

ASHLEY J. TELLIS

# STRIKING ASYMMETRIES

NUCLEAR TRANSITIONS  
IN SOUTHERN ASIA





**CARNEGIE**  
ENDOWMENT FOR  
INTERNATIONAL PEACE

**ASHLEY J. TELLIS**

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IN SOUTHERN ASIA**

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## **ABOUT THE AUTHOR**

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# PREFACE

In many ways, this report has been over two decades in the making. After I completed *India's Emerging Nuclear Posture: Between Recessed Deterrent and Ready Arsenal*, my book on the Indian nuclear force following the 1998 Indian and Pakistani nuclear tests, I had hoped to work on parallel studies of the Pakistani and Chinese nuclear programs—both of which I studied closely while at RAND. Although the U.S.-India civil nuclear cooperation agreement dominated my attention during the first decade of this century and Chinese and Indian conventional military modernization became a preoccupation in the subsequent decade, I followed the evolution of the Chinese, Indian, and Pakistani nuclear weapons programs throughout, discussing these issues with strategic thinkers and government officials in all three countries, Europe, and the United States.

The Indo-Pakistani crisis at Pulwama-Balakot in February 2019, however, stimulated closer scrutiny of their programs. The developments involving some components of their nuclear forces during that episode justified a focused examination of how the deterrents in both South Asian states had evolved since their nuclear tests some two decades earlier. And because China remains a critical participant in the South Asian “security complex”—no matter how adamantly Beijing may deny it—it seemed appropriate to take stock of the developments in all three countries, especially given the transformation of China’s own nuclear deterrent during this period. The Sino-Indian border crisis that exploded unexpectedly in May 2020 and is still ongoing only validated the necessity of examining the nuclear capabilities in all three countries—and especially the interactions between them. For all the calamities provoked by the COVID-19 pandemic, the absence of travel finally provided the respite required to write this monograph on a subject that had long engaged my interest.



Instead of simply documenting the changes in material capabilities—despite their centrality—it made sense to embed this discussion in a larger examination of the political interactions between China, India, and Pakistan, especially the multifaceted security competitions between them and, where Beijing and Islamabad are concerned, with other states. Because the shifts in their nuclear doctrines fundamentally reflect the changing nature of their security predicaments, this study attempts to map the entirety of the transformations visible in each of the three countries’ nuclear deterrents all the way from the ideational elements down to the nuts and bolts that characterize their evolving forces.

Although I have consulted the vast literature on this topic, I owe a special debt of gratitude to the policymakers, strategic thinkers, and military officers in each of the three countries—besides those in the United States and our closest European allies—who discussed the transformations in their nuclear programs with me over the years. I am especially grateful to Lieutenant General Balraj Nagal, then the director of the Center for Land Warfare Studies (CLAWS) in New Delhi, for hosting an illuminating discussion several years ago that brought together distinguished Indian diplomats, military officers, and academics for a conversation that greatly shaped my thinking about India’s evolving nuclear capabilities. A similar debt of gratitude is owed to Dr. Maria Sultan, director general and chairperson of the South Asian Strategic Stability Institute, who hosted a parallel discussion in Islamabad that allowed me to explore the nuances in Pakistan’s approach to its nuclear expansion. Finally, my own colleague at the Carnegie Endowment for International Peace, Tong Zhao, who is himself an expert on the Chinese nuclear weapons program, hosted a discussion at the Carnegie–Tsinghua Center in Beijing that exposed me to Chinese perspectives on how Beijing’s nuclear weapons program fits into both the South Asian theater and its rivalry with Washington.

The superb junior fellows that I have been privileged to work with at Carnegie provided wonderful research assistance over the past two years. I cannot thank Jonathan Kay enough for his extraordinary attention to detail and his critical eye as he read and reread various iterations of this manuscript. Caroline Duckworth, who succeeded Jonathan, enthusiastically took up the mantle, helping equally with research support and in preparing the maps and graphics. My old friend and collaborator from the days when we worked together at RAND over two decades ago, Gregory S. Jones, who has also written extensively and with authority on nuclear weapons, performed the nuclear effects calculations in this report and helped with the nuclear fuel assessments. He also read the manuscript carefully—and repeatedly—to save me from much embarrassment. Another friend, and for many years now my colleague at Carnegie, George Perkovich—who authored the definitive history of India’s nuclear weapons program—also read the manuscript closely and provided detailed suggestions for its improvement. I have also benefited greatly from the comments of many friends that improved the report considerably: Syeda Bokhari; John K. Culver; Colonel (retired) John H. Gill, United States Army; Neil Joeck; C. Raja Mohan; Brigadier (retired)

Naeem A. Salik, Pakistan Army; Rajesh Rajagopalan; Sadia Tasleem; Tong Zhao; and one U.S. government reader who has requested anonymity, are all owed my deepest gratitude. Finally, I am thankful to Cooper Hewell for his speedy editing of the manuscript, Jocelyn Soly for designing the cover and layout of the text, and Natalie Brase for diligently overseeing the entire process of publishing this report.

The Carnegie Endowment for International Peace remains a remarkable institution that has afforded me extraordinary latitude to pursue my interests in international security, especially as those pertain to Asia. The Tata Chair has supported this intellectual freedom, which has made the task of research and writing so much easier. And over the years, Charles (“Chip”) Kaye has been an extraordinary benefactor, supporting me and my work at Carnegie unstintingly, for which I am grateful beyond words. This report, like much of my other work in recent years, owes a great deal to his remarkable generosity.



# INTRODUCTION

The competitive and often antagonistic relationships between India and Pakistan and between India and China have historical roots that predate their possession of nuclear weaponry. India and Pakistan's intense rivalry dates to their creation as newly independent states from the detritus of the erstwhile British Empire in the Indian subcontinent.<sup>1</sup> Although India emerged from the political crises leading up to Partition as a more or less satisfied state, Pakistan's dissatisfactions—initially rooted in its multiple claims over many disputed princely states to include especially Jammu and Kashmir—were intensified by its wrenching defeat in the 1971 war with India. The loss of the eastern half of Pakistan (now Bangladesh) in this conflict deepened Islamabad's desire for new sources of security as well as for new instruments of vengeance, which resulted first in the focused pursuit of nuclear weapons and later in a concerted campaign of nuclear-shadowed terrorism against India.<sup>2</sup>

Just as Pakistan settled for nuclear weapons in the aftermath of a major conventional defeat against India, New Delhi too initiated what would eventually become its nuclear weapons program in the aftermath of a major defeat against China.<sup>3</sup> Although China and India are physically located in proximity to each other, the two nations traditionally enjoyed only thin strategic ties. Localized trade along the mountain frontiers, the transmission of ideas—especially through the travels of Buddhist monks—and the two countries' embeddedness in the larger global trading networks defined their interactions over the centuries but did little to increase the density of their geopolitical engagements.<sup>4</sup> The core of the traditional Chinese state faced East Asia—far away from the Indian subcontinent—while the Indian kingdoms locked within the South Asian landmass were mostly preoccupied with security competition among themselves and had little time or capabilities for rivalries with their neighbor(s) north of the Himalayas.

This pattern of mutual neglect began to change during the British Raj, when the British Indian Empire became increasingly sensitive to the need to protect its northern frontiers against Russian and Chinese penetration.<sup>5</sup> A series of British Indian military activities materialized in the late-nineteenth century. Although these were intended initially to protect the Indian frontier against Tibetan incursions, they evolved eventually into efforts aimed at transforming Tibet into a buffer state that would protect the Raj in the north. These interventions culminated in several inconclusive border agreements with China. The rivalries between Tibet and China and China's own weaknesses during the late Qing era, however, prevented these unsettled circumstances from becoming meaningful threats to India as long as the Raj remained the most capable military power in the region.<sup>6</sup>

The Chinese invasion of Tibet from 1950 onward changed this situation completely. Mao Zedong's 1949 revolution aimed to create and consolidate a new revolutionary state by, among other things, incorporating many outlying areas of the old Chinese empires by force. The annexation of Tibet was part and parcel of this endeavor: it destroyed the northern buffer that the Raj had worked assiduously to create and brought Chinese military power for the first time into close proximity with India, which, having become newly independent in 1947, had inherited and therefore dutifully defended the British Indian conception of its borders. Mao's ambition to reconstruct "great China," however, took Beijing in the direction of, first, eliminating the political presence and trading privileges that the Raj had bequeathed to India in Tibet and, thereafter, laying claims to significant territories allegedly lost to China that were now under Indian control. The resulting Sino-Indian disagreements over Tibet, and especially their common boundaries, eventually precipitated a short but intense border war in 1962—which India lost decisively.<sup>7</sup>

India's defeat in the 1962 conflict coincided with the maturation of China's own efforts to develop nuclear weapons with Soviet assistance. This program, precipitated by the First Taiwan Strait Crisis in 1954–55, was aimed at acquiring the means to defeat what the Chinese government later called "the U.S. imperialist policy of nuclear blackmail and nuclear threats."<sup>8</sup> The first Chinese nuclear test, in 1964, spurred India's interest in exploring its own nuclear option. This effort, dubbed the Study Nuclear Explosion for Peaceful Purposes, was initially pursued reluctantly by India's leaders who invested more capital in searching for external security guarantees against the emerging Chinese nuclear threat.<sup>9</sup>

The failure of this diplomatic effort would, in time, reinforce India's desire for a nuclear deterrent of its own, given its continued perception of the military dangers posed by China. Although this evolution was afflicted by ambivalence, delays, and even reversals along the way—in no small measure because of India's postindependence campaign for global nuclear disarmament—India's memory of its devastating defeat in the 1962 war with China combined with the recognition that Pakistan, too, had embarked on a nuclear weapons program after its defeat in the 1971 war with India would finally drive New Delhi toward the acquisition of nuclear weapon capabilities.<sup>10</sup>

## THE NUCLEARIZATION OF SOUTHERN ASIA

By the 1980s, Southern Asia was well on its way to concerted nuclearization. China was already a mature nuclear power: it had conducted some thirty-five nuclear tests between 1964 and 1990 and was immersed in “the second phase” of its nuclear force modernization program, which witnessed the introduction of its first solid-fueled road-mobile medium-range ballistic missile, a nuclear-powered ballistic missile submarine (SSBN), and “longer-range liquid-fuel moveable and silo-based intercontinental ballistic missiles (ICBMs) that put all of Russia and India and nearly all of the United States within reach.”<sup>11</sup> Less than three years after its first atomic test in 1964, China had already demonstrated its thermonuclear prowess as well—the shortest timespan for such a transition among the great powers. In any event, China’s early acquisition of nuclear capabilities permitted it to be recognized as a legitimate “nuclear-weapon State” under the 1968 Nuclear Non-Proliferation Treaty (NPT), “one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967.”<sup>12</sup>

India, which had tested a nuclear device for the first time only in 1974, did not qualify for comparable status. Although it is now an article of faith in India that New Delhi could have easily developed and detonated a nuclear weapon prior to the NPT’s cutoff date of January 1, 1967, had political authorization been consistent, the evidence suggests that the Indian nuclear program had not yet overcome critical technological constraints by that time.<sup>13</sup> All the same, in contrast to China, which had pursued its nuclear weapons program quite consistently since 1954 (even if not at the pace set by the United States and the Soviet Union), India’s “hesitant nuclear *realpolitik*” produced conspicuous oscillations in its nuclear weapons development:<sup>14</sup> New Delhi abruptly slowed the development of its nuclear weapons for several years after its initial 1974 test, before accelerating its efforts again in the late 1980s when it became clear that Pakistan was finally on the threshold of acquiring its own nuclear weapons.

Not surprisingly, and again in contrast to India, the Pakistani nuclear weapons program proceeded with singular purpose since 1972, focused as Islamabad was on acquiring an effective deterrent against New Delhi. Through a combination of internal efforts, stolen technology from abroad (thanks to A. Q. Khan), and the extraordinary Chinese transfer of nuclear weapons designs, technology, and weapons-grade fissile materials—what Stephen P. Cohen has described as “a triumph of espionage and assistance from a friendly power”<sup>15</sup>—Pakistan had acquired an embryonic nuclear weapons capability by 1987, thus opening the door to an energetic nuclear expansion that persists to this day.<sup>16</sup>

In 1998, both India and Pakistan openly tested their nuclear weapons and declared themselves to be nuclear-weapon states in a formal sense, thus joining China as declared nuclear powers and making transparent the nuclear rivalries that had stayed largely clandestine for several decades.

Today, the security competition between China, India, and Pakistan continues unabated, with China and Pakistan increasingly positioned as partners in their opposition toward India (despite the differences in how that resistance is expressed).<sup>17</sup> The older contentiousness between India and Pakistan persists, but it is now increasingly eclipsed by the intensifying rivalry between China and India. This shift in the larger patterns of regional competition is driven by the concurrent rise of China and India, albeit at different rates between them, and the slow decay of Pakistan as a viable national challenger to India, except where conventional military power and nuclear weapons are concerned.<sup>18</sup>

***The security competition between China, India, and Pakistan continues unabated, with China and Pakistan increasingly positioned as partners in their opposition toward India.***

Yet the parallelisms across the two dyads are fascinating: in each case, the weaker state—India vis-à-vis China and Pakistan vis-à-vis India—is far more concerned about the stronger than is true in reverse, yet the stronger entity remains compelled to persistently keep the weaker in its strategic field of view. Furthermore, in both

dyads, the geopolitical disputes involve struggles over territory, ideological and institutional antagonisms, and a quest for regional or extra-regional equality or primacy.

These challenges are further complicated by the fact that the greater South Asian region is also embedded in the larger geopolitical competition between China and Russia vis-à-vis the United States. Competition with China has brought Washington and New Delhi closer to each other than ever before; the Chinese and Pakistani rivalry with India has resulted in both neighbors reinvigorating their common cause against New Delhi, and sometimes against Washington as well; and Russia's opposition to the United States, because of its deep discomfiture with the U.S. centrality in the global system and the U.S.-led liberal order as well as because of geopolitical disputes involving Eastern Europe, has resulted in Moscow cozying up to Beijing, even as Russia and India mutually attempt to keep their relations on an even keel despite their differing attitudes toward China.<sup>19</sup>

As these interactions play out, their complexities are only deepened by the presence and sustained development of nuclear weapons and their associated delivery systems in China, India, and Pakistan. Although all three states have had a history of disdain, reluctance, and even outright opposition to nuclear weapons at different times in the past, they are today the primary examples (if North Korea is treated as an outlier) of countries whose nuclear weapons inventories are growing—in contrast to the rest of the world, where weapons stockpiles have been gradually decreasing.<sup>20</sup>

The fact that China, India, and Pakistan have been, comparatively speaking, “late nuclearizers” fundamentally accounts for this anomalous trend.<sup>21</sup> As has often been argued, the large disparities in nuclear capability between the advanced nuclear powers and the Southern

Asian trio intensifies this tendency; China, responding to U.S. (and Russian) nuclear capabilities, complicates the responsive Indian effort at strengthening its own deterrent, which, in turn, provides further—but not exclusive—grist for Pakistan’s continued nuclear force expansion.<sup>22</sup>

## **THE COMPLEXITIES OF REGIONAL NUCLEAR MODERNIZATION**

This conventional wisdom masks more complex realities. China certainly is modernizing its nuclear arsenal in an effort to limit the U.S. (and potentially Russian) capacity for damage-limiting strikes that could denature its deterrent, but part of its offensive force expansion and increasingly its emerging strategic defenses, at least for now, have been aimed at India. The second and third phases of China’s nuclear modernization, for example, witnessed several CSS-5 and CSS-10 missiles, respectively, allocated for missions against India. Once China’s strategic defenses mature, they will likely focus on parrying nuclear threats from all quarters. But for the moment, they seem most efficacious against regional nuclear powers such as India. China has long maintained nuclear forces targeted at its regional adversaries such as India, Japan, Vietnam, and the Philippines (as well as Russia historically),<sup>23</sup> and the continued enlargement of the Chinese nuclear arsenal permits Beijing to service these threats—and other new emerging targets such as Australia—even more easily and flexibly.

