic LACM with a range of 500 to 750 kilometers and a payload of 450 to 500 kilograms, and it is probably powered with a turbojet engine. As of 2011, Babur was

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11. Ibid.; "C-602 (HN-1/-2/-3/YJ-62/X-600/DH-10/CJ-10/HN-2000)."

12. Ibid.; Andrew, "China's Conventional Cruise and Ballistic Missile Force Modernization."

13. "Power Posturing—China's Tactical Nuclear Stance Comes of Age," *Jane's Intelligence Review*, August 12, 2010.

14. Brahmos can be configured to act as either an antiship or land-attack cruise missile, depending on its flight management and mission planning components. Thanks to Dennis Gormley for highlighting this point.

15. "Cruise Missile to Be Tested Next Year," *Times of India*, November 12, 2006, [http://articles.timesofindia.indiatimes.com/2006-11-12/india/27789888\\_1\\_cruise-missile-submarine-launched-version-flight-trials](http://articles.timesofindia.indiatimes.com/2006-11-12/india/27789888_1_cruise-missile-submarine-launched-version-flight-trials).

16. "India Gets Ready for 'Nirbhay', the New Cruise Missile," *MSN News*, February 2, 2010, <http://news.in.msn.com/national/article.aspx?cp-documentid=3622928>.

17. "Su-30MKI to get Indian Nirbhay Cruise Missile," *Aviation Week*, May 10, 2010, [http://www.aviationweek.com/aw/generic/story\\_generic.jsp?channel=awst&id=news/awst/2010/05/10/AW\\_05\\_10\\_2010\\_p28-224612.xml](http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=awst&id=news/awst/2010/05/10/AW_05_10_2010_p28-224612.xml).



reported to have been successfully tested several times to evaluate various subsystems including guidance, which is supposed to be based on a combination of inertial guidance, a Global Positioning System, and TERCOM/ DSMAC systems. In 2007, Pakistan tested the Raad, an air-launched LACM with a range of 350 kilometers and a payload of 400 kilograms.

## Nuclear Postures, Force Deployments, and Missile Defense in Southern Asia

### *China*

China's nuclear posture has two characteristic features. First, the doctrine specifies neither the contours of the nuclear arsenal nor the size, a strategy not only to bring a dynamic quality to the size of the arsenal but also to make ambiguity part of the deterrence posture.<sup>18</sup> Second, Beijing does not subscribe to nuclear war fighting, which requires arsenals and doctrines defined under an assured destruction or limited deterrence posture,<sup>19</sup> but also does not strictly adhere to a minimum deterrence posture that relies on a small force to deter an adversary and does not involve a triad.<sup>20</sup> In the cases of both China and India, this dichotomy possibly derives from a doctrine that might be called "credible" deterrence, which requires postures beyond minimum deterrence but below limited deterrence, resulting in a posture of "assured retaliation."<sup>21</sup>

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18. For detailed discussions of nuclear doctrine and nuclear force deployments in China, see the following sources: M. Taylor Fravel and Evan S. Medeiros, "China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure," *International Security* 35, no. 2 (Fall 2010): 48–87; Yao Yunzhu, "China's Perspective on Nuclear Deterrence," *Air & Space Power Journal*, Spring 2010; Jeffrey G. Lewis, "Chinese Nuclear Posture and Force Modernization," *Nonproliferation Review* 16, no. 2 (July 2009); Michael Chase, Andrew Erickson, and Christopher Yeaw, "The Future of Chinese Deterrence Strategy," *China Brief*, March 4, 2009; Rong Yu and Peng Guangqian, "Nuclear No-First-Use Revisited," *China Security*, issue 13 (2009); Wang Zhongchun, "Nuclear Challenges and China's Choices," *China Security*, issue 5 (2007); Jing-dong Yuan, "Effective, Reliable, and Credible: China's Nuclear Modernization," *Nonproliferation Review* 14, no. 2 (July 2007); and Sun Xiangli, "China's Nuclear Strategy," *China Security*, issue 1 (2005).

19. Limited deterrence "requires a limited war fighting capability to inflict costly damage on the adversary at every rung on the escalation ladder, thus denying the adversary victory in a nuclear war." Alastair Iain Johnston, "China's New 'Old Thinking': The Concept of Limited Deterrence," *International Security* 20, no. 3 (Winter 1995–1996): 5–42.

20. For a discussion pertaining to different models of nuclear posture, see Rajesh Basrur, *Minimum Deterrence and India's Nuclear Security* (Stanford, Calif.: Stanford University Press, 2005), 26–29.

21. For a discussion on the posture of assured retaliation in China and India, see Fravel and Medeiros, "China's Search"; and Rajesh Rajagopalan, "India: The Logic of Assured Retaliation," in *The Long Shadow: Nuclear Weapons and Security in 21st Century Asia*, edited by Muthiah Alagappa (Singapore: NUS Press, 2009).

Since its first nuclear test in 1964, China has made a steady effort to develop and/or deploy various segments associated with a nuclear triad, albeit its delivery through ballistic missiles and aircraft has achieved more operational maturity. The solid fuel 2,150-kilometer DF-21 for regional targets and the longer-range DF-31, capable of reaching targets over 7,200 kilometers, are in the process of becoming the main components of China's ballistic missile arsenal.<sup>22</sup>

China's strategic bomber force consists of Hong-6 (B-6/Badger) and Qian-5 (A-5/Fantan) bombers. Hong-6 can deliver one to three nuclear bombs to range of 3,100 kilometers, and Qian-5 can deliver one nuclear weapon to a limited distance of 400 kilometers. Although the Russian-derived fighters Su-27s and Su-30s and the indigenously developed fighter-bomber FB-7 are capable of delivering nuclear payloads, evidence does not suggest that China has made necessary modifications to these aircraft for nuclear missions.<sup>23</sup>

Until the commissioning of the second-generation Type 094 SSBN (Jin-class) in 2008, China's underwater nuclear weapon delivery platform was more of a "paper tiger" due to the limited operational capabilities of its first-generation SSBN (Xia-class Type 092).<sup>24</sup> The Type 094 SSBN reportedly carries the JL-2 submarine-launched ballistic missiles (SLBMs), which was first successfully tested from under water in 2005.<sup>25</sup> Reports portray JL-2s deployed on Jin class ballistic missile submarines as China's "first reliable nuclear 'second strike' capability."<sup>26</sup> However, it is sensible to assume that the submarine would need more time at sea to master the full range of operational concepts necessary to undertake nuclear missions.<sup>27</sup>

In last few years, China has also initiated efforts of varying degrees to establish elements of missile defense, albeit without a declared policy in this direction. China conducted a test in January 2010, with the official statement noting that it was a ground-based midcourse missile interceptor.<sup>28</sup> As missile defense interceptors and antisatellite (ASAT) kinetic kill weapons share similar technical requirements, the 2007 ASAT test by Chinese military could also have provided useful data.

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22. Robert S. Norris and Hans M. Kristensen, "Chinese Nuclear Forces, 2010," *Bulletin of the Atomic Scientists* 66, no. 6 (2010).

23. Jing-dong Yuan, "Effective, Reliable, and Credible: China's Nuclear Modernization," *Nonproliferation Review* 14, no. 2 (July 2007): 293.

24. Bill Gertz, "China Tests Ballistic Missile Submarine," *Washington Times*, December 3, 2004.

25. Andrew S. Erickson, William Murray, and Andrew R. Wilson, eds., *China's Future Nuclear Submarine Force* (Annapolis, Md.: Naval Institute Press, 2007), 64, 161–196.

26. *Jane's Sentinel Security Assessment: China and Northeast Asia* (London: Jane's, 2005).

27. For now, a lack of accessible information limits ability to determine the exact operational status of Jin SSBN and JL-2.

28. "China Reaffirms Its Missile Interception Test Defensive," Xinhua, January 12, 2010, [http://news.xinhuanet.com/english/2010-01/12/content\\_12797459.htm](http://news.xinhuanet.com/english/2010-01/12/content_12797459.htm); "China Conducts Test on Ground-Based Midcourse Missile Interception," Xinhua, January 11, 2010, [http://news.xinhuanet.com/english/2010-01/11/content\\_12792329.htm](http://news.xinhuanet.com/english/2010-01/11/content_12792329.htm).

Listing the precise drivers for the decision to conduct the missile defense test in 2010 is difficult. For the moment, the effort could be understood as signaling or as a technology demonstrator.<sup>29</sup> Thus, the 2010 test could merely be a reaction to the U.S. arms sale to Taiwan or a signal to the international community to accelerate the progress toward the Outer Space Treaty. Alternatively, the test might be the first step toward establishing a missile defense system to strengthen the credibility of China's nuclear deterrent, especially now that several countries in Asia, including Taiwan and Japan, are progressing toward establishing elements associated with missile defense.<sup>30</sup>

## *India*

India and China share certain similarities in their nuclear postures.<sup>31</sup> India also follows ambiguity in describing the parameters of its nuclear arsenal and avoids nuclear war-fighting capabilities. Further, China and India rely on a no-first-use posture that necessitates a secure second-strike capability, a requirement that probably drives the development of multiple delivery systems.

Presently, the two main nuclear delivery systems for India are ballistic missiles (Agni and Prithvi series) and aircraft (Jaguars and Mirages 2000H have reportedly been modified for the delivery of nuclear weapons).<sup>32</sup> As in the case of China, India also has Su-30s that can conduct nuclear missions, though it is not certain whether these aircraft have been modified accordingly. The launch of its first nuclear-powered submarine (*Arihant*) in 2009 does signal an important milestone for India in developing underwa-

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29. Russell Hsiao, "Aims and Motives of China's Recent Missile Defense Test," *China Brief* 10, issue 2 (January 2010), [http://www.jamestown.org/single/?no\\_cache=1&tx\\_ttnews%5Btt\\_news%5D=35943](http://www.jamestown.org/single/?no_cache=1&tx_ttnews%5Btt_news%5D=35943).

30. "Rose on Missile Defense," Voice of America, October 9, 2011, <http://www.voanews.com/policy/editorials/asia/Rose-On-Missile-Defense--129605098.html>; Jim Wolf, "U.S. and Japan Stage Successful Missile-Defense Test," Reuters, October 29, 2010, <http://www.reuters.com/article/2010/10/29/us-japan-usa-missile-idUSTRE69S0S120101029>; "Taiwan to Deploy New Missile Defense System by 2015," Reuters, September 8, 2010, <http://www.reuters.com/article/2010/09/08/us-taiwan-china-idUSTRE6871L120100908>; Masako Toki, "Missile Defense in Japan," *Bulletin of the Atomic Scientists*, January 16, 2009, <http://thebulletin.org/web-edition/features/missile-defense-japan>; Jeremiah Gertler, *The Paths Ahead: Missile Defense in Asia* (Washington, D.C.: CSIS, 2006), [http://csis.org/files/media/csis/pubs/0603\\_pathsahead.pdf](http://csis.org/files/media/csis/pubs/0603_pathsahead.pdf).

31. For detailed discussions of nuclear doctrine and nuclear force deployments in India, see the following sources: Rahul Roy Chaudhury, "India's Nuclear Doctrine: A Critical Analysis," *Strategic Analysis* 33, issue 3 (May 2009); Rajagopalan, "India"; Basrur, *Minimum Deterrence*; Ashley J. Tellis, "Toward a 'Force-in-Being': The Logic, Structure, and Utility of India's Emerging Nuclear Posture," *Journal of Strategic Studies*, 2002; W. P. S. Sidhu, "India's Nuclear Use Doctrine," in *Planning the Unthinkable: How New Powers Will Use Nuclear, Biological, and Chemical Weapons*, edited by Peter Lavoy, Scott Sagan, and James Wirtz (Ithaca, N.Y.: Cornell University Press, 2000), 125–157.

32. Robert S. Norris and Hans M. Kristensen, "Indian Nuclear Forces, 2010," *Bulletin of the Atomic Scientists* 66, no. 5 (2010).

ter deterrence capabilities.<sup>33</sup> However, more resources and time are needed before the submarine-launched missiles on which India is working are deployed.

During the last decade, discourse as well as systems procurement and testing suggest that New Delhi aims to make missile defense integral to India's nuclear posture. Between 2006 and 2010, India conducted five missile defense tests, with four of them marked as success.<sup>34</sup> The primary factor for establishing a missile defense system emanates from what it sees as Pakistan's propensity toward nuclear first use.<sup>35</sup> Additionally, an uncertain domestic situation marred with extremism and terrorism creates concerns within the Indian strategic calculus that this first use may even be accidental or unauthorized.

A second factor propelling missile defense in India is China. After the 1998 nuclear tests, India declared that China was the primary motive for transitioning from a "recessed deterrent" to a "force-in-being," that is, a formal nuclear weapons status.<sup>36</sup> Nevertheless, since then the government of India has followed a measured pace in instituting elements of nuclear deterrence. India is cognizant of both the qualitative and quantitative gaps between its own warheads and delivery systems and those of China. Although no efforts are evident for a rapid increase of its arsenal, some thinkers in the Indian strategic community believe that missile defense is a nonoffensive alternative to bridge this "gap."<sup>37</sup> Put another way, it is an effort to achieve parity through defense rather than offense.

Moreover, by opting to bridge this gap with missile defense, India averts the problem of exacerbating its security dilemma vis-à-vis Pakistan.<sup>38</sup> On the contrary, if New Delhi had opted to establish strategic parity with Beijing by expanding its arsenal of nuclear warheads and delivery systems, Islamabad would have been forced into an expensive arms race. Therefore, contrary to the prevailing perception in certain strategic quarters in Pakistan, proponents of missile defense note that this system has the potential to contribute to the strategic stability between India and Pakistan, and to uphold the tenets of

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33. Ibid., 76–81.

34. "India Tests Missile Shield," *Times of India*, July 27, 2010, [http://articles.timesofindia.indiatimes.com/2010-07-27/india/28316072\\_1\\_bmd-system-missile-defence-missile-shield](http://articles.timesofindia.indiatimes.com/2010-07-27/india/28316072_1_bmd-system-missile-defence-missile-shield).

35. Pant and Bharath, "India's Emerging Missile Capability," 384.

36. Tellis, "Toward a 'Force-in-Being.'"

37. A. Vinod Kumar, "A Phased Approach to India's Missile Defence Planning," *Strategic Analysis* 32, issue 2 (March 2008): 171–195; Bharath Gopaldaswamy and Harsh V. Pant, "Ballistic Missile Defence a Must for India," 2008.

38. A less sanguine assessment suggests that the missile defense / missile interception capabilities that India deploys may exacerbate Pakistan's feelings of vulnerability and may indeed drive it to build up its nuclear forces. Moreover, the argument that intercept capability is unproblematic because it is a "defensive system" creates a value bias that favors missile intercept by misconstruing its function. The author thanks the anonymous reviewer for broaching this issue. Although appreciating the complexity of the issue, the author merely points out that if India opts to maintain a modicum of parity with China, New Delhi presently has only two choices: either expand the size of nuclear forces or deploy a missile defense system, albeit a limited deployment; the second choice seems to be relatively "less" escalatory, though not necessarily the best option.

minimum deterrence.<sup>39</sup> Whether this strategic stability transmits into the conventional arena is open for debate.

## *Pakistan*

Pakistan also avoids going into specifics as to the size and contours of its nuclear arsenal.<sup>40</sup> Although officially its policy follows a posture of minimum deterrence, Islamabad has started to emphasize and develop nonstrategic, battlefield-oriented delivery systems for nuclear weapons. The Abdali-2 and Nasr short-range ballistic missiles are two examples of this effort. Moreover, according to recent estimates, it seems that Pakistan's stockpile of nuclear weapons is growing relatively faster than those of China and India.<sup>41</sup>

In spite of an absence of operational and doctrinal information pertaining to these developments, two preliminary observations are possible: First, nonstrategic, battlefield-oriented delivery systems are probably a response to India's efforts to develop new conventional concepts and force postures.<sup>42</sup> Second, the increase in fissile material stocks and nuclear weapons is being driven either by a desire to forestall any limitations imposed by a treaty imposing restrictions on fissile material production in the future or by the strategic enclaves dominated by the military and the scientific establishment.

For the delivery of nuclear weapons, Pakistan also relies relatively more on land-based ballistic missiles and aircraft. In fact, an often-overlooked aspect is that Pakistan's missile capability is more varied than India's in terms of scope and range of the missiles. Presently, the three Haft series (3, 4, and 5) short- and intermediate-range ballistic missiles are operational. The longer-range Haft-6 / Shaheen-2, with a 1,000-kilogram warhead and a range over 2,000 kilometers, is under development.<sup>43</sup> Pakistan relies on the F-16 A/B with a range of 1,600 kilometers and on the Mirage V with a range of 2,100 kilometers capable of delivering a single nuclear bomb across the border. At present, it is unknown whether the newly inducted F-16 C/D Block 52 would also be considered for a nuclear mission.<sup>44</sup> In the case of sea-based deterrence, technological and financial considerations limit Pakistan to develop a submarine-launched ballistic missile or a

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39. For a discussion of the positive impetus of missile defense on minimum deterrence, see Basrur, *Minimum Deterrence*, 102–12.

40. For detailed discussions of nuclear doctrine and nuclear force deployments in Pakistan, see the following sources: Rajagopalan, *Second Strike*, 36–66, Feroz Hasan Khan and Peter R. Lavoy, "Pakistan: The Dilemma of Nuclear Deterrence," in *Long Shadow*, ed. Alagappa; Bhumitra Chakma, *Pakistan's Nuclear Weapons* (London: Routledge, 2010), and E. Sridharan *The India-Pakistan Nuclear Relationship* (London: Routledge, 2007).

41. Hans M. Kristensen and Robert S. Norris, "Pakistan's Nuclear Forces, 2011," *Bulletin of the Atomic Scientists* 67, no. 4 (2011).

42. Several authors dispute the effectiveness of tactical nuclear weapons in the India-Pakistan context. See A. H. Nayyar and Zia Mian, *The Limited Military Utility of Pakistan's Battlefield Use of Nuclear Weapons in Response to Large Scale Indian Conventional Attack*, Pakistan Security Research Unit, November 2010; and Gurmeet Kanwal, *Indian Army Vision 2020* (New Delhi: HarperCollins, 2008).

43. Kristensen and Norris, "Pakistan's Nuclear Forces, 2011."

44. *Ibid.*

nuclear-powered submarine; however, speculations are that Babur could eventually be developed to be launched from a modified conventionally powered submarine.

### *Assessment*

*Force deployments.* Among the three countries, China surpasses both India and Pakistan in deploying comparatively more reliable and sophisticated nuclear delivery systems. Nevertheless, a qualitative and quantitative assessment reveals that the strategic forces of all the three countries currently rely more on the land-based ballistic missiles for assured retaliation.

In case of the aircraft designated for the delivery of nuclear weapons, two sets of challenges limit mission effectiveness: the first are limitations imposed by range and payload; and the second, more important, challenge is the in-country depth of most key targets and the difficulty of overcoming the multilayered air defense network. Moreover, a single-strike package requires not only bombers but also the accompanying escort and electronic warfare aircraft, which would represent a crucial diversion of resources during a crisis period. For example, these aircraft might otherwise be employed for air defense missions.<sup>45</sup>

It is therefore evident that all three countries have limited options in delivery of nuclear weapons. Cruise missiles have the potential to supplement the above-mentioned systems. Currently, only Pakistan seems to opt for using cruise missiles for nuclear missions; China and India have neither foreclosed nor opted for this option.

*Missile defense.* In both technological and operational terms, China and India have to take more time and devoted more resources to establish robust missile defenses. Although it is widely accepted that these defensive systems would have limitations with dealing with countermeasures, including dummy and/or maneuverable warheads, the proliferation of cruise missiles in the region introduces a new dynamic—which potentially offers an offensive counter to ballistic missile defenses.

## The Emerging Strategic Capabilities of Cruise Missiles

It is evident that China, India, and Pakistan have the intent to develop and deploy cruise missiles as a key war-fighting system. Therefore, it is timely to evaluate the impact of cruise missiles on the strategic calculus of these three countries, an evaluation that is undertaken through the following three questions. First, do cruise missiles contribute to deterrence stability or instead upset it? Second, could cruise missiles negate the effectiveness of missile defenses? And third, will a conventional cruise missile attack on missile defenses result in crisis escalation?

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45. Kalyan M. Kemburi, “Recalibrating Deterrence Theory and Practice: View from India,” in *Comparing the Comparable: China and India’s Nuclear Nexus*, edited by Lora Saalman (Washington, D.C.: Carnegie Endowment for International Peace, 2012).



## *Cruise Missiles and Nuclear Deterrence*

For all three countries in Southern Asia, cruise missiles can complement other systems and help fill deterrence gaps by providing a credible retaliatory strike option. The ability of cruise missiles to survive against missile defenses and counterforce operations makes them an ideal second-strike weapon. If missile defenses are uncertain against cruise missiles, planning counterforce operations are difficult.<sup>46</sup> Counterforce operations against cruise missiles during prelaunch phase are potentially problematic due to the size and mobility of the cruise missile transport-erector-launchers (TEL) systems, as well as their resemblance to other civilian and military vehicles.<sup>47</sup> The faint launch signature of cruise missiles also makes them more difficult to detect. U.S. counterforce operations in Iraq during Operation Desert Storm in 1991 and Operation Iraqi Freedom in 2003 illustrate this difficulty. During Desert Storm, in spite of devoting 20 percent of F-15E air sorties for the “Scud hunt,” the Coalition forces could not destroy even one Iraqi Scud ballistic missile launcher.<sup>48</sup> In the case of Operation Iraqi Freedom, even after the Iraqi forces’ use of cruise missiles, the Coalition forces could locate the Seersucker cruise missiles only after the war.<sup>49</sup>

The affordability and flexibility in developing and deploying cruise missiles also makes them an attractive weapon system. In 2005, a Congressional Research Service report, citing a study conducted by the U.S. Army, noted that a developing country with \$50 million could acquire 100 cruise missiles, as compared with a couple of advanced tactical fighters, or 15 tactical ballistic missiles and 3 TELs.<sup>50</sup> Comparative analysis of the cost-effectiveness of cruise missiles, ballistic missiles, and manned aircraft favors cruise missile acquisition. For a bomber or a ballistic missile to be cost effective, cruise missile attrition rate should be more than 80 percent compared with a bomber and seven times higher than a ballistic missile.<sup>51</sup> The operational cost also favors cruise missiles because they do not require an elaborate logistics chain or service infrastructure, as do ballistic missiles and advanced aircraft. In addition, cruise missiles could use aircraft, TELs, and naval vessels as launch platforms, thereby adding flexibility to mission planning and reducing the overall cost.

In 1979, the official newsletter of the Soviet Defense Ministry, *Red Star (Krasnaya Zvezda)*, summarized some of the key characteristics of a cruise missile: “Difficulties of

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46. A discussion pertaining to cruise missiles and missiles defense is provided in the following section.

47. Gormley, “Missile Defense Myopia,” 71.

48. Gormley, *Dealing with the Threat of Cruise Missiles*, 64.

49. Gormley, “Missile Defense Myopia,” 70–71.

50. Andrew Feickert, *Cruise Missile Proliferation* (Washington, D.C.: Congressional Research Service, 2005), 3.

51. This was calculated based on the rate of interception or failure of cruise missile to reach the target percentage compared with aircraft and ballistic missiles; for more information on this issue; see David J. Nicholls, *Cruise Missiles and Modern War: Strategic and Technological Implications*, Occasional Paper 13 (Montgomery: Center for Strategy and Technology, Air War College, Air University, 2000), 10–12.

detection in flight, . . . ease of camouflaging, owing to the small size of the missiles and their launchers, concealing them from exciting means of technical detection. . . . Their numbers and basing locations are extremely difficult to verify.”<sup>52</sup> Considering similar technical attributes and the long flight time required to the target, the United States considered cruise missiles as a secure second-strike weapon.<sup>53</sup>

In the context of Southern Asia, therefore, it is tempting to conclude that cruise missiles could contribute to deterrence stability by strengthening the credibility of an assured retaliation. But a closer look at the quotation given above from *Red Star* weakens this argument. Although both of the Cold War adversaries agreed on the technical attributes of cruise missiles, the Soviet Union considered them a first-strike weapon. The quotation ends by noting that cruise missiles would “facilitate their employment for a surprise attack.”<sup>54</sup> Therefore, even though cruise missiles may be able to perform a second-strike mission, they may not be assigned this role or thought of only in that way.

### *Cruise Missiles and Missile Defense*

In theory, missile defenses are capable of engaging low-flying cruise missiles; however, a combination of technical factors and operational requirements could severely tax even the most sophisticated missile defense sensors. Cruise missiles have a low radar cross-section (RCS), minimal infrared signature, and a low altitude.<sup>55</sup> Adding to the uncertainty about effectively defending against cruise missiles, end game countermeasures make the cruise missile detection difficult, if not impossible. For example, if an airborne-warning-and-control-system aircraft detects an enemy aircraft traveling at 800 kilometers per hour with a 7 square meters (m<sup>2</sup>) RCS at a distance of 370 kilometers, it can detect a cruise missile cruising at a similar speed with a 0.1 m<sup>2</sup> RCS only at 130 kilometers.<sup>56</sup> For a missile defense operator, this translates into a reaction time of 28 minutes in the case

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52. The quotation was previously cited by Raymond L. Garthoff, “Soviet Perceptives,” in *Cruise Missiles: Technology, Strategy and Politics*, ed. Richard K. Betts (Washington, D.C.: Brookings Institution Press, 1981), 345.

53. Ibid.

54. Ibid.

55. Unless noted, the information for this paragraph is from Gormley, *Dealing with the Threat of Cruise Missiles*, 62–63.

56. RCS for some major fighter aircraft: Su-27, 15 m<sup>2</sup>; Su-30 MKI, 4 m<sup>2</sup>; earlier version of F-16, 5 m<sup>2</sup>; and F-18, 1 m<sup>2</sup>. The Tomahawk cruise missile, which was designed in the 1970s, incorporates rather simple low-observable technologies but still has an RCS of 0.05 m<sup>2</sup>. It could be expected that cruise missiles of later generations would have an even stealthier RCS. It could be expected that cruise missiles of latter generation would have an even stealthier RCS. To illustrate, cruise missiles like Storm Shadow or SCALP have a RCS dimensions of 0.001 to 0.0001, resulting in detection times of only between several to 2 minutes. (Thanks to Dennis Gormley for providing this information.) For more information on RCS, see “Radar Cross Section,” *Global Security*, <http://www.globalsecurity.org/military/world/stealth-aircraft-rcs.htm>; and “Radar Cross Section,” *Aerospace Web*, <http://www.aerospaceweb.org/question/electronics/q0168.shtml>.

of an aircraft and 10 minutes for a cruise missile, thereby limiting the time required for friend or foe identification and taking multiple shots at the incoming missile.

Even with the detection of an incoming missile, missile defense systems may not have a successful interception. This is primarily due to the restricted line of sight for surface-to-air (SAM) batteries and air-to-air missiles resulting from the Earth's curvature. For example, although the U.S. Patriot missiles have a range of 70 kilometers, due to the Earth's curvature, the battlefield picture is less than 25 kilometers.<sup>57</sup> Another problem with detection of cruise missiles for ground-based radar installations arises from "dead space." To avoid the noise emitted from ground clutter, radars are tilted back about 3 degrees to lift the search beam above the ground, thereby creating dead space.<sup>58</sup> Therefore, cruise missiles flying at low altitudes could reach their targets undetected.

Thus, due to the restrictions imposed by the Earth's curvature and the dead space underneath radar search beams, the Patriot and Aegis radars can detect a cruise missile flying at 50 meter altitude only at a distance of less than 35 kilometers, giving missile defenses only a few minutes to react. The Soviet-derived air defense systems that are widely deployed in China and India do not fare any better. To illustrate, the SNR-125 Low Blow engagement radar deployed in India could track a target with 10 m<sup>2</sup> RCS at a distance of 148 kilometers and for 1 m<sup>2</sup> at a distance of 83 kilometers; whereas it can track a modern cruise missile with a 0.1m<sup>2</sup> RCS only at 28 kilometers.<sup>59</sup> This allows for a reaction time of only few minutes. Additionally, the P-18 radars that are linked to the S-125 surface-to-air missiles, the backbone of India's air defense network, could detect a MiG-21-sized target flying at 500 meters at 50 kilometers and 180 kilometers away if flying at 10,000 meters.<sup>60</sup>

A cost/exchange ratio between a cruise missile and a missile interceptor favors the attacker over the defender.<sup>61</sup> To illustrate, a Russian Alfa and Chinese Silkworm ASCM would cost between \$250,000 and \$300,000.<sup>62</sup> A U.S. Patriot Advanced Capability 3 interceptor, conversely, costs \$4.75 million, and a Standard Missile interceptor on an Aegis destroyer costs almost \$9.5 million.<sup>63</sup> Therefore, the acquisition of cruise missiles is not only affordable but also increases the cost of the adversary's defenses.

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57. The Earth's curvature imposes restrictions on the Patriot's line of sight, there by limiting the full utilization of the missile's 70-kilometer range.

58. Tanks, *Assessing the Cruise Missile Puzzle*, 19–20.

59. "Engagement and Fire Control Radars (S-Band, X-Band, Ku/K/Ka-Band)," Air Power Australia Technical Report APA-TR-2009-0102, August 2010, [www.ausairpower.net/APA-Engagement-Fire-Control.html](http://www.ausairpower.net/APA-Engagement-Fire-Control.html).

60. "P-18 Early-Warning Radar," *Jane's Radar and Electronic Warfare Systems*, July 20, 2010.

61. Ravi R. Hichkad and Christopher Bolkcom, *Cruise Missile Defense* (Washington, D.C.: Congressional Research Service, 2005), 6.

62. Gormley, *Dealing with the Threat of Cruise Missiles*, 53; correspondence with Dennis Gormley.

63. Dennis Gormley, "Cruise Control," *Bulletin of the Atomic Scientists* 62, no. 2 (March–April 2005): 29.

The capability of cruise missiles against missile defenses was brought to light during Operation Iraqi Freedom in 2003, when the United States and its allied forces deployed Patriot missile defenses with early warning provided by space-based satellites as well as sea-based radars. In spite of these extensive detection capabilities, all five cruise missiles fired by the Iraqi forces were neither detected nor intercepted by the Patriot missile defenses.<sup>64</sup> This failure of Patriots against cruise missiles when compared with the successful interception of all nine ballistic missiles fired by the Iraqi forces strengthens the penetrability credentials of the cruise missiles.

## Cruise Missiles in Southern Asia: An Assessment and Recommendations

The discussion in the previous sections clearly demonstrates that the South Asia region over next five years will witness the deployment of LACMs of various ranges with multiplatform launch capabilities. The strategic implications of this situation are twofold.