India, in contrast, is developing its nuclear forces increasingly with an eye to deterring China, moving away from the focus on Pakistan that dominated India’s nuclear calculations during the 1980s and 1990s. Even if China’s current nuclear modernization had not occurred therefore, India would be motivated to build up its nuclear capabilities vis-à-vis China in order to correct its past susceptibility to potential Chinese nuclear threats. Although there is no indication that India seeks to match the size of China’s nuclear weapons stockpile, let alone mimic the quality of the Chinese nuclear arsenal writ large, the slow growth of India’s nuclear deterrent will, over time, enable New Delhi to replace its previous abject vulnerability to China with a simulacrum of mutual vulnerability, however asymmetrical that may be.<sup>24</sup>

Pakistan, finally, although decrying any intention of engaging in an arms race, is moving as fast as its resources and its efficiency permit to build the largest, most diversified, and most capable nuclear arsenal possible.<sup>25</sup> The Pakistani military is unfettered by political constraints from its civilian government and enjoys considerable autonomy where nuclear force decisions are concerned. It is pushing the boundaries in regard to nuclear inventory size, the character of the capabilities involved, and the objectives its nuclear weapons are intended to service. After China, therefore, Pakistan will likely possess the largest and most diversified nuclear capabilities in Southern Asia because its program is increasingly driven less by what India is actually doing and more by its fervid imaginings of Indian capabilities coupled with an expansive—and expanding—conception of what its nuclear requirements entail.<sup>26</sup>



When all is said and done, therefore, strongly held beliefs in China, India, and Pakistan that they are still some ways from achieving the kind of nuclear capabilities required to protect their national interests ensure that all three states will continue to expand their nuclear arsenals for many years to come, even if the other established nuclear powers either stabilize their nuclear stockpiles or continue to pursue progressive reductions in stockpile size. One scholar has, in fact, argued that the evolving nuclear cascade moves not just from the global to the regional—as conventional wisdom would have it—but from Southern Asia to the core of nuclear order itself as New Delhi, reacting to Islamabad’s nuclear deterrent, stimulates a further expansion of China’s nuclear forces that “ultimately affect[s] the nuclear programs of both Russia and the United States.”<sup>27</sup> Although the analysis in this report suggests that such fears are overwrought because India’s nuclear weapons program remains remarkably placid despite the ferment in China and Pakistan’s own efforts, the continuing competition could yet “have dangerous ramifications on a global scale”<sup>28</sup>—not because of the expanding size or diversity of the arsenals, per se, but because of the manner in which the effects of nuclear possession are exploited, especially by Pakistan.

## **THE STRUCTURE OF THE REPORT**

This report examines the transitions in the nuclear weapons programs in China, India, and Pakistan that have been occurring over the last two decades or so. Using the May 1998 Indian and Pakistani nuclear tests as a point of reference, the analysis assesses the subsequent changes in all three nuclear weapons programs. Although India and Pakistan began a more open effort at developing their deterrents since the 1998 nuclear tests exploded the fiction of their non-nuclear status, transformations in China’s nuclear program began much earlier, some dating back to the nuclear tests aimed at developing new or smaller-yield nuclear warheads since the early 1980s.<sup>29</sup>

Where China is concerned, therefore, the “transitions” in question have to be scrutinized over a longer period of time. However, May 1998 remains a useful, if crude, benchmark because all three nations were then still unified by the belief in some form of “minimum deterrence.” This concept encompassed the conviction that strategic protection could be secured by a relatively small number of nuclear weapons, that deterrence by punishment sufficed as an overarching nuclear doctrine, and that nuclear capabilities need not be maintained at the high readiness levels necessary for prompt retaliation because their very presence provided effective deterrence beyond the myriad details relating to declaratory doctrine, force posture, or employment plans.

When compared to the U.S.-Soviet posture during the Cold War, Chinese, Indian, and Pakistani nuclear forces today still exhibit many of the characteristics summarized above, but they have also begun to evolve in important ways that could take them to different places over time should their decisionmakers so choose. With the aim of understanding the

character and extent of these evolutions, this report examines each country separately, but in every case reviews nuclear doctrine at both the declaratory and operational levels, the material components that constitute the backbone of the deterrent—fissile material stockpiles, nuclear weapons designs and inventories, delivery systems, command-and-control arrangements, and strategic defenses—and the operational posture, force employment options, and, if relevant, the extent of nuclear integration with conventional forces. Following these assessments, Chapter 4 examines the impact of the evolving nuclear transitions on arms race, deterrence, and crisis stability in the Sino-Indian and Sino-Pakistani dyads. Finally, the concluding chapter flags the challenges still to come and their possible impact on strategic stability.

As the discussion highlights at various points, the nuclear programs in China, India, and Pakistan are obscured by dense veils of opacity on almost every dimension, making a highly granular analysis impossible through published sources alone. The information available in the academic and professional literature, including data sources, supplemented by conversations over two decades with senior policymakers, strategic planners, and military officials in the region, however, permits an analysis in broad strokes. Because even the best published information is often incomplete or inconsistent—as will be obvious in many of the tables or charts included in this report—the analysis in the text should be given priority because it draws on conversations with scholars, diplomats, military officers, and policymakers in India and Pakistan—and, to a lesser degree, in China—as well as with U.S. and European government officials who follow strategic issues in Southern Asia.



## CHAPTER 1

# CHINA

### **PREPARING FOR GREAT POWER RIVALRY WITH THE UNITED STATES AMID OTHER THREATS**

Given China's ongoing modernization of its nuclear deterrent—a process that has manifested itself in successive phases going back to the 1960s—it seems quaint that the country's leadership initially appeared to be dismissive of nuclear weaponry. Not long after nuclear weapons were first used during World War II, Mao Zedong famously disparaged them as “paper tigers.” This airy dismissal was influenced largely by the impact of China's traditional strategic thought and the Marxist analysis of war and peace on Mao's thinking. Traditional Chinese approaches to strategy, as exemplified for instance by Sun Tzu's *The Art of War*, did not emphasize technology as critical to military success. Rather, the virtue of the combatants, along with their discipline and courage and the commander's ability to accurately judge the strategic situation, were believed to be disproportionately responsible for attaining victory in war. Consistent with these beliefs, Mao unfailingly argued that “Weapons are an important factor in war, but not the decisive factor; it is the people, not things, that are decisive. The contest of strength is not only a contest of military and economic power, but also a contest of human power and morale. Military and economic power is necessarily wielded by people.”<sup>30</sup>

This anthropocentric approach to political competition was only reinforced by Marxist theory, which, for the longest time, found it hard to accommodate the claim that nuclear weapons had effectively transformed the nature of conflict and, by implication, the evolution of the social system itself.<sup>31</sup> Karl Marx and Frederick Engels had first articulated the foundational proposition that political change occurs principally through class

struggles. Vladimir Lenin, further developing this idea, concluded that organized violence alone could produce the socialist revolution that was necessary for political change within countries. After the proletariat acquired national power, however, preparing for interstate conflict remained the only remedy to protect the revolution against the imperialist wars that would be inevitably launched by capitalist classes abroad. Socialist regimes, therefore, had to be prepared for incessant international hostilities, and no military technology *per se*—including nuclear weapons—could arrest violent class struggles as the motor of social change. Given these iron laws of history, it is not surprising that Mao, in common with most Marxists during the early postwar period, could not admit that nuclear weapons had, in fact, decisively transformed international politics. His own experience of victory, where a communist revolution produced by a “people’s war” had brought a new state into being, further confirmed his ideological conviction that revolutionary action, not technology, drove all large-scale political change.<sup>32</sup>

Ever the arch-realist, however, Mao soon came to understand both the importance of nuclear weapons and the urgency of acquiring them.<sup>33</sup> Although he often displayed a contempt for this new technology in his public comments and sometimes even in his actions—choosing, for example, to confront a nuclear power such as the United States in Korea in 1950 and again in the Taiwan Straits in 1954–55—this belittlement was arguably intended not to signal any renunciation of nuclear weapons but rather to bolster his nation’s confidence in resisting U.S. nuclear intimidation at a time when Beijing itself lacked these instruments. Both the Korean War and the earliest crises in the Taiwan Strait constituted important turning points on this score: the former event forced Mao and his leadership cohort to take seriously the threat posed by advanced military technologies, including nuclear weapons, while the latter, which engendered explicit U.S. nuclear threats against China, exemplified the nuclear coercion that was hard to neutralize simply by threatening a “people’s war.”<sup>34</sup>

Consequently, Mao followed up on his earlier 1952 decision to build a national civil defense system, which was intended to offer some immunity to U.S. nuclear weapons, by initiating a dedicated program to develop Chinese nuclear weapons with Soviet assistance. Exploiting the Sino-Soviet alliance to advance nuclear cooperation under the guise of peaceful purposes, Mao’s China finally decided in early 1955—roughly a decade after nuclear weapons were first used in war—to develop these capabilities both because they were judged to be essential for protecting Chinese security in the face of intense U.S. threats and because they were, by this time, also seen as critical instruments of national power in the emerging Cold War order. When the Sino-Soviet split ended nuclear cooperation between the two nations in 1960, China continued its quest for nuclear weapons independently, conceiving them as insurance equally against the United States and the Soviet Union.<sup>35</sup>

The small nuclear force that China initially produced as a result—a few score land-based bombers with gravity weapons complemented by a few tens of medium-, intermediate-, and intercontinental-range ballistic missiles—persisted throughout the Cold War.<sup>36</sup> The main-

tenance of such a modest deterrent suggested that Mao had recognized what would later come to be called “the meaning of the nuclear revolution”<sup>37</sup>—albeit with a twist. Nuclear weapons were enormously destructive and, as such, their value as a useable instrument for war was suspect. As Mao would declare in 1960: “Our country in the future may produce a few atomic bombs, but we by no means intend to use them. Although we do not intend to use them, why produce them? We will use them as a defensive weapon.”<sup>38</sup> Although Mao had initially believed, consistent with both Chinese and Marxist intellectual traditions, that technology was never a decisive factor in either history or warfare, the crises with the United States in the early 1950s had eventually compelled him to recognize that nuclear weapons must be feared because “they really are mass-destruction weapons.”<sup>39</sup>

Even if they had meager utility for warfare—because they could only destroy “big objects or targets such as big cities, industrial complexes, and naval vessels concentrated in large numbers,”<sup>40</sup> but could not enable physical occupation or secure political control of a country or stifle the revolutionary spirit of its defenders—they were nonetheless essential for China if, as Mao put it, “we don’t want to be bullied by others.” Hence, it was necessary that China “should have atomic weapons by all means.”<sup>41</sup> Not possessing them in circumstances where Beijing’s adversaries had already deployed them and even threatened their use was dangerous because it opened China to the hazards of nuclear attack and nuclear coercion. Mao had recognized this problem during the onset of the Korean War when he noted, “If the U.S. strikes with atomic bombs, we have none and can only allow it to strike. This is something that we cannot resolve.”<sup>42</sup>

China, therefore, acquired nuclear weapons because, given its long history of weakness and vulnerability to threats from the outside, the Maoist state needed to immunize itself against such perils. Their very presence was judged to be an effective deterrent even amidst the intense competition of the Cold War, and, for that purpose, possession alone seemed to be enough. As Mao emphasized, “the success [of China’s nuclear weapons program] will boost our courage and scare others,” and since the size of the Chinese inventory appeared to be immaterial for producing these effects, he declared that China “won’t build more atomic bombs and missiles than others.”<sup>43</sup> A few months after China’s first nuclear test in 1964, he reiterated the latter conclusion when he declared “We don’t wish to have too many atomic bombs ourselves. What would we do with so many? To have a few is just fine.”<sup>44</sup>

On this count, Mao was as good as his word. China built and maintained only a modest nuclear inventory throughout the Cold War, and Mao’s successors, at least until the advent of Xi Jinping, persisted with his conviction that large numbers of nuclear weapons

***China acquired nuclear weapons because, given its long history of weakness and vulnerability to threats from the outside, the Maoist state needed to immunize itself against such perils.***

were unnecessary for the realization of China's strategic aims. These strategic aims were circumscribed as well. Mao understood that despite the formidable destructiveness of nuclear weaponry, they could not by themselves ensure the successful occupation of an adversary's territory—clearly the most dangerous threat that one state could levy on another in a rivalrous international system. The nuclear revolution, accordingly, still left space for a “people's war”: it could not erase the necessity of the armed struggle that would be carried out in the aftermath of any nuclear attacks by China's huge population in defense of what is a vast and, by implication, hard-to-occupy territory. By thus declaring, “With only atomic bombs and without people's struggles, then atomic bombs are meaningless,”<sup>45</sup> Mao in effect reconciled the nuclear revolution with his Marxist commitment to the centrality of class struggle. As he summarized this synthesis, “We are afraid of atomic weapons and at the same time we are not afraid of them. . . . We do not fear them because they cannot fundamentally decide the outcome of a war; we fear them because they really are mass destruction weapons. Therefore, we have to deal with [the atomic bomb] with a scientific attitude.”<sup>46</sup>

If nuclear weapons were deemed irrelevant because “they cannot fundamentally decide the outcome of a war”—meaning that they cannot be used for the conclusive occupation and exploitation of territory—they were nevertheless important because their capacity to lay waste to population, economic, and military centers made it necessary to possess them as antidotes to nuclear attack. Deterring nuclear aggression, and the larger possibility of war against China, thus functioned as the chief reason why Mao would pursue the acquisition of these “paper tigers,” which, as he later concluded, happened to also dialectically exist as “living tigers, iron tigers, real tigers which can eat people.”<sup>47</sup> If these latter breeds were to be defanged, China would have to produce nuclear weapons because even though they “won't be used, the more they are produced, the more unlikely [it is] that a nuclear war would take place.”<sup>48</sup> Elaborating this idea in a meeting with a delegation from North Vietnam in 1970, Mao noted that “although the possibility of the major powers fighting a world war remains, everyone does not dare to start such a war only because they have nuclear weapons.”<sup>49</sup>

Preventing the nuclear coercion of China closely followed the deterrence of nuclear aggression as a strategic objective in large part because Beijing felt itself victimized by U.S. nuclear threats at various moments during the early Cold War. One Chinese scholar has in fact argued that “if China had not suffered from nuclear coercion in the first place, perhaps it would not have chosen to develop nuclear weapons.”<sup>50</sup> Although this conclusion is debatable, the fact remains that defeating nuclear blackmail constituted an important motivation underlying China's quest for the bomb. Mao conveyed his concern about this vulnerability when he declaimed, “Imperialists assess that we only have a few things and then they come to bully us. They say, ‘how many atomic bombs do you have?’”<sup>51</sup> To which the only sensible response from Mao's perspective was his defiant utterance in 1956: “We want to have not only more planes and heavy artillery, but also the atomic bomb. In today's world, if we don't want to be bullied, then we cannot do without this thing.”<sup>52</sup>

While acquiring nuclear weapons was thus essential to protecting China's security in the face of threatened nuclear attacks and coercion, the effectiveness of nuclear deterrence for Mao did not derive from any calculations about the need for a "credible second-strike capability."<sup>53</sup> Rather, the enormous destruction that these weapons could inflict was seen as sufficient to produce the requisite political immunity to aggression and coercion. Nor would the effectiveness of nuclear deterrence derive from their offensive employment. As the first objective enunciated in "The Guidelines for Developing Nuclear Weapons," the document supervised by Mao in 1958, stated, "Our country is developing nuclear weapons in order to warn our enemies against making war on us, not in order to use nuclear weapons to attack them."<sup>54</sup> In fact, the actual use of nuclear weapons became more and more unthinkable in the post-Hiroshima era. As Mao, combining sharp political acuity with traditional Chinese notions of rectitude, would exclaim, "How can an atomic bomb be used indiscriminately? If we have one, it could not be used indiscriminately, for to do so would be a crime."<sup>55</sup> Yet the very *possibility* of their use in extremis was what vested them with potent effectiveness as the ultimate safeguard of national security.

The power of nuclear weapons brought in trail other benefits as well: they were, especially in their thermonuclear variants, not only insanely destructive but they also represented the acme of technological sophistication (at least during the Cold War). Hence, their possession was judged by Mao as providing China with both successful deterrence and exceptional prestige in the international system: as he stated plainly in 1958, "[we] also want that atomic bomb. I hear that with such a big thing, if you don't have it, then others will say that you don't count. Fine, we should build a few."<sup>56</sup> If possessing nuclear weapons then bestowed on China the prestige of being a state that "counts," they also simultaneously advanced Mao's aim of breaking the nuclear duopoly that would have otherwise accrued to the United States and Russia. This consideration was very important to China as a revolutionary state: it animated Beijing's resistance toward all monopolies of power internationally and strengthened its early belief that proliferating nuclear weapons beyond its borders represented a "manifestation of proletarian internationalism."<sup>57</sup> As Zhou Enlai, repeating Mao's ideas, would declare in 1961, "If all countries have nuclear weapons, the possibility of nuclear wars would decrease."<sup>58</sup>

Where deterrence specifically was concerned, Mao concluded early on that a gigantic number of nuclear weapons—as the United States and the Soviet Union were then pursuing—was unnecessary for preventing nuclear attacks and nuclear threats against China. Zhou Enlai, echoing Mao again, would note that "the key does not lie with their quantity, rather, we need to have a minimum amount, quality, and variety."<sup>59</sup> Consequently, when China finally stood up a nuclear force during the Maoist period, it settled on a relatively small arsenal of high-yield weapons intended to support a strategy of relatively languid retaliation. The hydrogen bomb, in particular, brought diverse benefits simultaneously: it permitted China to stand shoulder to shoulder with the great powers where demonstrating technolog-



ical excellence was concerned, while maximizing the destructiveness that could be inflicted on China's adversaries without requiring a huge arsenal for effective deterrence.

The development of thermonuclear devices, accordingly, allowed China to persist with a small nuclear force, even though this capability was, by conventional standards, quite vulnerable to counterforce strikes by its more powerful adversaries. Yet deterrence was successfully obtained because even the comparatively weak Chinese nuclear arsenal constituted, in marshal Nie Rongzhen's inimitable phrase, which Jeffrey Lewis has fittingly popularized, "the minimum means of reprisal."<sup>60</sup> By their very presence, and irrespective of their specific vulnerabilities, they served to induce caution on the part of stronger rivals like the United States and the Soviet Union even during serious crises. This became evident when more-powerful Moscow was compelled to stay its hand in the face of serious temptations to attack what were obviously weak Chinese nuclear forces during the acute Sino-Soviet crisis of 1969.<sup>61</sup> Because the "minimum means of reprisal," when combined with the threat of an endless "people's war," proved adequate for effective deterrence against both nuclear attacks and intimidation in the real world of international politics, Maoist China avoided pursuing some alternative maximum nuclear force that was judged to be both wasteful and unnecessary.