First, creating a strategic deterrence role for cruise missiles will become increasingly attractive. Pakistan has already gone down this path, as the Babur and Raad LACMs are touted as potentially being part of the country's nuclear arsenal and would be involved in the delivery of nuclear warheads. Although LACMs in China and India theoretically could also be used for nuclear missions, at present it seems that these two countries have not opted to do so. In a region where early warning systems lack the sophistication to identify missiles with nuclear warheads versus those with conventional payloads, building nuclear missions for LACMs is a destabilizing initiative.

Second, in the recent period several countries in Asia are considering missile defenses as a contributing factor for strategic stability. India is one of the countries to top the list; in last five years, New Delhi has made efforts to integrate missile defense into its nuclear posture.<sup>65</sup>

Deploying LACMs against missile defense involves two scenarios: (1) using a nuclear-armed LACM to navigate through the missile defense network to attack targets, or (2) deploying conventional LACMs to degrade the adversary's command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems. Deploying LACMs in the first scenario is a redundant initiative, because in a limited missile defense environment, ballistic missiles can continue to target several other unprotected countervalue (and even counterforce) targets. In the second scenario, using conventional LACMs might create complications in evaluating the intentions of

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64. Gormley, "Missile Defense Myopia." Moreover, as pointed out by Dennis Gormley, because the first missile fired by Iraq was a cruise missile, American military commanders were forced to change their rules of engagement for Patriot. Instead of focusing exclusively on high-angle ballistic missile targets, Patriot batteries were instructed to look for both high- and low-angle threats. This led to several friendly fire casualties, which would have been even worse for coalition forces had Iraq employed more than five primitive cruise missiles.

65. Cited by Rajagopalan, "India."

the attacker. A strike against C4ISR systems could potentially be construed as a first step toward either commencing a conventional war or undertaking a nuclear first strike.

This paper therefore concludes that cruise missiles carry high risk and potentially could be destabilizing for the region. Although cruise missiles notionally strengthen second-strike capabilities, the deployment of a nuclear-capable stealth delivery system fails to augment strategic deterrence in the region. Using cruise missiles to counter missile defenses carries high risk due to the inherently offensive capability of the system. Moreover, the existing nuclear capabilities will not be rendered ineffective by the current missile defense plans, which are limited due to massive financial and technological requirements. Therefore, the cruise missiles' role in strategic missions in the region has several negative dimensions.

As China, India, and Pakistan are developing and deploying cruise missiles and associated operational concepts, the timing is appropriate to undertake measures that will steer the related developments based on security requirements, not merely driven by technology or by their respective strategic enclaves.

In a region where ambiguity and deception play an important role in nuclear postures and in safeguarding the second-strike capabilities, efforts should be channeled toward defining parameters that shape transparency. A preliminary step in this direction involves establishing credible modes of communication, which include expanding the nature and scope of the current military exchanges and institutionalizing Track 1.5– and Track 2–style forums.

Moreover, during the next five years, prudence warrants that China, India, and Pakistan should initiate efforts in the following three aspects to strengthen the prevailing stability and prevent crisis escalation. First, it is accepted within the Indian strategic community that New Delhi's effort to develop a missile defense system involves only a *limited* deployment, that is, a system capable of protecting only a selected number of cities and installations against a limited unauthorized or accidental missile attack. However, recent discourse and behavior from Pakistan contradict the prevailing perception in India that a limited missile defense system need not create a security dilemma for Pakistan.<sup>66</sup> Therefore, New Delhi should pursue means to alleviate concerns in Pakistan related to missile defense. This is feasible because a limited missile defense system would allow Pakistan to maintain its nuclear deterrence.<sup>67</sup> Conversely, this defensive

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66. One of the illustrations that Pakistan is not treating missile defense in India as limited is Islamabad's proclivity to deploy cruise missiles for nuclear missions.

67. A counterargument underlines that a limited defense from New Delhi's perspective need not be "limited enough" from Islamabad's viewpoint; the argument does hold a notional validity, but is limited for two practical reasons: the technological complexity of installing a fail-safe system, and the financial inflexibility to cover a country of India's size. Under a limited missile defense system, even in a scenario of deterrence breakdown (where Islamabad launches intentional nuclear attacks), Pakistan still has several unguarded Indian cities to target. In a country with a democratically elected government supported by provincial political parties, no government could choose one city from another.

system would safeguard key installations in India, including a decisionmaking structure from an accidental or unauthorized surprise nuclear attack.

Second, China and India are the only two countries with a declared nuclear “no first use” (NFU) policy. Historically, during bilateral interactions between China and India, nuclear issues were either not part of the agenda or involved only general discussions, without involving the specific areas that could potentially create tensions. Although recent years did witness a steady change in this situation, these interactions on nuclear issues lack consistency and depth.

The issue of establishing a regionwide NFU understanding is one that has great potential to strengthen bilateral engagement on nuclear issues. China and India, along with other like-minded countries in Asia and the Non-Aligned Movement, should consider sponsoring a resolution at the 2012 UN General Assembly’s First Committee session supporting a global NFU. Although the resolution would have only a symbolic value, it could be a first step toward creating a global NFU norm. Moreover, bilateral discussions between China and India toward sponsoring this resolution would further enhance each nation’s understanding of each other’s nuclear postures and policies.

Third, the issue of deploying LACMs for strategic deterrence roles requires further analysis and discussion, initially at the respective national levels in China and India and later graduating to a bilateral and, if possible, to a trilateral level to include Pakistan. With NFU defining China’s and India’s nuclear postures, first-strike-capable delivery systems such as cruise missiles contradict the existing doctrinal ethos.<sup>68</sup> In the case of Pakistan, which eschews NFU for strategic reasons, the prevailing nuclear posture does not necessarily imply a first-strike nuclear posture. Pakistan’s posture is more in line with first use, not first strike, in reaction to an overwhelming conventional thrust by the Indian military.<sup>69</sup> Even if India succeeds in establishing a limited missile defense system, Pakistan’s first-use policy remains intact. The most compelling reason lies in the inability of New Delhi to protect all its population and economic hubs with a “limited” system; therefore safeguarding the ability of Islamabad to deter any major conventional war initiated by New Delhi. These measures have the potential to assist greatly in increasing openness and predictability as well as to facilitate a recognition of common interests—common interests that would strengthen peace and stability in the region.

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68. Although stealth aircraft and nuclear-submarine-launched missiles can be described as first-strike-capable delivery systems, at least for now, in Southern Asia only cruise missiles demonstrate first-strike capabilities.

69. A first-strike posture requires an extensive counterforce and countervalue capabilities. If a first-strike posture is opted against a country of India’s economic and geographic size, the technological and financial requirements for Pakistan would easily overwhelm its fragile economy. For more information on the issue of first use and Pakistan, see Rajagopalan, *Second Strike*, 36–66.



# Qualitative Considerations for the U.S. Nuclear Force at Lower Numbers vis-à-vis Peer and Near-Peer Adversaries

Jeff Larsen, Justin Anderson, Darci Bloyer, Thomas Devine, Rebecca Davis Gibbons, and Christina Vaughan<sup>1</sup>

## Abstract

This paper is based on a larger research project that addresses the challenge of attempting to reduce the quantity of U.S. nuclear weapons without compromising the qualities underpinning the U.S. arsenal's ability to meet policy and strategy requirements that currently rely upon nuclear options. This challenge will be central to future arms control negotiations and other U.S. military and diplomatic efforts to reduce global nuclear stockpiles. This paper, thus informed by the national strategic objectives for the U.S. nuclear force identified in the 2010 Nuclear Posture Review Report, evaluates the impact of quantitative reductions of the U.S. nuclear force on the qualitative requirements associated with deterring adversaries, prevailing over opponents, and maintaining strategic stability vis-à-vis peer and near-peer nuclear weapons states. The paper identifies the key qualitative characteristics of the U.S. nuclear force and conducts a detailed analysis to determine which characteristics increase or decrease in relative importance for the objectives of deterrence, prevailing over adversaries, and strategic stability as the United States reduces its force numbers.

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1. This paper is part of a larger study, "Qualitative Considerations of Nuclear Forces at Lower Numbers and Implications for Future Arms Control Negotiations," conducted by Science Applications International Corporation (SAIC) for a government client. The authors are analysts with SAIC supporting the Strategic Plans and Policy Division of the U.S. Air Force. This project was part of an emerging issues program that provides research on national security issues identified as possessing the potential to significantly impact the Air Force in the future. The views expressed in this paper are those of the authors and do not necessarily reflect the views of SAIC or the U.S. Air Force.

## Introduction

The United States is on the path toward reducing its nuclear arsenal. The recently released defense strategy document, *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense*, declares that “it is possible that our deterrence goals can be achieved with a smaller nuclear force.”<sup>2</sup> In line with this guidance, the Obama administration is in the midst of establishing nuclear guidance and preparing the groundwork for a next round of arms control negotiations beyond the New Strategic Arms Reduction Treaty (New START). While there has been considerable debate about the nuclear force’s downward trajectory in quantitative terms, there has been little sustained discussion or analysis of the qualitative characteristics of the arsenal the United States requires today or in the future. This paper posits that, for the nuclear force, qualitative characteristics such as promptness, accuracy, and survivability matter as much as the numbers of weapons. Often, analysts focus on specific numbers, such as 500 or 1,000 warheads, without tying these numbers to the mission sets for which these weapons are required. This study seeks to fill this analytical gap by focusing on the qualitative characteristics of the U.S. nuclear arsenal and how those characteristics serve the varied missions and potential adversaries faced by the United States. General Kevin Chilton, when he was commander of the U.S. Strategic Command, endorsed this approach over one that focuses on numbers:

When contemplating the appropriate size and posture of the nuclear deterrent force, whether contemplating reductions or even growth, one should never begin with numbers. Rather, we should always begin with a clear-eyed examination of the geopolitical reality of the day and even more importantly, the geopolitical uncertainty of the future. From this should flow a strategy to address our deterrent needs, and this strategy, with appropriate hedges for our documented inability to precisely predict the future, should drive the size and the posture of our forces and the size of our nuclear stockpile.<sup>3</sup>

The primary questions driving this research project are: What qualitative characteristics of the current U.S. nuclear force are most critical to the nation’s nuclear mission, and how might they change in importance at lower numbers? And what are the implications for future arms control negotiations?

## Methodology

The six-member study team began by establishing the most important qualitative characteristics of the U.S. nuclear force, which currently includes bombers, submarine-launched ballistic missiles, intercontinental ballistic missiles, and dual-capable aircraft. To discern the key qualitative characteristics, the research team gathered information

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2. U.S. Department of Defense, *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense* (Washington, D.C.: U.S. Government Printing Office, 2012), 5, [http://www.defense.gov/news/Defense\\_Strategic\\_Guidance.pdf](http://www.defense.gov/news/Defense_Strategic_Guidance.pdf).

3. General Kevin P. Chilton, “Challenges to Nuclear Deterrence,” keynote speech, Air and Space Conference, Washington, September 13, 2010.

from open-source government documents, academic publications, and Department of Defense studies on nuclear weapons; surveyed military and scientific subject matter experts; hosted two workshops with selected experts from government, industry, and academia; and submitted draft lists and definitions of characteristics for the assembled experts to review. Wherever possible, the team sought to combine or integrate similar or complementary concepts in an attempt to find a balance between the many qualitative characteristics associated with the nuclear force and the need to restrict the list of terms to a manageable number for subsequent analytic tasks. The team deliberately avoided associating any one characteristic with any one delivery system or warhead, seeking to identify general characteristics that apply to all types of nuclear forces and to both present-day and future arsenals.

Ultimately, the team developed two categories of qualitative characteristics: those that are foundational to the arsenal, and those that are variable. Foundational qualitative characteristics are defined as those characteristics that the United States considers essential to fielding a viable nuclear force. Any uncertainty regarding these characteristics may result in U.S. decisionmakers concluding that deployments or operations involving nuclear forces are unacceptably risky. In addition, any doubts in the minds of adversaries *or allies* regarding foundational characteristics will lead to decisions in foreign capitals that may harm U.S. foreign interests, possibly including brinkmanship, nuclear intimidation, and nonnuclear allies pursuing nuclear weapons programs.

### *Foundational Characteristics*

The four foundational qualitative characteristics associated with nuclear forces are defined as follows:

- *Command and control*: the exercise of authority and direction by a properly designated commander over assigned and attached nuclear forces in the accomplishment of missions assigned to these forces. This requires reliable and secure communications between command authorities and nuclear forces at all times.
- *Reliability*: the physical properties of the warheads and the mechanical properties of the delivery platforms are such that they will perform as expected.
- *Safety/security/surety*: matériel, personnel, and procedures that contribute to the safe and effective control of nuclear warheads, preventing inadvertent use, ensuring successful employment, and reducing the risk of accidents, incidents, loss, or degradation in performance.
- *Sustainability*: the ability of a nuclear weapons complex to supply new warheads and delivery systems in response to force requirements and successfully maintain and/or overhaul existing warheads and delivery systems. Relevant factors include the supply of fissile materials, mechanisms to test reliability of warheads, and infrastructure to design and build nuclear warheads and delivery systems to meet evolving mission requirements.

Having noted these key foundational characteristics, however, this study focuses primarily on the second set of definitions—those qualitative characteristics that are considered variable. Whereas the four foundational characteristics remain uniformly important at all levels of nuclear forces, the relative importance of variable characteristics changes as a result of geopolitical circumstances, selected strategies, and numbers and types of fielded nuclear forces.

### *Variable Characteristics*

The eight variable qualitative characteristics associated with nuclear forces are defined as follows:

- *Accuracy*: the ability to deliver a strike with sufficient precision for the assigned mission; precision is often measured as circular error probable.
- *Ability to defeat defenses*: the ability to overcome active and passive defenses and destroy a target.
- *Promptness*: the ability to rapidly deliver destructive effects upon a target following the decision to engage or attack.
- *Ability to reconstitute*: the ability to expand the numbers and/or the diversity of the deployed nuclear force via an uploading or regeneration of forces in reaction to operational or geopolitical change.
- *Ability to retarget*: the ability to change the desired point of warhead impact after the delivery vehicle is in flight.
- *Ability to signal*: the ability of nuclear forces to visibly communicate intent through the enhancement of alert levels, a repositioning of forces, or other mechanism for transparency.
- *Survivability*: The ability of nuclear forces to absorb a strike from an adversary and deliver a desired response.
- *Variety of yield options*: The ability to produce varied nuclear effects on targets by adjusting the yields of individual warheads or fielding delivery systems capable of carrying and delivering a range of warheads of different yields.<sup>4</sup>

### *Missions and Adversaries*

After establishing the variable characteristics, the study team assessed the importance of these characteristics across a set of missions and adversary types. The Nuclear Posture Review identifies four national strategic objectives for nuclear weapons: maintaining

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4. More broadly, this qualitative characteristic refers to means, methods, and capabilities that provide control, management, or limitation of the possible consequences of executing a nuclear attack. A prominent example of these means and methods is the ability to select a variety of yield options. The research project uses the term *variety of yield options* as a proxy for managing the consequences of a nuclear strike.

strategic stability, deterring adversaries, prevailing over adversaries if deterrence fails, and assuring allies. The larger project examined the relative importance of characteristics for assuring allies as well as those for deterring and prevailing against four different types of adversaries: peers, near-peers, regional powers, and armed nonstate actors. Due to space constraints, this paper focuses only on the analysis conducted for deterring and prevailing over peer and near-peer adversaries. This decision is largely based on the fact that study findings show a shift in importance of the characteristics for deterring and prevailing over these two types of adversaries as the number of weapons in the U.S. nuclear arsenal declines (conversely, the distinct characteristic sets for regional and armed nonstate actors remained constant at lower numbers). This paper highlights the rationale behind these movements in characteristics' importance and concludes with an assessment of the most important characteristics for maintaining the United States' strategic stability vis-à-vis the other major nuclear powers, which the team collectively terms "peer" and "near-peer" adversaries.

A "peer adversary" is defined as a state whose nuclear force could pose an existential threat to the U.S. homeland. It could launch hundreds of nuclear weapons at a broad range of U.S. targets on short notice using a variety of platforms. This type of adversary fields several hundred long-range delivery systems, including air-, sea-, and land-based (both mobile and fixed) means of delivery. It also possesses hundreds of shorter-range systems. A peer adversary possesses multiple independently targetable reentry vehicles and missile defense countermeasure technologies. Its warheads are roughly equivalent to those of the United States.<sup>5</sup> It fields 1,000+ warheads from very high to low yields, and it retains hundreds to thousands more as a hedge. It designs and builds all its delivery platforms and warheads. Finally, a peer adversary possesses limited missile defenses, extensive air defenses, and a robust command-and-control system designed to maintain operations during a major nuclear conflict.

A "near-peer adversary" is defined as a state whose nuclear force is numerically smaller than those of the U.S. arsenal, but are capable of causing unacceptable damage to the U.S. homeland. A near-peer can hold multiple U.S. locations at risk through the deployment of long-range, land-based delivery systems. A near-peer fields an adequate nuclear force to inflict severe damage on U.S. civil society, but it does not pose an existential threat. It is not capable of a disarming first strike. It deploys air-, sea-, and land-based nuclear-capable delivery systems of varying ranges. Its long-range systems number in the dozens, and include both fixed and mobile land-based systems. It designs and builds all its warheads and delivery systems. Its warheads number in the hundreds, and its overall number of nuclear warheads, to include hedge warheads, is in the hundreds but less than 1,000. It possesses extensive air defenses, but does not possess mis-

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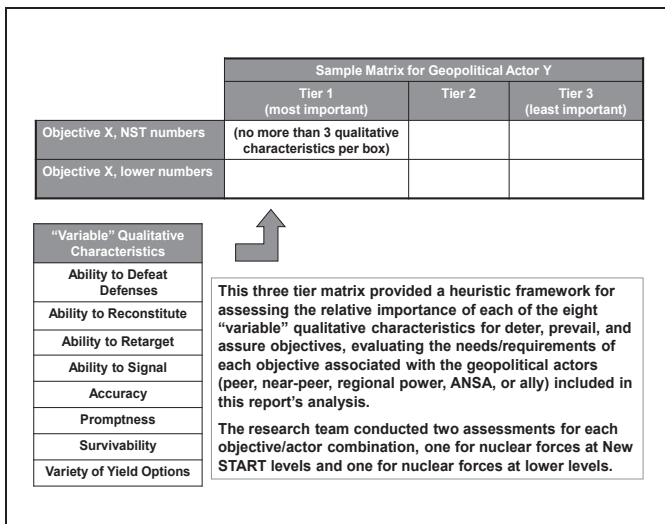
5. For the purposes of this analysis, warheads are defined as either "deployed" or "nondeployed" warheads. Deployed warheads are mated with delivery systems or kept relatively close to delivery systems; in short, the term applies to warheads that are not in storage. Nondeployed warheads (sometimes referred to as "hedge warheads") are kept in storage depots or other facilities; they are generally kept at a low state of readiness. Their deployment requires days, weeks, or even months.

sile defenses. Finally, a near-peer’s command-and-control system is not as sophisticated as that of a peer adversary, but it is capable and survivable, thereby ensuring controlled operations during a major nuclear conflict.

### Framework

Figure 1 illustrates the analytic framework developed by the study team to assess the relative importance of qualitative characteristics when considering the requirements for the objectives of deterrence, prevailing over adversaries, and strategic stability for different types of geopolitical actors.

**Figure 1. Matrix for Analyzing Quantitative Characteristics**



Note: The top and bottom matrixes of this figure (each one row, three boxes wide) display the results of the assessment of the relative importance of each of the eight variable characteristics with regard to deterring a peer adversary at New START numbers (top) and at lower numbers following force reductions (bottom). The middle matrix highlights the qualitative characteristics that change in relative importance as numbers decline, and notes their "movement" to a different tier.

The matrix shown in figure 1 represents a framework that is designed to identify the most important qualitative characteristics for a given mission (deter or prevail) vis-à-vis a specific type of adversary (peer or near-peer) at New START levels and at lower numbers. The framework establishes a three-tiered hierarchy of qualitative characteristics, representing a spectrum ranging from most valuable characteristics (Tier 1) to characteristics of lesser relative importance (Tier 2 and Tier 3). Each of the eight variable qualitative characteristics is placed into one of the three tiers, with each tier limited to no more than three characteristics.<sup>6</sup>

6. The limit of no more than three characteristics in each tier was a rule created by the research team to prompt an evaluation of the relative value of each characteristic in comparison with the other qualitative characteristics, and to make it easier to identify changes in priorities at lower numbers.



This framework provides a simple but sound means to assess the relative importance of certain qualitative characteristics of nuclear forces for each individual scenario considered by this analysis. The framework presents hard choices; all eight of the variable qualitative characteristics included within this report’s analysis represent critically important qualities of nuclear forces. The framework’s arbitrary limit of three qualitative characteristics per tier forces analysts to weigh the relative importance of these characteristics against each other in order to determine the handful of characteristics that are most valuable for achieving a particular mission. Qualitative characteristics grouped within any particular tier, however, are not further ranked. The decision to select a heuristic of grouping characteristics rather than ranking characteristics one through eight reflected the research team’s assessment that a rigid ranking hierarchy would prove unmanageable, requiring evaluations such as which characteristic is “seventh-most” important within a given scenario.

The research team developed this framework and tested it with a sample set of subject matter experts before the analytic phase of the project. These experts agreed to this approach for assessing the relative importance of qualitative characteristics of nuclear forces across various geopolitical scenarios.

The framework also allowed the study team to determine which qualitative characteristics increase or decrease in importance as forces are reduced. Rather than use a specific “lower” number, a key assumption of this analysis is that the force reductions required by New START provide a general template for the level of cuts that a future nuclear arms control treaty is likely to propose. This analysis assumes that the United States will seek slow but steady reductions of nuclear forces below the limits of New START via equitable, verifiable arms control treaties. It further assumes the United States will not go lower—in relative terms—than a peer competitor, will not make significant unilateral reductions, and will not drop its numbers abruptly.

The approach of using a three-tiered model provided sufficient differentiation between levels of importance to readily monitor “movement” up or down tiers as the research team compared the placement of characteristics for each scenario at New START levels and at lower numbers. Movement across tiers indicated that a characteristic rises or falls in relative importance as numbers decline. Identifying a characteristic that does not shift in importance, however, also represents an important data point. For example, a characteristic that remains within Tier 1 as numbers decline likely represents a quality of nuclear forces that is vital for every arsenal, regardless of size, and thus is something that is particularly important to preserve at lower numbers. Both types of findings may be relevant for future arms control negotiations.

## Findings

### *Deterring a Peer Adversary at New START Numbers*

The number and diversity of weapons in the nuclear force fielded by a peer adversary permit it to employ a range of nuclear strategies. A peer thus can use its nuclear force to deter or combat U.S. forces (both conventional and nuclear) in the field, beyond its borders, and in circumstances where nuclear weapons are not necessarily a “last resort.” A peer adversary could fight and possibly survive a major nuclear conflict with the United States.

*Tier 1.* At New START levels of nuclear forces, the most important qualitative characteristics for deterring a peer adversary are the *ability to defeat defenses*, *survivability*, and the *ability to reconstitute* (figure 1). The *ability to defeat defenses* supports the basic tenets of deterrence theory—being able to credibly threaten adversary targets. The ability to defeat defenses is vital in deterring peers, because a peer adversary has the national industrial and technical base to develop and deploy robust active defenses, such as anti-aircraft and (limited) missile defense systems. A peer also has the resources and know-how to harden a broad range of targets, to include key military, civilian, and communication facilities. To deter such an adversary, the United States must be able to guarantee the destruction of key targets despite the adversary’s efforts to defend them.

*Survivability* is another critical factor for maintaining stable deterrence against a nuclear peer. Failing to safeguard and maintain the survivability of nuclear forces in the face of an opponent whose own forces are capable, both in quantity and quality, of simultaneously attacking nuclear forces, command-and-control nodes, and key supporting infrastructure permits an adversary to contemplate launching a disarming first strike.

The *ability to reconstitute* forces is also critically important for deterring a peer adversary. In the near term, a peer adversary is the only type of adversary capable of significantly escalating the risk posed to the U.S. nuclear force through measures such as uploading ballistic missiles or mobilizing large numbers of de-alerted or inactive nuclear forces. A peer adversary undertaking these actions could upend the nuclear balance with the United States, throwing the ability of the U.S. nuclear force to deter it into doubt. By retaining the capability to match these moves, the United States ensures that a peer adversary will be unable to use a sudden change in its nuclear posture or numbers of fielded forces to gain the upper hand. At the same time, the United States must retain sufficient nuclear capabilities to ensure that it can deter a range of additional actors that may not be involved in the current crisis.

*Tier 2.* Three qualitative characteristics fall into the Tier 2 category for deterring a peer adversary. The *promptness* of the U.S. nuclear force promotes deterrence against a peer by granting the United States the capability to swiftly respond to any provocation. But the deterrent value of this characteristic is uncertain and linked with a peer adversary’s perception of the risk posed by the size and speed of America’s nuclear force. If a peer adversary believes that its forces are not particularly survivable against current U.S. nuclear capabilities, it may fear that the United States could rapidly launch an attack to

eliminate its own forces. A peer adversary that feels vulnerable to an all-out attack delivered with little notice may feel compelled to launch a preemptive attack. However, if a peer adversary believes that its forces (or a large part of its forces) are highly survivable against an American nuclear attack, the *promptness* of U.S. forces may not deter it, because it may believe that its arsenal can survive a U.S. “bolt from the blue” and respond with a devastating counterattack.

*Accuracy*, especially when combined with *promptness*, contributes to deterrence by putting an adversary’s leadership, command-and-control centers, and other counterforce targets at risk. For a peer, however, its deterrent value is also uncertain. Similar to *promptness*, the *accuracy* of U.S. forces can deter a peer adversary because it may view this characteristic (particularly when combined with characteristics such as the *ability to defeat defenses*) as allowing the United States to match it weapon for weapon—that is, each U.S. nuclear weapon fired has a high probability of hitting its intended counterforce target. If a peer adversary views its forces as highly survivable, however, it may willingly absorb a fast *and* accurate first strike, believing that its defenses will allow many of its delivery systems to remain operational and thus granting it the capability to respond with a major nuclear attack.

The *ability to signal* provides a means to show resolve with nuclear weapons without engaging in armed conflict. The United States can signal that it is willing to match, counter, and combat the nuclear force of a peer adversary through means such as visibly deploying weapons to forward operating areas. Whether this deters a peer from undertaking a particular course of action, or merely confirms to a peer that it can move forward with its plans because the United States can match but not decisively defeat its nuclear force, however, is difficult to determine.

*Tier 3.* The two qualitative characteristics assessed as less important for deterring peer competitors are *variety of yield options* and *ability to retarget*. A peer adversary can match the United States in developing, building, and fielding nuclear weapons with a range of yields. The United States’ ability to reduce or increase yield does not deter a peer adversary, which may believe that it can fight and win a nuclear war with the United States regardless of the scale of the conflict, from a limited exchange of small weapons to large-scale attacks including both sides’ full nuclear arsenals. The *ability to retarget* weapons is also relatively less important, primarily because this characteristic does not necessarily improve the deterrence posture of the United States when faced with the vastness of a peer adversary’s target set.

### *Deterring a Peer Adversary at Lower Numbers*

As the number of nuclear weapons in the U.S. nuclear arsenal declines, the most important qualitative characteristics for deterring peer adversaries remain unchanged. At lower numbers, the qualitative characteristics *ability to defeat defenses*, *ability to reconstitute*, and *survivability* remain critically important to deterring peer adversaries (figure 1).

*Tier 1.* As stated above, this analysis assumes that any U.S. reductions will occur in tandem with a peer. Even if the United States and a peer adversary undergo significant

reductions, however, a peer will keep a large number of deployed nuclear weapons. The *ability to defeat defenses* remains key to peer deterrence. Reductions of delivery vehicles, even if implemented equally, will reduce the ability of the United States to destroy peer targets. In addition, as nuclear arsenals are reduced, the incentives to build up both active and passive defenses to compensate for lower numbers are high for both sides. Deterrence is weakened if a peer adversary concludes that arms reductions lower the potential costs of nuclear conflict. Maintaining the *ability to defeat defenses* at lower numbers stabilizes the United States–peer deterrence relationship, ensuring that the peer remains at risk of sustaining significant to devastating losses if it initiates a nuclear conflict.

The general scope of reductions under a future arms control treaty considered by this analysis still permits a peer to maintain a large hedge force and robust nuclear complex. A peer will likewise retain the capability to rapidly change its number of deployed forces and force posture, and to introduce force modifications or even new platforms. As nuclear force levels decline, any change involving even a small number of forces may become strategically significant. Within this environment, maintaining an *ability to reconstitute* forces is a significant bulwark against deterrence failure.

In addition, taking steps to protect or enhance the *survivability* of a reduced nuclear force is vital to deterring a peer adversary at lower numbers. With parity in numbers maintained but the overall numbers and types of platforms and warheads reduced, a peer adversary attempting to seek an advantage is likely to carefully weigh whether any part of the United States’ remaining nuclear force is a “weak link” that could be significantly degraded by strikes using only a small number of nuclear weapons.

*Tier 2.* At lower numbers, *ability to signal* and *accuracy* remain Tier 2 characteristics for deterring peer adversaries. As numbers decline, a peer adversary will likely play close attention to any signals from the United States regarding its equivalently reduced force. Whether a signal is clearly received, however, is another matter, particularly as lower numbers drive all adversaries—peers included—to view each individual weapon as more valuable. At lower numbers, the *ability to signal* remains a characteristic that may be of either high or low value for deterrence, depending on the situation.

As noted above, this research project assumes that the relative parity between a peer adversary’s nuclear force and the U.S. force will remain at lower numbers. In such a scenario, the *accuracy* of the U.S. force will remain linked to an adversary’s assessment—on a system-by-system basis—of whether the low circular error probable of the U.S. force is strategically significant or unimportant. Its deterrent value will also vary broadly depending on a peer adversary’s current threat assessment.

These characteristics are joined by *variety of yield options*, which becomes more important at lower numbers. As numbers go lower, the research team assesses that the likelihood of an all-out conflict between a peer and the United States declines. Any nuclear conflict at lower numbers will be limited in scope and weaponry, in part because each side will have a greater awareness that other nuclear powers now—by relative comparison—possess strategically significant arsenals of their own. Either state could

foresee scenarios where “victory” over the other might leave them relatively weaker than a near-peer nuclear power. Within this context, a limited nuclear conflict will likely require smaller nuclear weapons. Accordingly, *variety of yield options* moves up one level in our Tier rankings.