The rationale for China persisting with a small nuclear arsenal for most of the Cold War has precipitated extensive discussion among scholars over the years and a variety of explanations have been proffered. These include: the Chinese leadership's recognition of the enormous destructiveness of nuclear weapons which, even when not publicly emphasized, was perceived as functionally changing the character of great power rivalry; the extraordinary effectiveness of nuclear deterrence even at low force levels because of the terrible and arguably unacceptable costs of even modest or uncertain retaliatory attacks to the assailant; the primacy of protecting the people's war concept even in the face of the nuclear revolution; the differences in the Chinese leadership's attitudes to risk, including where the survivability of their nuclear forces were concerned, in comparison to those prevalent in both the United States and the Soviet Union during the Cold War; the relatively high costs of a large nuclear deterrent that China could not afford given its significant economic constraints in the 1960s and 1970s; the absence of organizational pressures from the People's Liberation Army (PLA) for a bigger nuclear arsenal due, in part, to its lack of professional experience in managing such capabilities at a time when its leadership was composed mostly of revolutionary veterans; and, finally, because the domestic turbulence during the Maoist period prevented the uniformed military—which remains the armed wing of the Chinese Communist Party (CCP) and not the defense force of the Chinese state—from thinking seriously—and expansively—about nuclear requirements despite the competitive international context.<sup>62</sup>

Each of these explanations captures a different aspect of the calculation that drove Chinese policymakers toward a small nuclear force historically. But, as M. Taylor Fravel and Evan Medeiros's excellent review of this issue suggests, the modesty of China's Cold War nuclear

deterrent cannot be explained apart from the towering figure of Mao Zedong and his quite canny assessment of nuclear weapons as instruments of deterrence in world politics.<sup>63</sup> His recognition of the import of the “nuclear revolution,” however belated and qualified, left an enduring imprint on his successors who have broadly persisted with his legacy in the following ways: maintaining modest nuclear forces oriented primarily toward deterring nuclear attacks through the threat of retaliation rather than through preemptive damage-limiting strikes; treating nuclear weapons primarily as political instruments for averting attack and coercion rather than as warfighting devices for neutralizing operational and tactical threats; and seeking the deterrence benefits of nuclear possession primarily for protecting the Chinese homeland, its people, and its interests rather than safeguarding the security of distant allies.<sup>64</sup> Even Xi Jinping’s current innovations have not comprehensively transformed this Maoist legacy yet—though the previous emphasis on maintaining small nuclear forces and disavowing all missions other than slow punitive countervalue retaliation appears poised for significant, and even dramatic, changes.

In the final analysis, however, Beijing’s conservative approach toward nuclear weaponry was arguably sustained only because of its specific positioning in the Cold War international system. For all of China’s rivalries with the United States, the Soviet Union, and others, it was not a principal protagonist in the central nuclear competition of that era. The Cold War order was fundamentally bipolar, including and especially where nuclear interactions were concerned. For political, technological, strategic, economic, and perhaps even cultural reasons, the United States embarked on a nuclear strategy that essentially “conventionalized” nuclear weapons, using these devices not only to deter attacks on its homeland and that of its allies but also treating them as substitutes for conventional forces on the battlefield.<sup>65</sup> The Soviet Union followed suit and even more ambitiously conceived of nuclear weapons employment strategies designed to produce “victory” in the land wars that were anticipated in Europe and elsewhere.<sup>66</sup> The net result was that both sides ended up deploying huge nuclear arsenals intended to service expansive nuclear strategies, including damage limitation through offensive counterforce attacks.

All the other nuclear powers—the United Kingdom, France, and China—effectively became bystanders in this race, developing picayune nuclear arsenals in comparison to the United States and the Soviet Union and relying largely on the mutual deterrence existing between the two superpowers to create the conditions that prevented their own more modest nuclear forces from ever seriously coming into play. The secondary nuclear states were thus able to derive benefits from their limited arsenals in large measure because the main antagonists—the United States and the Soviet Union—had succeeded in checkmating one another through a relatively effective system of mutual deterrence built upon many tens of thousands of nuclear weapons on both sides. This resulting impasse transformed bipolar nuclear deterrence into something resembling a collective good, where benefits were provided to others without necessarily requiring exorbitant contributions from them in return.<sup>67</sup> These “positive externalities” of superpower nuclear deterrence enabled the sec-

ondary nuclear powers to preserve their security even though they possessed only modest arsenals because the latter, in effect, either reinforced the benefits otherwise provided by bipolar deterrence or served as peripheral substitutes were superpower deterrence to improbably fail.

China, accordingly, could get away with small nuclear forces during the Cold War because it was not the principal adversary facing either superpower. The tripolar interactions between the United States, the Soviet Union, and China only made Beijing's unassuming nuclear strategy even more viable by creating a situation where neither Washington nor Moscow could permit the other to neutralize Beijing without suffering harm to their own interests.<sup>68</sup> Thus, Soviet nuclear weapons benefited China until about 1960, while U.S. nuclear weapons—as became evident when Washington opposed Soviet plans for a nuclear attack on China in 1969—produced benefits for Chinese security from 1969 onward and certainly from 1972 until the end of the Cold War.<sup>69</sup> China's weak nuclear deterrent was thus transformed by the structural character of the bipolar competition into a strategic reserve that provided additional—ineluctable and non-dissipative—insurance against dangers emanating from one or the other or both superpowers.

Whether Beijing's Cold War nuclear deterrent would have stayed so limited if China had to face the United States as its principal antagonist during that era is an interesting counterfactual. Given what is known about Mao and his cohort's views about nuclear weaponry, it could be cautiously concluded that China would have built larger nuclear forces, as Xi Jinping now seems to be doing, but mainly to ensure their survivability and to enable Beijing to inflict enough retaliation in the face of Washington's generalized nuclear superiority and its pursuit of damage-limiting nuclear strategies. Yet it is unlikely—as seems to be corroborated by Beijing's nuclear modernization today—that China would have embarked on developing the symmetrical nuclear capabilities required to execute comprehensive counterforce operations as the United States did during the Cold War and still does presently. Obviously, this inference cannot be conclusive, but the stark differences in the Chinese leadership's attitudes to nuclear weapons—in contrast to the views that came to dominate both in Washington and Moscow—suggest that Beijing arguably would have ploughed a different course even if it had faced the United States alone. The coming decades will provide an interesting test of this proposition.

In any event, China's judgment that the presence of nuclear weapons had made major war improbable because of the inescapable reality of deterrence and, in time, the deepening "tradition of non-use of nuclear weapons" produced two effects:<sup>70</sup> it left China satisfied with a small nuclear force that seemed sufficient to neutralize both nuclear aggression and nuclear coercion even as it stimulated a conspicuous advocacy of nuclear disarmament. In what would become a leitmotif over the years, China first proposed a global summit to discuss the complete prohibition and ultimate elimination of all nuclear weaponry immediately upon conducting its first nuclear test in 1964. Since then, it has further expanded its disar-

mament agenda to include arguing the immorality of nuclear use, disavowing the first use of nuclear weapons and all extraterritorial nuclear deployments, and advocating a binding regime of strong negative security assurances toward all non-nuclear-weapon states.<sup>71</sup>

To this day, China formally holds onto a vision of complete nuclear abolition—just as India does—which it believes ought to be initiated by the states with the largest arsenals reducing their inventories systematically and irreversibly “so as to create conditions for other nuclear-weapon states to join the nuclear disarmament process.”<sup>72</sup> As this sequence unfolds, China argues that the major nuclear powers must construct a new mode of international politics, where the “stability and uncompromised security for all states” is protected, in order to permit even the lesser powers to renounce their nuclear inventories eventually.<sup>73</sup> Whether this expectation is sincere is up for debate. But it is consistent with China’s ideational rationale for procuring nuclear weapons, which demands that Beijing retain its nuclear arsenal as long as the threat of nuclear aggression and coercion are plausible. These dangers derive simply from the reality of other states possessing nuclear weapons. But should this landscape be transformed through some negotiated process of disarmament, China claims that it too would give up its nuclear weapons because it does have sufficient alternative instruments to protect its security in a non-nuclear international system.<sup>74</sup>

It is highly unlikely that these Chinese promises will be tested anytime soon, in part because Beijing does not believe that U.S. and Russian nuclear arms reductions thus far are sufficient to make its own participation appropriate. Consequently, keeping its gaze on the still large and diversified American (and Russian) nuclear arsenals—and without forgetting other regional nuclear threats such as India and latent nuclear powers such as Japan, not to mention the steady introduction of new advanced non-nuclear warfighting technologies around the world (including cyber-warfare tools and precision conventional strike systems)—China has modernized and expanded its own nuclear inventory steadily, even as it continues to advocate nuclear disarmament.

This effort has gone through several iterations since Beijing first inducted nuclear weapons. From the mid-1960s to the early 1980s, the Chinese nuclear arsenal consisted entirely of air-delivered gravity weapons and liquid-fueled ballistic missiles (some of which were mobile) with ranges of about 3,000 kilometers (km). The penetrativity of China’s nuclear-capable aircraft was highly uncertain; while its missiles carried high-yield warheads, their limited reach ensured that only Soviet targets east of the Urals and U.S. bases on China’s maritime periphery in Asia lay within reach. China corrected these deficits when it deployed liquid-fueled moveable and silo-based ICBMs for the first time in the early 1980s. These systems enabled China to hold major Soviet, American, and Indian population centers at risk, but their small numbers and uncertain survivability hardly made them a formidable deterrent. China began to introduce solid-fueled mobile medium-range ballistic missiles in the mid-1980s, directed mainly at regional competitors, Soviet targets, and U.S. military bases in proximity to China. Beijing also developed its first ballistic missile submarine during this

time, though it was more a testbed than an operational system. By the end of the Cold War, China's nuclear capabilities thus essentially resided in a small, quite vulnerable, intercontinental ballistic missile force and a steadily enlarging contingent of modern medium-range ballistic missiles. It still retained an air-delivered nuclear capability, but this arm was most efficacious only in a regional context.<sup>75</sup>

The dramatic developments that jumpstarted more consequential iterations of Chinese strategic modernization occurred after the Cold War ended. The spectacular demonstration of U.S. military power during the 1991 Gulf War, followed by the 1995–1996 Taiwan Straits crisis, and culminating with the 1999 U.S. bombing of the Chinese embassy in Belgrade—which Beijing did not view as accidental but premeditated—all cumulatively combined to deepen Chinese suspicions of the United States and intensify the pressure for a more resolute modernization of China's nuclear forces. By the turn of the century, Beijing increasingly assumed that the United States would become its principal strategic rival and began to orient its military capabilities accordingly.<sup>76</sup> Ever since the 1995–1996 Taiwan crisis, China focused on building and deploying numerous conventional short-range ballistic missiles designed to interdict various Taiwanese (and other regional) targets. This program proceeded in tandem with the development of new conventional medium- and intermediate-range anti-ship ballistic missiles intended to defeat U.S. surface vessels operating off China's maritime frontiers. These conventional precision strike systems were complemented by a further modernization of China's nuclear deterrent: new solid-fueled, nuclear-armed, mobile ICBMs such as the CSS-10 Mod 1 and Mod 2 began to make an appearance, older liquid-fueled systems such as the CSS-4 ICBMs were modernized with multiple independently targetable reentry vehicles, and a new generation of Jin-class SSBNs was launched, all in the first decade of the twenty-first century.

These efforts took on a fresh intensity thanks to other developments in the United States. Washington's erection of a thin national missile defense system (complemented by the deployment of theater missile defenses in Japan and South Korea); its quest for new high-speed, long-range, conventional precision strike weapons (Prompt Global Strike) supported by a sophisticated global intelligence, surveillance, and reconnaissance network; and its formidable and growing space and cyberspace warfare capabilities forced Beijing to reckon with its vulnerabilities anew at a time when U.S.-China strategic competition was gradually arriving at the center stage in international politics.<sup>77</sup> The modernization of China's military forces accelerated accordingly and took on a dramatically different complexion with Xi Jinping's arrival in office. Conclusively burying Deng Xiaoping's reform legacy of "hide and bide," Xi has taken China boldly in the direction of seeking to become a new superpower, even if that involves directly challenging the United States.<sup>78</sup> As part of his desire to secure "the great rejuvenation of the Chinese nation," Xi has sought to revamp the Chinese military in all its dimensions in order to advance Beijing's ambitions of returning to its previous centrality in the global system—which has, as its inevitable corollary, the restoration of Chinese primacy in Asia as well.<sup>79</sup>

These objectives cannot be secured without neutralizing U.S. military power more generally, but especially those elements residing in Asia and along its periphery; they also require Beijing to offset the military capabilities possessed by Washington's friends and allies in the region. Thus, in a sharp departure from the 1995–2010 period when China focused its efforts on building up its conventional short-range ballistic missile force against Taiwan and possibly other local adversaries, Beijing is now concentrating on increasing the numbers of its longer-ranged weapons, such as medium-range ballistic missiles (MRBMs), intermediate-range ballistic missiles (IRBMs), and long-range cruise missiles, to target U.S. military bases at great depths in the Western Pacific as well as other regional competitors that are located some distance from China.<sup>80</sup>

These conventional investments are reinforced by the accelerated modernization of the nuclear segment. The fastest-growing component of the PLA Rocket Force (PLARF) currently is its nuclear-tipped ICBMs, a development that confirms China is no longer satisfied to rely on weak nuclear forces when it comes to deterring the United States.<sup>81</sup> The 2018 U.S. Nuclear Posture Review undertaken by then president Donald Trump signaled in Chinese eyes an increased U.S. reliance on nuclear forces: it reiterated the possibility of U.S. nuclear responses to conventional attacks on its critical civilian and military infrastructure, emphasized completing the modernization of the U.S. nuclear triad, reaffirmed the value of low-yield nuclear warheads, and removed previous review language that emphasized the maintenance of strategic stability with China. As a result, the 2018 review only confirmed for Beijing the wisdom of expanding, diversifying, and transforming its own nuclear capabilities—an endeavor that not only had been long underway but also oriented toward sustaining unprecedented changes in Beijing's nuclear arsenal.<sup>82</sup> These alterations include building up a much larger and more variegated nuclear weapons inventory than Chinese leaders had ever suggested was desirable previously, resuscitating the air-breathing arm of the nuclear triad that had been inactive since at least the turn of the century, and altering the character of China's traditional nuclear posture.

***China is transforming its nuclear deterrent to meet the demands of a new era that will be defined centrally by U.S.-Chinese rivalry at the core of the international system.***

All told, these developments prove that China is transforming its nuclear deterrent to meet the demands of a new era that will be defined centrally by U.S.-Chinese rivalry at the core of the international system. Even as it prepares for this intensified competition, China has to manage its growing rivalry with Japan and India to include the latter's growing, albeit still modest, nuclear capabilities. Moreover, China's desire to control large swaths of the Western Pacific, the South China Sea, and the Indian Ocean eventually—in the face of the consternation caused by its assertiveness throughout the Indo-Pacific region—have brought it to a point where it has to seriously confront the possibility of resisting both U.S. military power and ever more resolute intra-Asian balancing against itself directly. Thus, it

should not be surprising that China is now determinedly pursuing the transformation of its entire military, but especially its nuclear deterrent. As subsequent discussion will elaborate, however, Beijing's still strong belief that the actual use of nuclear weapons is improbable thanks to the strength of the "nuclear taboo" and its generally conservative vision about the utility of nuclear weaponry have, at least thus far, combined to sustain modest increases in the size of the Chinese nuclear force when compared to the deterrents still maintained by the United States and Russia. Whether this expansion will stay restrained over the long term remains to be seen.

## **CHINA'S NUCLEAR DOCTRINE**

The foregoing analysis provides relevant context for exploring the transitions in China's nuclear "doctrine." This term is understood here not in the Western sense, which treats doctrine narrowly as "the glue of tactics,"<sup>83</sup> but in the broader former Soviet terminology, which refers to "a nation's officially accepted . . . views on the nature of modern wars and the use of the armed forces in them, and also on the requirements arising from these views regarding the country and its armed forces being made ready for war."<sup>84</sup> This conceptualization is equally useful for understanding Indian and Pakistani nuclear doctrines. In the Chinese case, though, it is challenged by the fact that Beijing's nuclear doctrine at the declaratory level is conspicuously laconic—just as British and French nuclear doctrines traditionally were too.