*Tier 3.* The Tier 3 characteristics for lower force numbers are the *ability to retarget* and *promptness*. The research team assesses the reduction of numbers of peer and U.S. arsenals as reducing the (already very low) likelihood of nuclear conflict between the two; if a conflict were to occur, however, it would be limited in nature. Within this environment, neither side would face “use-it-or-lose it” pressure, and *promptness* would not play a significant role in deterrence. The *ability to retarget*, which is important for deterring and prevailing over an adversary whose forces are either primarily or solely mobile, does not carry great weight for the deterrence of a peer. Because a peer adversary is fielding both a wide range of fixed and mobile systems, and also possesses defenses that can reduce the effectiveness of any force that “loiters” or “hunts” for targets before a final decision to fire is made, it is not particularly deterred by the *ability to retarget*.

### *Deterring a Near-Peer Adversary at New START Numbers*

The nuclear capabilities of a near-peer adversary permit it to threaten a number of targets on the U.S. homeland, but it lacks the numbers to pose a significant threat to the U.S. nuclear force. In a situation of potential nuclear conflict, the weapons in the U.S. nuclear force significantly outnumber those of a near-peer. A near-peer, however, is the only adversary besides a peer that is largely self-sufficient in designing and manufacturing delivery systems and warheads. It may have the potential to build up its limited arsenal relatively quickly.

*Tier 1.* The most critical qualitative characteristics for deterring a near-peer adversary are the *ability to reconstitute*, *ability to defeat defenses*, and the *ability to signal* (figure 2). A near-peer’s capability to expand its nuclear force underscores the importance of the *ability to reconstitute* nuclear forces for the purpose of deterrence. If a near-peer is capable of rapidly accelerating efforts to build up its nuclear arsenal, it may conclude that in a relatively short amount of time it can reach parity with the U.S. nuclear force (also referred to as a “breakout” scenario). Maintaining the *ability to reconstitute* its nuclear force ensures that the United States can respond to any near-peer expansion of its nuclear arsenal and retain a significant edge over this type of adversary.

A near-peer’s nuclear force, which includes both fixed and mobile ballistic systems, is quantitatively inferior to that of a peer adversary but is qualitatively similar. It fields highly capable, possibly well-defended, and hard-to-locate nuclear weapons. This might lead a near-peer to speculate that a part of its arsenal could survive an initial attack from a numerically superior foe. Ensuring that the United States maintains its nuclear force with a robust *ability to defeat defenses* is important to deterring a near-peer and convincing this type of adversary that the United States has the capability to launch a disarming strike that holds its entire arsenal at risk.

**Figure 2. Deterring a Peer Adversary as Numbers Decrease**

Tier 1 (most important)	Tier 2	Tier 3 (least important)
Deter Peer Adversary at NST Numbers		
Ability to Defeat Defenses Ability to Reconstitute Survivability	Ability to Signal Accuracy Promptness	Ability to Retarget Variety of Yield Options
Movement from NST Numbers to Lower Numbers		
Ability to Defeat Defenses Ability to Reconstitute Survivability	Ability to Signal Accuracy <u>Promptness</u>	Ability to Retarget <u>Variety of Yield Options</u>
Deter Peer Adversary at Lower Numbers		
Ability to Defeat Defenses Ability to Reconstitute Survivability	Ability to Signal Promptness Variety of Yield Options	Ability to Retarget Accuracy

The *ability to signal* is also critical for deterring a near-peer. Although it cannot match the U.S. nuclear force overall and only possesses a limited number of long-range delivery systems, a near-peer might believe that it could use its nuclear force to challenge the United States in a theater conflict or crisis. In these types of scenarios, a near-peer could bring a much broader range of nuclear weapons to bear against forward-deployed U.S. weapons. A near-peer could also attempt to use its nuclear force to change the stakes of a regional conflict in its favor. For example, a near-peer may calculate that the communication of a nuclear threat against the U.S. homeland will slow or halt U.S. intervention in its region, granting it a freer hand. Clear signals of resolve sent via the U.S. nuclear force, however, could convince a near-peer to deescalate.

*Tier 2.* Three characteristics fall into Tier 2: *accuracy*, *promptness*, and *survivability*. A near-peer adversary will likely assume a high degree of *accuracy* for the entirety of the U.S. nuclear force. The build-up of its defenses in part reflects a recognition that it may face an opponent with a very accurate nuclear force. If a near-peer is highly confident in its defenses, however, it may not be completely deterred by the *accuracy* of the U.S. nuclear force, believing that it can “ride out” an attack.

Similar to a peer adversary, the *promptness* of the delivery of a nuclear weapon also has less bearing on the deterrence of a near-peer adversary than Tier 1 characteristics. This is due to the fact that the United States maintains a credible second-strike capability in any scenario involving a near-peer adversary, including an unlikely “bolt from the blue” attack in which an adversary unleashes its full nuclear force against the United States. Whether slow or fast, a survivable U.S. nuclear force is assured of an opportunity to respond with overwhelming force to any attack from a near-peer.

The second-strike capability of the United States also places the *survivability* of its nuclear force in Tier 2 when considering deterrence of a near-peer adversary. Even if



caught by surprise, and even if a near-peer's force proved highly accurate and lethal, enough U.S. weapons, by virtue of their sheer quantity, would survive an initial near-peer attack to counterattack with devastating consequences. *Survivability*, however, becomes more important within any near-peer breakout scenario.

*Tier 3.* The two qualitative characteristics deemed of lesser importance for near-peer deterrence are the *ability to retarget* and the possession of a *variety of yield options*. A near-peer's range of capabilities and strength of its defenses are such that the flexibility these characteristics grant to the U.S. nuclear force could only complicate, not defeat, a near-peer's ambitions. A near-peer views its ability to expand its range of nuclear capabilities and strengthen its defenses as measures complicating the U.S. nuclear force's ability to effectively counter its regional ambitions. Consequently, the inherent flexibility and dexterity that these two characteristics give the U.S. nuclear force are of limited deterrent value relative to other characteristics that hold targets at risk more effectively.

### *Deterring a Near-Peer Adversary at Lower Numbers*

*Tier 1.* The most critical qualitative characteristics for deterring a near-peer adversary at lower numbers are the *ability to defeat defenses*, the *ability to reconstitute*, and *survivability* (figure 3). *Survivability* is new to Tier 1, having moved up in importance at lower numbers. If the United States were to reduce its nuclear force while a near-peer's force remained at current levels, a near-peer's numerical disadvantage vis-à-vis the United States, though still significant, would become less acute. As discussed above, with a capable indigenous nuclear complex backing its current fielded forces, a near-peer might contemplate taking steps to close the quantitative gap between its nuclear force and that of the United States. U.S. reductions could be one of several factors considered by a near-peer weighing the decision to expand its nuclear arsenal, and the size, scope, and speed of this expansion. The *ability to reconstitute* will remain important to deterring a near-peer at lower numbers, granting the U.S. force the flexibility to respond to any attempt by a near-peer to break out and achieve nuclear parity following a future round of United States-peer reductions. The *ability to defeat defenses* also maintains its position as a Tier 1 qualitative characteristic. Convincing a near-peer that the United States has the ability to rapidly overwhelm its nuclear force (including its mobile systems) during a conflict, despite the near-peer's efforts to defend them, remains important to deterring this type of adversary.

At lower numbers, *survivability* becomes more of a concern due to a near-peer adversary's ability to hold at risk a larger percentage of the U.S. nuclear force. At New START levels, this percentage was low enough to place *survivability* in Tier 2. At lower numbers, however, the increase in risk from a near-peer to the components of the U.S. nuclear force, particularly those weapons stationed or deployed outside the United States for extended deterrence purposes, makes the *survivability* of these U.S. weapons more important.

**Figure 3. Detering a Near-Peer Adversary as Numbers Decrease**

Tier 1 (most important)	Tier 2	Tier 3 (least important)
<b>Deter Near-Peer Adversary at NST Numbers</b>		
Ability to Defeat Defenses	Accuracy	Ability to Retarget
Ability to Reconstitute	Promptness	Variety of Yield Options
Ability to Signal	Survivability	
<b>Movement from NST Numbers to Lower Numbers</b>		
Ability to Defeat Defenses	Accuracy →	Ability to Retarget
Ability to Reconstitute	Promptness ←	Variety of Yield Options
Ability to Signal	Survivability ←	
<b>Deter Near-Peer Adversary at Lower Numbers</b>		
Ability to Defeat Defenses	Ability to Signal	Ability to Retarget
Ability to Reconstitute	Promptness	Accuracy
Survivability	Variety of Yield Options	

Significantly, as a result of this shift, the three characteristics that are most important for deterring a near-peer adversary at lower numbers are the same as those for deterring a peer adversary. At lower numbers, the two categories of peer and near-peer are not identical, but begin to blend into one, as the most important Tier 1 characteristics are the same for both. Following United States–peer reductions, a near-peer remains significantly behind the numbers of the U.S. force, but its calculations of risk and cost/benefit analysis of scenarios involving nuclear forces begin to change in its favor. As a result, the deterrence requirements of a near-peer increasingly mirror those of a peer well before a near-peer reaches numerical parity with the United States.

*Tier 2.* Other changes can be seen in the movement of some of the Tier 2 characteristics: *ability to signal*, *promptness*, and *variety of yield options*. Due to the elevation of *survivability* to Tier 1 status for deterring a near-peer at lower numbers, the *ability to signal* was moved to the second Tier. However, the ability to visibly demonstrate resolve remains important even at lower numbers. Thus, this demotion is more representative of rise in stature of *survivability* at lower numbers than any decrease in importance of the *ability to signal*.

As the United States moves toward lower numbers, adversaries may question its willingness to use nuclear weapons, undermining the credibility of U.S. resolve. For example, if a future reduced U.S. arsenal were limited to high-yield weapons, or if low-yield weapons were only available on platforms susceptible to an adversary’s active defenses (e.g., dual-capable aircraft and bombers) an adversary might conclude that the United States was self-deterred, incapable of seriously damaging it, or both. At lower numbers, a *variety of yield options* provides an increased credibility to the U.S. nuclear deterrent that warrants an increase from its Tier 3 position at New START numbers.

*Promptness* remains in Tier 2. Though a near-peer may be concerned that the U.S. nuclear force is, in general, more prompt than its own, its value for deterrence purposes is not as high as the other qualitative characteristics in Tier 1. The importance of the speed of a U.S. response remains below those qualitative characteristics that equip the U.S. nuclear force to penetrate a near-peer’s best-laid defenses, ensure that a significant

part of the force survives any near-peer strike, and preclude any possibility of a near-peer breakout. By granting the United States an advantage in a conflict of any duration, whether short or long, and whether the U.S. force is responding to a preemptive strike or launching first, the three qualitative characteristics in Tier 1 ensure that *promptness* remains a Tier 2 characteristic. It remains above Tier 3, however, as it continues to provide an immediate existential threat to a near-peer's nuclear arsenal in response to any act of aggression by this type of adversary.

*Tier 3.* The short timeline and overwhelming numbers associated with a U.S. response to a nuclear attack is a greater deterrent to a near-peer than any calculus of the *accuracy* of the force itself. A near-peer is likely to recognize that, barring a breakout, even at lower numbers the United States can afford to devote multiple weapons to a number of targets associated with its own arsenal. Joining *accuracy* in Tier 3 is the *ability to retarget*. This placement is unchanged from its position at New START numbers. Even after the U.S. force is reduced, the perceived strength of a near-peer's defenses and its combination of dispersed fixed and mobile systems diminishes this characteristic's deterrent utility.

### *Maintaining Strategic Stability vis-à-vis Peers and Near-Peers*

According to the 2010 Nuclear Posture Review, a key role of the U.S. nuclear force is to “maintain strategic stability with major nuclear powers.” While maintaining stability was not a scenario considered within the research project, during the course of the analysis it became apparent that the relationship between nuclear weapons and strategic stability could be assessed using a methodological approach similar to that employed for determining the key qualitative characteristics of nuclear forces associated with the objectives of deterrence, prevailing over adversaries, and strategic stability. Accordingly, this section discusses strategic stability and the qualitative characteristics of nuclear forces that are important for establishing and maintaining a managed and transparent deterrence posture between states. The analysis treats peer and near-peer powers as “major nuclear powers.”

Strategic stability between nuclear powers entails each power balancing the force capability to attack another state's nuclear arsenal with a force posture that ensures that the latter party does not conclude that its nuclear force is being held at an unacceptable level of risk. In the past, nuclear strategists generally linked the concept of strategic stability with postures that ensure mutual vulnerability. In addition, many arms control negotiators view “stability” as rooted in a continuously cultivated relationship between nuclear powers, rather than as the outcome of a discrete decision or policy.

Some aspects of strategic stability, including symmetries of capabilities between adversaries, cannot be captured with the qualitative characteristics of one side's arsenal alone. Nonetheless, the qualitative characteristics that best promote strategic stability between the United States and peer powers (and potentially rising near-peer powers) are those that maintain mutual vulnerability and communicate intent regarding nuclear forces. In contrast, qualities that aid first-strike attacks are harmful to strategic stability, raising the possibility that one party might consider it possible to preemptively attack, and disarm or destroy, the other party or parties.

*Tier 1.* The Tier 1 characteristics for strategic stability, therefore, are the *ability to signal*, the *ability to defeat defenses*, and *survivability*. The *ability to signal* promotes stability by providing means for each side to communicate their intent to the other (figure 4). This intent could be escalation or deescalation. The ability to credibly signal restraint is especially important for promoting stability in periods of tension. In addition, the ability of nuclear weapons to *defeat defenses*, if shared by both sides, creates a sense of mutual vulnerability. Neither side can presume that its defenses, whether active or passive, will prevent destruction from an incoming attack. Furthermore, the presence of highly *survivable* forces on both sides contributes to strategic stability by disincentivizing first-strike attacks, ensuring that such an attack will be met with a punishing response.

**Figure 4. Maintaining Strategic Stability with Major Nuclear Powers**

Tier 1 (most important)	Tier 2	Tier 3 (least important)
Ability to Defeat Defenses	Ability to Reconstitute	Ability to Retarget
Ability to Signal	Variety of Yield Options	Accuracy
Survivability		Promptness

*Tier 2.* The Tier 2 qualitative characteristics for strategic stability are the *ability to reconstitute forces* and a *variety of yield options*. The ability to deploy a nuclear force carrying weapons with a range of yields, including lower-yield weapons, that may be viewed by some parties as more “usable,” could lead to nuclear conflict being viewed as more likely by all parties. Conversely, some parties view large-yield warheads—particularly if they are the only type, or majority type, of warhead within a national arsenal—as inherently threatening and therefore destabilizing. Larger weapons are more destabilizing because of their inherent destructive power. If used for counterforce targeting, larger weapons could destroy an entire base or defeat the strongest passive defense system. If used for countervalue targeting, larger weapons could result in the loss of an entire city or cities. Larger weapons are especially destabilizing if only one adversary has these weapons; in this circumstance, there can be no concept of limited war if these weapons are deployed. As such, fielding a *variety of yield options* might be viewed as stabilizing, granting states a range of options and offering protection against technical<sup>7</sup> or strategic<sup>8</sup> deterrence failure.

7. This is the case if, e.g., a state’s central or only warhead type unexpectedly fails.

8. An arsenal that lacks diversity in terms of warheads may impose significant constraints regarding strategy; for example, a state only fielding warheads of one yield may discover there are certain targets it cannot destroy (if the yield is too low) or that it is self-deterred from employing nuclear forces because it will cause unacceptable collateral damage (if the yield is too high).

Similarly, another party could view the ability of a state to reconstitute its force as either stabilizing or destabilizing. It might be viewed as stabilizing if the observer believed that the ability of a nuclear force to adapt to geopolitical change ensured that the state in question would never feel compelled to take risky actions due to a fear that it might “lose” its capabilities. Other parties, however, might consider this qualitative characteristic to be threatening, assessing that it granted a potential adversary the capability to rapidly upgrade or expand its force, giving it an edge over other states. Transparency measures may address this concern by building confidence that each side is (or will be) aware of the other’s reconstitution capabilities. With both qualitative characteristics having the potential to contribute to stability or instability, they are placed within Tier 2.

*Tier 3.* For the purposes of establishing strategic stability between nuclear states, the qualitative characteristics *accuracy*, *promptness*, and *ability to retarget* are placed in Tier 3. All these characteristics support quick, precise strikes. They are potentially destabilizing because a nuclear-armed state could view these characteristics as permitting a potential adversary to launch a decapitating first strike against its leadership and command-and-control infrastructure. Accurate weapons also increase the viability of attacks against opposing nuclear forces, even at lower yields, because the overpressure generated is greater than with less accurate weapons of the same yield.

### *Strategic Stability and Force Reductions*

At lower numbers, the relative importance of qualitative characteristics for the purposes of strategic stability remains the same; characteristics retain their placement in the same tiers. At lower numbers, however, Tier 1 characteristics may require greater emphasis, because maintaining characteristics in strength becomes increasingly difficult.

*Survivability* is just as important for strategic stability at lower numbers as it is for current numbers; but at lower numbers, it is possible that the calculus of adversaries may change. For example, at lower numbers a potential adversary may view a first strike as potentially useful for destroying a significant portion of the U.S. arsenal, even if it could not plausibly destroy all U.S. weapons. Nevertheless, it may consider a first strike either because it gambles that the remaining weapons in the U.S. force will have difficulty responding to a surprise attack and/or it believes that it can absorb the damage meted out by the surviving U.S. force and still emerge victorious. In addition, maintaining the *ability to signal* may prove difficult at lower numbers if those delivery systems whose deployment or alert status is more readily observed are reduced or eliminated.

The one characteristic that could potentially increase in importance for maintaining strategic stability at lower numbers is the *ability to reconstitute*. At lower numbers, each additional new weapon will have a greater impact than a weapon added to current numbers. If an adversary were to consider a breakout scenario in reaction to geopolitical change vis-à-vis the United States or another state, the United States may want to match this state numerically in order to maintain stability. For the reductions contemplated by this research project, however, and given current adversary policies and capabilities, the research team does not view the *ability to reconstitute* as changing in terms of its relative importance.

Promoting strategic stability goes beyond the characteristics of nuclear arsenals to the communication efforts, confidence-building exercises, and transparency measures that exist between nuclear states. These activities may be further complicated at lower numbers if there are more states within the “peer” category of potential adversaries. Maintaining the United States’ strategic stability vis-à-vis the USSR was challenging during the Cold War, but the two parties were primarily concerned with establishing a stable relationship between each other’s nuclear forces. At low numbers, the United States may need to establish strategic stability vis-à-vis more than one nuclear power, including states that may have an interest in strategic stability with the United States but not with each other. Furthermore, there is no guarantee that at low numbers other nuclear powers will accept the general “template” of nuclear arms control established over the years between the United States and Russia, or abide by the broader framework of global nuclear nonproliferation and testing treaties. If reductions by the United States and peer powers lead to several states possessing limited nuclear arsenals of roughly equivalent sizes, these and other factors will present a complex challenge for future negotiations seeking to build confidence, encourage transparency, and establish strategic stability across a multipolar nuclear environment.

## Study Conclusions

Based on the analysis of the characteristics best suited for the missions identified in the U.S. Nuclear Posture Review—namely, deterring adversaries, prevailing over adversaries when deterrence fails, and maintaining strategic stability vis-à-vis peer and near-peer adversaries—the study team developed four conclusions.

First, today’s key qualitative characteristics remain critical for tomorrow’s smaller U.S. nuclear force. Reducing the U.S. force in tandem with that of a peer competitor following the negotiation of a future arms control treaty would not significantly change the diverse range of qualitative characteristics required to ensure that the United States achieves its objectives of deterrence, prevailing, and stability vis-à-vis all adversaries. Although this study has focused on the shifting relative importance of individual qualitative characteristics for objectives concerning peer and near-peer adversaries, the overall depth and breadth of the qualitative requirements associated with countering the full range of nuclear-armed adversaries and protecting allies around the globe will remain unchanged for the U.S. nuclear force even as its numbers decline.

Second, with regard to deterring and prevailing over other major nuclear powers, *survivability* is the one characteristic whose relative importance significantly increases as numbers decline. A nuclear force that can survive an adversary’s nuclear strike and mount a decisive response—whether due to its weapons’ and systems’ physical properties, deployment, posture, or a combination of factors—is vital to the maintenance of deterrence. As the numbers in a nuclear force are reduced, the importance of *survivability* grows, particularly for ensuring stable relationships between major nuclear powers. As arsenals decline, a major power might conclude that the cumulative costs of a nuclear exchange also decline. Maintaining a highly survivable force, even as overall numbers



of weapons are reduced, enhances stability by preserving the ability of the United States and its remaining force to credibly threaten all powers, including those retaining significant numbers of weapons, with unacceptable costs if they attempt to launch a nuclear attack on the United States or its allies.

Third, if the United States continues to reduce its nuclear force, more nuclear-armed states will become “peer adversaries.” The relative capabilities of near-peers will increase if the United States and a peer field increasingly smaller arsenals to the point that quantitative considerations become more salient; that is, “quantity” becomes a variable qualitative characteristic of the force. Pursuing further reductions may lead the United States to face additional “peer adversaries,” as the distinction between current peer and near-peer adversaries will eventually collapse at lower numbers—particularly if states in the latter category build up their forces. If this occurs, the qualitative characteristics for deterring and prevailing over former near-peer adversaries will shift to those required to deter and prevail over a peer.

Fourth, and finally, sustaining strategic stability with a reduced nuclear force requires the force to be composed of an arsenal whose qualitative characteristics hold the other party’s nuclear weapons at risk, while also signaling a steady state of mutual deterrence. Strategic stability between major nuclear powers requires both parties to acknowledge that each has the ability to cause unacceptable damage to the other and will forgo actions that undermine mutual vulnerability. The establishment (and maintenance) of stability requires the qualitative characteristics of the *ability to defeat defenses*, *survivability*, and the *ability to signal*—qualities ensuring that a nuclear force can weather an attack, mount a decisive response, and retain the ability to clearly communicate intent in times of peace or war. Although maintaining strategic stability between major nuclear powers is a complex process not solely dependent upon the sizes and composition of their respective nuclear forces, these forces remain the linchpin of a relationship founded upon mutual recognition of one another’s deterrent capabilities. To prevent force reductions from threatening strategic stability, a smaller arsenal should retain these three qualitative characteristics, ensuring that the remaining forces are capable of communicating a posture of peacetime deterrence and mounting an assured, decisive response in the event of a nuclear conflict.

# The Duma/Senate Logjam Revisited: Actions and Reactions in Russian Treaty Ratification

Anya Loukianova<sup>1</sup>

## Abstract

This paper analyzes the political dynamics and debates surrounding the passage of five nuclear arms control agreements in the Russian State Duma during the last 20 years. It contends that treaty ratification has become easier in light of the increased degree of cohesion between the executive branch and the legislature's majority party in Russia. However, concentrating only on this centralization of foreign policy in the Kremlin over the past decade obscures the impact of internal parliamentary debates on Moscow's nuclear policy. Moreover, ongoing changes in Russia's political system are introducing structural uncertainty into Moscow's decisionmaking. The paper first introduces the "logjam" between the Duma and the U.S. Senate that thwarted the implementation of the arms control agenda pursued by the Bill Clinton and Boris Yeltsin administrations. It then provides an overview of the Russian legislative branch, highlights its role in foreign policy and treaty ratification, and summarizes the changes in the legislature's political composition over time. The paper further offers an assessment of arms control treaty passage votes, recurring themes in legislative debates, and key points of ratification resolutions and declarations. In conclusion, it argues that political instability and the nationalistic mood in Russia, coupled with prevailing attitudes in the U.S. Senate, may lead to still another legislative logjam dynamic in future arms control treaties.

## The Duma/Senate "Logjam"

The domestic bipartisan consensus on nuclear arms control in the United States unraveled in 2010. That year saw the Barack Obama administration and the Senate's wrangling over the ratification of the April 2010 New Strategic Arms Reduction Treaty (New START). For months, the executive branch had not been sure whether it would have enough votes

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in Congress to pass this treaty, which had become unexpectedly controversial. As part of the treaty-vetting process, Senate committees held 20 hearings on matters pertinent to the U.S.–Russian agreement that featured testimonies from current and former executive branch officials.<sup>2</sup> The legislators submitted nearly a thousand questions for the record and drafted a ratification resolution that voiced significant concerns. Ultimately, New START passed in a dramatic December 2010 vote with the approval of 71 of the 100 senators.<sup>3</sup>

### *New START in the Duma*

By comparison, the prospects for New START's ratification in the Russian State Duma seemed substantially better. The nuclear arms control pact was of great importance to Russia's ruling tandem at the time, President Dmitriy Medvedev and Prime Minister Vladimir Putin.<sup>4</sup> Moreover, the fact that the United Russia party, which supports Medvedev and Putin, held the majority of seats in the Duma augured well for easy passage of the agreement.<sup>5</sup> In July 2010, the Duma's Foreign Affairs Committee recommended New START for a floor vote, pending the pact's ratification by the U.S. Senate.

However, in November 2010, the Duma's Foreign Affairs Committee surprised Washington observers by withdrawing its support from New START.<sup>6</sup> The lawmakers were concerned less about the treaty itself and more about the potential security implications of the U.S. Senate's accompanying ratification resolution, which included a set of declarations, conditions, and understandings of the bilateral agreement.<sup>7</sup> The Foreign Affairs Committee's chairman, Konstantin Kosachev, noted that he was particularly troubled that the resolution's understandings pertaining to missile defense, rail-mobile intercontinental ballistic missiles, and strategic-range non-nuclear weapons systems could hold legal weight.<sup>8</sup>

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2. John F. Kerry, "New START Debate: John Kerry Responds to Mitt Romney," *Boston Globe*, December 3, 2010, [http://www.boston.com/bostonglobe/editorial\\_opinion/blogs/the\\_angle/2010/12/new\\_start\\_debat.html](http://www.boston.com/bostonglobe/editorial_opinion/blogs/the_angle/2010/12/new_start_debat.html).

3. Ellen Tauscher, "Interview: The Status of the New START Treaty," National Public Radio, November 17, 2010, <http://www.npr.org/templates/story/story.php?storyId=131393368>.

4. Josh Rogin, "U.S. Officials: No Daylight between Medvedev and Putin on Nuke Treaty," *Cable*, March 31, 2010, [http://thecable.foreignpolicy.com/posts/2010/03/31/us\\_officials\\_no\\_daylight\\_between\\_medvedev\\_and\\_putin\\_on\\_nuke\\_treaty](http://thecable.foreignpolicy.com/posts/2010/03/31/us_officials_no_daylight_between_medvedev_and_putin_on_nuke_treaty).

5. See, e.g., the comments by Konstantin Kosachev in "Russian MPs 'Want to Take Their Time' on Arms Deal Ratification," RIA Novosti, July 6, 2010, <http://www.en.rian.ru/russia/20100706/159713750.html>.

6. "Russian Lawmakers Drop 'New START' Endorsement," *Global Security Newswire*, November 3, 2010, <http://www.nti.org/gsn/article/russian-lawmakers-drop-new-start-endorsement/>.

7. "Russian Lawmakers Could Reconsider 'New START,'" *Global Security Newswire*, November 1, 2010, <http://www.nti.org/gsn/article/russian-lawmakers-could-reconsider-new-start/>.

8. Joshua Pollack, "What the Senate's New START Resolution Says," *Arms Control Wonk*, November 3, 2010, <http://pollack.armscontrolwonk.com/archive/3501>.

Shortly thereafter, key committee members began to argue that the Duma's simple advice and consent on New START would no longer be possible. Meanwhile, Communist Party deputies sought to delay and derail key votes on the pact.<sup>9</sup> Nevertheless, accompanied by a newly written ratification resolution of its own, the Duma passed New START in January 2011 with the support of nearly 78 percent of its lawmakers.

### *The 1990s "Logjam"*

Before sending the bilateral nuclear arms control pact for approval by the U.S. and Russian legislatures, presidents Obama and Medvedev agreed to synchronize the accord's ratification. This move was designed to avoid the kind of political paralysis that resulted in the Bill Clinton and Boris Yeltsin administrations' failure to acquire the advice and consent of the Senate and the Duma for a handful of arms control agreements. The memories of that 1990s action-and-reaction dynamic that had taken the arms control agenda hostage, with the legislatures battling against the presidents while also pointing at each other as the cause for delay, were still all too fresh in Washington and Moscow.

In a 1997 article in the *Nonproliferation Review*, George Bunn and John Rhinelander described a "growing logjam of arms control treaties" awaiting legislative approval in both capitals.<sup>10</sup> This dynamic, they argued, hindered the passage of the Strategic Arms Reduction Treaty (START II) of 1993, the Comprehensive Test Ban Treaty of 1996 (CTBT), and the 1997 amendments to the Anti-Ballistic Missile (ABM) Treaty, as well as the protocols for the Treaty of Pelindaba and the Treaty of Rarotonga (the latter two would create nuclear-weapons-free-zones in Africa and the South Pacific, respectively). In addition, the "logjam" had the potential "also [to] prevent progress towards START III and further bilateral nuclear reductions."<sup>11</sup>

Bunn and Rhinelander suggested that this "logjam" was actually the result of certain similarities between the U.S. and Russian legislatures, both of which were fresh out of an elections cycle. "New crops of post-Cold War legislators are focused more on domestic problems than on international relations [while] many remain suspicious of the other country's intentions and therefore have adopted highly nationalistic attitudes towards arms control," they argued.<sup>12</sup> Moreover, the restructuring of Russia's government institutions provided the opportunity for the legislature to challenge the president, setting a historical precedent.<sup>13</sup>

Bunn and Rhinelander posited that there was no way to resolve this "logjam." Instead, they concluded that Moscow and Washington had to wait it out until the nationalist rhetoric dissipated and the domestic political environment was more conducive to the

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9. Nikolai Sokov, "Apparent Smooth Sailing Obscures Submerged Drama and Revelations," Center for Nonproliferation Studies, January 25, 2011, [http://cns.miis.edu/stories/110125\\_russia\\_new\\_start\\_ratification.htm](http://cns.miis.edu/stories/110125_russia_new_start_ratification.htm).

10. George Bunn and John B. Rhinelander, "The Duma-Senate Logjam on Arms Control: What Can Be Done?" *Nonproliferation Review* 3 (1997): 73-87.

11. *Ibid.*, 73.

12. *Ibid.*

13. *Ibid.*

passage of arms control agreements. In the meantime, the Clinton and Yeltsin administrations could pursue their agendas through reciprocal unilateral measures, political commitments, and executive agreements—or, in other words, means other than treaties that required action by their legislatures.<sup>14</sup>

### *The Research Proposal*

Looking back, Bunn and Rhinelanders' analysis of the bilateral political dynamics appears prescient. START II, passed by the Senate in 1996, was eventually ratified by the Duma in 2002, but it never entered into force. The CTBT, passed by the Duma in 1997, was never ratified in the U.S. Senate. The ABM Treaty's succession package, which was agreed upon by the two nations' presidents in 1997, never passed, and that treaty was abrogated in 2002. And the protocols for the African and South Pacific nuclear-weapons-free-zone treaties remain unratified by the U.S. Senate to this day. (The Russian Duma has ratified the latter with conditions and has yet to ratify the former.)

This paper examines the difficulty of passage of START II, the CTBT, the Moscow Treaty (also known as the Strategic Offensive Reductions Treaty), and New START. It focuses on the Duma deputies' concerns regarding these treaties and the factors that delayed their ratification. The paper seeks to explain the impact of Duma political dynamics on arms control initiatives in the past and probably in the future.

## A Primer on the Russian Legislature

Before analyzing treaty ratification processes, a broad overview of the Russian legislative branch and its role in national security policymaking is in order. During the past two decades, each parliamentary election in Russia has heralded interesting shifts in the political party composition of the Duma. Every shift, a reflection of public attitudes toward the executive branch, has either decreased or increased the degree of consensus on arms control treaties.

Russia's bicameral legislature, the Federal Assembly, consists of a lower house, the State Duma, and an upper house, the Federation Council.<sup>15</sup> The State Duma has 450 members, who are elected every five years based on party lists with proportional representation. The Federation Council, in turn, has 166 members, and these representatives are chosen by regional officials. The legislature plays an important role in the ratification of treaties. Treaty passage requires a majority vote in the Duma (226 votes), followed by a majority vote in the Federation Council. The Duma is the instrumental body in this process, however. If the Federation Council rejects a treaty, the Duma can still override that vote with a two-thirds majority.

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14. Ibid., 73–78.

15. See additional information on the Web sites of the State Duma and the Federation Council, respectively, at <http://www.duma.gov.ru> and <http://www.council.gov.ru>.

## *Shifts in the Duma's Influence*

As the “logjam” discussion above suggests, the Duma played a key role in thwarting the arms control goals of the Yeltsin administration. Indeed, the Russian lawmakers took a page from the playbook of their U.S. counterparts in threatening to defund programs, drafting ratification resolutions, and requiring executive branch reporting on nuclear policy. However, the legislature’s direct impact on the policymaking process has waxed and waned over the past two decades. In stark contrast to an empowered institution that would be willing and able to block action on issues of the highest importance to the executive branch, the Duma of the first decade of the 2000s has been much more compliant with the president’s positions on national security.

This contrast has been the result of structural changes within the Russian political system. As Dmitri Trenin and Bobo Lo wrote in 2005, “political power has become re-centralized, [with the] field of public politics [shrinking] to its smallest since the beginning of Gorbachev’s perestroika.”<sup>16</sup> To that end, “the legislature has been more or less the legislative arm of the Presidency.” And the speakers of both chambers, “both trusted lieutenants of the president, [have been] occasionally charged with foreign policy missions, but their real, as opposed to protocol, roles [have been] minimal.”<sup>17</sup>

In turn, the role of the chairmen of the Foreign Affairs Committees in the Duma and the Federation Council is to shepherd treaties through the legislative process.<sup>18</sup> During the past decade, the Duma’s Foreign Affairs Committee chairman, Kosachev, and his Federation Council counterpart, Mikhail Margelov, have been closely aligned with one another, the United Russia party, and the Putin and Medvedev administrations.<sup>19</sup> More recently, it has even been rumored that Kosachev, who was shifted from the chairmanship after the December 2011 parliamentary elections, would take a high-level post in the executive branch.<sup>20</sup> Predictably, these relationships have boded well for the policy agendas of Putin and Medvedev.

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16. Dmitri Trenin and Bobo Lo, *The Landscape of Russian Foreign Policy Decision-Making* (Moscow: Carnegie Endowment for International Peace, 2005), 13.

17. *Ibid.*, 13.

18. As Trenin and Lo also note, “in comparison [with the Foreign Affairs Committees], the defense and security committees of both houses do not deal much with foreign policy issues.”

19. However, during the ratification of the Moscow Treaty in 2002, the two foreign affairs committee chairmen butted heads. That was at a time when the Duma’s foreign affairs committee head was Dmitry Rogozin, now famous (or infamous) for his role as Russia’s ambassador to NATO and the special representative on missile defense.

20. Kosachev was reportedly offered a variety of posts, including Russia’s ambassador to NATO. Polina Khimshivshili and Natalya Kostenko, “Konstantin Kosachev May Leave the Duma for a Move Up,” *Vedomosti*, February 22, 2012, [http://www.vedomosti.ru/politics/news/1510718/v\\_pomosch\\_diasporam](http://www.vedomosti.ru/politics/news/1510718/v_pomosch_diasporam).



## *The Duma's Party Composition*

In a structural sense, a “logjam” of 1990s magnitude has not been possible in the Duma since the early 2000s. As table 1 highlights, the Duma had become a much less dynamic political institution than it was in the past. In 1993, the legislature had six large political blocs, none of which numbered less than 20 or more than 65 deputies. In 2003, the number of formidable political blocs dropped to four, and the pro-Putin United Russia bloc was just six seats shy of a two-thirds voting majority. With Putin’s popularity rising, the public support for the majority party similarly increased.

**Table 1. State Duma Election Results by Party or Coalition, 1993–2011**

Party or Coalition	2011	2007	2003	1999	1995	1993
United Russia / Unity + Fatherland All Russia	238	315	220	73+66	—	—
Communist Party (KPRF)	92	57	52	113	157	42
LDPR	56	40	36	17	51	64
Fair Russia/ Rodina	64	38	37	—	—	—
Yabloko	—	—	4	20	45	27
Agrarian	—	—	2	—	20	37
Union of Right Forces / Russia's Choice	—	—	3	29	9	64
Women of Russia	—	—	—	—	3	21

Sources: Summary of 1993–2007 election results is from Russia Votes, a Levada Center–University of Aberdeen research project, [http://www.russiavotes.org/duma/duma\\_elections\\_93-03.php](http://www.russiavotes.org/duma/duma_elections_93-03.php); the results of the 2011 elections are from the Central Election Commission of the Russian Federation, [http://www.cikrf.ru/banners/duma\\_2011/index.html](http://www.cikrf.ru/banners/duma_2011/index.html).

In 2005, Putin pushed through a package of reforms that essentially reduced the number of parties in the parliament. The crux of the reforms was that the mixed-member system was replaced by proportional representation, and only registered parties—a separate, stringent party registration law had been passed a few years before—could now compete in the elections.<sup>21</sup> Further, a party had to get 7 percent of the votes (instead of 5 percent) in order to get seats in the Duma. There was also no minimum turnout for the election, and the option to vote “against all candidates” was eliminated.<sup>22</sup>

In 2007, only four parties gathered enough votes to pass the thresholds established by the new legislation. That year, United Russia also captured 70 percent of the Duma’s seats. Since then, the “opposition” has been composed of the deputies of the Communist Party (Kommunisticheskaya Partiya Rossiyskoy Federatsii, KPRF); the ultranationalists, the so-called Liberal Democratic Party of Russia, LDPR; and the Fair Russia party.<sup>23</sup>

21. *Duma Election Law: Details* (Moscow: Levada Center–University of Aberdeen, 2005), [http://www.russiavotes.org/duma/duma\\_election\\_law.php](http://www.russiavotes.org/duma/duma_election_law.php).

22. *Ibid.*

23. Critics have charged that these parties have not been willing to challenge the executive branch’s agenda.

## *The December 2011 Election*

Over time, the United Russia party began to lose public support. Backed by federal and regional government officials, the party became associated with corruption in government institutions and the concentration of wealth among ruling elites.<sup>24</sup> In the period before the December 2011 parliamentary election, the KPRF capitalized on public discontent, also attacking United Russia as the “party of crooks and thieves.”

A November 2011 poll by Levada offered some insights into the public mood of that time. When asked which of the parties had proposals on the issues that Russia was faced with today, 35 percent of those polled said that no such party existed, while 33 percent did not know. And 67 percent said that Russia needed a real opposition party that could have a genuine impact on policy.<sup>25</sup>

That said, and fraud allegations notwithstanding, the results of the December 2011 parliamentary election did not yield a dramatic shift in the party composition of the Duma. While United Russia lost 77 seats, it still commands a majority, with 238 seats. The KPRF’s negative advertising against United Russia secured them an 35 additional seats. In turn, Fair Russia and the LDPR acquired seats and traded places. In sum, given the public’s frustration with the current state of affairs, the gains in seats by the opposition parties are best interpreted as votes against United Russia—or perhaps as votes against all the candidates.

## Treaty Passage Statistics, Debates, and Resolutions

In the context of the previous section’s discussion of Duma political dynamics, this section examines the difficulties of ratifying START II, the CTBT, the Moscow Treaty, and New START. As noted above, postelectoral shifts in the legislature’s party composition have either obstructed or eased the executive branch’s policymaking efforts. In addition, the fluctuation of nationalistic attitudes in the Duma has depended on electoral politics and external events.

### *START II*

The ratification of START II took more than seven years and Yeltsin’s retirement from office.<sup>26</sup> During that time, the debate in the Duma focused on many issues. Key among them was the concern that compliance with the treaty would require a costly modernization of Russian nuclear forces. Because Moscow was in terrible economic shape for

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24. See, e.g., an overview given by Simon Shuster, “Russia Rising: The Blogger Who Is Putin’s Greatest Challenger,” *Time*, December 29, 2011, [www.time.com/time/world/article/0,8599,2103203,00.html](http://www.time.com/time/world/article/0,8599,2103203,00.html).

25. See poll results (in Russian), November 8, 2011, at Levada Web site, <http://www.levada.ru/08-11-2011/reitingi-odobreniya-pervykh-lits-polozheniya-del-v-strane-elektoralnye-predpochteniya>.

26. The key sources for this section were the materials in the Russia country profile on the Nuclear Threat Initiative website. See Nikolai Sokov, “Russia Profile—Nuclear,” Nuclear Threat Initiative, December 2011, <http://www.nti.org/country-profiles/russia/nuclear>.

most of that decade, it could not afford and did not want to make this investment. Among security threats, deputies were concerned about missile defense and NATO's expansion into Central and Eastern Europe.

START II's ratification was repeatedly delayed by internal political power struggles. The Yeltsin administration faced a challenging presidential election in 1996, the year after the KPRF gained seats in the Duma. In addition, a range of other factors affected the deputies' attitudes toward the treaty, including NATO's operations in the former Yugoslavia; the imposition of U.S. nuclear nonproliferation sanctions on Russian companies; and U.S. strikes in Iraq, Sudan, and Afghanistan.

Eventually, the Duma ratified START II with a push from Putin. The ratification was largely symbolic, however, because the legislature also passed a ratification resolution that made the treaty's implementation impossible. The resolution linked START II's entry to force to the United States' compliance with the ABM Treaty (and the Senate's ratification of the 1997 ABM Treaty's succession package) and a halt to NATO's expansion.<sup>27</sup> The resolution also set a deadline for the negotiation of START III in December 2003. Finally, it obligated the Russian government to deliver an annual report to the legislature on strategic nuclear forces and treaty implementation.

However, even despite the symbolism of its passage, a third of the legislature voted against the agreement. This voting pattern, where the KPRF and LDPR rallied to defeat the treaty, would persist into the future.

### *The CTBT*

Presidents Clinton and Yeltsin signed the CTBT in September 1996.<sup>28</sup> However, Yeltsin submitted the bill for ratification only in November 1999, a month after the treaty was rejected by the U.S. Senate. The Duma took six months to ratify the agreement, and did so right after it approved START II. The final vote took place when Yeltsin was already out and Putin was in as president. The vote was more favorable for the CTBT than that for START II, with only 74 legislators voting against the agreement.

The debate in the Duma focused largely on the state of the U.S.–Russian relationship at that time and voiced indignation about the actions by the U.S. Senate. An additional factor was the concern among some lawmakers about the nuclear tests conducted in 1998 by India and Pakistan.

In turn, the CTBT ratification resolution noted the need to ensure funding for the development of nuclear forces, expressed concern about the United States' inability to ratify (some deputies had suggested that the United States was keeping the door open to

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27. Former lawmaker and current Medvedev administration official Dmitry Rogozin maintains that the linkage was his idea. See the discussion by Dmitry Rogozin, *Vrag Naroda* [Enemy of the People] (Moscow: Algoritm, 2008), 327–328. For background on the 1997 agreement, see “The 1997 START/ABM Package at a Glance,” Arms Control Association, undated, <http://www.armscontrol.org/factsheets/pack>.

28. The key sources for this section were the materials in the Russia country profile on the Nuclear Threat Initiative website. See Sokov, “Russia Profile—Nuclear.”

using “nuclear components” in “destabilizing anti–ballistic missile systems”), and called on other countries to ratify the treaty as soon as possible.

### *The Moscow Treaty*

The Moscow Treaty (i.e., the Strategic Offensive Reductions Treaty) was signed in May 2002 and was submitted for ratification that December.<sup>29</sup> However, the passage of the agreement took about a year, because the bill had to be resubmitted after its rejection in committee due to concerns about funding for nuclear forces and about cutting systems that had not yet reached the end of their service lives. Further, the deputies were concerned about the United States’ ability to upload reserve nuclear warheads for a first strike (i.e., upload potential).

The ratification process also became tricky because the chairman of the Foreign Affairs Committee of the Duma, Dmitry Rogozin, disagreed with his Federation Council counterpart, Margelov. Deputy Rogozin argued that the Moscow Treaty should be delayed because of the U.S. invasion of Iraq. In the end, however, this delay never happened. The final vote was similar to START II, with nearly a third of the deputies voting against.

The ratification resolution mandated presidential reporting on nuclear force developments and noted that key legislators should be included in interagency planning. In addition, though withdrawal provisions had been discussed in all the past resolutions, this one was notable because it showed concern about the development of not just U.S. strategic forces and missile defenses but also those of other states. Finally, the resolution offered a list of additional arms control measures, especially in the bilateral context, and called on the United States to ratify the CTBT.

### *New START*

New START was signed in April 2010. The debates in the Duma were attuned to the back-and-forth between Obama administration officials and the Senate about the treaty and the discussions about the future of U.S. nuclear forces, missile defense, and prompt global strike. As discussed above, the Senate voted in December and the Russian ratification came—after a brief delay—the following January (a total nine-month wait). The final vote, the result of a coalition between United Russia and Fair Russia, was 350 for and 96 against.

The New START resolution called on the president to adopt a nuclear posture program and report to the Duma on its progress and its funding needs.<sup>30</sup> It argued for the need to monitor the balance between offense and defense and reported concern about the forces of “other countries.” The resolution noted the need to discuss new offensive

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29. The key sources for this section were the materials in the Russia country profile on the Nuclear Threat Initiative Web site. Ibid.

30. See a translation of the resolution in “Russian New START Resolution,” *Arms Control Wonk*, January 15, 2011, <http://lewis.armscontrolwonk.com/archive/3481/russian-new-start-resolution>.

systems, such as those related to prompt global strike, in the bilateral verification commission before these systems were deployed. And, crucially, instead of seeking to address tactical nuclear weapons in the next arms control agreement, it argued for the need to address prompt global strike, space-based systems, missile defense, and conventional force imbalance issues.<sup>31</sup>

## The “Logjam” Revisited

For a third of the Duma, arms control consistently has remained a contentious issue. This section thus offers a glance at legislative action timelines and final votes on the five arms control agreements over 20 years. It also discusses some of the limitations on the future of bilateral nuclear reductions.

As table 2 suggests, New START’s ratification took much less time than the preceding four arms control agreements. An assessment of their passage suggests that the cohesion between the administration, the Foreign Affairs Committee chairmen, and the United Russia party has made treaty ratification much easier. By contrast, if the number of KPRF and LDPR lawmakers in the Duma had been greater, treaty ratification would have been impossible.

**Table 2. Statistics on Arms Control Treaty Passage in the State Duma**

Treaty	Timeline from Signing to Ratification	Votes (226 needed for passage)
START II	7+ years; January 1993–April 2000	288, Yes / 131, No / 4, Abstained
CTBT	3 years, 9 months; September 1996–May 2000	298, Yes / 74, No / 3, Abstained
Strategic Offensive Reductions Treaty	1 year; May 2002–May 2003	294, Yes / 134, No / 22, Abstained
New START	9 months; April 2010–January 2011	350, Yes / 96, No / 1, Abstained

Source: Nikolai Sokov, “Russia Profile—Nuclear,” Nuclear Threat Initiative, <http://www.nti.org/country-profiles/russia/>.

During the past 20 years, ratification has generally been delayed by domestic elections, U.S. and NATO military activities, and actions by the U.S. Senate. In addition, Duma deputies have sought to express their concerns through debates and lay out policy guidance through ratification resolutions. Frequent themes in these debates and resolutions have included concerns about Russia’s security in light of missile defense developments and deployments, NATO expansion, and nuclear forces of other states (not just the

31. Sokov has noted that, in writing the resolution, the deputies closely cooperated with executive branch officials, essentially echoing their talking points.

United States but also the United Kingdom, France, and, increasingly, China), as well as a call to modernize nuclear (and sometimes conventional) forces and support the defense industry. Predictably, the absence or presence of these delaying factors has either propelled or imperiled arms control agreements in the Duma.

In the post-2011 election Duma, if Russia's president chooses to negotiate and conclude an arms control agreement, the legislature should have no trouble ratifying it. The United Russia party still has more than a two-thirds majority of votes on its own to pass a treaty and, as with New START, it will probably to get 60 votes of support from Fair Russia on arms control.

In contrast, the KPRF and LDPR, which have traditionally been backed by conservative military elements in their national security policy positions, will continue to vote against bilateral arms control initiatives. At present, they have 148 solid votes. In practice, this means that a third of the Duma still does not support any kind of engagement with the West, especially if it involves security cooperation.<sup>32</sup>

Moreover, it also needs to be noted that Duma Foreign Affairs Committee chairman Kosachev, a moderate and experienced United Russia deputy and a proponent of eventual nuclear abolition, recently turned over his chairmanship to a newly elected United Russia lawmaker, Alexey Pushkov.<sup>33</sup> Pushkov, a former TV show host with a résumé that includes a stint as a speechwriter for Mikhail Gorbachev, is arguably one of Russia's more vocal critics of NATO.<sup>34</sup> In light of this development within United Russia, and, given the default position of the KPRF and LDPR as noted above, the legislature as a whole will be not be a constructive player in the ongoing U.S.–Russian and NATO–Russian dialogue on missile defense and future nuclear reductions.

## Conclusion

In both the United States and Russia, the successful development and implementation of arms control policy is a matter of reaching a consensus on national security within the legislature and between the executive and legislative branches. The degree of this consensus shifts with the changes in the domestic political cycle. It is also closely related

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32. See Konstantin Kosachev, "The Goldilocks Conundrum in Russian Foreign Policy," Valdai Discussion Club, August 24, 2011, <http://valdaiclub.com/politics/30300.html>.

33. See Khimshivshili and Kostenko for a discussion of Kosachev's future; also, both Kosachev and Margelov are signatories to Global Zero. "Full List of Signatories," Global Zero, not dated, <http://www.globalzero.org/full-list-signatories>.

34. For an example of Pushkov's views, see Alexey Pushkov, "Broken Promises," *National Interest*, April 16, 2007, <http://nationalinterest.org/commentary/broken-promises-1535>. In a column written in November 2011, he noted that Russia should pass legislation that mirrors the Jackson-Vanik Amendment if the latter is not rescinded by the U.S. Congress. See "Vstupleniye Rossii v VTO—eto eksperiment na zhivom organizme" [Russia's entry into the WTO is an experiment on a live organism], November 15, 2011, <http://www.km.ru/spetsproekty/2011/11/14/peregovory-o-vstuplenii-rossii-v-vto/vstuplenie-rossii-v-vto-eto-eksperiment>. For a selection of Pushkov's columns in Russian, see <http://www.km.ru/pushkov>.



to the perceived legitimacy of the executive branch and the resonance among the public of the nationalist arguments put forward by current officials and candidates for office.

In the next five years, Russia's willingness to negotiate an arms control agreement with the United States will depend on the perceived legitimacy of Russia's next president. Traditionally, the country's governing elites have played on the public's nationalist sentiments to assert their legitimacy. And now that Putin is once again the president, he appears more than willing to argue that internal political instability is a product of Western meddling in domestic affairs. His arguments, though of questionable credibility, have effectively eroded support for future nuclear reductions.

To be sure, as astute U.S. observers have noted, it is in Moscow's interest to eventually negotiate further nuclear cuts with Washington simply due to the pending obsolescence of certain nonstrategic weapons.<sup>35</sup> However, during his third term as president, Putin's future options for security engagement with the United States may turn out to be severely limited. At present, his hostile rhetoric retrenches nationalist and isolationist tendencies at home and provides ammunition to certain constituencies abroad, such as the opponents of arms control in the U.S. Senate.

As of this writing, Moscow and other major cities remain a stage for organized protests against government corruption. With an eye toward a March election, key Putin allies have called on the government to annul the results of the December 2011 parliamentary elections.<sup>36</sup> The outcome of these protests remains difficult to determine.<sup>37</sup> To be sure, the development of a stronger party system and a parliament with greater independence from the executive branch is in the best interest of Russia's polity. However, combined with nationalist attitudes, such a system also creates the structural conditions for another Duma/Senate "logjam."

In any case, the evolution of Russia's political institutions toward greater representation of and accountability to the public will have an increasing impact on Moscow's security cooperation with the West. Surveys of public opinion suggest that more than a half of Russians today have a positive attitude toward the United States and the European Union.<sup>38</sup> That said, a third of those polled still believe that Western states pose an external threat to Russia.<sup>39</sup>

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35. See, e.g., remarks by Barry Blechman and the exchange with Linton Brooks, "Next Steps in U.S.–Russia Arms Control: The Good, the Bad, and the Ugly," transcript of talk and discussion at National Defense University and National Defense Industrial Association Capitol Hill Forum, Washington, October 14, 2011, 2.

36. See, e.g., Kathy Lally, "Putin Allies Urge Him to Take Protesters' Grievances Seriously," *Washington Post*, January 8, 2011.

37. For an excellent attempt at this determination, see Simon Saradzhyan and Nabi Abdullaev, "Putin, the Protest Movement and Political Change in Russia," European Union Institute for Security Studies, February 17, 2002, [www.iss.europa.eu/publications/detail/article/putin-the-protest-movement-and-political-change-in-russia/](http://www.iss.europa.eu/publications/detail/article/putin-the-protest-movement-and-political-change-in-russia/).

38. See a September 2011 Levada poll (in Russian), at <http://www.levada.ru/18-10-2011/rossiya-na-mezhdunarodnoi-arene>.

39. A July 2011 Levada poll suggested that 32 percent of those polled saw an external threat

In thinking about the future, it is important to remember that, 20 years into Russia's new period of history, there is still no domestic consensus on the country's identity or agreement on how it should engage the West. Kosachev, a self-described "reasonable mean" politician, has noted that the spectrum of cooperation lies somewhere between the "pseudo-patriotic isolationists" who preach "the self-imposed isolation of the Cold War," such as the KPRF and the LDPR, and the "geopolitical utopianists" who bring to mind the "similarly unilateral, naive openness of the 1990s" among unelected liberal politicians.<sup>40</sup>

Nuclear policy is bound to remain at the heart of the most important questions about Russia's identity. This paper has argued that the Duma is possibly the only political institution in the country that has reflected Russia's dramatic diversity of opinions on this matter during the last 20 years. It is thus the perfect bellwether for national attitudes toward the arms control initiatives of the future.

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in Western states and 29 percent in Islamic states. Yet only 15 percent of those polled were certain that Russia was faced with an external threat, while 36 and 32 percent suggested that it was possibly or possibly not, respectively, faced with one. Available in Russian at <http://www.levada.ru/category/rubrikator-oprosov/strana-i-mir>.

40. See, e.g., the discussion of contrasting views by Kosachev, "Goldilocks Conundrum."

# Quantifying the Impact of Nuclear Weapons Enterprise Consolidation

Carol Meyers<sup>1</sup>

## Abstract

The U.S. Department of Energy's nuclear weapons complex has undergone substantial consolidation in the decades since the Cold War. The extent of this consolidation is best illustrated through the interrelated effects on the nuclear infrastructure, stockpile, and critical skills of the weapons workforce. This paper reviews the impact in each of these areas and its implications for the weapons complex as a whole. With regard to future consolidation efforts, the National Nuclear Security Administration uses a variety of mathematical tools to quantify the potential effects of future stockpile decisions. The paper discusses several examples of such tools and how they have successfully been used to aid and inform policy decisions.

## Overview of Weapons Enterprise Consolidation

The control of production, design, and testing of nuclear weapons in the United States is housed within the Department of Energy (DOE). Formerly the Atomic Energy Commission, this civilian agency was intentionally established separately from the Department of Defense (DoD), which is tasked with deploying such weapons. This dichotomy helps to ensure a balance of power among the entities responsible for the country's most powerful weapons, in that their ultimate ownership lies outside the military that might be using them.

### *Infrastructure*

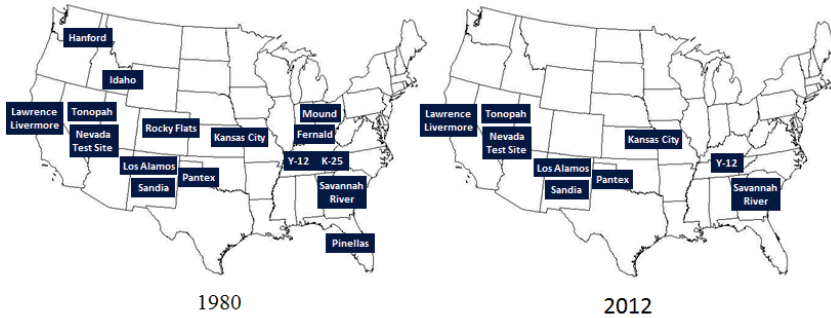
Within DOE, the National Nuclear Security Administration (NNSA) manages the day-to-day operations of the country's nuclear production, design, and testing laboratories. At the height of the Cold War, there were 16 such sites located around the country (figure 1, 1980 map); as of 2012, only 9 sites remain within the NNSA complex (figure 1, 2012

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1. Carol Meyers is a mathematician involved in enterprise modeling at Lawrence Livermore National Laboratory. This paper was prepared by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344; LLNL-JRNL-529931.

map), a downsizing of more than 40 percent. Of the 7 sites that have left the complex, 1 is now a DOE lab engaged in nonweapons activities (Idaho), 1 is commercially managed (Pinellas), and the other 5 have closed and are undergoing environmental remediation and cleanup activities.

**Figure 1. Department of Energy Nuclear Weapons Complex Sites in 1980 and 2012**



Source: Author's illustration.

Of the existing 9 sites, there are 3 nuclear design and engineering labs (Lawrence Livermore, Los Alamos, and Sandia), 4 production sites (Pantex, Kansas City, Y-12, and Savannah River), and 2 testing sites (Nevada Test Site and Tonopah Testing Range, which is managed by Sandia). The square footage of these sites is additionally undergoing consolidation; NNSA is currently implementing a plan to eliminate nearly a third of the current complex footprint, from 35 million to 26 million square feet.<sup>2</sup> Since 2002, the Y-12 plant alone has eliminated approximately 1.3 million square feet.<sup>3</sup>

The goal of NNSA's current infrastructure funding is to modernize and revitalize certain key facilities, while sustaining capabilities at many others to ensure the complex retains sufficient capacity to meet its primary mission functions.<sup>4</sup> Deferred maintenance is a key issue in sustainment, and NNSA is currently working to eliminate \$900 million of outstanding deferred maintenance activities in its existing facilities.<sup>5</sup> As the total com-

2. U.S. Department of Energy (DOE), *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement* (Washington, D.C.: U.S. Government Printing Office, 2008), S-31, <http://nnsa.energy.gov/aboutus/ourprograms/defenseprograms/complextransformation>.

3. DOE, *Final Site-Wide Environmental Impact Statement for the Y-12 National Security Complex* (Washington, D.C.: U.S. Government Printing Office, 2011), 2–10, <http://www.y12s-weis.com/y12document.html>.

4. DOE, *FY 2012 Stockpile Stewardship and Management Plan* (Washington, D.C.: U.S. Government Printing Office, 2011), 33.

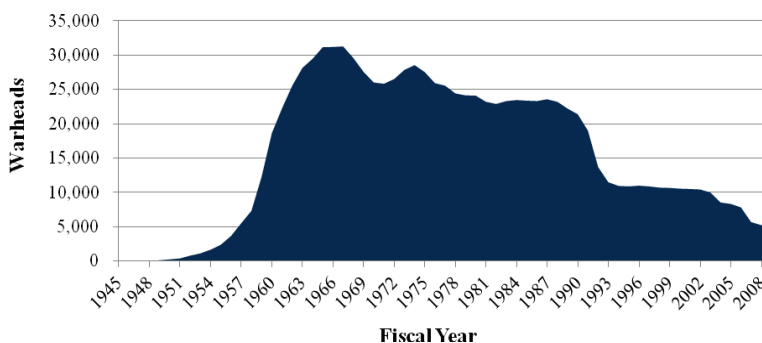
5. *Ibid.*, 102.

plex real property is valued at roughly \$40 billion, this represents a significant portion of the whole.<sup>6</sup>

### *Stockpile*

Recently declassified stockpile numbers illustrate the extent to which the U.S. nuclear stockpile has shrunk since the height of the Cold War (figure 2); as of September 2009, the stockpile had declined nearly 84 percent from its maximum at the end of 1967, and over 75 percent since the fall of the Berlin Wall in 1989.<sup>7</sup> In addition, the number of nonstrategic weapons has fallen by approximately 90 percent in the last two decades.<sup>8</sup> This extraordinary consolidation is consistent with arms control limitations specified by the Strategic Arms Reduction Treaty and the Strategic Offensive Reductions Treaty and reflects the evolving role of nuclear weapons in U.S. foreign policy.

**Figure 2. U.S. Nuclear Weapons Stockpile (Active and Inactive Weapons), 1945–2009**



Sources: U.S. Department of Defense, Fact Sheet: Increasing Transparency in the U.S. Nuclear Weapons Stockpile (Washington, D.C.: U.S. Government Printing Office, 2010), 1, <http://www.defense.gov/news/d20100503stockpile.pdf>; and U.S. Department of Energy, “Declassified Stockpile Data 1945 to 1994,” press release, June 27, 1994, <https://www.osti.gov/opennet/forms.jsp?formurl=document/press/pc26tab1.html>.