### **The Declaratory Level**

Authoritative Chinese articulations of its nuclear doctrine, much less its nuclear strategy, have been few and the key themes articulated immediately after its first test in 1964 were echoed endlessly since the Cold War era. These themes include: the conviction that nuclear weapons exist principally "for defense and for protecting the Chinese people" against the dangers of nuclear attacks and threats by others, meaning, primarily as a deterrent rather than as usable instruments of war; the assurance that China still sought complete nuclear disarmament; and, most importantly from the perspective of strategy, the commitment "that China will never at any time and under any circumstances be the first to use nuclear weapons." This "no-first-use" pledge has been the most conspicuous element of China's declaratory doctrine and was supplemented for the first time in 1995 by the undertaking—reiterated frequently since—"not to use or threaten to use nuclear weapons against non-nuclear-weapon states or nuclear-weapon-free zones at any time or under any circumstances."<sup>85</sup>

Although much has been made about China's linguistic rejection of the term "nuclear deterrence" in academic discussions,<sup>86</sup> this casuistry did not negate the fundamental reality that Chinese leaders concluded, in Mao's words, that "though there still exists the possibility for

major powers to fight world wars, the atomic bombs have prevented them from doing so.”<sup>87</sup> In other words, deterrence works: the existence of nuclear weapons has served to prevent nuclear attacks or coercion by other nuclear-weapon states. From this appraisal flowed the twin corollaries that China did not have to use its nuclear weapons first against nuclear adversaries or use them at all against non-nuclear states to gain the benefits of security, positions that were encompassed by its broader and persistent no-first-use pledge. The gradual ingraining of the “nuclear taboo” in international politics only reinforced these two beliefs and gave China’s no-first-use pledge a talismanic quality.<sup>88</sup> Further, the circumstances characterizing China’s strategic environment helped to make its commitment to disavowing nuclear first use plausible. Most of China’s neighbors are weaker states and Beijing, accordingly, did not need to rely on nuclear first use to protect its interests in any rivalries with them. Consequently, its no-first-use promises would have been tested primarily in conflicts with superior military powers such as the United States and the erstwhile Soviet Union. But, even here, Mao’s domestic stature, his assessment of the pacifying consequences of wider nuclear possession, and the unwillingness of Beijing’s great power rivals to risk any major military conflicts on Chinese soil, all combined to ensure that China’s unconditional no-first-use policy survived throughout the Cold War.

### **The Operational Level**

Because China effectively held to the conclusion that Mao reached eventually—that the nuclear revolution was real and transformative in international politics even if it did not displace his own emphasis on the axial significance of “people’s war”—China’s nuclear doctrine at the operational level manifested itself through two distinctive dimensions: maintaining a small nuclear force that resembled a “minimum deterrent,” and orienting that centrally controlled force toward slow retaliatory punishment rather than preemptive strategies of denial. In even greater contrast to China’s terse declaratory doctrine, these operational dimensions were never amplified by Chinese leaders but could be inferred from the character of China’s traditional nuclear arsenal supplemented by the opinions offered by Chinese strategists on these issues.

China’s nuclear inventory throughout the Cold War was remarkably small in comparison with the arsenals maintained by the superpowers. It consisted initially of air-delivered gravity bombs and was later complemented—and eventually substituted—by high-yield thermonuclear warheads delivered by ballistic missiles with ranges sufficient to target both its regional competitors and more distant adversaries such as the United States. In 1970, some six years after China’s first nuclear test, the Chinese nuclear inventory was assessed to consist of some seventy-five nuclear weapons in comparison to the 26,000 weapons possessed by the United States and the close to 12,000 weapons possessed by the Soviet Union.<sup>89</sup> By 1984, the U.S. Defense Intelligence Agency judged the Chinese nuclear stockpile to consist of between 150 and 160 weapons, based on the number of discoverable delivery systems,



at a time when the United States and the Soviet Union had over 23,000 and 37,000 weapons, respectively.<sup>90</sup> Although the exact size of the Chinese nuclear force when the Cold War ended in 1991 is unclear, it is unlikely to have greatly exceeded the level maintained around 1984 since its nuclear arsenal around 1993 was estimated to consist of between 72 and 82 missiles of all kinds (plus some number of gravity bombs).<sup>91</sup> Such sources read in their totality suggest that China's operational nuclear inventory during the entirety of the Cold War probably never exceeded 200 weapons—despite the exaggerated assessments or projections about Beijing's nuclear forces that frequently appeared during this period.<sup>92</sup> The United States and the Soviet Union, in contrast, had about 19,000 and 35,000 nuclear weapons, respectively, when the Cold War ended.<sup>93</sup>

The Chinese nuclear force thus comported at first sight with the concept of a “minimum deterrent,” understood as a “nuclear strategy in which a nation (or nations) maintains the minimum number of nuclear weapons necessary to inflict unacceptable damage on its adversary even after it has suffered a nuclear attack.”<sup>94</sup> This force consisted of a small number of mostly high-yield weapons: the yields of the missile-borne warheads on systems such as the CSS-2 IRBM and the CSS-3 and early CSS-4 ICBMs ranged from about 3 to 5 megatons. The yields of the aircraft-delivered gravity bombs are unknown: Chinese air-dropped nuclear weapon tests between 1964 and 1993 produced yields anywhere from 8 kilotons to 4 megatons, thus enabling the air-breathing arm to deliver a wide range of weapons, but their explosive power is unlikely to have exceeded those of China's missile warheads.<sup>95</sup> Both kinds of delivery vehicles were most effective primarily for retaliatory countervalue attacks because the inaccuracy of China's long-range ballistic missiles—whose circular error probable (CEP) ran into a few thousand meters—did not allow for counterforce strikes either preemptively or retrospectively.<sup>96</sup> China's bomber force, in contrast, was incapable of penetrating the air defense systems of either the Soviet Union or the United States; hence, shallow attacks on cities in the vicinity of China (either Soviet or those of regional rivals) was about all that could be achieved. Fighter-borne nuclear weapons, similarly, could have been used largely against tactical targets on the battlefields (or cities) along China's frontiers, but not at any significant depth.<sup>97</sup>

The nuclear retaliation that China could undertake in the aftermath of absorbing an adversary's first strike would of necessity also be slow because most early Chinese long-range missiles—such as the CSS-1 MRBM, the CSS-2 IRBM, and the CSS-3 and CSS-4 ICBMs—were liquid-fueled, thus requiring lengthy preparations prior to launch. Moreover, they were ordinarily sequestered either in silos or in mountainous underground hides without their nuclear warheads. For reasons of both safety and security, Chinese nuclear operations generally involved assembling the warheads and mating them to their carrier missiles only prior to fueling the latter in anticipation of their launch. Even when China's solid-fueled canisterized nuclear missiles, such as the CSS-5 MRBM, later entered the force during the mid-1980s, they were (and still mostly are) maintained in garrisons without their warheads arguably for reasons that include security.<sup>98</sup> (Canisterized missiles are those stored inside a

temperature-controlled tube to protect them from environmental vicissitudes.) The warheads themselves were likely to have been maintained at low states of assembly in order to enhance both safety and longevity: the latter is an often-overlooked consideration but an important one because fully assembled nuclear weapons invariably deteriorate over time, thanks to the corrosive impact of the highly chemically reactive fissile materials on both the high explosive lenses and the electronic systems within the warhead.

Maintaining nuclear systems that were “de-mated” in various ways made sense for many reasons. It minimized the possibility of accidents (or accidental launches) and allowed the CCP, the true guardian of the state, to physically safeguard the warheads by preserving them separately under the watchful eye of military security detachments and its political commissars. The transfer of these separated warheads to the launch units would usually occur when the missile battalions (or the bomber or fighter regiments historically) were alerted for possible retaliatory operations. The entire preparatory sequence in any case depended on the receipt of “strategic warning,” meaning the leadership’s assessment of war being either likely or imminent. When confronted with this prospect, the various components that constituted China’s nuclear deterrent would be integrated and dispersed to their often-disguised field (or launch) locations, ready to ride out the anticipated attacks before they were launched in retaliation.<sup>99</sup>

The fundamental decisions that regulated this process lay in the hands of China’s highest civilian political authority, which for most of the Cold War was personified by Mao Zedong and his closest confidants. Although the advice of military officers serving on the party’s Central Military Commission (CMC) would likely have been sought on issues pertaining to nuclear alerting and force integration, the final decisions lay with China’s preeminent civilian leaders.<sup>100</sup> This remained true even after Deng Xiaoping moved China toward a collegium model of leadership after Mao. Although the CMC, symbolizing collective responsibility between civilians and the military, grew in prominence as a decisionmaking entity thereafter, all the critical decisions about nuclear forces—their procurement, operations, and especially use—rested “uniquely” in civilian hands consistent with the principle that the PLA exists principally to protect the party and is accordingly subservient to it.<sup>101</sup> Despite their myriad weaknesses, therefore, the command and control of China’s nuclear weapons was never decentralized and the principle of “assertive” (vice “delegative”) control was maintained even when it was recognized that such a model would be stressed by the country’s no-first-use nuclear strategy.<sup>102</sup>

Since the smaller Chinese deterrent was admittedly vulnerable to the nuclear forces of its superpower rivals, Beijing’s reprisal operations would likely have been delayed. These delays could occur either because sufficient strategic warning was unavailable (and hence China’s nuclear systems could not have been prepared prior to an attack), or because the first strikes absorbed by China inflicted enough damage (including on its command-and-control system) to retard the speedy reconstitution of its deterrent. The marked imbalance in strategic

capabilities between China and its superpower rivals made both outcomes plausible. Thus, for example, Chinese airbases, which hosted its nuclear bombers, could have been destroyed by surprise nuclear first strikes either before the aircraft could be mated with their weapons or before takeoff.

Similarly, the Chinese CSS-2, CSS-3, and CSS-4 missiles stored in garrisons, underground hides, or silos could have been neutralized by U.S. or Soviet surprise counterforce attacks.<sup>103</sup> Those that were transportable or could be rolled out to launch from their garrisons or hides were more survivable if they could be flushed out on receipt of strategic warning and moved to their launch locations undiscovered. These systems could be ready for retaliatory operations relatively quickly, depending on the resilience of their associated command-and-control systems. But other missiles that remained ensconced in their underground storage facilities would have become available for retaliatory operations—if they had survived—only days to weeks after an attack, all depending on how much damage the adversary's strikes inflicted on the adits connecting the tunnels to their launch sites.

Even if the worst eventualities—a lack of strategic warning or a successful surprise strike—had failed to materialize, Chinese leaders may well have settled on delayed retaliation if successful decapitating attacks had forced the reconstitution of the command authority or if they believed that they needed more time to develop a better understanding of the situation. This could include gaining a more accurate understanding of the scale of the nuclear attack, the extent of the damage caused, and the identity of the perpetrator—all issues of critical significance depending on both the political circumstances surrounding the war and the toll exacted on China's ability to assess the losses it had suffered. Chinese leaders may also have required time to think through the best retaliation strategy necessary, given the country's relative weakness in comparison to its adversaries during the Cold War. In any event, taken all together, the challenges of assessing the enemy's intentions, discerning how the international system was responding to the attack on China, judging the best targets for retaliation and the manner and sequence for so responding, and agreeing to the goals for retaliation could have delayed China's response even if it was technically capable of executing retaliation expeditiously.

The possibility of delayed retaliation, however, did not seem to faze Chinese leaders because they concluded that given the catastrophic consequences of any nuclear reprisal, even the prospect of ragged or sluggish retaliation, would have had enough deterrent effect. As Deng Xiaoping described in a meeting with the Canadian prime minister in 1983:

We have a few nuclear weapons. France also has a few. These weapons themselves are useful only for [creating] pressure. We have said many times that is the point of our few nuclear weapons! Only to show that we also have what they have. If they want to destroy us, they themselves will also suffer some retaliation. We have consistently said that we want to force the superpowers not to dare to use nuclear

weapons. In the past, this was to deal with the Soviet Union, to force them not to use these weapons rashly. To have even only a few weapons after all is a kind of restraining force.<sup>104</sup>

Two Western analysts confirmed Deng's judgment a year after his remarks by quoting one Chinese strategist who summarized this aspect of Beijing's operational policy as "based on 'launch at any uncertain time.'" Declaring that China's adversaries "cannot preempt all of China's nuclear missiles, which are carefully stored in caves or otherwise protected and camouflaged," any country that launched a first strike on China "would have to continue to worry about Chinese retaliation 'perhaps hours, days, weeks, months or even years later'."<sup>105</sup>

The certitude of retaliation—when China was finally ready—was thus judged to be sufficient for deterrence because the enormous destructiveness of its nuclear weapons was far more important for producing pacifying effects than the alacrity of its response.

Because it was unclear, however, whether any Chinese nuclear forces would survive an adversary's first strike—given their relatively small numbers, their low levels of routine readiness, the uncertain survivability of their leadership, and the possibility that the weapons and delivery systems could be successfully entombed if not actually destroyed—China's operational doctrine for most of the Cold War, although ostensibly centered on slow but certain retaliation, was in practice effectively pegged to an even weaker standard: the mere possibility of retaliation. This criterion for deterrence sufficiency, again, was never formally articulated by Chinese leaders but, based on their appreciation of the nuclear revolution, the positive externalities of superpower mutual deterrence, and the costs of even modest nuclear reprisals in the real world of international politics, they seem to have concluded that even a tiny number of surviving weapons—from what was a small nuclear force anyway—would suffice to dissuade enemies from launching first strikes to begin with.

On closer examination, the traditional Chinese nuclear posture at the operational level thus gravitated toward an "existential deterrent,"<sup>106</sup> where the capacity to discourage aggression or threats derived mainly from the presence of nuclear weapons itself rather than the need to safeguard some "minimum number of nuclear weapons necessary to inflict unacceptable damage" on an adversary.<sup>107</sup> As the 2013 edition of *The Science of Military Strategy* summarized:

When China first decided to develop nuclear weapons, it was to break the nuclear powers' nuclear monopoly and was the archetypal existential deterrent strategy. The development of nuclear weapons since then has also abided by the recognition of 'you have, and I have them too,' i.e., the existence of nuclear weapons is itself deterrence. Under the new historical conditions, it is still the nation's strategy and the basic goal of nuclear struggle to better exercise the existential function of nuclear weapons and to contain nuclear threats and the outbreak of nuclear war.<sup>108</sup>

Because this objective relied on “first strike uncertainty”<sup>109</sup>—the expectation that an adversary could never be confident of executing a “splendid first strike”<sup>110</sup> that completely destroyed the Chinese nuclear deterrent—Beijing could treat even its modest nuclear force as sufficient to ward off attacks or coercion even by superior nuclear powers, especially in a situation where each superpower had already checkmated the other through mutual deterrence.

## Post-Cold War Doctrinal Transformations

### China’s No-First-Use Policy

All three elements of China’s traditional nuclear doctrine became subject to extensive discussion after the Cold War ended. The no-first-use pledge in particular—the singularly distinctive component of China’s declaratory doctrine—proved especially controversial as several PLA officers, serving and retired, as well as senior Chinese diplomats and academics raised questions about the viability of this commitment when the United States was no longer checked by Soviet power, when U.S. conventional precision strike capabilities were demonstrably displayed in major conflicts in the Middle East, when Washington remained adamantly willing to use nuclear weapons first if pressed in a crisis, and when the broader U.S. threat to China—especially in the context of Washington’s possible intervention in a Taiwan crisis—persisted indefinitely.

Throughout the 1990s and in the following decade, there were extensive discussions in the Chinese strategic community about the wisdom of retaining the no-first-use pledge in circumstances where China was now the direct target of an unconstrained superpower rival. Consequently, there appeared sporadic insinuations that the no-first-use pledge was not as unconditional as it originally appeared, thus opening the door, for example, to speculation that China could threaten the first use of nuclear weapons either on its own territory or in disputed areas that China claims as its own.<sup>111</sup> In a similar vein, *The Science of Second Artillery Campaigns* mentions “reducing [or lowering] the nuclear *deterrence* threshold” (emphasis added)—which is not synonymous with “lowering the nuclear *employment* threshold”—when it discusses qualifying China’s no-first-use policy in cases where an enemy threatens conventional strikes against important nuclear facilities; attacks against major strategic targets such as big dams, critical hydroelectric plants, and major political, population, or economic centers; or when China faces the threat of major defeat in a high-stakes conventional conflict.<sup>112</sup>

These deliberations did not arise from any new policies articulated by the Chinese leadership but rather from the newly empowered Chinese strategic community that, benefiting from the broader liberalization in the country, began to discuss previously closed matters more openly.<sup>113</sup> The availability of classified Chinese military writings in the West complicated things further, even though these texts reflect the concerns of a professional military

whose job is to prepare for unpalatable contingencies. All told, none of the discussions conclusively repudiated the no-first-use commitment, yet their conjectures acquired resonance because China's no-first-use pledge is inherently unverifiable. Moreover, these speculations also materialized at a time when the Chinese nuclear force was being steadily modernized, smaller-yield Chinese nuclear weapon test explosions were occurring, and prominent Western scholars of China began to declare that China was moving away from its traditional minimum deterrence doctrine to something resembling "limited deterrence,"<sup>114</sup> which was read as conveying a willingness to use nuclear weapons discretely to achieve specific operational effects in times of war.

Whenever Chinese leaders at the highest levels spoke to the issue of no first use, however, they repudiated all the revisionist speculations occurring in the Chinese strategic community. They emphasized over and over again that the no-first-use pledge was robust, a commitment that was reiterated repeatedly in China's defense white papers issued by the State Council Information Office, including in its most recent 2019 iteration.<sup>115</sup> Even though these unconditional commitments are a priori unverifiable, there is good reason to believe that China has not altered its no-first-use policy after the Cold War despite the growing difficulties with the United States. The viability of this pledge ultimately derives from whether it comports with China's strategic interests and given the Chinese leadership's perception about the enduring transformation of the nuclear revolution (which appears to have survived to this day), there are few scenarios where Chinese aims would be well served by the first use of nuclear weapons even in intense conventional conflicts with a superior military power such as the United States. As Rong Yu and Peng Guangqian summarized it, "The questions facing a unilateral NFU [no-first-use] policy are tough ones and are hard to resolve satisfactorily, at least for the time being. First-use policy, however, is also at least equally, if not more unrealistic. . . . It is eminently foreseeable that using nuclear weapons first will have grave consequences, whose cost will far outweigh its benefits."<sup>116</sup>

Although it is possible to imagine contingencies where Chinese nuclear first use—either for symbolic purposes, or for securing limited operational effects, or in response to "use it or lose it" dilemmas—might be plausible, there is little evidence thus far suggesting that the Chinese *leadership* is preparing to exercise such options, although there is considerable discussion of such possibilities within the Chinese military and Western academic communities.<sup>117</sup> Several Western scholars have pointed out that Chinese interlocutors (including officials in private exchanges) in recent years as well as Chinese publications have flagged circumstances where Beijing's no-first-use commitments might be stressed: these center particularly on concerted conventional attacks or "non-contact" warfare waged against China's nuclear deterrent with the aim of neutralizing it in the context of some larger military conflict.<sup>118</sup>

While such dangers constitute plausible provocations that might stimulate Chinese nuclear first use in principle, two mitigating factors must be considered. First, both civilian and mil-

itary leaders in Beijing recognize the gravity of these challenges, especially as China and the United States evolve into the principal geopolitical antagonists in the international system. But—at least at the Chinese civilian leadership level, the apex decisionmaking authority within the state—nothing has changed on the fundamentals: the chasm between conventional and nuclear warfare is still viewed as absolute and the imperative of preventing China from becoming a victim of either nuclear attack or nuclear coercion remains enduring—for which a no-first-use policy arguably suffices.<sup>119</sup> Second, precisely because China’s nuclear deterrent might be threatened by new non-nuclear instruments of war, civilian and military leaders in Beijing are unified by the conviction that enhanced investments in the survivability of their nuclear forces are indispensable.<sup>120</sup> Whether this insurance materializes in the form of an “Underground Great Wall” designed to protect China’s land-based missiles from nuclear attack, or the expansion of China’s sea-based nuclear deterrent in order to preserve a residual strike capability, or the modernization of China’s command-and-control systems to ensure leadership survival and its persistent connectivity with the dispersed nuclear forces, these programs have been pursued precisely *because* Beijing expects that its nuclear deterrent could be attacked either inadvertently or deliberately in any major war—especially with the United States—yet seeks to avoid finding itself in a position where it must employ nuclear weapons not because they advance any affirmative aims of policy but merely to stave off ending up defenseless against future nuclear attacks or nuclear coercion.<sup>121</sup>

These calculations are reflected most clearly in the PLARF’s preparations for nuclear operations, which still overwhelmingly emphasize force survivability and the ability to respond effectively after absorbing an adversary’s nuclear attack.<sup>122</sup> One comprehensive Western analysis has, accordingly, concluded that China’s no-first-use commitment is conceived as holding even in case its nuclear systems were to be attacked by conventional ordnance in the course of a conflict, again, an assessment that is consistent with the Chinese leadership’s broader perception of the utility of nuclear weapons.<sup>123</sup> Yet on this issue—China’s threat to use nuclear weapons in response to conventional attacks on its nuclear deterrent—more than any other, it is likely that the messages coming out of Beijing will be mixed, with many voices, especially those of the PLA, insinuating that China could resile from its no-first-use pledge if its strategic reverses were to be attacked by non-nuclear means.

The fact that no Chinese civilian leader has ever uttered such threats, however, is significant and suggests reasons to remain confident that the no-first-use commitment is still a priori meaningful. But the reasons for the professional military and other voices introducing ambiguity over the robustness of the no-first-use pledge are also understandable. They are intended to strengthen deterrence by signaling that even non-nuclear attacks against China’s nuclear capabilities carry inherent risks and as such should be eschewed even by superior adversaries in any conflicts with China. The colocation of conventional and nuclear missiles in the mixed brigades (primarily involving DF-26/CSS-18 systems) that have appeared in recent years could also be aimed at reinforcing the same objective: preventing any attacks on China’s rocket forces that might have the effect of deliberately or inadvertently under-

mining its nuclear deterrent.<sup>124</sup> When all is said and done, however, any Chinese decision to use nuclear weapons first will be determined more by the logic of circumstances than by the strength of any prewar commitments. The demands of deterrence in this instance will be the overarching driver and the evidence suggests that the Chinese leadership's continuing obsession with appearing rectitudinous coupled with the investments Beijing is making to ensure the survivability of its growing nuclear forces combine to give its no-first-use pledge a certain viability, at least for a while longer.

### A Not-So Modest Deterrent?

Like the no-first-use pledge, the Chinese emphasis on fielding a modest deterrent also seems to guide the nuclear modernization efforts that have gathered steam after the Cold War, but Beijing's conception of what constitutes a "modest" capability is poised to change rather dramatically. Until the end of the Cold War, China's nuclear force comported quite consciously with Mao and Zhou Enlai's injunction that it should be composed of "a few but excellent" weapons.<sup>125</sup> How this translated into numbers, however, was never publicly defined. As China steadily moved toward considering the United States its principal strategic threat, the previous "theory of a few"<sup>126</sup> gave way to what official publications since the 2006 defense white paper have described as China's current objective: seeking a "lean and effective" nuclear force.<sup>127</sup> Again, the numerical meaning of such a capability has not been publicly articulated, and many Chinese scholars, somewhat counterintuitively, insist on treating the concept of a "lean and effective" force as essentially synonymous with the older notion of possessing "a few but excellent" weapons.<sup>128</sup>

All the same, China's decisionmakers appear to be pursuing a considerably expanded nuclear force—at least in comparison to their Cold War inventory—which involves reaching specific quantitative targets as well as realizing a particular force structure. Both these ambitions are unlikely to remain fixed in perpetuity and will change depending on China's strategic environment, but the larger transition from an existential to a more qualified minimum deterrent—where Beijing seeks to protect a significant number of surviving warheads relative to both its adversaries' expected counterforce strikes and their countervalue targets sought to be held at risk—is already underway. The "limiting factors" that determine the size of its evolving nuclear force are obviously influenced by the reality that China faces multiple nuclear rivals but most importantly now confronts the United States, with its superior nuclear and non-nuclear military capabilities as well as emerging strategic defense systems, in what has become the defining contest of the early twenty-first century.<sup>129</sup> As a consequence, whether China's prospective nuclear force can be satisfactorily described as a "minimum" deterrent will be debatable, yet in the final analysis this disputation is entirely semantic: Beijing's nuclear inventory, however characterized or labeled, will be larger, perhaps even by an order of magnitude eventually, than it ever was historically, and its nuclear forces will be able to undertake more missions than merely countervalue retaliation, even if they concentrate primarily on this objective.



Consistent with this expectation, China's nuclear force levels have grown beyond the fewer than 200 weapons that likely existed in its arsenal in 1991. But the rate of growth has been relatively steady, if not slow, in comparison to the nuclear competition that occurred between the United States and the Soviet Union at the height of the Cold War. The Chinese nuclear arsenal in 2021 has been estimated at some 350 operational nuclear weapons.<sup>130</sup> This total is derived by counting the number of missile launchers believed to exist in the Chinese inventory together with additional assumptions about the number of missile airframes, reloads, and warheads available per missile or aircraft. As such, the number is speculative, and it is possible that the real number of frontline weapons may be different either in their total or in their internal composition. The U.S. Department of Defense's 2020 *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China*, for example, estimated that China's current nuclear warhead stockpile size is "in the low 200s."<sup>131</sup>

When viewed in retrospect, the size of and projections about China's nuclear inventory have traditionally been overestimated by Western sources, and even more so by Russian assessments.<sup>132</sup> Consequently, forecasts of future Chinese forces should be treated with caution. What can be said with confidence nonetheless is that Beijing's operational nuclear inventory is growing and will grow progressively larger in time. Based obviously on a close assessment of the number of nuclear delivery systems China possessed and appeared to be pursuing in 2019, together with other intelligence, the then director of the U.S. Defense Intelligence Agency, Lieutenant General Robert P. Ashley Jr., stated that "Over the next decade, China will likely at least double the size of its nuclear stockpile in the course of implementing the most rapid expansion and diversification of its nuclear arsenal in China's history."<sup>133</sup> If the Chinese stockpile consisted of something more than 200 weapons in 2019, Ashley's judgment suggests that China's future nuclear force could consist of more than 400 operational nuclear weapons by 2030, depending, of course, on the rate at which China builds out its desired capabilities. These increased numbers in part would derive from new additions to the Chinese nuclear arsenal, such as Beijing's current SSBN force, which alone adds at least 72 weapons to the total, and the new People's Liberation Army Air Force (PLAAF) nuclear bomber contingent, which, armed with the new air-launched ballistic missile (ALBM), would also bring significant though smaller numbers of new nuclear warheads into the inventory. The presence of sea-based nuclear platforms and the resuscitation of air-delivered nuclear weapons obviously represents new developments for a deterrent that previously consisted mainly of land-based systems.<sup>134</sup> If China's nuclear inventory, however, consisted of some 350 weapons in 2021, as the Federation of American Scientists suggests, then doubling the stockpile implies that Beijing would have 700 weapons by 2030 (or even earlier as the U.S. Department of Defense's 2021 *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China* has more recently suggested).<sup>135</sup>

In April 2021, the commander of the U.S. Strategic Command (STRATCOM), Admiral Charles A. Richard, testified before Congress that "China is rapidly improving its strategic

nuclear capability and capacity . . . and [is] well ahead of the pace necessary to double [its] nuclear stockpile by the end of the decade.”<sup>136</sup> Writing elsewhere, he assessed that “China’s nuclear weapons stockpile is expected to double (if not triple or quadruple) over the next decade.”<sup>137</sup> This implies that the Chinese nuclear stockpile could expand to as many as (or close to) 1,000 warheads by 2030 (if the base is assumed to be an inventory in the low 200s), or close to 1,400 warheads by 2030 (if the Chinese stockpile today consists of some 350 weapons). Obviously, both the expected size of the inventory and the timelines for its realization could shift depending on the pace of Beijing’s nuclear investments during this decade. One respected analyst, Hans Kristensen, in his attempts to assess what a progressively larger Chinese nuclear force might look like, has concluded that such an expansion would at the very least require increased production capacity, new storage facilities, and significant force structure changes.<sup>138</sup> The evidence available thus far suggests that China is already making significant progress on all these counts.

In any event, whether the maximal projections about China’s nuclear force size bear out by 2030 only time will tell, but they are not a priori implausible. China’s current nuclear transformation includes sharp increases in the number of land-based siloed and mobile missiles (both in single reentry vehicle [RV] and multiple independently targetable reentry vehicle [MIRV] variants), a variety of new developmental systems, new submarine-launched ballistic missiles (that eventually may be armed with multiple reentry vehicles), ALBMs, and possibly new nuclear cruise missiles—all of which in their totality would allow Beijing to maintain an inventory of some 1,000 deliverable warheads if it were to so choose. The siloed and mobile land-based missiles alone seem poised to contribute disproportionately to the current force expansion. Moreover, one of its more conspicuous characteristics would be the predominance of long-range strike systems—that is, weapons that can reach the continental United States—because neutralizing the threats posed by Washington as the principal strategic competitor has now become the fundamental motivating driver underlying Beijing’s nuclear transformation under Xi Jinping.<sup>139</sup>

***Although the Chinese nuclear inventory will expand to preserve the largest residual retaliatory capability possible, the resulting operational force will still be smaller than its U.S. and Russian counterparts.***

Although the Chinese nuclear inventory will accordingly expand to preserve the largest residual retaliatory capability possible—given China’s assessments of U.S. offensive nuclear and non-nuclear resources as well as strategic defenses—the resulting operational force will still be smaller than its U.S. and Russian counterparts. This is especially true when reserve warheads are taken into account.<sup>140</sup> For all the reductions that have taken place in recent years, the United States and Russia still possess rather large nuclear arsenals. The Federation of American Scientists, for example, estimates that the United States currently has about 3,600 nuclear warheads in its active stockpile, while Russia has about 4,300 (which includes deployed plus reserve

warheads in both cases).<sup>141</sup> Consequently, if Beijing expands its arsenal to some 1,000 (or 1,400) warheads by 2030, it will be in a class by itself: possessing a bigger nuclear inventory than those maintained by other nuclear powers such as France, the United Kingdom, Pakistan, India, Israel, and North Korea, but still well below those of Russia and the United States. This fact underlies the persistent Chinese claim that its nuclear force, even if expanding, would not exceed the requirements of “minimum deterrence,”<sup>142</sup> which is conceived as maintaining the smallest survivable capabilities necessary for retaliation rather than denial.

The need to maintain a modest deterrent seems to enjoy a widespread consensus in the Chinese strategic community. Although the Chinese nuclear force is increasing in comparison to past levels and although it will continue to expand until it satisfies the leadership’s requirement that sufficient numbers of China’s nuclear weapons survive the notional attacks that may be launched by an adversary’s nuclear, conventional, or other “non-nuclear strategic weapons” (which now include cyber, space, and electronic warfare systems),<sup>143</sup> Chinese thinkers and their leaders are unified by the belief that a large arsenal of the kind maintained by the United States or Russia is unnecessary for implementing the country’s “self-defensive nuclear strategy.”<sup>144</sup> Chinese Foreign Ministry spokeswoman Jiang Yu summarized this conviction in 2010, noting that China “exercises extreme restraint over developing nuclear weapons and we will continue to maintain our nuclear power at the lowest level, only for national security needs.”<sup>145</sup>

What is clear, however, from both the diversity and the scale of China’s current nuclear modernization is that its leadership is no longer content to rely on the token nuclear force of yesteryear—which was an existential deterrent—but rather seeks to preserve, through larger forces than before, the capacity for executing a guaranteed “nuclear counterattack,”<sup>146</sup> or what Western scholars have now persuasively characterized as “assured retaliation.”<sup>147</sup> The U.S. Department of Defense’s 2021 report, *Military and Security Developments Involving the People’s Republic of China*, notes that PLA writings have characterized this emerging arsenal as a “limited deterrent,” which in Chinese military theory occupies “the very wide space between a minimum and [a] maximum deterrent.”<sup>148</sup> Whatever the labels used in the professional Chinese military literature, China’s expanding nuclear force nonetheless continues to be oriented primarily toward deterring nuclear attacks and nuclear coercion by various adversaries. But in an era where China and the United States are likely to be the most significant competitors in a new bipolar system, Beijing seeks to possess nuclear capabilities that would confidently survive even large and significant U.S. attacks and thereby deter them.

To that degree, it has moved away from its previous expectation that the mere possibility of paltry nuclear reprisals suffices for stable deterrence. No other conclusion is compatible with China’s current emphasis on expanding the size of its siloed and mobile ICBM force, equipping many of these delivery vehicles with MIRVed warheads, inducting multiple SSBNs (some of whose missiles might carry multiple warheads in years to come), and incorporat-

ing diverse penetration aids into all its advanced long-range offensive missiles.<sup>149</sup> Yet even as these missiles increase in number across diversified basing regimes, Beijing strikingly has not focused on improving their accuracy to enable hard-target counterforce attacks. Such improvements are well within Chinese capabilities, as demonstrated, for example, in many of its theater missile systems. But the fact that China has not concentrated on increasing the accuracy of its strategic missiles across the board suggests that it is intent—at least for now—on preserving these weapons primarily for punitive retaliation on soft area targets rather than attempting to interdict hard point targets, which would almost inevitably also require preemptive nuclear strategies.

When viewed in their entirety, China's nuclear forces thus arguably still remain “minimal” in character—certainly by the Chinese definition, which stresses the lowest numbers necessary for successful retaliation rather than denial—but its capacity to punish nuclear aggression reliably will have increased manifold because of the larger residual capabilities that may be expected to survive attacks mounted by even advanced nuclear rivals.<sup>150</sup> The ends that China's minimum deterrent now serve have thus shifted pointedly: Beijing seems intent on acquiring the wherewithal not merely to mete out “assured retaliation” but rather extensive and guaranteed destruction when required on the calculation that the threat of overwhelming countervalue punishment is necessary to restrain large, continental-sized, adversaries from endangering China's survival or its core interests. The capabilities that China is now acquiring will thus enable it to inflict diverse levels of punishment as the political circumstances demand, including discrete nuclear retaliation that constrains its opponents' freedom to prosecute any limited nuclear wars to Beijing's disadvantage.

Although the future nuclear force balances obtaining between China and its major rivals such as the United States (and Russia) will favor the latter in both quantitative and qualitative terms even after the current phase of Chinese nuclear modernization is completed, Beijing's capability to inflict horrendous punishment in absolute terms when required is unlikely to be erased. Consequently, academic analyses that highlighted China's previous vulnerability to the threat of splendid first strikes by its adversaries are likely to be less and less veracious as Beijing's nuclear modernization proceeds.<sup>151</sup> For the moment, and continuing with the attitudes inherited from the past, Chinese leaders do not seem inclined to attempt any “sprint to parity” with the United States or Russia,<sup>152</sup> thus suggesting that inculcating “first strike uncertainty” still remains the guiding norm where their nuclear modernization is concerned. But because Beijing now seeks the ability to punish expansively and with certitude—rather than merely relying on its adversaries being deterred by the possibility of punishment as was the case when it possessed an existential deterrent—the number of Chinese nuclear weapons will steadily increase, Chinese delivery systems will progressively grow more diverse and capable, and China's nuclear posture is certain to change in important ways.