Concurrent with the decline of the stockpile itself has been a great increase in the number of nuclear weapons undergoing dismantlement. From fiscal years 1994 to 2009, over 8,700 weapons were dismantled, with an additional several thousand awaiting dismantlement in coming years.<sup>9</sup> Numerous weapon systems have completed final disman-

6. Clifford Shang and Bernard Mattimore, *Forward-Projection, Risk-Based Metrics in an Infrastructure Margins and Uncertainty (IMU) Framework*, Technical Report COPJ-2011-0630 (Livermore, Calif.: Lawrence Livermore National Laboratory, 2012), 3.

7. U.S. Department of Defense (DoD), *Fact Sheet: Increasing Transparency in the US Nuclear Weapons Stockpile* (Washington, D.C.: U.S. Government Printing Office, 2010), 1, <http://www.defense.gov/news/d20100503stockpile.pdf>.

8. *Ibid.*, 1.

9. *Ibid.*, 1.

tlement, including most recently the W62 intercontinental ballistic missile (in 2010)<sup>10</sup> and the massive B-53 bomb (in 2011).<sup>11</sup> All weapons retired before 2009 are currently scheduled to be dismantled no later than the end of fiscal year 2022.<sup>12</sup>

NNSA's current stockpile goals include performing annual surveillance to ensure the safety and effectiveness of the current stockpile; initiating life extension programs to address aging issues in current stockpile systems; reducing the number of warhead types by pursuing options for adaptable warheads that are deployable across different platforms; and completing all scheduled dismantlements in a timely manner.<sup>13</sup> This supports the agency's previously stated goals to maintain the smallest possible stockpile that is consistent with national security needs.<sup>14</sup>

### *Critical Skills*

With the consolidation in the U.S. nuclear weapons infrastructure and stockpile has come a corresponding decline in the size of the nuclear weapons workforce, and concerns about the retention of critical skills necessary to perform stockpile activities. The DOE weapons complex workforce has shrunk over 60 percent in the last two decades, from 51,000 in 1992 to 20,000 in 2007.<sup>15</sup> Nearly every site in the NNSA complex has experienced layoffs or voluntary separation initiatives over the past decade.

The nuclear workforce itself is considerably older than the population of the United States at large (figure 3); as of 2007, more than 40 percent of DOE laboratory essential workers and 45 percent of weapons plant workers were over the age of 50.<sup>16</sup> A large majority of the DOE weapons workforce will be eligible for retirement in the next 10 years; this has not been offset by recent hiring trends, which suggests that the workforce's size will continue to decline.<sup>17</sup> There is a real and valid concern that the specialized skills required to maintain the country's nuclear forces may be lost unless attention is devoted to their sustainment.

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10. DOE, "Energy Secretary Announces Completion of W62 Dismantlement Program," press release, August 12, 2010, <http://www.nnsa.energy.gov/mediaroom/pressreleases/chupantex081210>.

11. DOE, "NNSA Announces Dismantlement of Last B53 Nuclear Bomb," press release, October 25, 2011, <http://nnsa.energy.gov/mediaroom/pressreleases/b53dismantle102511>.

12. DOE, *FY 2012 Stockpile Stewardship and Management Plan*, 17.

13. *Ibid.*, 2–3.

14. DOE, *Final Complex Transformation SPEIS*, S-55.

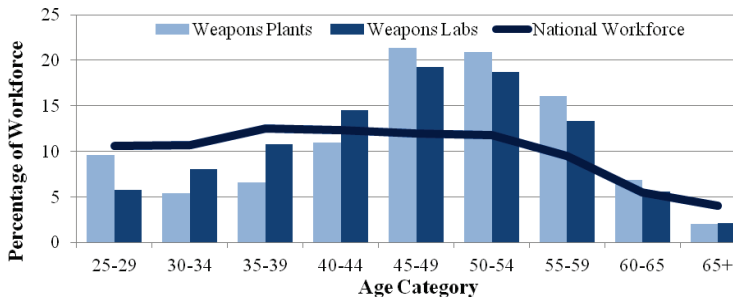
15. DoD, *Report of the Defense Science Board Task Force on Nuclear Deterrence Skills* (Washington, D.C.: U.S. Government Printing Office, 2008), 61, <http://www.acq.osd.mil/dsb/reports/ADA487983.pdf>.

16. *Ibid.*, 61.

17. *Ibid.*, 60.



**Figure 3. Demographics of DOE Weapons Plants and Labs, Compared with the National Workforce**



Note: For both plants and labs, the population is restricted to workers with “essential weapons program skills.”

Source: U.S. Department of Defense, Report of the Defense Science Board Task Force on Nuclear Deterrence Skills (Washington, D.C.: U.S. Government Printing Office, 2008), 63, <http://www.acq.osd.mil/dsb/reports/ADA487983.pdf>

A major challenge for NNSA is ensuring that a new generation of weapons designers, code developers, experimentalists, and engineers are capable of a fundamental understanding of nuclear weapons in an environment where computer-aided design has taken the place of hands-on testing. Their goals for the future include introducing occasions for such critical skills to be exercised, through annual safety and security assessments and opportunities to develop and mature technologies with the potential for stockpile modernization.<sup>18</sup> This includes analyses of options for future lifetime extension program activities, using a predictive capability framework capable of certifying the safety and security of weapons without additional testing.<sup>19</sup>

### *Interdependence*

The data given above have illustrated the extent to which the current DOE weapons complex has consolidated over the past decades, including some of the challenges of continued consolidation. I conclude by noting that all three of the examined areas—infrastructure, stockpile, and critical skills—are inherently interdependent, as well as being strongly influenced by the overall DOE nuclear weapons budget. From fiscal years 2004 to 2010, a downward trend in the weapons activities budget resulted in a loss of purchasing power of 20 percent for NNSA’s defense programs.<sup>20</sup> However, the current presidential administration has requested a nearly 10 percent increase in weapons activities funds,<sup>21</sup> to enable achieving NNSA’s future goals and to implement the requirements of the most recent Nuclear Posture Review.<sup>22</sup>

18. DOE, *FY 2012 Stockpile Stewardship and Management Plan*, 18.

19. *Ibid.*, 24–26.

20. *Ibid.*, 58.

21. *Ibid.*

22. DoD, *Nuclear Posture Review Report* (Washington, D.C.: U.S. Government Printing Office, 2010), <http://www.defense.gov/npr/docs/2010%20Nuclear%20Posture%20Review%20Report.pdf>. Goals for the complex are mentioned throughout the report, under the broad categories

# Mathematical Tools for Quantifying the Effects of Weapons Enterprise Policies

There are four main categories of mathematical tools that our team at the Lawrence Livermore National Laboratory has used to help NNSA quantify the effects of future stockpile decisions: simulation tools, optimization tools, economic analysis tools, and decision analysis tools. This paper covers each of these in turn, and the kinds of policy decisions each tool is best suited to help answer.

## *Simulation Tools*

The goal of simulation tools is to mathematically represent the NNSA complex in a manner that captures the overall flow of operations, and then assesses the impact of policy decisions by demonstrating how the system's behavior changes, or would change if certain policies were adopted. Our team has employed simulation tools in a number of different contexts, most notably including stockpile management and the evolution of critical skills.

In terms of stockpile evolution, we have adopted a discrete event simulation approach, which offers added flexibility over a previously used systems dynamics approach.<sup>23</sup> In other sectors, discrete event models have been used in the electronics,<sup>24</sup> automotive,<sup>25</sup> and health care fields,<sup>26</sup> among others, resulting in savings of up to billions of dollars. In our models, each of the sites in the NNSA enterprise is included, and operations affecting the state of the current stockpile (e.g., assembly and disassembly at the Pantex and Y-12 plants) are modeled in as great a degree of detail as possible (down to individual lines and parts, and their interrelations; see figure 4). For micro-level policy decisions (i.e., those affecting a single plant), we can infer the resulting effects on the entire system, and for macro-level policy decisions (affecting the entire stockpile at once), we can assess the effects on each of the individual sites. Uncertainty can be readily incorporated in such models, including Monte Carlo analyses that employ random sampling over different distributions of parameters.

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of reducing the role of U.S. nuclear weapons; maintaining deterrence at reduced nuclear force levels; and sustaining a safe, secure and effective nuclear arsenal.

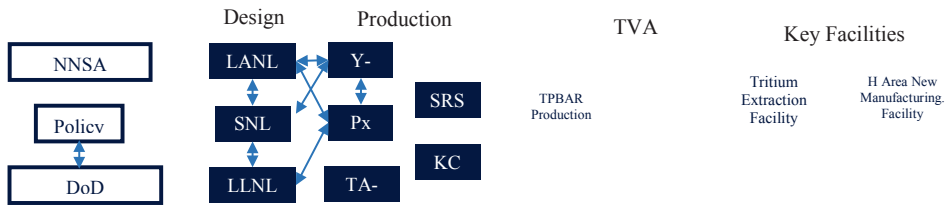
23. Arnie Heller, "Modeling the Future: a Computational Tool Aims to Help the U.S. Create a Responsive Nuclear Enterprise," *Science and Technology Review*, December 2005, <https://www.llnl.gov/str/December05/Shang.html>.

24. Robert Leachmann, Jeenyoun Kang, and Vincent Lin, "SLIM: Short Cycle Time and Low Inventory in Manufacturing at Samsung Electronics," *Interfaces* 32, no. 1 (January–February 2002): 61–77, <http://interfaces.journal.informs.org/content/32/1/61>.

25. George Pfeil, Ron Holcomb, Charles Muir, and Shahram Taj, "Visteon's Sterling Plant Uses Simulation-Based Decision Support in Training, Operations, and Planning," *Interfaces* 30, no. 1 (January–February 2000): 115–133, <http://interfaces.journal.informs.org/content/30/1/115>.

26. Kay Aaby, Jeffrey Herrman, Carol Jordan, Mark Treadwell, and Kathy Wood, "Montgomery County's Public Health Service Uses Operations Research to Plan Emergency Mass Dispensing and Vaccination Clinics," *Interfaces* 36, no. 6 (November–December 2006): 569–579, <http://interfaces.journal.informs.org/content/36/6/569>.

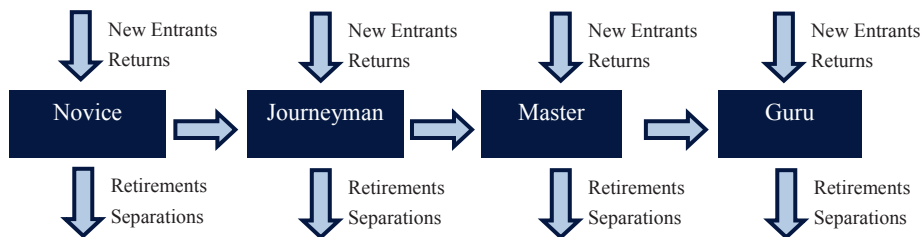
**Figure 4. High-Level Schematic of Our Discrete Event Simulation Model**



Note: The overall model structure is on the left; detail of the Savannah River Site Model is shown on the right.

For critical skills modeling, our team has applied tools to simulate the career progression of employees over time, including the acquisition and refinement of weapons-related expertise. We use the conceptual model in figure 5, which is based on work in previous NNSA studies.<sup>27</sup> In our model, transition rates are determined for all entries into and exits from the system, via historical hiring data, and data such as “time to promotion” are used to establish the transitions between levels.<sup>28</sup> Simulating the system over time reveals trends in the retention and attrition of different critical skills, which help gauge the readiness status of the overall complex.

**Figure 5. Conceptual Model of Critical Skills Evolution over the Course of an Employee’s Career**



27. DOE, *Right Size: Determining the Staff Necessary to Sustain Simulation and Computing Capabilities for National Security* (Washington, D.C.: U.S. Government Printing Office, 2010), <http://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/RightSize12-7-10SAND.pdf>.

28. Foundational work in this methodology is described by John Edwards, “A Survey of Manpower Planning Models and their Application,” *Journal of the Operational Research Society* 34, no. 11 (November 1983): 1031–1040.

## Optimization Tools

Often, it is desirable not only to predict how the complex might evolve over time but also to optimize the behavior of the complex under different scenarios. Optimization is a complementary approach to simulation (and the two approaches are often used together<sup>29</sup>): Although simulation tools can typically model a system to a greater degree of detail, only mathematical optimization tools can provide solutions that are (mathematically) provably close to the best possible. The appropriate tool for the job depends on the question being asked and the required time frame. Optimization is particularly applicable for long-term policy questions; some companies will start with one approach and then switch.<sup>30</sup>

In a mathematical optimization framework, the parameters of the system in question are modeled as mathematical variables, and the behavior of the system is defined via a set of constraints over these variables. The quantities over which to optimize are specified in terms of an objective function defined on the same variables. There are a variety of different tools available to solve such problems, according to the form of the objective function and constraints (e.g., linear, quadratic, or nonlinear).<sup>31</sup> Such optimization approaches have previously been applied in the weapons complex, including production and dismantlement planning operations at Pantex<sup>32</sup> and prioritizing remediation techniques for hazardous waste cleanup across numerous DOE sites.<sup>33</sup>

Our team has developed a mixed-integer optimization model capable of calculating optimized NNSA sustainment and retirement paths to a desired stockpile size and composition, incorporating different infrastructure scenarios. This tool has been used to evaluate Nuclear Posture Review scenarios, the current NNSA program of record, and various proposed hybrid scenarios. The most common objective function we use is to minimize the total number of weapon “red years” (see figure 6), in which a weapon is in the stockpile past its expected lifetime. This objective function ensures that the greatest possible fraction of the current stockpile is in good working condition and thus is less likely to need additional attention or surveillance. Mathematically, the model is run in parallel (multithreaded) on supercomputers, using an NNSA lab-developed algebraic modeling language.<sup>34</sup>

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29. Ronald Toland, Jack Kloeber Jr., and Jack Jackson, “A Comparative Analysis of Hazardous Waste Remediation Activities,” *Interfaces* 28 no. 5 (September–October 1998): 70–85, <http://interfaces.journal.informs.org/content/28/5/70>.

30. Jeffrey Alden et al., “General Motors Increases Its Production Throughput,” *Interfaces* 36, no. 1 (January–February 2006): 6–25, <http://interface.highwire.org/content/36/1/6>.

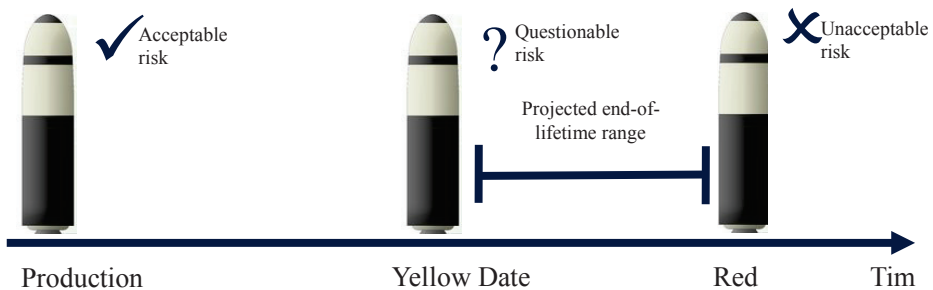
31. See *OR/MS Today*’s annual optimization software review for a partial list: <http://www.orms-today.org/surveys/LP/LP-survey.html>.

32. Edwin Kjeldgaard et al., “Swords into Plowshares: Nuclear Weapon Dismantlement, Evaluation, and Maintenance at Pantex,” *Interfaces* 30, no. 1 (January–February 2000): 57–82, <http://interfaces.journal.informs.org/content/30/1/57>.

33. Toland, Kloeber, and Jackson, “Comparative Analysis.”

34. William Hart, Jean-Paul Watson, and David Woodruff, “Pyomo: Modeling and Solving Mathematical Programs in Python,” *Mathematical Programming Computation* 3, no. 3

**Figure 6. Definition of a Weapon “Red Date”**



Note: A common model objective is to minimize the number of “red” weapons per year.

### *Economic Analysis Tools*

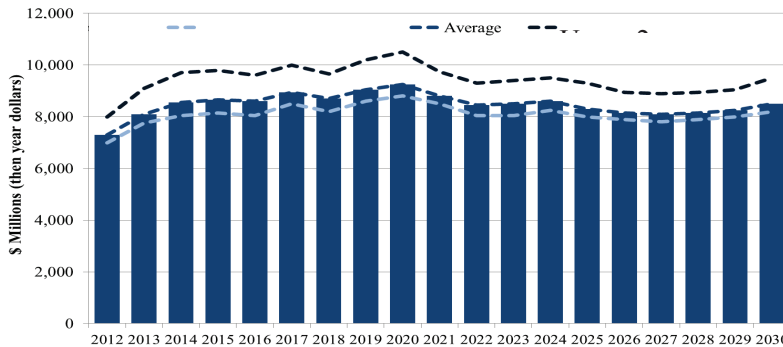
One of NNSA’s chief tasks is to implement the recommendations of the Nuclear Posture Review within its allocated budget.<sup>35</sup> This budget includes different allocations for numerous stockpile, infrastructure, and science programs and campaigns.<sup>36</sup> We have developed economic models that project the cost trajectories of these programs and campaigns over the coming decades. In this context, stockpile costs include both sustainment and acquisition activities; infrastructure costs include sustainment, acquisition, and disposition/cleanup activities; and science costs include supporting the careers and development of weapons complex employees. Figure 7 shows an overall cost trajectory for NNSA along with an estimate of the uncertainty range within 2 standard deviations, which was determined via Monte Carlo analysis. (This figure represents an aggregate view, and our usual analyses include far more detail on the contribution of each constituent program.)

(September 2011): 219–260, <http://www.springerlink.com/content/r06184431253725q/>.

35. DOE, *FY 2012 Stockpile Stewardship and Management Plan*, 58.

36. See DOE, *Department of Energy FY 2012 Congressional Budget Request* (Washington, D.C.: U.S. Government Printing Office, 2012), 62–68, <http://www.cfo.doe.gov/budget/12budget/Content/FY2012Highlights.pdf>.

**Figure 7. Overall Cost Projection for NNSA, with Uncertainty Bands for 2 Standard Deviations**



In general, one of the biggest challenges in economic analyses is taking the outputs of numerous simulation and projection codes and stitching this together into an integral cost model. NNSA facility cost modeling alone encompasses numerous codes and has been the subject of entire workshops.<sup>37</sup> Care must be taken to include all relevant costs and also to avoid double-counting costs. Although we have limited our discussion to costs incurred by NNSA, DoD costs and policies are strongly interrelated<sup>38</sup> (e.g., then-DoD secretary Robert Gates asked for \$5 billion to be transferred from DoD to DOE to achieve Nuclear Posture Review objectives).<sup>39</sup> The issue of cost is likely to remain a key policy driver in future complex downsizing efforts.

### *Decision Analysis Tools*

When addressing questions of policy, we often find that qualitative data—in particular, the preferences of different decisionmakers—are at least as important as quantitative data (raw numbers). Formalized in the 1960s,<sup>40</sup> the field of decision analysis provides a rigorous framework in which such qualitative preferences can be encoded in a mathematically consistent and logically correct manner. This allows for a direct comparison of the relative values of different alternatives according to the stated preferences of decisionmakers. Such methods have been used to assess alternatives for the disposition of

37. For the workshop contents, see Whitestone Research, “Whitestone Hosts the 2010 Facility Cost Planning Workshop for the Department of Energy Clients,” paper presented at workshop, Napa, Calif., May 25–26, 2010, <http://www.whitstoneresearch.com/research/reports/facility-cost-planning-workshop.aspx>.

38. For a historical treatment of the costs of nuclear weapons, including both DoD and DOE estimated spending, see Stephen I. Schwartz, *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940* (Washington, D.C.: Brookings Institution Press, 1998).

39. DoD, *Nuclear Posture Review Report*, i.

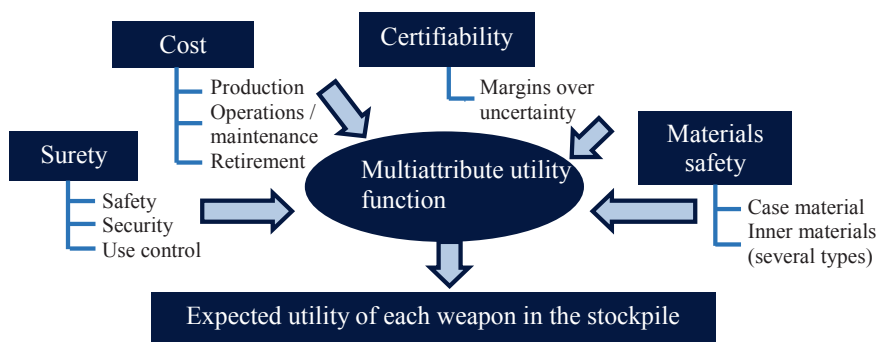
40. Foundational work in this methodology is described by Ronald Howard, “The Foundations of Decision Analysis,” *IEEE Transactions on System Science and Cybernetics* 4, no. 3 (September 1968): 211–219.



weapons-grade plutonium,<sup>41</sup> the realignment and closure of army bases,<sup>42</sup> and managing the nuclear waste from power plants,<sup>43</sup> among others.

We use the techniques of multiattribute utility theory,<sup>44</sup> a form of decision analysis, to help quantify the enterprise consolidation preferences of decisionmakers. In such an analysis, different criteria of interest are represented as attributes, possibly with corresponding subattributes (see figure 8 for an example we have used to quantify the relative goodness of different weapons in the stockpile). Each attribute (or subattribute) is associated with a value function, which can have a variety of forms; the relative values of different attributes are evaluated using mathematical trade-offs, which are elicited from decisionmakers. Decisionmaking alternatives are assessed by computing their scores on each of the value functions, then combined using the elicited trade-off values to calculate a single numerical utility that can be compared across different alternatives.

**Figure 8. Components of a Tool for Computing the Overall Utility of Each Weapon in the Stockpile**



41. James Dyer et al., “A Multiattribute Utility Analysis of Alternatives for the Disposition of Surplus Weapons-Grade Plutonium,” *Operations Research* 46, no. 6 (November–December 1998): 749–762.

42. Paul Ewing Jr., William Tarantino, and Gregory Parnell, “Use of Decision Analysis in the Army Base Realignment and Closure (BRAC) 2005 Military Value Analysis,” *Decision Analysis* 3, no. 1 (March 2006): 33–49, <http://faculty.nps.edu/plewing/docs/Ewing-Tarantino-Parnell-deca%201060%200062.pdf>.

43. Ralph Keeney and Detlof von Winterfeldt, “Managing Nuclear Waste from Power Plants,” *Risk Analysis* 14, no. 1 (February 1994): 107–130.

44. This framework is fully described by Ralph Keeney and Howard Raiffa, *Decisions with Multiple Objectives: Preferences and Value Trade-Offs* (New York: Wiley, 1976).

## Conclusion

This paper has shown how mathematical tools have been used to help NNSA in making policy decisions relating to weapons complex consolidation, a process that is ongoing. Until this point, I have not mentioned a crucial part in this process, which is the availability of real quantitative data that can be used in such models. We have been fortunate to work with excellent people from around the NNSA complex who have provided us with such data, as well as site-specific expertise that is crucial to maintaining the accuracy of our models. Just as policy cannot be made in a vacuum, mathematical models cannot be truly useful without data. This cooperation and trust between sites in the NNSA complex is instrumental to the progress that we have made and continue to make in informing policy, and we hope to continue building and refining such models together for years to come.<sup>45</sup>

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45. Although I am the sole author on this paper, the models I have described are very much a group effort. I am especially indebted to Clifford Shang for his excellent guidance in leading our team. Our group at Lawrence Livermore consists of Clifford Shang, Victor Castillo, Lisa Clowdus, John Compton, John Estill, John Futterman, William Liou, Katy Lu, Bernard Mattimore, Peter Norquist, Marilyn Pickens, Tri Tran, William Romine, and Jeene Villanueva; I am grateful to them all for many excellent discussions. Special thanks are due to NNSA for the intellectual and practical support of members of its management staff: Tim Driscoll, Alan Felser, Robert Herrera, Michael Thompson, Jeff Underwood, and Kyle Wagner. We have also benefited greatly from interactions with and support from our colleagues at the Department of Defense: Lou Arnold, Pat McKenna, Mark Wittig (STRATCOM), Andrew Wiedlea (DTRA), and Rick Paulsen (AFNWC).

# Reconceptualizing the Case for Nuclear Disarmament

Jonathan Snider<sup>1</sup>

## Abstract

Nuclear disarmament has reemerged as a major issue in international security. Advocates claim that disarmament will provide two benefits: It will reduce the risk of nuclear terrorism, and it will make it easier to build international political support for measures to prevent nuclear proliferation. The perceived benefits of disarmament give impetus to efforts to create the conditions necessary to eliminate nuclear weapons. But there is substantial disagreement over which factors are most important for creating these conditions. Insights from the early history of disarmament can provide a useful contribution to this debate. Official disarmament studies conducted by the U.S. government in the 1940s and 1950s were primarily concerned with a particular military threat—a surprise attack. This paper contends that, minus nuclear weapons, effectively managing the surprise attack threat will likely require deep reductions in conventional weapons. However, this disarmament “solution” creates its own problem because deep conventional reductions will complicate efforts to police a nuclear-weapons-free world. Therefore, disarmament will lead to an “enforcement paradox,” as the process of nuclear disarmament will require deep cuts to the conventional weapons required to enforce the rules in a nuclear-weapons-free world.

## Introduction

The seven-decade-old quest to figure out how to safely eliminate nuclear weapons continues. Though this endeavor has found new energy in the last several years, reliable knowledge about the necessary conditions to support a future world without nuclear

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weapons remains as elusive as ever. Official statements reflect this lack of knowledge as they tend to conflate the conditions required for deeper cuts in nuclear arsenals with the conditions necessary to achieve a world without nuclear weapons.<sup>2</sup> Conflating these two sets of conditions falls into the trap of linear reasoning; it suggests that the measures necessary to eliminate nuclear weapons will be a simple extension of those required to achieve further nuclear reductions. But if nuclear weapons revolutionized the way states think about the use of force against each other, does it not follow that their elimination will require states to fundamentally rethink how they provide for their security?

Over the years, a number of disarmament “visions” of what a world would look like without nuclear weapons have emerged. Surprisingly, few of these ideas actually trace the early disarmament record to better understand what conditions across time were perceived to be necessary to eliminate nuclear weapons. A relatively consistent belief found across several decades, and one that appears no less relevant in the contemporary security environment, is the notion that safely eliminating nuclear weapons will also entail a substantial level of *conventional* weapons disarmament. In other words, eliminating nuclear weapons is likely not sufficient to achieve a *safer* world without nuclear weapons.

Intuitively, the disposition of nuclear weapons would appear to be the most important factor in a distant world without nuclear weapons. After disarmament, future security will to a large extent turn on how nuclear zero is defined and implemented as well as how a ban on these weapons would be monitored and enforced. But the historical record provides much evidence suggesting that the international community should be careful not to put too much emphasis upon the *nuclear* element in disarmament, given that the configuration of conventional weapons will be a critical pillar in supporting a world without nuclear weapons. Insights gleaned from history can help reconceptualize how we should think about eliminating nuclear weapons. A study of how nuclear disarmament has been envisioned historically demonstrates that eliminating nuclear weapons is a responsibility that extends well beyond nuclear weapon states. It also works to magnify the complexity of strategic issues involved in achieving a nuclear-weapons-free world.

This paper is organized as follows. The next section introduces the concept of “strategic disarmament” as an alternative to the disarmament commitments previously made by states. A second section placing disarmament in historical perspective then follows, which illustrates why contemporary disarmament analysis is conceptualizing the disarmament question too narrowly. Third, the logic of strategic disarmament is developed more fully, building upon insights provided by early thinking on disarmament. And the final section concludes by introducing additional issues requiring more systematic thought, which flow from the arguments presented here.

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2. Ambassador Laura E. Kennedy, “Creating the Conditions for a World Free of Nuclear Weapons,” remarks to the International Physicians for the Prevention of Nuclear War World Congress, Basel, August 27, 2010.

## The Conceptual Problems with Previous Disarmament Commitments

A critical factor in assessing the desirability of eliminating nuclear weapons continues to be overlooked, or at least significantly downplayed, in contemporary disarmament analysis. Observers often gloss over the types of conventional weapons to be permitted, and at what levels, in a world without nuclear weapons. Existing concepts may be partially to blame. How the international community thinks about disarmament largely stems from the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Article VI of the NPT frames the disarmament debate around two key terms: “nuclear disarmament” and “general and complete disarmament [GCD].”<sup>3</sup>

Frameworks built exclusively around either of these two terms will likely miss the mark. The term “nuclear disarmament” is conceptually too narrow because it is not likely fully consistent with a world without nuclear weapons in practice. The difference in meaning between these two ways of presumably referring to the same outcome is subtle, but important. As several senior statesmen have noted, “A world without nuclear weapons will not simply be today’s world minus nuclear weapons.”<sup>4</sup> In practice, a safer world without nuclear weapons will involve restraints and agreements on far more weapon systems than merely those with nuclear weapons.

And, likewise, the concept of GCD and its implementation imply an international order that is far more radical than one necessary to support merely a world without nuclear weapons. The concept of GCD, in short, envisions the elimination of *all* conventional and nuclear weapons. States would be permitted to retain only those capabilities required to maintain internal order—in other words, only those weapons needed to carry out various police functions. The truly revolutionary nature of GCD is perhaps made more apparent by pointing out that the United Nations Charter embodies the rights of states to provide for their defense through the continued possession of military arms. Clearly, GCD would take the international community far beyond its existing security architecture.

The historical record suggests that “strategic disarmament” is a more appropriate conceptual guide for future disarmament efforts. Conceptually, this term occupies the policy territory somewhere between nuclear disarmament and GCD. Strategic disarmament implies that conventional weapons with strategic implications will need to be eliminated while others are restrained at the same time that nuclear weapons are eliminated. Unlike GCD, it does not contend that the vast majority of a state’s conventional weapons will need to be eliminated. A fundamental assumption informs this middle approach: Se-

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3. International Atomic Energy Agency (IAEA), “Treaty on the Non-Proliferation of Nuclear Weapons,” INFCIRC/140, April 22, 1970, <http://www.iaea.org/Publications/Documents/Infcirc/Others/infcirc140.pdf>.

4. George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, “Deterrence in the Age of Nuclear Proliferation,” *Wall Street Journal*, March 7, 2011, <http://online.wsj.com/article/SB10001424052748703300904576178760530169414.html>.

curity would likely not be improved if nuclear weapons alone were eliminated but states were completely unrestrained with respect to all other strategic weapons.

## Disarmament in Historical Perspective

### *The Truman Years*

Just months after the end of World War II, U.S. president Harry Truman sought the elimination of nuclear weapons. Strategic uncertainty colored the postwar environment. At the time, nuclear disarmament (then termed the “international control of atomic energy”<sup>5</sup>) seemed a safer way to ensure the future security of states than all other strategic options. Despite holding good intentions, however, the Truman administration made some dangerous disarmament mistakes. These major missteps were soon corrected in time.

The first “working idea” to eliminate nuclear weapons was the Acheson-Lilienthal Report, which, after some modifications, was presented to the UN Atomic Energy Commission in June 1946. The primary strategic objective of this plan was simple: to eliminate the threat of a nuclear surprise attack. Illustrating the perceived centrality of this threat at the time, a study sponsored by the U.S. Joint Chiefs of Staff concluded in October 1945:

It is plain that the advent of the atomic bomb and other new weapons puts a greater premium than ever before upon surprise in the initiation of warfare. If defense measures are absent or ineffective because of surprise, a truly devastating blow might be dealt a nation in the first moments of war. It must, therefore, be anticipated that any future major war will be initiated by an attempt to achieve the effects of Pearl Harbor on a vast scale by the simultaneous attack of the most important cities of the nation.<sup>6</sup>

Physically, U.S. cities were seen as extremely vulnerable to a surprise attack because they were important centers of economic activity and thus a prime military target. And the intense secrecy surrounding the Soviet regime raised concerns about a sudden attack. It was easy to assume the worst about Soviet intentions when little reliable information was available.<sup>7</sup>

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5. Chester I. Barnard et al., *A Report on the International Control of Atomic Energy: Prepared for the Secretary of State's Committee on Atomic Energy* (Washington, D.C.: U.S. Department of State, 1946), [http://www.foia.cia.gov/cgi/1946/03%20-%20March%201946/Report\\_on\\_the\\_International\\_Control\\_of\\_Atomic\\_Energy\\_16\\_Mar\\_1946.PDF](http://www.foia.cia.gov/cgi/1946/03%20-%20March%201946/Report_on_the_International_Control_of_Atomic_Energy_16_Mar_1946.PDF).

6. Joint Chiefs of Staff, *Over-All Effect of Atomic Bomb on Warfare and Military Organization*, J.C.S. 1477/1, Records of the Joint Chiefs of Staff, Part II, 1946–1953, August 17, 1945.

7. Bernard Brodie, *The Absolute Weapon: Atomic Power and World Order* (Freeport, N.Y.: Books for Libraries Press, 1972; orig. pub. 1946), contrary to conventional wisdom, argued “the element of surprise may be less important than is generally assumed.” He contended that nuclear weapons favored a surprise attack, and thus aggressive behavior, only if a single state possessed them. This early logic of an assured second-strike capability is easier to comprehend with contemporary weapon systems that are relatively invulnerable. At the time Brodie was writing, such



This *limited* objective of nuclear disarmament has been lost in the modern debate. Early observers fully recognized that disarmament would not prevent war. The most that could be asked of disarmament was to alter the incentives of states to go to war and to shape how a war would be initiated if it occurred. After the war, as the quotation given above attests, American strategists assumed that the outbreak of any future war would involve the early and decisive use of nuclear weapons. Based on this premise, a sudden nuclear attack posed the greatest national threat.

Overarching concern about this particular military threat wholly shaped the American disarmament plan. Simply put, because of the way existing threats were narrowly perceived, the plan privileged nuclear weapons. Other forms of weaponry, though acknowledged in the preceding months to be relevant to disarmament considerations, were excluded from the final plan presented to the United Nations in 1946. Ultimately, the Soviet Union rejected the American disarmament offer. This Soviet decision was probably fortuitous. Conventional wisdom holds that the American offer was heavily biased in its favor, because many believed it would have perpetuated the American nuclear monopoly preceding actual disarmament.<sup>8</sup>

Upon closer historical inspection, it is not clear that an American monopoly of nuclear weapons was necessarily foreordained. A working assumption within the Truman administration was that until international control was firmly established, the United States would continue producing atomic bombs.<sup>9</sup> Establishing an effective international agency to control atomic energy required an extended period of time for states to negotiate and deliberate. Secretary of State Dean Acheson, among others, believed that it would take many years for the proposed international Atomic Development Authority (ADA) to become fully operational.<sup>10</sup> Some informed individuals thought that the Soviet Union could build a nuclear weapon in as little as six years.<sup>11</sup> And, until the ADA was up and running, the Soviet Union would likewise be free to pursue the development of the atomic bomb. If the Soviet Union had agreed to the American disarmament offer and stated that it, too, would pursue nuclear weapons until the ADA was fully operational, an interlude of several years suggests that the American nuclear monopoly would have vanished before nuclear weapons were to have been eliminated.

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logic was not immediately grasped.

8. Barton J. Bernstein, "The Quest for Security: American Foreign Policy and International Control of Atomic Energy, 1942–1946," *Journal of American History* 60, no. 4 (March 1974): 1003–1044.

9. "Groves Sees Perils in Atom Inspection," *New York Times*, November 29, 1945.

10. Discussion by Under Secretary of State Dean Acheson and Dr. Vannevar Bush with Larry Lesueur. Dean G. Acheson Papers, Publications File, 1936–1971, Speeches and Articles File, 1936–1971, box 134, April 23, 1946, International Control of Atomic Energy, CBS Broadcast Folder, Harry S. Truman Presidential Library, Independence, Mo.

11. "Atomic Bombs and the Postwar Position of the United States in the World, Spring 1945," Atomic Bomb Collection, Subject File, box 1, Clemson University, documents from the James F. Byrnes Papers Concerning Leo Szilard, 1945 folder.

The failure of the Soviets to accept the American offer from this vantage point is overshadowed by the failure of the United States to link the elimination of nuclear weapons to either reductions in conventional weapons or the elimination of other weapons of mass destruction. Truman and his advisers fought to keep conventional disarmament delinked from efforts to eliminate nuclear weapons.<sup>12</sup> Nuclear weapons, many thought, incorporated “peculiar” issues that had to be addressed separately from all other weapons. The early history of the Cold War makes clear that the conventional strength of the Soviet military grew rapidly in the early postwar years, prompting a greater reliance upon nuclear weapons by the United States to overcome this conventional imbalance. A disarmament plan along the lines of the early American offer would have left the United States and its allies dangerously exposed to the growing Soviet conventional threat. Truman quickly realized his disarmament policy mistake. Two months after the outbreak of the Korean War, he explicitly linked nuclear and conventional disarmament.

### *The Kennedy Years*

Disarmament diplomacy during the Kennedy administration went well beyond efforts to eliminate nuclear weapons. The official rhetoric of both the United States and the Soviet Union escalated to encompass the idea of eliminating all military weapons, conventional and nuclear. Perhaps the most dramatic expression of this goal was President John Kennedy’s claim in a speech at the United Nations: “The weapons of war must be abolished before they abolish us.”<sup>13</sup> In this same speech, Kennedy urged the Soviet Union to join the United States in a “peace race, . . . until general and complete disarmament has been achieved.”<sup>14</sup>

To be sure, GCD was idealistic, providing little more than a diplomatic platform for political theater. But it also contained kernels of the disarmament logic consistent with learning from the early disarmament mistakes of the Truman administration. The tabled American GCD “outline,” a term stopping short of meaning a draft treaty, called for nuclear disarmament to occur only after 75 percent of all conventional armaments were eliminated from national armories.<sup>15</sup>

In addition to overreaching, this proposal was strategically flawed. Specifically, substantial numerically driven reductions in conventional armaments ahead of eliminating nuclear weapons would likely only *increase* reliance upon nuclear weapons in national

12. In a January 1947 speech, Secretary of State James Byrnes reaffirmed the nonlinkage of nuclear and conventional weapons in disarmament efforts. Byrnes stated that “we have urged priority for the control of atomic weapons because they are the most destructive of all weapons. . . . We are convinced that if there can be agreement on that subject, there can be agreement on the control of other major weapons and a general reduction or armaments.” See Secretary of State Byrnes, “We Must Demonstrate Our Capacity in Peace,” *Department of State Bulletin*, January 19, 1947, 89.

13. Address by President John F. Kennedy before the General Assembly of the United Nations, New York, September 25, 1961.

14. *Ibid.*

15. Arnold Wolfers et al., *The United States in a Disarmed World: A Study of the U.S. Outline for General and Complete Disarmament* (Baltimore: Johns Hopkins University Press, 1966).

security strategies. Paradoxically, the scale and sequencing of conventional disarmament in this instance would work to make eliminating nuclear weapons more difficult to achieve. Thus, while the basic logic of tying conventional weapons elimination to nuclear disarmament was consistent with earlier efforts, the sequencing of disarmament steps worked against the general effort to improve the security of states.

### *The Johnson Years*

Both disarmament frameworks—nuclear disarmament and GCD—perhaps unsurprisingly—were incorporated into the NPT in 1968. Article VI of the NPT codifies a commitment by member states “to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to *nuclear disarmament*, and on a Treaty on *general and complete disarmament* under strict and effective international control” (emphasis added).<sup>16</sup> Viewed from the perspective of the historical evolution of disarmament, this article’s wording reflects much uncertainty about how to safely eliminate nuclear weapons, for each framework represented distinct ideas about how to achieve a world without nuclear weapons.

In many ways, the NPT simply formally recognized previous disarmament efforts. The hasty manner in which Article VI was ultimately included in the treaty is reflected in its textual construction. The treaty-based term “nuclear disarmament” suffers from the narrowness that David Lilienthal warned against in his memoirs. Reflecting upon his early disarmament work, he recalled, “Our obsession with the Atom led us to assign to it a separated and unique status in the world.”<sup>17</sup> And the NPT, as experts claim, is the second most important international treaty behind the United Nations Charter.<sup>18</sup> If all states were to effectively disarm to GCD levels, how is the United Nations Security Council to enforce international peace and security? Collective security is premised upon the idea of lawfully *armed* states. Full implementation of Article VI would effectively turn the idea of collective security into a house of cards.

### *The Reagan Years*

The close strategic linkage between the level of nuclear weapons and conventional weapons was made clear in a different way during the Reagan administration. The proximity of the Reagan years makes disarmament arguments in the 1980s of particular interest for study. Disarmament efforts in this administration are intriguing because they stand at odds with much previous strategic thinking and are, ultimately, difficult to fully understand.

Remarkably, Reagan repeated Truman’s early mistake of overemphasizing nuclear weapons in disarmament efforts. While talk of addressing conventional force imbalances arose in internal discussions leading up to Reykjavik, this topic was not raised

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16. IAEA, “Treaty on the Non-Proliferation of Nuclear Weapons.”

17. David E. Lilienthal, *Change, Hope and the Bomb* (Princeton, N.J.: Princeton University Press, 1963), 18–19.

18. Thomas Graham Jr., *Disarmament Sketches: Three Decades of Arms Control and International Law* (Seattle: University of Washington Press, 2002).

in Iceland. In retrospect, observers routinely question the extent to which the Reagan administration was prepared to discuss disarmament in Iceland. Some senior administration officials later admitted that they devoted little attention to the disarmament issue at the time.<sup>19</sup> This questionable level of preparation is perhaps best evidenced by the National Security Council's Decision Directive 250, which Reagan issued shortly after returning from Reykjavik, in which he sought ideas on achieving his offer of a world free from "offensive ballistic missiles."<sup>20</sup> It appears that Reagan's diplomatic offer was extensively studied only *after* he made it.

Though it remains classified, the 93-page Joint Chiefs of Staff response to Reagan's directive would be insightful if observers could review it. Some available evidence points to the idea that many in the Reagan administration thought a massive conventional *build-up* was the necessary price to pay for implementing Reagan's limited disarmament offer.<sup>21</sup> One day after returning from Reykjavik, Reagan spoke to Margaret Thatcher by phone. A partially redacted summary of the conversation makes clear that Thatcher was concerned about the Soviets' unfavorable superiority in conventional forces. Reagan's response is telling. The summary suggests that "the president replied that we do not believe the conventional situation is so imbalanced. . . . We would, however, have to increase our conventional efforts."<sup>22</sup> Reagan was likely expressing ideas already swirling among his military advisers.

Why was the military now recommending a build-up in conventional forces when, historically, the United States' position was to link conventional to nuclear disarmament? What changed conditions had prompted such a radical break in disarmament policy? Was the position of the Joint Chiefs of Staff grounded more in bureaucratic politics than strategic logic? These are questions for future research. At this point, observers must guard against drawing overly firm conclusions given that the bulk of the historical record relating to the Reagan administration remains publicly unavailable.

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19. Kenneth L. Adelman, *The Great Universal Embrace: Arms Summitry—A Skeptic's Account* (New York: Simon & Schuster, 1989), 69.

20. Post-Reykjavik Follow-Up, National Security Decision Directive 250, November 3, 1986, Executive Secretariat, National Security Council, National Security Decision Directives Files, box 91297, NSDD 250 (1 of 9) folder, Ronald Reagan Presidential Library, Simi Valley, Calif.

21. Memorandum for the President from John M. Poindexter, "Why We Can't Commit to Eliminating All Nuclear Weapons within 10 Years," October 16, 1986, Alton Keel Files, box 91636, Reykjavik Briefings Memo regarding Eliminating Nuclear Weapons (3 of 3) Folder, Ronald Reagan Presidential Library; Memorandum for the President from Frank C. Carlucci, "Arms Reduction Strategy Paper," Robert Linhard Files, box 92117, National Security Planning Group, September 8, 1987 (3 of 3), folder, Ronald Reagan Presidential Library.

22. Memorandum of Telephone Conversation between the President and Prime Minister Thatcher from Peter R. Sommer to John M. Poindexter, October 14, 1986, Robert Linhard Files, box 92116, Thatcher Visit, November 15–16, 1986, folder, Ronald Reagan Presidential Library.

## The Logic of Strategic Disarmament

Revisiting disarmament from a historical perspective provides a useful context for improving our understanding of the conditions that need to materialize in order for nuclear weapons to be safely eliminated. History suggests that the often-repeated term—nuclear disarmament—is conceptually too narrow and, even worse, is potentially misleading as a construct to fully inform policy. Central to the notion of “strategic disarmament” is the idea that conventional weapons holding strategic implications will likely need to be reduced and eliminated in order to achieve nuclear disarmament.

Two anticipated threats in a future world without nuclear weapons help to explain why strategic disarmament is likely to be the more appropriate analytical construct. First, at or near “nuclear zero,” the threat of a nuclear surprise attack will resurface as a central military threat. Though it took many years to materialize, an assured second-strike capability emerged as the “supreme solution” to the threat of a nuclear surprise attack.<sup>23</sup> Once this capability materialized in the 1960s, American talk of disarmament as a solution faded. But disarmament, by definition, physically eliminates the means whereby some states manage the threat of a surprise attack. The policy question then becomes: What new “solution” is to replace the one based on deterrent forces-in-being?

A future variant of this military threat is the perceived potential for a state to cheat and covertly retain some number of nuclear weapons while all other states are disarmed. A worst case scenario might include a cheating state launching some sort of sneak attack on another state. This nontrivial potential for cheating presents formidable obstacles to eliminating nuclear weapons. Unless robust protective measures were first in place, it is virtually unthinkable that any state would agree to accept the high risks associated with this potential threat.

Strategic disarmament holds the promise to substantially mitigate this threat. At a minimum, it would significantly alter the incentives of any state, including a cheating state, to attack in the first place. Insight into how the nature of this threat is changed by strategic disarmament can be found in the words of one observer shortly after Pearl Harbor: “The lesson of Pearl Harbor is clear. To strike a heavy but indecisive blow at a powerful enemy, *without possessing the resources to follow it up by invasion and occupation of the homeland*, is to court ultimate disaster” (emphasis added).<sup>24</sup> Aggressive states would be less inclined to initiate an attack if they largely lacked the nonnuclear forces to capitalize on a sudden strike.

The offensive use of nuclear weapons in any cheating scenario appears to critically depend upon the balance of *conventional* forces. Covertly retaining a few nuclear weapons does little to improve a state’s strategic situation if the balance of conventional forces is heavily weighed against it. The use of some hidden nuclear weapons would be

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23. Patrick M. Morgan, “Nuclear Deterrence and Strategic Surprise,” in *Challenge to Deterrence: Resources, Technology and Policy*, edited by Stephen Cimbala (New York: Praeger, 1985).

24. P. M. S. Blackett, *Military and Political Consequences of Atomic Energy* (London: Turnstile Press, 1948).

unlikely to substantially destroy the conventional forces of its intended target, thereby opening the cheating state to conventional retaliation.

The second anticipated threat in a future world without nuclear weapons is a recurring point made by disarmament critics: that the elimination of nuclear weapons would create fertile conditions for a major conventional war. The potential use of nuclear weapons in war, most agree, works to make war a grossly uneconomical and unattractive option. Disarmament critics fear that eliminating nuclear weapons would dangerously alter the calculus of war by making it less costly and thus a more tempting option for aggressively inclined states.

Critics, however, tend to wholly ignore the configuration of conventional forces when assessing the likely pitfalls of a world without nuclear weapons. This omission is of critical importance because the likelihood of major conventional war turns on the nature and balance of conventional weapons. Whether the likelihood of conventional war is increased or decreased depends upon the nature of the disarmament effort—specifically, on whether nuclear disarmament occurs in tandem with, or separate from, conventional disarmament; and also on the characteristics of all the weapons that are eliminated. As is true with nuclear disarmament, not all conventional disarmament proposals will be stabilizing. Some may increase security, while others may decrease it. But the larger point here is that manipulating the conventional forces that states possess directly alters the incentives of states to fight because it has a substantial impact on their ability to conduct certain military strategies with a high rate of success. In this respect, if strategic disarmament is conceived and implemented appropriately, it may decrease the likelihood of conventional war in a world without nuclear weapons.

## Concluding Implications

Admittedly, the notion of strategic disarmament is not a cure-all for the numerous ailments associated with eliminating nuclear weapons. It is not unreasonable to suggest that the ideas presented here may well create dangerous unanticipated consequences. More generally, many future disarmament problems remain unknown because distant facts are beyond present-day observation. In this respect, it seems plausible to suggest that what we do not know at present may be just as important for assessing the desirability of eliminating nuclear weapons as what we currently do know. However, the intellectual task at hand is to ensure that we are making the most of discovering what can be known about the question of disarmament with the available resources.

The idea that the disposition of conventional weapons will be central to the prospects and desirability of eliminating nuclear weapons, though often underappreciated among nuclear weapons analysts, is not lost on global political leaders. Consider the recent remarks of Pierre Sellal, secretary-general of the French Ministry of Foreign Affairs: “If we don’t complement nuclear disarmament with credible disarmament in all other fields (whether biological, chemical or conventional, missile defense and space),



it might lead again to a destabilizing scenario of arms race.”<sup>25</sup> And in a 2009 white paper, the British government opined: “Complete balance in conventional forces is unlikely to be attainable. But complex, multifaceted conventional arms control arrangements and confidence-building measures may be necessary to underpin a ban on nuclear weapons.”<sup>26</sup> This statement essentially embodies the position taken by the United States in most disarmament negotiations throughout the Cold War.

Thinking about old issues anew raises additional questions. Strategic disarmament points to two particular issues that demand closer attention. First, it is far from clear when nuclear weapons should be eliminated in connection with cuts in conventional weaponry. It will be necessary to think through this issue carefully; for at each stage in the disarmament process, the timing and sequencing of weapons elimination must be such that reliance upon nuclear weapons or the prospect of conventional war is not increased at any point in the process. Few topical areas associated with disarmament have received as little systematic attention as this question of disarmament timing and sequencing.

Second, the notion of strategic disarmament raises a perplexing paradox. If the elimination of nuclear weapons is to include a nontrivial reduction in strategic conventional arms, then how is the international community to credibly enforce, by military force if necessary, a ban on nuclear weapons? There are no immediate answers to this “enforcement paradox.” Enforcing nuclear disarmament in a world without nuclear weapons will likely require a formidable conventional arsenal. Strategic disarmament would seem to impair any enforcement effort. However, it is now far from clear what conventional weapons will need to be eliminated and to what extent in the future. Thus, it is hard to be precise about how much conventional power states will need to retain in a nuclear-disarmed world to effectively enforce it. And it is not clear which states in the international community will need to possess the requisite conventional strength and how this power will need to be counterbalanced to safeguard against abuse or opportunism.

The overall thrust of this analysis is sobering: Safely eliminating nuclear weapons portends to be exceptionally difficult because conventional disarmament will add many new strategic wrinkles. Substantial disagreements are likely to arise between states as to which conventional weapons hold “strategic” implications. The relevant conventional weapons that need to be eliminated in one security context may be wholly different from those in another. Good analytical tools do not yet exist to determine how to make these asymmetrical trades. Though inadequate, history may be the best tool we have to inform disarmament policy.

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25. Pierre Sellal, “Opening Session,” remarks delivered at Global Zero Summit, Paris, February 2, 2010.

26. David Miliband et al., *Lifting the Nuclear Shadow: Creating the Conditions for Abolishing Nuclear Weapons* (London: Foreign and Commonwealth Office, 2009).

# The Enhanced Nuclear Detonation Safety Theme: An Introduction

Raymond B. Wolfgang<sup>1</sup>

## Abstract

The United States, to maintain a viable and robust nuclear deterrent, needs to support a safe, reliable, and predictable stockpile of nuclear weapons. How can it be assured that over the course of a weapon system's lifetime, which can be up to 30 years or more, the workers on these weapons as well as the surrounding community remain safe? At stake are the continued functioning of the complex; the world's confidence in the United States' ability to maintain a stockpile of these weapons for itself and its allies; and, most important, the safety of the weapons workers and surrounding communities. This paper first discusses several accidents that occurred early in the United States' nuclear weapon program, and then presents the safety requirements (the Walske Criteria) that were developed in response to those accidents. The bulk of the paper describes the current version of this safety theme—Enhanced Nuclear Detonation Safety (ENDS), which comprises three principles—isolation, incompatibility, and inoperability—supported by the concept of independence. Examples of the theme's relevance for both normal and abnormal (i.e., accident) environments are presented to illustrate the requirements in practice. Designing weapons to this theme helps to solve the problem of how to keep personnel and the environment safe while storing, transporting, and maintaining weapons in the nation's nuclear stockpile—a stockpile that is key for U.S. national security and the protection of nations allied with the United States.

## Introduction

Even a small nuclear weapons accident that involved a nuclear yield would be catastrophic for the local community, the operation of the nuclear weapon complex, and the

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world's confidence in the United States' ability to safely maintain a sustainable deterrent. These consequences drive the need to assure there are absolutely no U.S. nuclear detonations resulting from anything else than a declared launch by the U.S. president. Fortunately, there have not been any inadvertent nuclear detonations in U.S. history, but there have been several other accidents without detonations along with inadvertent radiological dispersals. This paper describes the requirements that were levied on U.S. nuclear weapons laboratories as a result of these accidents in the 1950s and 1960s: the Walske Criteria. This safety policy led to the design theme used today by the U.S. weapon design laboratories (Los Alamos, Lawrence Livermore, and Sandia) to build and refurbish nuclear weapons—the ENDS theme, which is formed by the three pillars of isolation, incompatibility, and inoperability, along with the concept of independence, which is used to help implement the safety design. This theme is described in detail below. First, however, an analysis of early nuclear weapon history is required to examine the motivation behind the Walske requirements.

## History

### *Accidents*

No U.S. nuclear weapon accident has involved an inadvertent nuclear detonation of any yield (i.e., there has been no “blinding white flash”). The most severe accidents have involved radiological dispersal from the detonation of the high explosive (HE) in the weapon. When radioactive material is scattered by the force of the HE blast, it is referred to as an HE violent reaction. Some of the more severe accidents are described below, with an emphasis on those parts of the accident that motivated the development of a set of quantitative safety requirements being levied on all new and refurbished weapon systems. These new requirements, referred to as the Walske Criteria, further prompted the development of the ENDS theme. These criteria were first promulgated in a letter by Carl Walske, then chair of the Military Liaison Committee (MLC; precursor to today's Nuclear Weapons Council), to the Atomic Energy Commission (an early precursor of today's Department of Energy).<sup>2</sup> The Walske Criteria, as originally expressed in the letter, are as follows:

The probability of a premature nuclear detonation of a bomb (warhead) due to bomb (warhead) component malfunctions (in a mated or unmated condition), in the absence of any input signals except for specified signals (e.g., monitoring and control), shall not exceed:

Prior to receipt of prearm signal (launch) for the normal\* storage and operational environments described in the STS, 1 in  $10^9$  per bomb (warhead) lifetime.

Prior to receipt of prearm signal (launch), for the abnormal\*\* environments described in the STS, 1 in  $10^6$  per warhead exposure or accident.

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2. “The Walske Letter,” memo from the Department of Defense Military Liaison Committee (Carl Walske) to the Atomic Energy Commission (General Edward B. Giller), March 14, 1968.

\* Normal environments are those expected logistical and operational environments, as defined in the weapon's stockpile-to-target sequence (STS) and military characteristics (MCs) in which the weapon is expected to retain full operational reliability.

\*\* Abnormal environments are those [unexpected] environments, as defined in the weapon's stockpile-to-target sequence (STS) and military characteristics (MCs) in which the weapon is not expected to retain full operational reliability.

A prearm signal is a signal that must be sent to the weapon firing system before final arming, fusing, and firing of the weapon can occur; it is most often incorporated as a safety feature to prevent accidental arming of a warhead. In the Walske letter, the prearm signal was the physical acceleration experience by the weapon during launch; once such acceleration was felt by the warhead, subsequent arming and firing steps could take place. A more thorough analysis of nuclear weapon safety measures as they relate to the Walske Criteria is presented in R. E. Kidder's 1991 report to Congress.<sup>3</sup> The goal of the Walske Criteria, and implementing the safety theme to meet them, is to prevent nonstandard events of any type during warhead handling—particularly HE violent reactions or inadvertent nuclear detonations.

### *Early Safety: Removable Capsules*

One early design of nuclear weapons involved a removable capsule of nuclear (fissile) material, as shown in figure 1. (Note that all the figures in this paper are strictly notional and do not represent any U.S. weapon design.) This design required that, before deployment, the nuclear part of the weapon be physically inserted into the body of the weapon casing; this would usually happen inside the aircraft bomb bay during flight. Most designs required that this capsule, also known as the *pit*, be stored separately from the weapon in a special storage container called a *birdcage*. The advantage offered by this design was that, in the event of an accident, an HE detonation would not necessarily produce any radiological dispersal, since it was possible to transport weapon cases without any nuclear material on board the transport plane. Among the 32 nuclear weapon accidents in U.S. history,<sup>4</sup> several had HE detonations without a live capsule present and several others had weapons and capsules on board without the capsules inserted. These latter accidents—even though an HE violent reaction occurred—did not involve any radiological dispersal. Two accidents, each with capsules and weapon cases in the same transport vehicle, only involved contamination limited to the immediate accident area. There was also an accident with only two capsules on board, but no weapon case with an HE to cause dispersal. Finally, not every accident in the capsule-era resulted in an HE explosion, although one such accident resulted in slight alpha contamination of a firefighter's clothing.

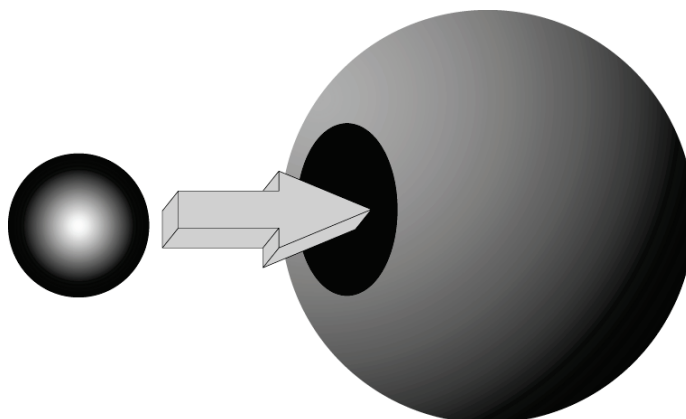
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3. R. E. Kidder, *Report to Congress: Assessment of the Safety of U.S. Nuclear Weapons and Related Nuclear Test Requirements*, UCRL-LR-107454 (Livermore, Calif.: Lawrence Livermore National Laboratory, 1991).

4. U.S. Department of Defense, *Unclassified Narrative Summaries of Accidents Involving U.S. Nuclear Weapons, 1950–1980* (Washington, D.C.: U.S. Government Printing Office, 1981).

**Figure 1. Nuclear Capsule, or “Pit” (left), Inserted into Weapon Case**

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Source: Author's notional design.

There were many substantial disadvantages to separable-pit weapons, including difficulties associated with tracking the nuclear material, increased exposure of workers to radiation, and the limitation of designs to bomb-type weapons. Later weapon designs were “sealed-pit” weapons, where the nuclear material is placed inside the weapon during manufacture (figure 2) and is not removable during normal operation. This type of weapon is much easier to maintain, and avoids the potentially dangerous and fallible operation of inserting the capsule while the aircraft is in midflight. This design also allows delivery of weapons via intercontinental ballistic missiles, since it is not realistic from an engineering standpoint to insert a capsule into a warhead during missile flight and still have the warhead meet a reasonable yield requirement.

Sealed-pit weapons present a different safety challenge, since the HE and the nuclear material are now within the same bomb casing. An example of the new risk that this poses was seen in an accident over Goldsboro, North Carolina.<sup>5</sup> Here, two weapons separated from the aircraft during a structural failure of the right wing. One bomb's parachute deployed, and the bomb underwent only minor damage as shown in figure 3; the other bomb broke apart. Neither bomb's HE detonated on impact, avoiding certain substantial radiological dispersal. A separate accident involved weapons mounted on an airplane taxiing on the tarmac.<sup>6</sup> Due to a runway accident in icy conditions, the bombs experienced both extreme cold and then intense heat from the ensuing fire. Parts of the five weapons on board burned up, and contamination was limited to the immediate area of the accident and subsequently removed. More important, this accident provided an example of a bomb experiencing an environment—simultaneously hot and cold—not anticipated by the original designers. This drove the need for a systematic way to design safety into a weapon, instead of designing a weapon specifically for certain environments.