## Shifting Toward Rapid Retaliation

If the emerging emphasis on minimum deterrence keyed to implicit threats of guaranteed extensive destruction promises to hold into the foreseeable future, the second element of China's past operational doctrine—the satisfaction with delayed punishment—is already mutating as its nuclear modernization evolves. This shift is precipitated by both technical and political factors. As China's nuclear deterrent comes to be composed increasingly of land-based solid-fueled mobile missiles (which can be mated with their warheads and flushed from their hides at the earliest strategic warning), siloed missiles that could be maintained with their warheads routinely in a ready-to-fire condition, and sea-based systems such as SSBNs (which would customarily deploy with their nuclear warheads), Beijing will be able to mount retaliatory strikes with any weapons that survive relatively quickly after suffering a nuclear attack, assuming that its nuclear command, control, and communications (C3) system is minimally resilient. The most fundamental constraints on the rapidity of retaliation in the future will likely be the duration of strategic (and eventually tactical) warning and the survivability of its weapons and command system: if the appropriate alerting is available, China will be capable of preparing its weapons and delivery systems, dispersing them together with various command elements as necessary, and executing quick retaliation with the surviving assets in a wide variety of circumstances.

Just like in India and Pakistan, the length of the available warning time becomes crucial for Chinese nuclear operations. Many, if not most, of Beijing's nuclear warheads are still not maintained routinely in fully assembled form,<sup>153</sup> nor are they customarily mated to their missiles, even if some of the latter are now canisterized systems. Whether the new silo-based missiles, which could include CSS-10s and CSS-20s (both canisterized in their mobile variants), will be routinely deployed with their warheads is unclear. If they are, they would be the most advanced land-based systems in the Chinese arsenal that could execute instantaneous launches when ordered to do so. This is equally true of China's sea-based systems if its leadership maintains at least some SSBNs constantly on patrol in the future. Other land-based systems, such as nuclear bombers and mobile missiles, would require time to (possibly) complete the assembly of their warheads. Even if some warheads are maintained in a fully assembled state, mating them to the mobile delivery systems is in any case a lengthier process. Because China's current mobile missiles, however, do not require involved preparations—as its older land-based liquid-fueled missiles did—and because China will seek to mate these systems with their weapons and disperse them at the onset of any serious crisis, the Chinese leadership will be able to unleash punishing retaliation far more rapidly than it could in earlier times.

The modernization of the Chinese nuclear deterrent thus makes more rapid retaliation technically possible. Based on the extent of available warning time (and, in case of a surprise attack, the scale of the absorbed strike and its targets), Chinese nuclear operations, however, might require as many as several hours to a few days depending on the time required for

warhead assembly and mating with the carrier missiles, the distance that the missile launchers have to travel to their pre-surveyed or prepared launch sites (either from their bases or from their field hides), and the time required to complete their system checkouts and alignment procedures prior to firing. More rapid retaliation, therefore, does not automatically imply a prompt response, although China's land-based nuclear systems are shifting toward a posture where the surviving weapons would be able to launch quickly after receiving valid orders in the aftermath of any absorbed attacks—depending, of course, on the number of missiles involved and whether these systems were alerted and dispersed to begin with.<sup>154</sup> Both siloed missiles and mobile missile systems that are maintained on “combat readiness duty” or “high alert duty,”<sup>155</sup> as well as patrolling SSBNs, should be able to launch their weapons quite swiftly in contrast to past practices that contemplated a more relaxed rejoinder.

In any event, the evolution toward faster retaliation is prompted by political reasons as well. Unlike during the Cold War when China could rely on mutual deterrence between the United States and the Soviet Union for cover, evolving global politics is witnessing increasingly direct competition between China and the United States. In such circumstances, Chinese leaders are seeking the capability to retaliate quickly against U.S. nuclear attacks simply to avoid being paralyzed by any building international pressures for restraint, which could emerge if China were technically or operationally unable to conduct its reprisals expeditiously. Although external constraints are likely to matter less when China becomes a peer competitor of the United States, its leadership may well want to bind its own hands to quick retaliation in order to strengthen deterrence: the incipient shift toward maintaining “at least a portion of its force on a LOW [launch on warning] posture” therefore suggests, more than anything else, that China seeks to deny the United States (or any other rival) the luxury of believing that it might be able to escape retaliation by bringing other influences to bear on China in the interim if Beijing required lengthy preparations to unleash its retribution.<sup>156</sup>

The imperative of defeating this “discounting problem” is obviously greatest for weak nuclear powers facing stronger rivals, but because the prognosticated Chinese nuclear force even at maturity will likely be smaller than its U.S. (and Russian) counterpart (although sufficiently potent), Chinese leaders will want to fortify deterrence by, at least implicitly, conveying to all adversaries that they would pay an enormous price for nuclear aggression immediately.<sup>157</sup> While the Chinese nuclear deterrent is thus being readied for quicker retaliatory missions than before, including by maintaining a subset of the force capable of threatening an “early warning counterstrike”<sup>158</sup>—where China launches its weapons in response to tactical warning of any adversary's missile launches but before these nuclear weapons actually detonate on Chinese soil—its previous ironclad commitment to centralized command and control has not altered one wit. The ongoing nuclear force transformation does not incorporate either decentralized command arrangements or a delegative nuclear posture. All nuclear use decisions, accordingly, remain nominally under the direct control of the party's CMC.

But it is even more likely to reside primarily, if not solely, under the (civilian) authority of the chairman of the CMC, who also happens to be the general secretary of the Chinese Communist Party and the president of the People's Republic of China—or his successors. Under Xi Jinping, this concentration of nuclear decisionmaking authority is only likely to intensify, thus ensuring that China's traditionally centralized nuclear authority structures will remain indubitably so for a long time to come.<sup>159</sup>

Although China's shift toward quicker retaliation is baked into both the technical design of its ongoing nuclear modernization and the political imperatives that accompany it, a detailed understanding of what retaliation entails in any “nuclear counterattack campaign” is still elusive.<sup>160</sup> This term “nuclear counterattack campaign” refers to the reprisals that China's nuclear forces are expected to undertake in response to nuclear attacks, and the principal operation here consists of “key point counterattacks,”<sup>161</sup> meaning the centrally directed applications of nuclear firepower on crucial adversary targets. Chinese military theory emphasizes the importance of “close protection”<sup>162</sup>—that is, safeguarding its offensive weapons through passive and active defenses—because ensuring the survivability of Chinese nuclear forces is a precondition for successful retaliation and, by implication, effective deterrence. The emphasis on “close protection” is thus not particularly remarkable, but what is striking—especially given China's dramatically transforming nuclear forces—is the insistence that all nuclear retaliation fundamentally aims “to cause huge losses for the enemy and to cause the enemy to be very shaken psychologically in order *to achieve the goal of weakening their will to wage war*” (emphasis added).<sup>163</sup> This emphasis on nuclear retaliation as punishment that simultaneously seeks to retard the adversary's war waging capabilities and thereby induce war termination is consistent with China's larger doctrinal conception about the utility of nuclear weapons. The *Campaign Theory Study Guide* confirms this when it declares that the goal of the nuclear counterattack campaign is “to thwart the enemy's strategic designs, shake the enemy's will, paralyze the enemy's command systems, retard the enemy's operational activities, weaken the enemy's war potential, *and deter the escalation of nuclear warfare*” (emphasis added).<sup>164</sup>

The focus on nuclear retaliation as an instrument for deterring further nuclear attacks and bringing the conflict to a close as expeditiously as possible is noteworthy precisely because, for all of Beijing's nuclear transformations, China still does not conceive of nuclear weapons as instruments of warfighting—as the United States and Russia arguably still do. And the characteristics of China's evolving delivery systems only reinforce the point. Even the Chinese land-based strategic missiles that are slated to become the mainstay of its deterrent (not to mention the sea-based systems) are best suited for attacks on countervalue and soft military targets because their relative inaccuracy, despite their substantial yields, makes them unsuitable for counterforce strikes against hard point targets. China could obviously deploy more accurate nuclear missiles if it chose to, but its primary emphasis on punishing an adversary's nuclear aggression clearly makes targeting soft, high-value population, economic, and military centers more appropriate.

Furthermore, although the professional Chinese military literature argues the importance of being able to “[carry] out a number of waves of nuclear missile strikes after the initial nuclear strike” if necessary,<sup>165</sup> the overwhelming imperative to “deter the escalation of a war”<sup>166</sup> suggests why Chinese leaders have betrayed no indication of developing elaborate ladders pertaining to nuclear escalation.<sup>167</sup> The discussion in documents such as *The Science of Second Artillery Campaigns* clearly indicates that the PLARF has given thought to options beyond singular all-out retaliatory attacks.<sup>168</sup> Any professional military would be expected to develop such contingency plans. But the overarching notion of “war control,” which encompasses the efforts “to limit and consciously restrain the occurrence, development, intensity, and outcome of a war,”<sup>169</sup> is still anchored in the recognition that, as *The Science of Military Strategy* summarizes, “nuclear weapons’ ultimate destructive effect place[s] human society’s war goal and war means in extremely great contradiction. And the limitlessness of the destructive might of [nuclear] weapons, in turn, demand[s] an explicit restriction on the political goal of war, so as to avoid the limitlessness of the war’s political goal to bring the disasters of a nuclear great war.”<sup>170</sup>

Because the presence of nuclear weapons thus transforms all conflicts necessarily into limited wars, *The Science of Military Strategy* enjoins the defender “not overdo the degree of force in war, and not take as primary threatening of the adversary’s survival and comprehensive stripping away of the adversary’s military capability, but rather take forcing the adversary to come to terms as [the] primary [objective of a military campaign].”<sup>171</sup> These discussions suggest that even if nuclear weapons use was inescapable in retaliation for nuclear attacks suffered by China, they ought to be oriented toward forcing conflict termination rather than pursuing repeated nuclear interdiction in support of some amorphous conception of victory. To be sure, there is much that is still unclear in Chinese writings on escalation. And the capabilities being developed indicate that Beijing seeks to maintain large enough nuclear forces that would enable it to respond to multiple iterations of nuclear attacks by an adversary while still preserving a survivable reserve to protect its interests after hostilities cease. But there does not appear to be an interest yet in acquiring the forces intended to fight and win nuclear wars as seen in both the United States and Russia—in however constrained a fashion—to this day.<sup>172</sup> On the contrary, Chinese texts such as the *China Strategic Missile Force Encyclopedia* affirm that “the goal of nuclear deterrence is to prevent a conventional war from escalating into a real nuclear war and to suppress a limited nuclear war . . . from escalating into a full-scale nuclear war.”<sup>173</sup>

Reflecting such views, the Chinese leadership—just like its Indian counterparts—appear to be more concerned about strengthening the firebreak between conventional and nuclear war, given the extraordinarily high costs associated with the latter. They have, therefore, refused to indulge in any speculation that might suggest that some kinds of limited, gradual, or sequential nuclear weapons exchange is acceptable out of concern that China’s adversaries might seek to legitimize such conceptions of nuclear war when Chinese leaders would prefer to eliminate such possibilities entirely. Consequently, their declaratory policies, ori-



ented toward preventing any nuclear attacks on or threats to China, have been based on the presumption that any adversary nuclear use would be catastrophic and consequently its aftermath too would be essentially uncontrollable.<sup>174</sup> Whether they actually believe this cannot be confirmed from the outside. Even if they do, it seems to reflect a more realistic assessment of the risks associated with any nuclear war in the current (and likely future) international environment than they are often given credit for.

The transitions in China's nuclear doctrine suggest a broad continuity over time, but there are important variations in the nuances. The conception of nuclear weapons as having utility fundamentally as deterrents against nuclear attacks or coercion—rather than as instruments of warfighting—has survived, as has the commitment to no first use, despite considerable internal debates about its risks. The emphasis on maintaining a limited nuclear force aimed primarily at punishment for nuclear attacks suffered by China also seems to have endured, although the size of the force deemed to be essential for protecting Chinese interests has grown in absolute terms and will continue to grow further as China prepares to compete with both regional threats and more importantly the United States as its principal international antagonist. Despite this expected growth, the Chinese nuclear deterrent will remain smaller than the capabilities maintained by first-rank nuclear powers such as the United States and Russia. The importance of orienting punishment toward retarding the adversary's ability to continue nuclear attacks on China and thereby prioritizing war termination is also now more clearly conveyed through the evolving Chinese force structure than at any time during the Cold War: the enlarging Chinese nuclear deterrent is, in fact, intended to signal to its most important nuclear adversary, the United States, that Beijing will have sufficiently survivable nuclear forces to be able to extensively retaliate against any plausible number of U.S. nuclear strikes on China, thereby credibly deterring Washington from embarking on any nuclear attacks to begin with. And, finally, the previous emphasis on deterrence through uncertain retaliation both in fact and in time, while never officially articulated or repudiated, has evolved in a direction where China seeks the assured capability to launch nuclear reprisals far more quickly than before.

## **CHINA'S NUCLEAR ARSENAL**

Given this doctrinal evolution, the discussion that follows focuses on examining various issues relating to the size and character of China's transforming nuclear deterrent. The growing Chinese nuclear capability obviously highlights the issue of the force size desired by Beijing. Although this targeted number, over whatever timeframe, will not be static unless it is limited by some arms control agreement, it is constrained by the quantity of military-related fissile materials in the Chinese inventory. In a strict sense, China faces no fissile material constraints on its ability to build a nuclear weapons stockpile of any size it chooses because, as a recognized nuclear-weapon state under the NPT, it is not obliged to safeguard

fissile material production facilities nor is it constrained from acquiring natural uranium feedstock from the international market for producing weapons-grade fissile materials. Thus far, however, China has not needed to either divert fissile materials from its civilian nuclear program or import natural uranium from abroad for weapons because it appears to have a significant stockpile of military-usable fissile materials already.

## **Fissile Material Production and Stockpiles**

The Chinese nuclear program, which began in the mid-1950s, was oriented for the longest time solely toward the production of nuclear weapons. In contrast, Beijing's civilian nuclear program started only in the mid-1980s, when construction began on the Qinshan-1 nuclear power plant.<sup>175</sup> China commenced production of highly enriched uranium (HEU) first at the Lanzhou complex in 1964 and later at the Heping (or Jinkouhe) complex in 1970. These facilities produced HEU for China's weapon program through gaseous diffusion, the technology developed in Great Britain early in World War II. The original Lanzhou plant, constructed with Soviet assistance, continued to produce HEU until sometime in the 1980s and was finally decommissioned in 2000. A more modern plant at Lanzhou, utilizing gas centrifuges, began to operate after 2001. Russia had initially supplied gas centrifuge technology for this plant in 1996, after having agreed to build another uranium enrichment plant utilizing this same technology at Hanzhong in 1993. The Russian centrifuges at Lanzhou were later supplemented by "indigenized" Chinese variants on a commercial scale in 2012, with both the Lanzhou and the Hanzhong plants currently producing low-enriched uranium (LEU) for China's rapidly expanding nuclear energy program.<sup>176</sup>

The Heping cluster, in contrast, appears oriented toward military and dual-use purposes. From 1970 until 1987, it concentrated solely on producing HEU for China's nuclear weapons program. Since 1987, however, its activities have been more ambiguous. This unsafeguarded complex subsumes an enrichment plant at Jinkouhe and another group of facilities at Emeishan. The Jinkouhe gaseous diffusion facility, which once produced HEU on a large scale for China's nuclear weapons, may have later produced LEU for naval reactors and possibly "HEU for tritium production and some research reactors,"<sup>177</sup> but its operational status currently is unclear. The Emeishan facilities are more mysterious and could be producing HEU for China's weapons even today. They consist of two centrifuge enrichment plants plus one pilot-sized facility with an assumed capacity of around 2.45 million separative work units (SWU)/year.<sup>178</sup> Often referred to collectively as part of Plant 814—a label that covers Jinkouhe as well—these facilities have been operating continuously except for brief periods of shutdown and are likely to expand further. One analyst, reviewing the plant's thermal signature in 2015, concluded that "China may still enrich uranium for military purposes, including fuel for naval reactors. Indeed, the district remains closed to foreigners, lending credence to the idea that the facility still has a sensitive military purpose."<sup>179</sup>

Besides HEU, which was the first—and still the dominant—material used in Beijing’s nuclear weaponry, China also began to produce weapons-grade plutonium (WGPu) sometime in the 1970s at the Jiuquan and Guangyuan reactors. These two plutonium-producing reactors were decommissioned by 1991, thus suggesting that China had ceased all active production of WGPu for weapons by that time at the latest.<sup>180</sup> Because a supplementary material such as tritium, which is required to boost China’s nuclear weapons, has a short half-life of twelve years, its production almost certainly continues in some Chinese research or test reactors, such as the High-Flux Engineering Test Reactor (HFETR) in Jiajiang.<sup>181</sup>

Chinese officials privately indicated in the late 1980s that Beijing had either terminated the production of weapons-grade materials such as HEU and WGPu or would do so soon, although China consciously refrained from making any binding commitments to this effect.<sup>182</sup> Today, it is even more unlikely to do so outside of the successful completion of the Fissile Material Cutoff Treaty (FMCT) negotiations, which, for all practical purposes, are going nowhere. Given Chinese concerns now about the future of U.S. and other offensive nuclear forces, the emergence of strategic defenses and precision conventional strike capabilities, and the new threats posed by cyber warfare, Beijing will refrain from accepting any obligations not to produce more weapons-grade fissile materials. Because China had never formally committed to terminating the production of weapons-grade fissile materials, any continuing production of HEU at the Emeishan facilities, for example, would be entirely legitimate. And as the discussion following will suggest, China may be faced with new pressures to start HEU and WGPu production on a substantial scale if it seeks to expand its nuclear weapons inventory to the highest levels speculated by U.S. military officials.

At first sight, China has a substantial stockpile of HEU and WGPu already, arguably enough to equip a nuclear force larger than its current size. The best public estimates suggest that China has a stockpile of somewhere between 11,000 and 17,000 kilograms of military HEU and about 2,300 to 3,500 kilograms of WGPu.<sup>183</sup> Even if such figures assume somewhat greater production efficiencies than are believed to historically characterize the Chinese program, they represent a good benchmark to characterize the notional limits of the Chinese nuclear weapons inventory. Translating the fissile material stockpile into numbers of weapons, however, is difficult because the types of warheads and the amount of fissile material required by each design are unknown. A crude back-of-the-envelope calculation, accordingly, is the best that is possible, but that ought to suffice here for the purpose of analysis.

If a Chinese thermonuclear warhead of, say, 250 kilotons is taken as the standard, the following may be deduced based on nuclear physics even in the absence of detailed nuclear weapon design information. Samuel Glasstone and Philip J. Dolan’s classic manual *The Effects of Nuclear Weapons* notes that a typical thermonuclear weapon derives about half of its yield from fusion and half from fission.<sup>184</sup> If so, the fission yield in this instance would be 125 kilotons: part of this yield would materialize from fissioning uranium-235 (U-235)

and part from uranium-238 (U-238). In order to simplify the calculations, half of the fission yield is assumed to be from the U-235 and half from the U-238. To secure 62.5 kilotons of yield would require the complete fissioning of about 3.6 kilograms of U-235. If this amount is contained in 90 percent HEU, the total works out to about 4.0 kilograms of HEU. Since the efficiency of a weapon is never 100 percent, a 50 percent efficiency—completely hypothetical but not unreasonable—suggests that such a weapon would require about 8 kilograms of HEU in the secondary stage. Since the primary is hypothesized to contain about 10 kilograms of HEU (along with some plutonium), a 250-kiloton weapon would require about 18 kilograms of HEU per warhead. If a warhead yield of double this size, say 500 kilotons, is considered, the quantity of HEU required in the primary would remain 10 kilograms, but the quantity in the secondary would double to 26 kilograms, thus requiring some 36 kilograms per weapon.

Given the estimates of China's fissile material inventory, therefore, Beijing could notionally produce anywhere from 611 to 944 warheads of 250-kiloton yield or 305 to 472 warheads of 500-kiloton yield. Hui Zhang reaches a comparable conclusion: using somewhat different parameters—4 kilograms of WGPu in the primary stage and about 20 kilograms of HEU in the secondary stage of a notional Chinese warhead—he concludes that the current fissile material inventory would permit Beijing to build about 730 weapons.<sup>185</sup> However, since this materials stockpile has already been drawn down to produce the weapons currently in the arsenal (some 200-plus, or some 350, depending on the source involved), to support China's forty-five or more nuclear tests and its ongoing weapons research activities, and to accommodate losses due to waste in manufacturing, assessing how much Beijing could further expand its weapons inventory requires good information on the extent of the stockpile's depletion.<sup>186</sup> This information is impossible to secure from the outside nor is any easy calculation possible for multiple reasons: China's nuclear warheads traditionally were large and almost certainly used far more fissile materials than the calculations above (including Zhang's) suggest; the quantity of fissile material expended in tests and wasted in the fabrication of the weapons cannot be discerned confidently; and, complicating matters further, China probably recycles pits from older retired warheads, thus allowing them to be reused in ways that bungle any calculation.

In any event, if the numbers above are treated as a vague measure, and if China is assumed to have possessed some 200 500-kiloton weapons around 2020, it could increase this inventory to the 472 weapons deduced above—in effect, more than doubling the size of its arsenal—without running into any binding HEU or WGPu constraints. By Zhang's estimate, this objective would be even easier to realize. If 250-kiloton warheads are treated as the standard, China could double or triple its weapons inventory (depending on which end of the above range is factored in) without having to increase its fissile materials stockpile. If China, however, possesses some 350 warheads of 250-kilotons yields currently, then it will find itself skating on thinner margins. Given that it possesses a significant WGPu stockpile in addition to HEU, Beijing could increase a 250-kiloton warhead inventory to

some 700 nuclear weapons—in effect, doubling the size of the force—without running into serious shortages of either fissile material. But tripling or quadrupling the arsenal within the current decade, even with such lower-yield warheads, would require China to restart HEU production on a significant scale beyond whatever the Emeishan facilities may have been producing. The three centrifuge enrichment plants at Emeishan—one pilot- and two industrial-sized—have substantial latent capacity and could produce anywhere from 1,200 kilograms to close to 12,000 kilograms of HEU annually depending on the scale of their commitment.<sup>187</sup> China can, therefore, ramp up HEU production quite easily if that were required.

Depending on how large a nuclear warhead inventory China seeks—especially if tripling or quadrupling a 350-strong stockpile of 250-kiloton-class weapons is desired—Beijing will require a new plutonium production reactor to sustain this buildup, especially if more compact nuclear weapons are pursued. Many Western scholars have already pointed out that the Chinese fast breeder reactor program and the complementary reprocessing capabilities are poised to expand dramatically: Beijing is constructing two large fast breeder reactors that are projected to begin operation in 2023 and 2026, respectively, and is constructing two large reprocessing plants as well, both of which will become operational during this decade. Simply by exploiting the fast breeder reactors alone, China could potentially produce over 1,200 new nuclear weapons by 2030.<sup>188</sup> Consequently, only if it is presumed that China

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seeks to exceed the current U.S. nuclear force, which consists of 1,744 deployed warheads (plus another 1,964 warheads in reserve), or the current Russian strategic force, which consists of 1,588 warheads (with an additional 2,889 warheads in reserve),<sup>189</sup> would it need to commit its civilian fast breeders entirely to the weapons program in order to obviate the “hard constraints” imposed by its current fissile material stockpile.<sup>190</sup>

There is no evidence yet, however, that China seeks a nuclear arsenal of the size maintained by the United States and Russia. Nor is there information suggesting that China intends to divert plutonium from its civilian sector to weapons use. But if tripling or quadrupling its current nuclear force were its fundamental objective—something that is not implausible given China’s preparation for intensified strategic competition with the United States—Beijing could use its Heping gaseous enrichment plant to restart production of HEU from local or imported feedstock or, more likely, accelerate HEU production at Emeishan utilizing its more efficient centrifuge technology in tandem with producing plutonium from one of its breeders before constructing any new replacements for the Jiuquan and Guangyuan reactors to restart production of WGpu. The plain fact of the matter is that China is uncon-

strained in both legal and physical terms from expanding its arsenal as it chooses. This leaves it at par with the other NPT-recognized nuclear-weapon states, while giving it advantages over local nuclear rivals such as India.

## Nuclear Weapon Designs

For all practical purposes, this same conclusion also holds where China's nuclear device designs are concerned. Based on what can be gleaned from China's nuclear tests and the kinds of nuclear systems it has deployed over the years, Beijing has the capacity to deploy a diverse nuclear arsenal consisting of everything from fission to fusion to enhanced radiation weapons that can be carried by aircraft and, more importantly, by ballistic and cruise missiles. The ballistic missiles, deployed over the past several decades, suggest that China's "standard" nuclear devices today are thermonuclear weapons. (At the moment, China does not appear to have deployed any nuclear-tipped cruise missiles.<sup>191</sup>) Since China's nuclear strategy consists of holding at risk big but soft targets—such as cities, industrial centers, and important static military sites like large ports, airfields, and bases—thermonuclear weapons, which produce high yields from relatively low weight payloads, are ideal deterrents.

The little that has been published on China's nuclear warheads, and whatever can be inferred from its nuclear operations, suggests that its traditional nuclear device designs were relatively conservative.<sup>192</sup> They used large quantities of fissile material, sought to produce the maximum desired yields consistently, and employed technical features that emphasized reliable performance and easy maintainability at their storage sites while allowing for rapid integration with their delivery vehicles in what may be less than pristine operational conditions. U.S. nuclear weapon designs represent a study in contrast. They embody the acme of sophistication and complexity, invariably pushing the edge of the envelope to secure maximum yields for specific operational purposes, using the smallest quantities of fissile materials possible in design architectures that put a premium on compactness, weight reduction, and absolute safety because, being sealed systems designed for prompt operations, they cannot rely on other solutions such as insertable pits or variable levels of assembly to enhance their safety and security when deployed.

All U.S. nuclear weapon designs thus subsist on the knife edge between superlative performance and failure that could be caused by the tiniest deficiencies in either their components or their overall architecture. The W-88 warhead, which exemplifies contemporary U.S. two-stage thermonuclear weapons, accordingly, has been described by one authority as "a 'delicate' and neat package."<sup>193</sup> In pursuit of such sophistication, the United States has relentlessly tested its nuclear weapon designs to ensure their performance, reliability, and safety under every imaginable condition. Toward that end, it conducted 1,032 nuclear tests to validate the 100-plus nuclear device designs that were deployed since 1945, in contrast to China, which conducted less than fifty tests of probably not more than a dozen weapon designs between 1964 and 1996.<sup>194</sup>

One scholar has suggested that China traditionally had only three types of warheads: a 15-kiloton, a 3-megaton, and a 4–5-megaton design.<sup>195</sup> Two other academics, who have written extensively on China’s nuclear program, have contended that China has used variants of only a single reliable warhead design on the multiple missiles now in its arsenal.<sup>196</sup> While the judgment about the yields of China’s older warheads rings true, the claims about the singularity of its reliable design are hard to verify. Another scholar, writing in the late 1990s, had more plausibly suggested that China possessed “at least six distinct warhead and bomb types.”<sup>197</sup> Beyond the obvious problems deriving from secrecy, these differences in assessment arise in part because of the ambiguity about what constitutes a distinct device design in China. Consequently, given the differences in the size, volume, and throw weight of the post-boost vehicles on different Chinese missiles, it seems reasonable to suggest that Beijing has diverse nuclear devices with specific variants common to particular classes of delivery systems. The nomenclature of these weapons is unknown, though it is conceivable that the Chinese tradition of using a three-digit designator for its nuclear weapons continues. The first Chinese implosion device, for example, was labeled the 596 design, while China’s famous fourth test device (CHIC-4), which was subsequently transferred to Pakistan, was labeled the 548 design.<sup>198</sup>

In any event, the new Chinese missile systems that are either entering service or which will be deployed in the future—such as the DF-41 and the JL-3—are certain to use variants of the device designs that were tested during the 1990s. The nuclear tests undertaken during that decade were intended to develop the smaller and more efficient warheads that will remain staples of the Chinese arsenal for years to come.<sup>199</sup> These warheads are believed to utilize smaller quantities of fissile materials, incorporate more robust electronics and safety features (such as insensitive high explosives), and permit—where appropriate—a continuation of the traditional Chinese approach of maintaining systems in de-mated condition until prior to launch.<sup>200</sup>

There is little doubt that China is continuing its research on advanced nuclear warheads, but whether its moratorium on hot testing constrains its ability to deploy such weapons remains an open question. In the past, China circumvented the limitations of its modest testing history “by using generic [nuclear weapons] designs of wide adaptability.”<sup>201</sup> Beijing also developed and tested some specialized nuclear weapons, such as enhanced radiation devices, though it ultimately chose not to deploy them. Similarly, it continues to develop other special capabilities such as electromagnetic pulse and low-yield nuclear warheads.<sup>202</sup> Given that China cannot conduct full-up hot tests of these devices today (though others have been validated by previous testing), it has sought to mitigate its limitations by relying on computational modeling, through surreptitious cooperation with more advanced nuclear-weapon states such as Russia, and by covert nuclear testing of different kinds.

China has invested heavily in computer simulation capabilities; what it lacks, at least in comparison to the United States, is extensive design codes—data pertaining to the myriad

transformations that occur during a nuclear explosion.<sup>203</sup> The United States patiently accumulated this information through hundreds of nuclear tests. China, bereft of such benefits, will find it difficult to validate radically new designs entirely through simulations alone. This limitation has motivated China to target the acquisition of U.S. data through espionage and to collaborate with Russia for assistance. Using information from U.S. codes gathered surreptitiously, however, is a gamble when developing new nuclear designs. Seeking assistance from another advanced, friendly, nuclear power is another matter: there is evidence that Russia has already aided China for this purpose, and such cooperation could increase as Beijing and Moscow deepen their efforts to balance against U.S. power.<sup>204</sup> Finally, China will attempt to mitigate some of its hot-testing constraints by conducting subcritical and hydronuclear tests as all other nuclear powers do. On the basis of classified evidence, the Trump administration had in fact insinuated that China is engaged in covert nuclear testing that goes beyond the “zero-yield” constraint associated with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Although the administration’s public claims were nuanced, it had privately concluded that China was, in fact, conducting covert nuclear experiments and tests in explosive containment chambers that were intended to obscure any supercritical yields.<sup>205</sup>

Although many of these clandestine testing activities are probably driven by the challenges of managing warhead degradation and safety<sup>206</sup>—both serious problems for a nuclear force with a relatively sparse record of hot testing—they are also focused on validating the new warheads that will be required by the “lean and effective” deterrent that China seeks for the future. The evolution of the Chinese nuclear arsenal suggests that after a brief early period, when Beijing produced relatively low-yield weapons for aircraft and missile delivery, it moved quickly toward deploying heavy, high-yield missile-borne warheads, a trend that held for much of the Cold War. These weapons generally weighed some 2,000 kilograms or more and produced yields of anywhere between 3 and 5 megatons. Newer Chinese missiles, however, carry lighter, lower-yield weapons that weigh 600 kilograms or less and produce yields in the range of 300 to 500 kilotons.<sup>207</sup> Even with such smaller yields, China’s thermonuclear weapons are capable of holding at risk the soft, high-value targets possessed by an adversary, and they can be deployed across diverse delivery systems, including those not previously committed to nuclear missions such as land-attack cruise missiles.

The evolution of China’s nuclear warhead development program raises two important questions for the future: First, how low will the yields of China’s desired warheads go? And second, will China finally deploy the specialized nuclear warheads that it has previously experimented with or is currently developing? The answers to the first question are important because they speak to the issue of whether China will persist with its traditional counter-value targeting strategy indefinitely or whether it might be in the process of entertaining some forms of counterforce targeting over time. Alternatively, as the U.S. Department of Defense notes, “the introduction of new precise small-yield nuclear weapons could possibly allow for the controlled use of nuclear weapons, in the warzone, for warning and deter-



rence.” The prospect of such “limited nuclear employment on the battlefield suggest[s that Chinese] nuclear thinkers could be reconsidering their long-standing view that nuclear war is uncontrollable.”<sup>208</sup>

The diminishing yields of China’s strategic warheads, from the previous high of 3–5 megatons to the emerging norm of 300–500 kilotons on its new but relatively inaccurate strategic missiles, suggest that countervalue and countermilitary interdiction of large area targets still remain a priority and, as such, are most consistent with a retaliatory nuclear strategy. If China, however, deploys lower-yield warheads in the range of a few tens of kilotons or just a few kilotons (or in the sub-kiloton range), then the possibility of a shift toward more complex nuclear strategies would have to be taken seriously. The same judgment would be reinforced by the answer to the second question above: if China were to deploy its specialized warheads, such as enhanced radiation weapons, or to develop earth-penetrating warheads for its ballistic missiles, it would signal a switch to something other than a pure strategy of retaliation. Rather ominously, senior U.S. military officials, including U.S. STRATCOM commander Admiral Charles Richards, have declared that “China is already capable of executing any plausible nuclear employment strategy within their region and will soon be able to do so at intercontinental ranges as well. *They are no longer a ‘lesser included case’ of the pacing nuclear threat, Russia*” (emphasis in original).<sup>209</sup>

If this testimony is any indication, China could deploy new nuclear device designs without further hot testing because the previous tests, especially during the 1990s, presumably sufficed to validate the warheads that will be deployed aboard both its emerging strategic land- and sea-based ballistic missiles as well as on the substrategic systems that are currently being modernized. Of course, China might—just as it did with its enhanced radiation warheads traditionally—develop low-yield or other specialized warheads simply to stay au courant with the capabilities of other nuclear powers—but not deploy them. If so, these weapons would serve mainly as insurance against any further deterioration in the strategic environment. Given Admiral Richard’s judgment, however, it appears that China is already confident enough to induct even specialized nuclear weapons into its arsenal without any further need for open testing because the design validation from past nuclear tests, continued computer simulations, possible cooperation with Russia, continuing subcritical experiments, and covert very-low-yield nuclear testing all together suffice to confirm their effectiveness. As such, the presence of any new advanced nuclear designs will remain concealed unless Beijing’s announces them, or they are uncovered by U.S. (or other) intelligence services.