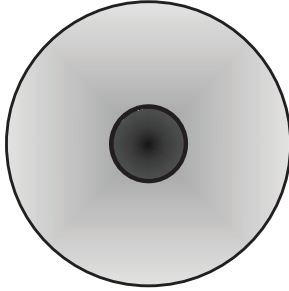
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5. Ibid., January 24, 1961 / B-52 / Goldsboro, N.C.

6. Ibid., December 8, 1964 / B-58 Hustler / Bunker Hill (now Grissom) Air Force Base, Ind.

**Figure 2. Sealed Pit Weapon; Nuclear Material in Center**

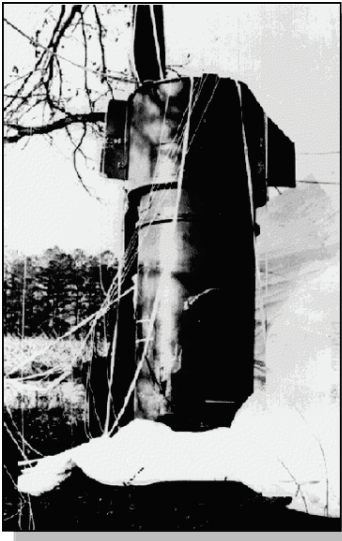
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Source: Author's notional design.

**Figure 3. Recovery of One of the Goldsboro Bombs**

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Source: Alton P. Donnell, "A Robust Approach to Nuclear Weapon Safety," Sandia Report SAND 2011-4123C. Unclassified; unlimited distribution.

Up to this point, most of the accidents had not resulted in nuclear material dispersal. Those that had were sufficiently minor that the radiation was confined to the immediate area of the accident—the wreckage, the crater, the immediate area, or someone's clothing. In all contamination cases, the spread was confined to the property of the military base involved. This changed in the late 1960s with two accidents—one over Palomares, Spain (see figure 4),<sup>7</sup> and the other near the airbase in Thule, Greenland.<sup>8</sup> Here are brief descriptions of these two accidents:

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7. Ibid., January 17, 1966 / B-52 & KC-135 / Palomares, Spain.

8. Ibid., January 21, 1968 / B-52 / Thule Air Base, Greenland.



January 17, 1966. A B-52 bomber and KC-325 refueling tanker collided during a routine high-altitude air refueling operation. Both aircraft crashed near Palomares, Spain. Four of the 11 crew members survived. The B52 carried four nuclear weapons. One was recovered on the ground and on April 7, one was recovered from the sea. Explosive materials exploded on impact with the ground releasing some radioactive materials. Approximately 1,400 tons of slightly contaminated soil and vegetation were removed to the United States for storage at an approved site. Representatives of the Spanish government monitored the cleanup operation.

January, 21, 1968. A B-52 crashed and burned some 11 miles southwest of the runway at Thule AB, Greenland, while approaching the base to land. Six of the seven crew members survived. The bomber carried four nuclear weapons, all of which were destroyed by fire. Some radioactive contamination occurred in the area of the crash, which was on the sea ice. Some 237,000 cubic feet of contaminated ice, snow, and water with crash debris were removed to an approved storage site in the United States over the course of a four-month operation. Although an unknown amount of contamination was dispersed by the crash, environmental sampling showed normal readings in the area after the cleanup was completed. Representatives of the Danish government monitored the cleanup operations.

These were the only two accidents that resulted in widespread dispersal of nuclear materials, and both occurred during the period of airborne alert, where the United States had airborne bombers loaded with nuclear weapons in the event of an attack. Later in 1968, airborne alert was terminated the day after the Thule accident.<sup>9</sup> These two accidents also resulted in a policy change by the top-level government committee governing all aspects of the nuclear weapons complex, the MLC.<sup>10</sup>

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9. Rebecca Grant, “The Perils of Chrome Dome,” *Air Force Magazine*, August 2011, <http://www.airforce-magazine.com/MagazineArchive/Pages/2011/August%202011/0811dome.aspx>.

10. Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs, *The Nuclear Matters Handbook: Expanded Edition* (Washington, D.C.: U.S. Government Printing Office, 2011), Annex A, [http://www.acq.osd.mil/ncbdp/nm/nm\\_book\\_5\\_11/docs/NMHB2011.pdf](http://www.acq.osd.mil/ncbdp/nm/nm_book_5_11/docs/NMHB2011.pdf).

Figure 4. Palomares, Spain, January 1966



Source: Alton P. Donnell, "A Robust Approach to Nuclear Weapon Safety," Sandia Report SAND 2011-4123C. Unclassified; unlimited distribution.

## Safety

### *The Walske Criteria*

Although the airborne alert was canceled in 1968, there was still concern at the policy level about whether there would be another accident. Carl Walske, then chair of the MLC, led a group of military and civilian officials that had the ability to levy requirements on any and all nuclear weapon development, maintenance, and retirement activities. The MLC passed onto the U.S. Military and the Atomic Energy Commission, precursor to today's Department of Energy, the following safety-related requirements for all new weapon development and refurbishment projects. These are known as the Walske Criteria, which set the following parameters for safety before launching nuclear weapons in "normal" and "abnormal" environments:

1. *In normal storage and operational environments . . .* the probability of nuclear yield greater than 4 lbs. equivalent TNT shall not exceed one in one billion (or 1 in  $10^9$ ) per warhead lifetime.
2. *In abnormal environments* as described in the system Stockpile-to-Target sequence . . . the probability of nuclear yield greater than 4 lbs. equivalent TNT shall not exceed (one in one million (or 1 in  $10^6$ ) per warhead exposure to the environment or accident.

To put the probability of failure in a normal environment into perspective, 1 billion ( $10^9$ ) seconds would last 31.7 years. One billion minutes into the past, the Roman Empire was still in existence. For abnormal environments, a failure probability of 1 in

1 million is roughly equivalent to the probability that one word was misspelled among 136 pages of text in *Encyclopaedia Britannica* (without spaces). One million U.S. dollar bills weigh approximately 1,000 kilogram, and 1 million seconds are equivalent to 11.6 days. Abnormal environments may include lightning events, underwater submersion, fires involving either petroleum-based fuel or missile propellant, or even extreme heat, cold, or humidity experienced during storage.

The Walske Criteria impose stringent safety standards that pose significant engineering and production challenges for the national laboratories responsible for weapon design, production, and surveillance.

### *The National Laboratories' Response*

The national laboratories that deal with nuclear weapon design are Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Sandia National Laboratories. Additionally, Sandia is responsible for the overall system's integration and thereby the safety of the overall nuclear weapon system. The following history is excerpted from Stan Spray's "Nuclear Weapon Safety from Production to Retirement,"<sup>11</sup> and a fuller version of the history is available in two other Spray documents.<sup>12</sup> In 1968, Sandia executive vice president Jack Howard formed the Independent Safety Assessment Group (ISAG); Stan Spray, a division supervisor under Jack Howard at the time, led a study of weapon safety in abnormal environments. This study soon led to a stockpile-wide review conducted jointly by Sandia and the Energy Research and Development Administration (ERDA) in the early to middle 1970s. (ERDA was a precursor of today's Department of Energy.) The conclusions of the review were that, in light of the Palomares and Thule accidents, safety improvements could be made—by ending airborne alerts, by retrofitting active systems, or by retiring systems from the stockpile. Having learned from these studies (in the late 1960s and early 1970s), ISAG also worked with systems and components groups at Sandia to develop a new approach to designing weapon systems and refurbishments that would address some of the new safety concerns—resulting in the ENDS theme.<sup>13</sup> This approach involves following certain design rules and guidance in the selection of weapon parts and in the overall weapon architecture. The ENDS theme may also drive the selection of material, safety features, and subcomponent design. For refurbishing a weapon, the safety theme drives the design of the replacement parts.

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11. S. D. Spray, "Nuclear Weapon Safety from Production to Retirement," Sandia Report SAND2001-0600, section 1, "Background." Official use only; distribution limited.

12. S. D. Spray, "History of Nuclear Weapon Safety at Sandia: Personal Recollections, Vol. 1," Sandia Report SAND2008-2881. Official use only; distribution limited; S. D. Spray, "History of Nuclear Weapon Safety at Sandia: Personal Recollections, Vol. 2," Sandia Report SAND2008-2879. Official use only; distribution limited.

13. David W. Plummer and William H. Greenwood, *The History of Nuclear Weapon Safety Devices*, Sandia Report SAND98-1184C, <http://www.osti.gov/bridge/servlets/purl/671923-JYRvMV/webviewable/671923.pdf>; Alton P. Donnell, "A Robust Approach to Nuclear Weapon Safety," Sandia Report SAND 2011-4123C. Unclassified; unlimited distribution.

# Enhanced Nuclear Detonation Safety

## *The Three I's: Isolation, Incompatibility, and Inoperability*

Three pillars support the ENDS theme: isolation, incompatibility, and inoperability. Isolation may be considered the first among equals, as the other two principles support isolation in different ways.

1. *Isolation*: The effort here is to isolate detonation-critical components from unintended energy (electrical or mechanical). Isolation components may include metal “exclusion barriers”, steel enclosures, or safety switches that stay in the off position until activated.
2. *Incompatibility*: This entails designing “enabling stimuli”—signals that eventually turn off safety features, arm the fuse, and fire the weapon—to be unique relative to signals found in nature. For instance, the theme directs the designer against using 440-volt, 3-phase signals, since that is a common commercial power supply voltage.
3. *Inoperability*: This requires the labs to design the weapon so that critical detonation features become inoperable beyond repair before the isolation features succumb to an abnormal environment. Inoperability may be considered similar to “fail-safe” features of key detonation-critical components. Another example is the small tube (often colored red in the United States) that melts in order to activate commercial sprinkler systems. (This tube melts away early in a fire so the water may start to flow. To be effective, the tube must melt away long before the steel sprinkler head starts to melt and malfunctions from the heat of the fire.)

## *Independence*

One aspect of implementing the ENDS theme that has evolved with continued weapon development and production is the use of multiple, independent subsystems for the safety features. While independence is not formally part of Carl Walske’s requirement set, the concept allows engineers to design two systems with failure probabilities  $\leq 10^{-3}$  instead of  $\leq 10^{-6}$ , which is much more difficult and expensive to build. The two systems would then be placed in a series, one following the other in the system, to achieve the required assurance level. Systems with failure probabilities  $\leq 10^{-6}$  are also almost impossible to verify. Specifically, far more parts would be required for testing and qualification—on the order of tens or hundreds of thousands—than would ever be produced for the weapons themselves.

## *Terminology*

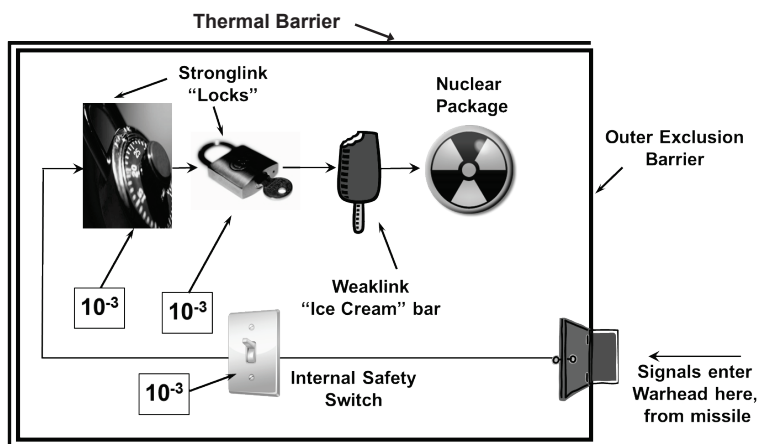
Before proceeding to a more detailed discussion of the ENDS theme, several terms must be defined. “Exclusion barrier” refers to a device that implements isolation of some type of energy—electrical, mechanical, or thermal. Exclusion barriers keep energy that could be compatible with firing the weapon outside those regions containing arming and firing circuitry, while

letting that same energy pass through in the event of authorized use. A “stronglink” refers to a safety subsystem that is designed to withstand different types of environments and still function normally—thus forming a “strong link” in the safety system. A “weaklink” may be considered a first-failure device, or a device that ensures the larger assembly of the weapon fails safely. Both stronglinks and weaklinks are in the essential pathway of signals needed to arm, trigger, and physically fire the weapon. A top-level description of the stronglink–weaklink relationship may be found in chapter 10 of C. R. Loeber’s *Building the Bombs* and in section 5.4 of *The Nuclear Matters Handbook*.<sup>14</sup>

## Normal Environments

The ENDS theme is meant to lead to a weapon design that is safe, can be produced efficiently, and can withstand normal operating environments over the course of the system’s lifetime. The components that implement the theme in these normal environments can be seen in the warhead schematic in figure 5. Starting with the outer barrier in the diagram, this represents the thermal barrier of the warhead. The inner rectangle represents the outer exclusion barrier, which is the underside of the warhead’s outer shell and acts as the electrical barrier to the outside environment.

**Figure 5. The ENDS Theme in Normal Environments**



Source: Author’s notional design.

In figure 5, starting from the lower right, by the door, we see communication signals enter the warhead from the host missile. A similar diagram could be drawn for a bomb

14. C. R. Loeber, *Building the Bombs: A History of the Nuclear Weapons Complex*, 2nd ed. (Albuquerque: Sandia National Laboratories, 2006); Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs, *Nuclear Matters Handbook*.

being carried in an airplane. The details of these signals do not affect the theme and are outside the scope of this paper; however these signals must pass into the warhead for proper operation. Once the signals enter the warhead, they must pass through different switches. A switch must be unlocked or “enabled” for the signal to pass through and perform its intended function in the warhead.

The first switch shown in figure 5 is an internal safety switch, perhaps of the on/off variety, which has a  $10^{-3}$  or less chance of failure. Failure of a switch in this case means that the switch is prematurely enabled. After this switch, the signals must pass through a second switch (shown as a combination lock), then finally through a third switch (represented by the padlock). Like the first switch, both these stronglink switches have a probability of failure of  $10^{-3}$ . The path is not yet complete, however. After the third switch, the signals must detect the intact presence of the weakink device, here symbolized as an ice cream bar, in order to arm the fuse and detonate the nuclear package. The weaklink must absolutely be intact, of the correct size and shape, and fully functional for the weapon to work.

When (1) the signals pass through all the switches successfully, (2) the weaklink is functional and intact, and (3) the weapon has had a nuclear package inserted, then the weapon may then be armed and then fired. Equally important is the fact that during the normal handling, storage, and transporting of the weapon, it does not detonate and remains safe to  $10^{-9}$  levels. In normal environments, the weapon is also required to meet its reliability requirements levied by the military.

The other scenarios consist of abnormal environments—that is, potential accidents. The theme is the same.

## Abnormal Environments

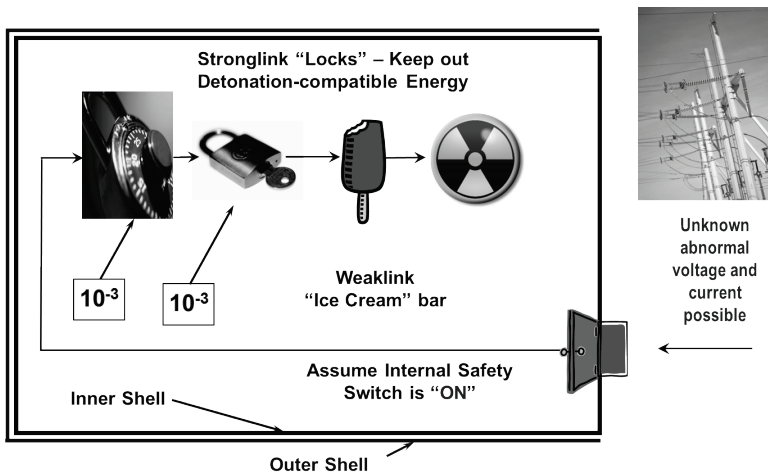
If the weapon is involved in an accident, the military requirement is no longer that the weapon function normally if pressed into service; thus, reliability is no longer an issue. However, the weapon must still remain safe to  $10^{-6}$  levels, per the Walske Criteria. This is a challenge from an engineering perspective, since the abnormal environments are far more stressful for the weapon than normal ones.

### *Electrical Environments*

There are many different accident scenarios that a unit could face. One such environment is electrical—such as exposure to a downed power line in the course of a transportation accident (figure 6) In this case, we assume that the internal safety switch has been damaged and bypassed by the nature of the accident. In an abnormal environment, all three safety subsystems are not expected to survive. The two abnormal-environment safety features are still operable and protect the weapon. These are the two stronglinks of the system.



**Figure 6. Abnormal Environment: Electrical Only (Both Stronglinks Function as Intended)**



Source: Author's notional design.

A unique feature of this electrical environment is that the weaklink (the ice cream bar), which is a detonation-critical component, remains intact. Fortunately, in this case, both stronglinks are still fully functional and operate as expected—providing isolation and insulation against the electrical energy present from the power line. The next subsection describes an environment where the weaklink does not survive: a fire.

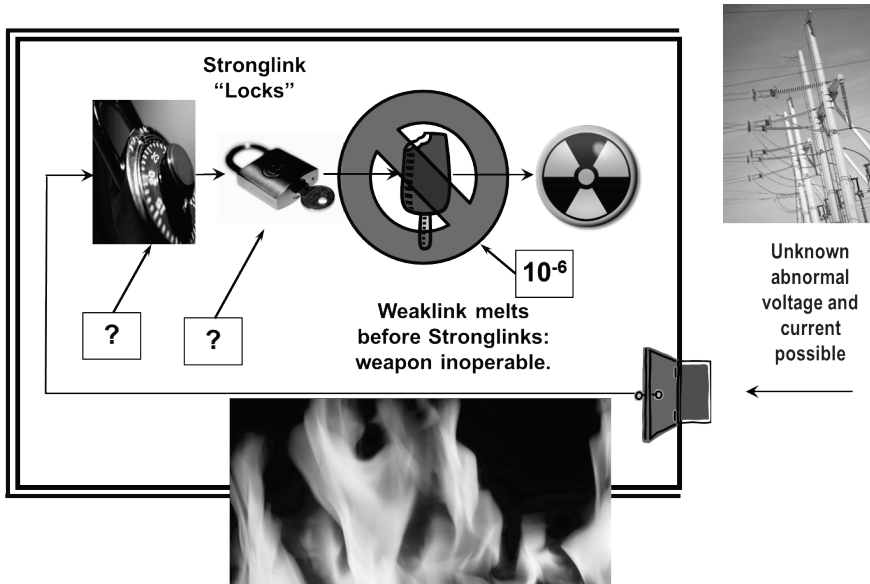
### *Thermal*

In the case of electrical insult, the two stronglinks operated as designed and together provided  $10^{-6}$  safety—which met the requirement of the Walske Criteria. If the accident scenario is expanded to include a fire (perhaps a fuel fire from the transporting vehicle), together with a downed power line, then at some point the two stronglinks will no longer each provide  $10^{-3}$  isolation since they will eventually fail in a fuel fire. This situation is illustrated in figure 7. The question arises, if both stronglinks are lost, would the weapon still meet the  $10^{-6}$  safety requirement?

This example demonstrates how, with a sufficiently unstable environment, isolation can no longer be assured. In the presence of the fire, the two stronglinks move from assured,  $10^{-3}$  safety (for each system), to an unknown but lesser safety level. To compensate for this situation, while maintaining  $10^{-6}$  safety in credible abnormal environments, weapon designs include a weaklink device. The key to weaklinks is that they make the device irreversibly inoperable far sooner than the stronglinks fail for the same accident scenario. By the time the two locks become “soft” and thus can no longer be assured to stay locked, the weaklink has long since lost its ability to function and, thus, so has the device as a whole. In other words, the ice cream bar had melted away. At this point, it does not matter if the stronglinks cannot provide isolation since without the weaklink,

the weapon cannot work. This is sometimes called the “thermal race”—the race to fail-ure by the weaklink versus the stronglinks. Notionally, this thermal race may be viewed as, “Which will melt faster in a fire, a steel combination lock or an ice cream bar?” The thermal race must be won for each weapon.

**Figure 7. Abnormal Environment: Electrical + Fire (Weaklink Provides the 10<sup>-6</sup> Safety)**



Source: Author’s notional design.

## Conclusion

The design, manufacture, and deployment of two nuclear weapons in the early and middle 1940s during wartime were gargantuan endeavors.<sup>15</sup> It is no smaller or less complex a pursuit to build and maintain an entire stockpile of weapons that are ready to use at a moment’s notice, with a shelf life of multiple decades, in a safe and secure manner. The problem this paper addresses is how to build this latter type of stockpile. An escalating series of accidents in the 1950s and 1960s, which happened in the course of then-normal transporting of weapons and weapon parts, brought about the development of new safety requirements issued by Carl Walske and the MLC in 1968; thus, the “Walske Criteria” led to the development of the ENDS theme. Weapons designed according to this theme could be asserted to have met the new safety requirements.

This paper has discussed the Walske Criteria; the ENDS theme; safety features such as exclusion barriers, stronglinks, and weaklinks; and normal and abnormal environments. The basics of the ENDS theme were presented: isolation, incompatibility, and inoperability. This was followed by a discussion of independence—the use of several in-

15. Richard Rhodes, *The Making of the Atomic Bomb* (New York: Touchstone, 1986).

dependent subsystems in a series to achieve safety requirements. A discussion of ENDS in normal environments followed, after which two accident scenarios were introduced: electrical only, and electrical in combination with fire. Each scenario (normal, electrical, and electrical with fire) showed how the ENDS theme helps designers build a weapon that can remain safe in multiple abnormal environments. An ENDS-designed weapon may also protect against scenarios that engineers have not thought of; this is why it is important to design to a theme, rather than to specific accident scenarios. Therefore, modern weapon systems in the U.S. stockpile all adhere to the ENDS principles, with newer systems implementing the theme in more technologically advanced ways. While no weapon is 100 percent safe, ENDS allows a program to meet its nuclear safety requirements while minimizing the nuclear safety risks inherent in maintaining a reliable, deployable, and safe nuclear weapon stockpile.

# Limiting Damage or Damaging Stability: Assessing Conventional Counterforce Strikes against Theater Nuclear Forces

Tong Zhao<sup>1</sup>

## Abstract

China and Russia are concerned about the development and deployment of U.S. conventional global strike systems that may change the existing offense/defense balance and threaten the credibility of their nuclear deterrent. This paper posits that a counterforce strike is more likely to target theater nuclear forces than intercontinental ballistic missiles and provides an analysis of the probability that U.S. conventional strikes might neutralize China's theater nuclear forces, which include DF-3A, DF-4, DF-21, DF-31, Type 094 nuclear submarines, and nuclear-capable H-6 bombers. The results indicate that China's strategy of building robust underground facilities can effectively protect its nuclear forces from preemptive strikes, making it unlikely that a U.S. conventional strike could destroy a meaningful part of China's theater nuclear forces. This study also assesses the potential capabilities of future conventional prompt global strike systems and reveals problems with the strategy of damage limitation. The final sections discuss the policy implications for avoiding an inadvertent escalation of conflicts and improving strategic stability between the United States and China.

## Theater Nuclear Weapons, Underground Facilities, and Conventional Counterforce Strikes

The United States has been investing in the development of conventional weapons that are aimed at time-sensitive targets and targets that are hardened and deeply buried. The Obama administration's 2010 Nuclear Posture Review Report states that "non-nuclear prompt global strike) capabilities may be particularly valuable for the defeat of time-

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urgent regional threats,”<sup>2</sup> which do not exclude strikes against nuclear targets.<sup>3</sup> The report on conventional strike produced by the Defense Science Board explicitly includes the scenario of using a conventional strike to preempt a perceived nuclear missile attack from a regional power.<sup>4</sup> A National Research Council report suggests keeping the option of using conventional prompt global strike weapons against Russia’s and China’s “critical targets” on the table. It claims that the risks associated with such a conventional strike are “sufficiently low and manageable,” and “they do not constitute a reason to forgo acquiring the capability.”<sup>5</sup>

Some analysts believe that a conventional counterforce capability will provide the United States with the option to eliminate a perceived imminent nuclear threat without having to risk the cost of initiating a nuclear war. Conventional weapons, according to this argument, will enable the United States to “conduct a counterforce strike without crossing the nuclear threshold, and without killing millions.”<sup>6</sup>

From the perspective of the offense/defense balance, a nuclear-dominated system enjoys a defensive advantage because it is much easier to launch a retaliatory nuclear strike than to conduct a nuclear first strike. Such a defensive advantage contributes to the lack of major wars since World War II. Nowadays, however, as advanced conventional offensive systems are incorporated into military capabilities, the existing defensive advantage may face challenges. To assess the impact of the advancement of conventional offensive military capability on the existing offense/defense balance in the nuclear field, we also need to study the nature and impact of new developments on the defensive side of the equation. China, for example, concerned about the survivability of its nuclear retaliatory capability, is putting an increasing portion of its nuclear forces on mobile delivery vehicles. China has also built extensive underground facilities to protect its nuclear forces, which may also undermine the effectiveness of conventional counterforce strikes against China.

Facing challenges on both sides of the equation, this paper assesses the potential of conventional global strike weapons and their impact on China’s nuclear weapons

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2. U.S. Department of Defense, *Nuclear Posture Review Report: April 2010* (Washington, D.C.: U.S. Government Printing Office, 2010), 35, <http://www.defense.gov/npr/docs/2010percent20nuclearpercent20posturepercent20reviewpercent20report.pdf>.

3. Hans M. Kristensen, *Global Strike: A Chronology of the Pentagon’s New Offensive Strike Plan* (Washington, D.C.: Federation of American Scientists, 2006).

4. Ronald Kerber and Robert Stein, *Report of the Defense Science Board Task Force on Time-Critical Conventional Strike from Strategic Standoff, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics* (Washington, D.C.: Defense Science Board, 2009). In this report, the scenario posits the regional power has “roughly ten mobile ICBMs moving among what appears to be a much larger number of hard and deeply buried under ground facilities (HDB UGFs) and large civilian structures. An additional three HDB UGFs are used for storage of spare nuclear weapons and missile support facilities.”

5. National Research Council, *U.S. Conventional Prompt Global Strike: Issues for 2008 and Beyond* (Washington, D.C.: National Academies Press, 2008).

6. Keir A. Lieber and Daryl G. Press, “The Nukes We Need: Preserving the American Deterrent,” *Foreign Affairs* 88 (2009): 6, 39–51.

capabilities, looking in particular at the vulnerability of China's theater nuclear forces, and taking into consideration the impact of China's underground facilities and mobile delivery vehicles.

The only scenario under which the use of nuclear weapons might be considered between the United States and China is an escalation of a conventional conflict over Taiwan. From the U.S. perspective, if China faces a catastrophic defeat using conventional weapons in a regional conflict over Taiwan, China might want to use nuclear weapons to reverse the situation on the battlefield. Under such circumstances, if the United States believed that the use of nuclear weapons by China against U.S. military assets near Taiwan was imminent and unavoidable, the United States might be forced to preemptively destroy that part of China's nuclear forces that would be most likely to be used against it in order to limit the potential damage to U.S. military capabilities. Or, if China had already launched a nuclear attack against U.S. military assets near Taiwan, the United States would want to quickly destroy the rest of China's nuclear forces to prevent further offensive strikes. In either case, the target of U.S. counterforce strikes would be theater nuclear forces because China would not be likely to use its intercontinental ballistic missiles (ICBMs) under these circumstances.

Official Chinese documents do not distinguish "theater nuclear forces" from "strategic nuclear forces." The term of "theater nuclear forces" is used here to describe those Chinese nuclear weapons that cannot reach the continental United States, such as China's medium- or intermediate-range nuclear missiles, nuclear-capable bombers, and possibly ballistic missile nuclear submarines.<sup>7</sup> These theater nuclear weapons pose real threats to U.S. military assets in the Asia-Pacific region. China's ICBMs, including a handful of silo-based DF-5 missiles and newly introduced land-mobile DF-31A missiles, however, are less relevant in a counterforce scenario because they would generally be reserved for retaliatory strikes against continental U.S. targets in an all-out nuclear war. A summary of China's current theater nuclear weapons is provided in table 1.

## The Survivability of China's Theater Nuclear Weapons against Conventional Precision-Guided Strikes

In general, China's theater nuclear forces can be grouped into four major categories: (1) land-based missiles with limited mobility; (2) land-based missiles with high mobility; (3) nuclear ballistic missile submarines; and (4) nuclear-capable aircraft. This section examines the survivability of each category in a total destruction scenario. The complete destruction of a nuclear weapon system is different from "functional defeat," which refers to causing sufficient damage to a weapon system or associated facilities so that the system is unable to function effectively. The issue of functional defeat is discussed in the following section.

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7. Chinese Type 094 nuclear submarine(s), if deployed within the First Island Chain and in waters close to China, their missiles may not be able to reach the continental United States and may only be capable of striking shorter-range regional targets.



**Table 1. China's Theater Nuclear Forces**

Type / Chinese Designation (U.S. Designation)	No. Deployed	Year First Deployed	Range (kilometers)	Warhead Loading	No. of Warheads
Land-based missiles with limited mobility	24				
DF-3A (CSS-2)	~16	1971	3,100	1 × 3.3 Mt	~16
DF-4 (CSS-3)	~12	1980	5,400 +	1 × 3.3 Mt	~12
Land-based missiles with high mobility	75				
DF-21 (CSS-5 Mods 1, 2)	~60	1991	2,150	1 × 200–300 kt	~60
DF-31 (CSS-10 Mod 1)a	10–20	2006	7,200+	1 × 200–300 kt ?	10–20
SLBMs	(36)				
JL-1 (CSS-N-3)	(12)	1986	1,000+	1 × 200–300 kt	N.A.
JL-2 (CSS-N-4)b	(36)	(?)	~7,400	1 × 200–300 kt ?	N.A.
Aircraft	>20				
H-6 (B-6)	~20	1965	3,100	1 × bomb	~20
DH-10	?			?	

Note: N.A. = not available or not applicable; ( ) = uncertain figure; SLBM = submarine-launched ballistic missile.

<sup>a</sup> The DF-31 missile is classified as a theater system because China defines DF-31 as a long-range ballistic missile, not an ICBM. Its range seems not long enough to reach continental United States. It is believed not primarily targeted against the United States, but is likely to be used for regional targeting. Also, DF-31 is generally regarded as a replacement for older DF-4 missile which only has a regional role.

<sup>b</sup> It is a little difficult to categorize JL-2 SLBM. On the one hand, some sources believe this missile is capable of reaching continental U.S. even when launched from waters close to China. On the other hand, the missile can certainly be also used to target nearer targets such as Guam or be used in a hypothetical regional conflict over Taiwan Strait. Ultimately, it depends on whether the United States would perceive JL-2 missile as a threat in a theater battlefield around Taiwan.

Source: Adapted from: H. Kristensen and R. Norris, "Chinese Nuclear Forces, 2011," *Bulletin of the Atomic Scientists* 67 (November 1, 2011): 6, 81–87; and Shannon N. Kile, Vitaly Fedchenko, Bharath Gopalaswamy, and Hans M. Kristensen, "Chinese Nuclear Forces," in *SIPRI Yearbook 2010: Armaments, Disarmament and International Security*, edited by Stockholm International Peace Research Institute (Oxford: Oxford University Press, 2010).

## *Land-Based Missiles with Limited Mobility*

DF-3A and DF-4 are two relatively old land-based missiles. Both of them are road-mobile and use liquid fuel.<sup>8</sup> DF-3A has a range of 3,100 kilometers and can be launched from either a permanent pad or a portable stand.<sup>9</sup> According to Kristensen, Norris, and McKinzie, China has a large number of underground facilities, and “placing important assets underground in some form seems to be a common element of China’s military planning.”<sup>10</sup> Since the “Third Line Project,” between 1964 and the middle to late 1970s, China built a large number of underground facilities in remote, mostly mountainous regions to protect its most important military and industrial assets. In the late 1970s, China made another decision: to construct the so-called Great Wall Project, which is aimed at building highly secure underground facilities for China’s nuclear forces.<sup>11</sup>

According to open sources, the Great Wall Project is an underground web of tunnels built in mountainous areas in China for the purpose of protecting the missiles of the Second Artillery, which has the responsibility for all China’s nuclear missiles. The project began in the late 1970s and early 1980s, and its construction (or some part of it) was reportedly completed in the 1990s. In 1995, a press report from *Jiefangjun Bao* (People’s Liberation Army Daily) noted that after more than 10 years of construction by tens of thousands of Second Artillery engineer troops, a major national defense project had been successfully finished. This is believed to be the first time that information about the Great Wall Project was reported openly.<sup>12</sup> In 2008, more than 10 years later, an official TV program, *Junshi Jishi* (Military Documentary), broadcast a documentary revealing that an engineering unit of the Second Artillery successfully built new underground missile bastions in the Kunlun Mountains in 2006 and 2007. This was widely interpreted by foreign analysts as a message that the Great Wall Project has been extended to the Qinghai-Tibet Plateau, and that ballistic missiles have been deployed to that region.<sup>13</sup> Therefore, it is likely that the Great Wall Project does not refer to one or more specific projects, but to a series of relatively new underground facilities built to conceal and protect missiles and other strategic assets of the Second Artillery.<sup>14</sup>

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8. It is mobile in the sense that it is not silo-based, and can be towed to a predesignated launch pad for launch.

9. U.S. Department of Defense, *The Military Power of the People’s Republic of China 2000* (Washington, D.C.: U.S. Government Printing Office, 2000), 17.

10. Ibid.

11. “Binghua Huang: A Missile Designer Who Fell Down at the Missile Bastion That He Designed” (in Chinese), *PLA Daily*, August 16, 2009.

12. Zijuan Huang, “Uncover China’s ‘Underground Great Wall’: Strategic Missile Arsenal Can Withstand Nuclear Attack” (in Chinese), *People*, <http://military.people.com.cn/GB/8221/72028/76059/78907/10568269.html>.

13. “DF-31 Missiles Deployed on Qinghai-Tibet Plateau,” China Center for International and Strategic Studies, <http://news.chinaiiss.com/html/20083/26/af6ac.html>; Zijuan Huang, “Uncover China’s ‘Underground Great Wall.’”

14. The term “relatively newly built” refers to the fact that these underground facilities were designed and built during or after the 1980s.

It is likely that a significant number of DF-3A and DF-4 missiles are deployed in these underground Great Walls. DF-3As are suspected to be deployed in at least four missile bases across six provinces.<sup>15</sup> Some of these missiles, such as those deployed in Qinghai and Liaoning provinces, are most likely targeting India and Russia.<sup>16</sup> Because this paper contemplates a hypothetical U.S. preemptive attack against China's nuclear forces, this analysis focuses on those nuclear forces whose combat radii are long enough to cover the Taiwan Strait. In the case of DF-3A missiles, at least three provinces—Shandong, Anhui, and Yunnan—are suspected of having DF-3A missiles close enough to the Taiwan Strait.<sup>17</sup> All three provinces have mountains that are suitable for building underground facilities. Anhui Province, for example, is reported to have a missile base located at Huangshan, which is a huge mountain range that extends over 1,200 square kilometers and is made up largely of granite.<sup>18</sup>

For DF-4s, it seems likely that the Great Wall Project may have been extended to regions where DF-4 missiles are deployed. The 2008 official release about the engineering units of the Second Artillery specifically mentions that new underground missile bastions had been recently built on the Qinghai-Tibet Plateau, where some analysts believe DF-4 missiles are deployed.<sup>19</sup> In addition to Qinghai Province, Henan Province is also suspected of having DF-4 missile bases.<sup>20</sup> Henan Province is where the Taihang mountain range and Qinling mountain range intersect, and thus it should have plenty of places appropriate for building underground facilities.<sup>21</sup> It is reasonable to assume that, like the DF-3A missiles, a certain proportion of the existing DF-4 stockpiles are deployed in Great Wall Project-style underground facilities.

For the purpose of protecting missiles from preemptive strikes, these underground facilities are reportedly built inside mountains that are made of hard rock such as gran-

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15. Bates Gill, James Mulvenon, and Mark Stokes, "The Chinese Second Artillery Corps: Transition to Credible Deterrence," in *The People's Liberation Army as Organization: V 1.0., Reference Volume*, edited by James C. Mulvenon et al. (Santa Monica, Calif.: RAND Corporation, 2002), 541–542; Hans M. Kristensen, Robert S. Norris, and Matthew G. McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Washington, D.C.: Federation of American Scientists, 2006).

16. Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces*.

17. Gill, Mulvenon, and Stokes, "Chinese Second Artillery Corps"; Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces*.

18. Gill, Mulvenon, and Stokes, "Chinese Second Artillery Corps."

19. Ibid.; Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces*.

20. Gill, Mulvenon, and Stokes, "Chinese Second Artillery Corps"; Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces*.

21. Both Qinling and Taihang Mountain are made of rock. Qinling Mountain, in particular, is made of granite, and seems ideal for building underground facilities. E.g., the suspected Chinese nuclear warheads central storage facility is located in Qinling Mountain (although this facility is close to but not exactly in Henan Province). See Mark A Stokes, "China's Nuclear Warhead Storage and Handling System," Project 2049 Institute (2010).

ite.<sup>22</sup> The tunnels are usually located as deep as hundreds of meters under the surface.<sup>23</sup> Physical and functional characteristics, such as the sizes of different missile vehicles, were taken into account when designing the specific shapes, sizes, and internal structures of the tunnels.<sup>24</sup> The following analysis, therefore, assesses the robustness of these underground facilities against a hypothetical conventional precision-guided strike.

An earth-penetrating weapon, whether it is nuclear or conventional, works in the same way: The warhead hits the surface of ground at a very high speed, penetrates into the ground, and explodes at the deepest point. The powerful shock wave will crush tunnels within a certain range. The depth of the penetration to a large extent is determined by the speed of the warhead. However, as the speed increases, the weapon material may no longer be able to survive the severe ground impact and explode as designed. At present, the maximum impact speed for the hardest steel is about 1 kilometer per second. Under such a limitation, the maximum penetration depth into reinforced concrete is roughly about four times the length of the penetrator.<sup>25</sup> For typical conventional earth penetrators in the current U.S. arsenal, such as BLU-109s and BLU-116s, their length is about 2.4 meters (8 feet),<sup>26</sup> meaning that their maximum penetration capability is about 9.6 meters into reinforced concrete.<sup>27</sup> Accordingly, it is reasonable to assume that 10 meters is approximately the maximum depth that a typical conventional precision-guided weapon can penetrate into reinforced concrete. After penetration and detonation, the range of destruction is largely proportional to the cube root of the force of the explosion.<sup>28</sup> The approximate depths of destruction of conventional precision-guided weapons are shown in table 2.

As shown in table 2, a typical conventional precision-guided weapon in the current U.S. inventory has a destruction range of no more than 25 meters in granite. Even the most powerful Massive Ordnance Penetrator (MOP), which is still in development, has a destruction range of about 35 meters. It seems unlikely, even under extreme circumstances when a number of these weapons can be delivered repeatedly at pinpoint

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22. Granite is a type of felsic and igneous rock. Its density and strength is similar to reinforced concrete.

23. Jingjing Wang, “‘Underground Great Wall’ Guarantees the Safety and Security of China’s Nuclear Forces,” *Communists* 2 (2010): 50.

24. Ibid.

25. Robert W. Nelson, “Low-Yield Earth-Penetrating Nuclear Weapons,” *Science and Global Security* 10 (2002): 1–20.

26. Michael A. Levi, *Fire in the Hole: Nuclear and Non-Nuclear Options for Counterproliferation* (Washington, D.C.: Carnegie Endowment for International Peace, 2004).

27. This is a conservative assessment that probably overestimates the penetrating capability of these weapons. In practice, even if the weapon material does not wear out during penetration, the munitions might not withstand the very high deceleration and could be destroyed or malfunction. This conservative estimation reinforces the results of the analysis that proves the limits of conventional earth penetrators.

28. Ivan Oelrich, Blake Purnell, and Scott Drewes, “Earth-Penetrating Nuclear Warheads against Deep Targets: Concepts, Countermeasures, and Consequences,” Federation of American Scientists, April 2005, <http://www.fas.org/resource/04192005105503.pdf>.

precision, that there is any chance for conventional weapons to destroy targets buried hundreds of meters underground in granite, the reported depth of typical Great Wall Project tunnels.<sup>29</sup>

**Table 2. Approximate Destruction Ranges for Conventional Precision-Guided Weapons in Granite**

Weapon Warhead/Penetrating Munitions	Explosive Weight (kilograms)	Yield (kilograms, TNT equivalent) <sup>a</sup>	Range of Destruction (meters, distance from detonation point)
BLU-109	243	365	~14
BLU-116	243 or less <sup>b</sup>	365 or less	< 14
BLU-113	N.A.	304 <sup>c</sup>	~14
SLAM-ER (AGM-84H)	230	345	~14
JASSM (AGM-158A)	450	675	~18
TLAM	450 or less <sup>d</sup>	675 or less	< 18
CALCM (AGM-86C/D)	N.A.	1,300 <sup>e</sup>	~22
MOP (Massive Ordnance Penetrator)	3,500	5,250	~36

<sup>a</sup>The advanced explosives that BLU-109 carries are reported to have about 18 percent or even up to 50 percent increased explosive power relative to TNT. See Keir A. Lieber and Daryl G. Press. “The Nukes We Need: Preserving the American Deterrent (Technical Appendix),” [http://www.dartmouth.edu/~dpress/docs/Press\\_FA-2009-Appendix-12-post.pdf](http://www.dartmouth.edu/~dpress/docs/Press_FA-2009-Appendix-12-post.pdf). In order not to underestimate the capacity of weapons, this study assumes that advanced explosives are used for all conventional precision-guided weapons, and these explosives are 50 percent more powerful than TNT.

<sup>b</sup>“Blu-116 Advanced Unitary Penetrator [Aup],” *Global Security Newswire*, <http://www.globalsecurity.org/military/systems/munitions/blu-116.htm>.

<sup>c</sup>“Blu-113/B, a/B Penetrator Warhead,” *Global Security Newswire*, <http://www.globalsecurity.org/military/systems/munitions/blu-113.htm>.

<sup>d</sup>Raytheon Company, “Tomahawk Land Attack Missile,” [http://www.raytheon.com/capabilities/products/stellent/groups/public/documents/content/cms01\\_055764.pdf](http://www.raytheon.com/capabilities/products/stellent/groups/public/documents/content/cms01_055764.pdf).

<sup>e</sup>Yevgeny Miasnikov, “The Counterforce Potential of Precision-Guided Munitions,” in *Nuclear Proliferation: New Technologies, Weapons, Treaties*, edited by Alexei Arbatov and Vladimir Dvorkin (Moscow: Carnegie Moscow Center, 2009).

In fact, even if China’s tunnels are not built in granite, but simply under wet earth, they do not seem vulnerable to conventional precision-guided strikes. Calculations have shown that even in wet earth, conventional weapons with yields at the level of 0.1 to 1.0 kilotons can only reach a depth of no more than 70 meters underground.<sup>30</sup> The maximum destruction range for the most powerful MOP weapon with a yield of 3.5 kilotons would therefore be no more than 90 meters. In other words, even if China’s tunnels are covered simply by hundreds of meters of wet earth, not by granite as is reported, they seem relatively safe from repeated strikes by conventional precision-guided weapons.

29. Current technology does not offer such a pinpoint accuracy, even for precision-guided weapons.

30. Levi, *Fire in the Hole*, 14.

Moreover, all this assumes accurate targeting. But such accuracy is hard to achieve because, as tunnels go deep into mountain bodies, there is no way to identify the exact locations of the tunnels. Especially for the large and complex tunnel webs of the Great Wall Project, which has a reported length of more than 5,000 kilometers, the entire underground network of tunnels can cover an extensive area, making it essentially impossible to employ a barrage strategy of destroying the entire area with conventional precision-guided weapons in the current U.S. inventory.

### *Land-Based Missiles with High Mobility*

Both DF-21 and DF-31 missiles are attached to a transporter-erector-launcher (TEL) and have a higher degree of mobility. The missiles themselves are contained within and protected by launch canisters and need less logistical support than DF-3As or DF-4s. As a result, DF-21s and DF-31s seem less vulnerable and more adaptable to various battlefield environments. In addition, these two types of missiles share many operational features. For the purpose of analysis, this section will use DF-21s in survivability assessment.

China is suspected to have about 60 nuclear-armed DF-21 missiles. It is reasonable to assume that, in peacetime, China may keep a significant number of DF-21 missiles in safe and secure facilities and send a number of missiles out for exercises. Based upon the analysis given in the previous sections of this paper, DF-21 missiles that are kept in Great Wall Project–style underground facilities are safe from any conventional precision-guided strike. Nonetheless, when a DF-21 missile is on a road TEL, its survivability against a conventional attack may be reduced.

Results of calculations indicate that most of the conventional precision-guided weapons in the current U.S. inventory have a more than 70 percent chance of destroying a DF-21 missile vehicle with a single shot.<sup>31</sup> If the United States uses up to three weapons to target one Chinese missile vehicle, the probability of causing “severe damage” would approach 100 percent.

It is important to note that these results are based on two assumptions: first, a Global Positioning System (GPS) signal is present, which helps the warhead to identify its own location during the flight; and second, the warhead can receive real-time updates about the coordinates of a moving target, which is usually achieved through radio communication with a satellite or other sources of intelligence. In practice, however, China’s military probably would try to block or jam GPS and other radio signals in areas where nuclear missile vehicles are deployed, especially at a time of crisis when its leaders believe that an adversary might contemplate a preemptive strike. In order to take this into account, the following analysis assesses the survivability of DF-21 missile vehicles when real-time communication is not available for U.S. precision-guided munitions during the final phase of their reentry.

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31. Tong Zhao, “Conventional Counterforce Strike: An Option for Damage Limitation in Conflicts with Nuclear-Armed Adversaries?” *Science & Global Security* 19 (2011): 195–222.



For GBU-32s/BLU-109s, if the GPS signal is effectively jammed and the weapon can only use its inertial navigation system, its accuracy decreases significantly, from about 5 meters to more than 30 meters.<sup>32</sup> Accordingly, this study assumes that without GPS guidance, most precision-guided weapons' circular error probable (CEP) will decrease as much as fivefold, if not more. Under such conditions, their destruction probability is shown in table 3.

The results given in table 3 show that if the GPS signal is effectively jammed, single-shot destruction probability will decrease significantly. More weapons will be required to achieve a relatively high overall destruction probability. However, for some precision-guided munitions, even as many as six weapons do not seem enough to guarantee a high probability of the destruction of the target.

Moreover, if the target is moving and if radio signals (including the GPS signal) to the precision-guided weapon are jammed during its final phase of flight, it would be unable to be updated with new coordinates of the target or to identify its own location.<sup>33</sup> If one assumes that the communication signal is jammed during the last 30 seconds of the flight and the target is moving at a normal velocity of 30 miles per hour, the missile vehicle can travel as far as 400 meters during the half minute. Under this scenario, the United States might need to consider using the barrage strategy to strike the entire area with a radius of meters. The problem is, when the GPS signal is jammed, the accuracy of most conventional precision-guided weapons drops so dramatically that their lethal radius becomes smaller than CEP (see table 3), which makes it essentially impossible to effectively cover the entire area, even if a large number of weapons are used. Therefore, if the communication signal is jammed, the overall destruction probability falls significantly; and more important, the weapon will be no longer capable of detecting and tracking the movement of the target, which further undermines the destruction probability. Reliable radio communication (including the GPS signal) seems critical for conventional precision-guided weapons to have a chance to hold China's DF-21 missiles at risk.

### *Nuclear Ballistic Missile Submarines*

Existing foreign analyses of China's submarine forces indicate that submarine bases are more difficult to conceal and protect than land-based underground facilities. Foreign experts have identified underground facilities with sea entrances at some of China's submarine bases.<sup>34</sup> It looks as if China's nuclear submarines are usually hidden in underground facilities and drive in and out of these submerged tunnels through sea entrances.

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32. Lieber and Press, "Nukes We Need."

33. It is assumed that the weapon relies on radio signals to receive the coordinates of a moving target. It is possible that a weapon can be equipped with advanced sensors that can independently detect and identify a moving target and therefore does not need GPS signal to know the coordinates of the target. It is difficult, however, to assess how well such sensors may work, due to the scarcity of publicly-available sources of information.

34. Nuclear Information Project, "China's Nuclear Missile Submarine Base," <http://www.nukestrat.com/china/subcave.htm>; Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces*.

**Table 3. Probability of Destruction by Conventional Precision-Guided Weapons (without GPS Guidance) against a Stationary DF-21 Missile Vehicle**

Weapon Warhead / Penetrating Munitions	Guidance System LR (meters)	CEP (meters)	LR (meters)	SSPK	P(2)	P(3)	P(4)	P(5)	P(6)
BLU-109	INS	~ 30	~14	0.146	0.270	0.376	0.467	0.545	0.611
BLU-116	Laser	~ 50	~14	0.055	0.107	0.156	0.203	0.247	0.288
BLU-113	Laser	~ 50	~13	0.049	0.095	0.140	0.182	0.222	0.260
SLAM-ER (AGM-84H)	INS, Teleguided	~ 12.5	~14	0.582	0.825	0.927	0.970	0.987	0.995
JASSM (AGM-158A)	INS	~ 12	~18	0.773	0.948	0.988	0.997	0.999	1.000
TLAM	INS, Terrain Contour Matching	~ 25	~18	0.289	0.495	0.641	0.745	0.819	0.871
CALCM (AGM-86C/D)	INS	~ 12.5	~22	0.879	0.985	0.998	1.000	1.000	1.000
MOP (Massive Ordnance Penetrator)	INS	~ 25	~35	0.738	0.931	0.982	0.995	0.999	1.000

Note: CEP, which stands for "circular error probable," is a measure of a weapon's accuracy; LR refers to lethal radius; SSPK is "single-shot probability of kill"; and P(n) is the overall chance of destroying the target, whereas n is the number of weapons that are used in the strike.

At a time of crisis, the United States may not be confident about whether the submarines are in or outside the underground facilities, because the submarines may be able to leave the facility secretly and undetected through the submerged sea entrances. When the submarines are at sea, their survivability may increase substantially, particularly if they are deployed in waters close to China where they are protected by China's airplanes and surface ships and are less susceptible to attacks by America's advanced antisubmarine platforms. Unfortunately, there are very few open sources upon which an accurate assessment of the survivability of China's submarines against U.S. antisubmarine warfare capability can be made. These uncertainties create problems for decisionmakers who want to consider conventional counterforce strikes against China's nuclear submarines during crises.

### *Nuclear-Capable Aircraft*

China is believed to possess a small number of nuclear-capable H-6 intermediate-range bombers, which do not seem to pose a serious threat. If not on alert, H-6 bombers can be very vulnerable under U.S. conventional precision strikes. The bombers do not appear to be protected by underground tunnels or other hardened facilities.<sup>35</sup> Both the aircraft and the runways can be destroyed by conventional weapons without much difficulty. The nuclear gravity bombs that are assigned to the bombers may be more difficult to destroy, because they are believed to be stored in separate facilities close to the airports, and many of China's military airports are close to the mountains where underground facilities have been identified. If the nuclear bombs are stored in these underground facilities, they might not be vulnerable to any conventional precision-guided strike, according to previous analyses. However, in a preemptive strike with the purpose of damage limitation, the existence of nuclear gravity bombs might not be much of a concern as long as the bombers that are used to deliver them can be destroyed.

## Functional Defeat

Functional defeat is a strategy that seeks to paralyze rather than completely destroy a target. The functional defeat of China's theater nuclear forces may serve to meet the U.S. objective of damage limitation, and at the same time requires fewer and less powerful munitions.

A significant number of China's land-mobile nuclear missiles seem to be deployed in hardened and deeply buried underground tunnels. Although the tunnels are extremely robust and cannot be compromised by conventional strikes, their entrances may be vulnerable. If all entrances to tunnels are destroyed by conventional precision-guided weapons, the nuclear missiles would be trapped in the tunnels and become essentially useless until the debris is cleared and the entrances reopened, which could take a long time.

Beijing seems to have already taken this scenario into consideration when designing and building its underground "Great Walls." A press release specifically mentioned that

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35. Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces*.

countermeasures have been taken to diminish the possibility that all entrances can be destroyed in a conflict.<sup>36</sup> A large number of entrances have been built at various locations in the tunnel network, so that even if some of the entrances are blocked, there will still be a number of entrances left intact. Many dummy targets have been created around the facilities to increase the difficulty of identifying and destroying all the real entrances.<sup>37</sup>

On the U.S. side, historical records show that it is very difficult to successfully identify important facilities for weapons of mass destruction. The 1991 Persian Gulf War and the 2003 Iraq War both demonstrated this problem.<sup>38</sup> Therefore, the efficacy of functional defeat operations can be seriously undermined both by the adversary's countermeasures and the need for highly accurate intelligence.

## The Potential for Future U.S. Conventional Prompt Global Strike Systems

Besides existing weapon systems, the United States has a range of near-term to middle-term plans for future conventional prompt global strike systems. A brief summary of proposed conventional prompt global strike systems is provided in table 4.

In theory, the striking capability of conventional weapons can be improved in three ways: increased accuracy, a shortened response time, and greater explosive power. The last approach, increasing the explosive power, generally requires a larger yield, which translates into bigger warheads carrying more explosives. This, however, does not seem to be the approach that the United States is taking. Most of the proposed near-term to middle-term weapon delivery systems have relatively limited payload capacities. Therefore, these proposed new delivery systems do not present a significantly greater payload capacity than existing systems.

Although new weapons may penetrate deeper into the ground, their range of destruction (the distance between the detonation point and the deepest position where the explosion can reach and cause a certain level of damage) will probably not increase substantially. Because the range of destruction is proportional to the cube root of the force of the explosion, the limited payloads of new weapon delivery systems do not seem adequate to deliver conventional weapons that are of very high yields. Therefore, the overall depth of impact (the depth of penetration plus the range of destruction) will not increase substantially, and new conventional weapons may not have the potential to threaten China's underground facilities. A significant proportion of China's theater nuclear forces—including DF-3As, DF-4s, and DF-21s—may continue to be well protected by the Great Wall Project and may be highly survivable against advanced conventional weapons in the near-term to long-term future.

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36. Jingjing Wang, "Underground Great Wall."

37. Ibid.

38. Charles L. Glaser and Steve Fetter, "Counterforce Revisited: Assessing the Nuclear Posture Review's New Missions," *International Security* 30 (2005): 2, 84–126.

**Table 4. Summary of Proposed Conventional Prompt Global Strike Systems**

Weapon System	Launch Vehicles	Combat Range (nautical miles)	Munitions Payload Capacity (pounds)	Accuracy (meters)	Earliest Initial Operational Capability (IOC)
Conventional strike missile (CSM) / Hypersonic test vehicle (HTV-2)	Minotaur IV	> 6,000	1,000–2,000	~3	2016–2020
Advanced hypersonic weapon (AHW)	Strategic targets system booster stack	< 6,000	N.A.	< 10	N.A.
Arclight	Standard missile 3	2,000	100–200	N.A.	N.A.
Hypersonic cruise missile	Launched on land, from aircraft, or from ships	> 500	1,000–2,000	3–5	2020–2024
Submarine-launched global strike missile (SLGSM)	2-stage rocket booster	3,000	2,000	< 5	2015–2018
Space operations vehicle	Trans-atmospheric vehicle	Global coverage	1,000	~ 3	Later than 2020
Space-based launch platform	Rockets	Global coverage	> 2,000	~ 3	Later than 2020

Sources: U.S. *Conventional Prompt Global Strike: Issues for 2008 and Beyond* (Washington, D.C.: Committee on Conventional Prompt Global Strike Capability, Naval Studies Board, Division on Engineering and Physical Sciences, National Research Council of the National Academies, 2008); Todd C Shull, *Conventional Prompt Global Strike: Valuable Military Option or Threat to Global Stability* (Monterey: Naval Postgraduate School, 2005); William L. Spacy II, "Does the United States Need Space-Based Weapons? (School of Advanced Airpower Studies, Air University, 1998); Matt Bille and Rusty Lorenz, "Requirements for a Conventional Prompt Global Strike Capability," in *NDIA Missile and Rockets Symposium and Exhibition*, 2001; Amy F. Woolf, *Conventional Warheads for Long-Range Ballistic Missiles: Background and Issues for Congress*, CRS Report for Congress (Washington, D.C.: Congressional Research Service, 2009); Bruce M. Sugden, "Speed Kills: Analyzing the Deployment of Conventional Ballistic Missiles," *International Security* 34, no. 1 (2009): 113–146.

## Conclusion

If the United States were to consider a first strike against China for the purpose of damage limitation, it would be likely to target China's theater nuclear forces. The analysis presented here suggests that much of China's theater nuclear forces—which include DF-3As, DF-4s, DF-21s, DF-31s, Type 094 nuclear submarines, and nuclear-capable H-6 bombers—would likely survive strikes by current U.S. conventional precision-guided weapons. China's strategy to build robust underground facilities, in particular, seems effective in protecting nuclear forces from threats of preemptive strikes.

An assessment of the potential of planned U.S. conventional strike systems shows that these proposed new systems will not add much to the existing U.S. conventional preemptive strike capability against China. Even if the proposed global strike systems are successfully developed and fully deployed, China's theater nuclear forces will remain highly survivable against U.S. strikes.

This analysis does not take into consideration a number of additional factors that could further undercut the efficacy of conventional strikes against China's theater nuclear forces. For example, this study does not take into account the decoys that China has created to confuse and distract enemy firepower, or the extent to which China's early warning, air defense, and missile defense capabilities might be able to blunt a conventional strike. China currently has a very limited early warning capability against potential preemptive strikes, but it may make progress in enhancing this capability in the middle- to long-term future.<sup>39</sup> After China improves its early warning capability, it will have the chance to deploy emergency protective measures for its nuclear forces to make them more survivable. China is also improving its air defense capability and seems to have a plan for developing missile defense systems.

It is generally believed that an “out of the blue” preemptive strike is more likely to succeed than a strike during a crisis when tensions build gradually, because China would have time to put its nuclear forces on higher alert and thereby increase their survivability. Under the current Chinese strategy of hiding nuclear forces underground, it is not very likely that the United States would be able to detect or deter China if it put its nuclear forces on alert during a crisis. As mentioned in previous sections, the Great Wall Project-style facilities are made up of networked underground tunnels in which China can conduct a series of operations, including putting its missiles on different levels of alert.<sup>40</sup> The United States would not be able to tell the alert status of Chinese underground nuclear missiles. During a crisis, China's nuclear submarines might also be able to leave ports unnoticed through the submerged sea entrances of its underground facilities.

China's nuclear-capable bombers may make the most noise if they are put on alert, but bombers are also its least reliable nuclear forces. In short, the way that China deploys its nuclear weapons makes it almost impossible for its adversary to know the exact level

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39. Steven A. Smith, *Chinese Space Superiority? China's Military Space Capabilities and the Impact of Their Use in a Taiwan Conflict?* (Montgomery: Air Force College, Air University, 2006).

40. Jingjing Wang, “Underground Great Wall.”



of alert of most Chinese theater nuclear forces. And it is unlikely that China would refrain from raising its nuclear alert status during a crisis.

Another serious problem with the U.S. strategy of damage limitation is uncertainty of intelligence. It could be very difficult for the United States to detect all China's theater nuclear weapons in the first place with 100 percent certainty. Even if the United States could identify all China's theater nuclear weapons before an attack, it would still be extremely difficult for the United States to accurately assess the outcome of the conventional preemptive strike. It is likely that after the United States launched the first strike, it would be concerned about the possibility of Chinese retaliation, and, as a result, it would be attentive to what the Chinese military seemed to be doing or planning to do. It is possible that China's emergency measures for postattack disaster relief and recovery, or China's actions to mobilize and disperse its surviving nuclear forces, could be misinterpreted as preparations for retaliation. If the United States were to perceive that China was preparing for retaliatory strikes, it might feel pressed to strike again to preempt the retaliation.

Thus, the strategy of using conventional preemptive strikes to prevent escalation (i.e., up to the nuclear level) and to reduce damage might actually cause inadvertent escalation. This paper concludes, therefore, that a U.S. conventional counterforce strike against China would be practically unachievable and would most likely accelerate escalation instead of prevent or control escalation.

Advanced offensive conventional weapons cannot easily change the existing defensive advantage in the nuclear field, particularly if the adversary adopts effective measures to protect its nuclear forces. Not only is it difficult to achieve the objective of damage limitation through conventional counterforce strikes, but such strikes can also lead to the inadvertent escalation of a conflict and thereby increase damages. A conventional counterforce strike is an ineffective and risky strategy, the results of which could be damaging from a stability standpoint. It is necessary for major nuclear weapon states to begin considering measures to avoid conventional military competitions and to prevent the integration of advanced conventional weapons from introducing new risks and uncertainties into the already-dangerous and delicate balance of terror.

In the future, coordination among major international players on the introduction of advanced conventional weapons will be necessary to maintain strategic stability. Dialogues and other communication initiatives on issues of conventional military capabilities will also be essential for removing barriers on the path toward deeper nuclear reductions. Reducing nuclear arsenals and limiting the development of advanced conventional arsenals will be a better and more direct way to address the issue of damage limitation.





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