## China’s Evolving Delivery Systems

If China can thus live with the warhead designs tested prior to its signing the CTBT—because they can be flexibly deployed across multiple delivery systems—the latter themselves are undergoing a remarkable transformation. The modernization of China’s nuclear delivery capabilities continues the efforts begun in the 1980s: these are aimed at deploying a reli-

able, survivable, and responsive nuclear arsenal that is effective enough to deter both great powers and regional adversaries who may possess strong offensive forces as well as strategic defenses. This program has accelerated in recent years and is manifested along four different dimensions: changes in force capabilities, force size, force organization, and force posture.

## Land Systems

The most striking change in China's nuclear capabilities is the dramatic growth and transformation of its long-range missile systems that are targeted—for now—primarily at the United States. These systems reside predominantly on land, though new sea-based capabilities are entering the arsenal as well in a distinctively subordinate role. The PLARF thus remains the preeminent guardian of China's nuclear deterrent: as Xi Jinping described its previous incarnation, the Second Artillery Force, in 2012, it “is the core force of [the] country's strategic deterrence, the strategic support of China's status as a major power, and an important cornerstone of safeguarding national security.”<sup>210</sup> The People's Liberation Army Navy (PLAN), which controls the SSBN force, and the PLAAF, which has acquired renewed nuclear responsibilities primarily in a regional context today, remain largely secondary to the PLARF.

Where long-range nuclear missile systems are concerned, the transformations in China are nothing short of dramatic. At the end of the Cold War, this component consisted of a very small number of land-based CSS-3 (DF-4) and CSS-4 Mod 1 and 2 (DF-5/5A) liquid-fueled ICBMs. The ~6,000-kilometer-range CSS-3s, each carrying a warhead of around 3 megatons, are moveable missiles, usually stored in caves and rolled out to launch. These systems, of which perhaps ten or fewer remain, are likely to be retired within a few years.<sup>211</sup> The ~12,000-kilometer-range CSS-4 Mod 1 has been retired, but the silo-based ~12,000-kilometer-range Mod 2 is still operational and carries a single high-yield warhead of around 5 megatons.<sup>212</sup> These missiles will remain in service for a while longer but are increasingly supplemented (and will be eventually replaced) by the silo-based Mod 3 version, which carries multiple independently targetable warheads with yields of somewhat less than 500 kilotons,<sup>213</sup> and the silo-based Mod 4 version, which could carry either smaller-yield multiple independently targetable warheads or a single high-yield warhead of some 5 megatons like the CSS-4 Mod 2. Much will depend on whether the CSS-4 Mod 4 is intended to take on the targeting responsibilities currently serviced by the obsolete CSS-3 and the older CSS-4 Mod 2 ICBMs; if so, the CSS-4 Mod 4 could be deployed with a single high-yield nuclear warhead. Although both the CSS-3 and the CSS-4 family of ICBMs are vulnerable to counterforce attacks, they are likely to be maintained in service for a long time—as the development of the Mod 4 version suggests—because they offer complete targeting coverage

***The most striking change in China's nuclear capabilities is the dramatic growth and transformation of its long-range missile systems that are targeted—for now—primarily at the United States.***

of the entire United States. The large size of the CSS-4 post-boost vehicle will also permit China to deploy a variety of penetrating aids that could permit Beijing to defeat U.S. missile defenses.

China has moved to modernize its land-based ICBM force in two ways. In an effort to increase its force size and to complicate adversary targeting simultaneously, Beijing initially focused on inducting new, more survivable, and responsive solid-fueled mobile ICBMs that, equipped with diverse penetrating aids, offered reasonable assurance of being able to defeat its opponents' missile defenses. These systems, such as the CSS-10/DF-31 and the CSS-20/DF-41, are intended for global targeting but especially with an eye on the United States. Depending on the variant, the CSS-10 missiles have ranges between ~8,000 to ~13,000 kilometers and are equipped with one warhead each with a yield of somewhere under 500 kilotons, while the ~12,000-kilometer-ranged CSS-20 missile will be equipped with multiple independently targetable warheads of similar or perhaps smaller yields.<sup>214</sup> Some CSS-10 missiles cannot range the entirety of the continental United States, though the CSS-10 Mod 2 and the CSS-20 missiles come close to holding almost all of the country at risk from their current deployment locations. Depending on what the final range of the mature CSS-10 Mod 3 turns out to be and its base location, it could target the continental United States comprehensively.<sup>215</sup> If China desires complete and redundant targeting of the United States with newer systems from deep inside the Chinese landmass—beyond what is already bequeathed by liquid-fueled missiles such as the CSS-4 ICBM—it will push forward with developing follow-on weapons that possess maximum ranges closer to 15,000 kilometers. These systems, which could include either new developmental ICBMs or ICBMs equipped with nuclear-armed hypersonic glide vehicles, would enable Beijing to comfortably reach all of the United States from anywhere within China.<sup>216</sup>

Beyond its new mobile, solid-fuel ballistic missiles, China has surprisingly doubled down on enlarging the size of its siloed missile force. The early expectations were that China would eventually retire most, if not all, of its siloed ICBMs because of their inherent vulnerability to counterforce attack and replace them with mobile solid-fuel missiles. It is now clear that China will deploy both siloed and mobile ICBMs concurrently, with the former possibly running into a few hundred systems.<sup>217</sup> The three new missile silo fields recently discovered at Hanggin Banner, Yumen, and Hami can host some 300 ballistic missiles and, when fully operational, could result in the creation of the first new PLARF Bases in fifty years.<sup>218</sup> Although the final size or configuration of the siloed missile component is unclear, it seems as if China will add its most advanced solid-fuel missiles, such as the CSS-10s and CSS-20s with lower-yield warheads, to the liquid-fuel CSS-4s, currently tipped with lower-yield and possibly high-yield warheads as well, in its expanding silo network.<sup>219</sup>

There has been some speculation that not all of China's missile silos could have deployed missiles. Rather, China could use its silo system as a shell game, leaving many empty in order to force an attacker to expend numerous warheads targeting what may turn out to be

empty sites.<sup>220</sup> Whether this conjecture proves to be correct only time will tell, but Beijing cannot count on the possibility that an advanced nuclear adversary, such as the United States, will be unable to identify which silos are in fact loaded. The careful distancing between individual silos suggests that China has been attentive to the effective radius of various possible attacking warheads and, accordingly, intends to use its silo fields as a “warhead sponge” to force an adversary to expend a large fraction of its nuclear inventory on attacking targets that will likely contain real weapons. (Alternatively, if China comprehensively shifts toward a launch on warning posture somewhere down the line, the siloed missile force—if deployed routinely with its nuclear warheads—would be a prime candidate for executing prompt missions when required.) In any event, if the official U.S. expectation that China intends to triple or quadruple the size of its nuclear arsenal over the next decade or more is borne out, a large, siloed force with both solid- and liquid-fuel missiles carrying warheads of different yields will end up being a significant component of Beijing’s land-based nuclear force structure.

While China’s expansion of its strategic missile force vis-à-vis the United States (and latently Russia) will thus continue well into the foreseeable future, it has not overlooked the demands associated with targeting its regional adversaries in Asia, such as Japan, Vietnam, the Philippines, India and Australia.<sup>221</sup> Because China anticipates conventional conflicts with these states either bilaterally or in the context of a war over Taiwan, it has focused on producing different types of short-range ballistic missiles (such as the CSS-6 and CSS-7 series), medium-range ballistic missiles (such as the CSS-5, CSS-11, and CSS-22 series), intermediate-range ballistic missiles (such as the CSS-18 series), and ground- and air-launched cruise missiles with diversified conventional warheads aimed against these countries (some of which also host critical U.S. bases in Asia).

Yet nuclear targeting has not been forgotten by any means. Traditionally, China maintained a significant force of mobile solid-fuel CSS-5 missiles armed with nuclear warheads of some 500-kiloton yields for deterrence against these regional threats.<sup>222</sup> These weapons were not intended for counterforce missions, though their significant yields made them lethal instruments if employed against any large area military targets. The number of nuclear CSS-5s in the Chinese inventory has dropped since their peak, as China began retiring many of the oldest systems that first entered service in the 1990s. The surviving systems, however, are still important for holding at risk the most important large, soft targets in China’s neighborhood, even as Beijing has more recently focused on introducing new and highly accurate conventional versions of the CSS-5 (including the DF-21D anti-ship ballistic missile) into its force.

While such a priority is understandable in the context of China’s preparations for waging limited conventional wars along its periphery, the striking shift in its regional nuclear deterrence paradigm, however, is exemplified by the CSS-18 IRBM. The nuclear version of this missile is extraordinarily long-ranged, is highly accurate (with one conventional variant serving as an anti-carrier weapon), “is designed to rapidly swap conventional and nuclear

warheads,”<sup>223</sup> and “is the most likely weapon system to field a lower-yield warhead in the near-term.”<sup>224</sup> The nuclear-armed CSS-18, therefore, would be capable of conducting both countervalue attacks as well as some forms of “precision theater nuclear strikes” at great distances from China’s territory.<sup>225</sup> This emerging nuclear precision strike capability arguably does not repudiate either Beijing’s no-first-use doctrine or its rejection of nuclear warfighting in principle since such a system could be used for proportionate retaliation in the face of any limited nuclear use by China’s adversaries, especially the United States, which has never ruled out such possibilities. However, it represents a significant transformation in Chinese nuclear capabilities, which, heretofore, emphasized relatively inaccurate delivery systems carrying large-yield weapons primarily for interdicting soft area targets. The size of the nuclear CSS-18 contingent that China finally deploys will thus provide important clues to the character of its future strategic intentions.

Since some sixty-odd nuclear CSS-5s and CSS-18s are judged to have been in service in 2021, it seems evident that China is determined to maintain a sizeable enough force both to deter its regional adversaries and to maintain the capabilities required to respond to any limited U.S. (or Indian) nuclear use symmetrically. That targeting China’s regional competitors, even if some of them are not nuclear-weapon states, remains a priority is further evidenced by the fact that China still retains a small number of its old liquid-fueled CSS-3 ICBMs with a range of some 6,300 kilometers to complete its target coverage of countries such as India, Japan, and parts of Southeast Asia, which may lie beyond the range of the CSS-5 and CSS-18 IRBMs allocated for that purpose. In time, both the CSS-3s and the CSS-5s will be superseded entirely by newer theater systems, such as the CSS-18s, supplemented by newer ICBMs like the CSS-10s and the CSS-20s. Given the dramatic increase in the number of these latter systems, it is likely that some CSS-10 and CSS-20 missile brigades already have regional targeting responsibilities as well.

## Air Systems

China’s continued focus on regional missions, even as it expands its nuclear forces directed at the United States, is perhaps most strikingly underscored by the transformation of Beijing’s larger nuclear architecture. Although China nominally maintained a triad during the last decade of the Cold War, Beijing’s nuclear deterrent for all practical purposes was a dyad centered on its land-based missiles and its nuclear-capable H-6A and E bombers and Q-5 fighters. The aviation components lost their nuclear responsibilities as the Cold War ended, but the continued emphasis on regional targeting has now resurrected China’s nuclear bomber force for the first time in recent years. China’s modernized H-6N bombers, which can be aurally refueled, are now slated to carry its new ~3,000-kilometer-ranged air-launched ballistic missile, the CH-AS-X-13, whose warhead yield is unknown. Although the United States experimented with ALBMs during the Cold War, the idea never really caught on because it was simpler to launch ballistic missiles from the ground and enhance their survivability if required through mobility.

China's deployment of the CH-AS-X-13, however, has given ALBMs new life, and they are likely to constitute the principal nuclear armament of Beijing's bomber force over the next decade. The PLAAF's current bomber force, which consists of different versions of the H-6, is for the most part obsolete (even if modernized) and cannot prosecute any penetrating missions against respectable adversaries on its periphery—such as Japan and India—let alone further afield.<sup>226</sup> Consequently, their principal munitions remain standoff weapons, whether ballistic or cruise missiles, that can be launched from outside the range of an adversary's air defenses and have a better chance of reaching their targets while also increasing the survivability of the launching platform. Accordingly, China's bomber force, which sports both PLAAF and PLAN livery, invariably carries primarily conventional standoff weapons including cruise missiles for their land-attack and anti-ship missions, respectively.

Beyond being new, the PLAAF's acquisition of a nuclear role is also perplexing because, even when refueled, the H-6N's ALBM payload can reach only regional targets: the Asian periphery and much of Australia, the Middle East, Eastern Europe, and Alaska. These territories, however, are already amply covered by China's ballistic missiles. Consequently, one American scholar has attributed the air-launched ballistic missiles' deployment to "bureaucratic dynamics" in China because it makes "little sense strategically."<sup>227</sup> The ALBM-equipped H-6N, admittedly, would offer China potentially greater penetrativity because it allows for attacks from wider, and unexpected, azimuths and thus could help defeat some emerging missile defense systems. But there are certainly cheaper ways to achieve this objective, so the integration of ALBMs into China's nuclear deterrent force remains puzzling.<sup>228</sup>

Given these realities, the introduction of the nuclear ALBM suggests the following beyond bureaucratic politics: China seeks to stay at the frontiers of nuclear delivery technologies no matter how recondite they may be; it desires to reliably hold at risk the entirety of the Asian landmass and the outlying areas through a multiplicity of nuclear delivery systems including some that may be entirely redundant; and, finally, the CH-AS-X-13 ALBM (or its successors) could remain the primary standoff weapon even for China's future long-range stealth bomber, the H-20, which could be used for missions against the United States and its island territories if the aircraft does come to possess "a truly intercontinental power-projection capability."<sup>229</sup>

### Naval Systems

Because even mobile land-based missiles and strike aircraft are susceptible to counterforce attacks—depending on the effectiveness of the attacker's intelligence, surveillance, and reconnaissance systems, and the accuracy/yield of its weapons as well as the extent of strategic or tactical warning available to the defender—China has sought to increase the survivability and responsiveness of its deterrent by also investing in new nuclear ballistic missile submarines and their associated command-and-control systems. Already during the Cold War, the United States had developed the capabilities to interdict even the supposedly sur-

vivable land- and sea-based second-strike systems deployed by the former Soviet Union.<sup>230</sup> Washington continues to maintain a similar suite of capabilities vis-à-vis China consistent with its larger nuclear strategy of damage limitation. Hence, it is not surprising that China too is committing additional resources to increasing the survivability of its nuclear forces by both expanding their numbers and diversifying their basing modes.

Building up the sea-based leg represents a further evolution of China's emerging nuclear capabilities. China previously possessed a single Xia-class SSBN, with 12 JL-1 submarine-launched ballistic missiles (SLBMs), which is believed to have never embarked on a deterrence patrol. Based on its experience of constructing and operating the Xia, China has now deployed six new Jin-class SSBNs, each carrying twelve ~8,000-kilometer-ranged JL-2 single-warhead-equipped SLBMs with a range of some 8,000 kilometers. Over time, these Jin-class SSBNs will be complemented by new Type 096 submarines, each carrying sixteen to twenty-four new ~10,000-kilometer-ranged JL-3 SLBMs possibly with multiple warheads.<sup>231</sup> Based on the construction schedule of the 096 class, it is possible that China could operate the Jin-class SSBNs and some follow-on 096 boats concurrently. Furthermore, if development of the JL-3 SLBM progresses fast enough, it is possible that this missile could be retrofitted on some of the Jin-class SSBNs as well, long before the 096 vessels enter service. The 096-class SSBNs are expected to be quieter than their Jin-class predecessors, thus enjoying notionally increased survivability.

If the Jin or the 096 submarines are deployed in bastions in the South China Sea, the Bohai Bay, or the Yellow Sea, neither their JL-2 nor JL-3 missiles can target the entirety of the United States—although all of China's Asian adversaries would lie comfortably within reach. Targeting the United States completely with the current and prospective Chinese SLBMs would require deploying submarines to operate well east of the Second Island Chain where they would be even more vulnerable to U.S. open-ocean anti-submarine warfare (ASW).<sup>232</sup> Consequently, China's SSBN investments—at least for the moment—seem aimed at preserving a small reserve force in coastal bastions in the event that all or most of its land-based weapons are interdicted by the United States. Although their survivability even here is not at all assured, their ability to hold at risk important U.S. west coast and midwestern cities is obviously considered essential to shore up deterrence against a stronger nuclear adversary like the United States.<sup>233</sup> Over the longer term, it is likely that China will pursue the development of longer-ranged SLBMs capable of ranging the entirety of the United States from their coastal bastions in order to increase the survivability of the Chinese deterrent in the face of the expected U.S. ASW threats.

## China's Nuclear Inventory

The foregoing discussion about China's emerging nuclear capabilities highlights the dramatic transformations that are currently underway. When the additional investments in command-and-control systems and passive and active defenses are taken into account

(some of which will be discussed later when reviewing changes in China's nuclear posture), these alterations are consistent with Xi Jinping's injunction that China's nuclear deterrent must "achieve a great rise in strategic capabilities" by incorporating "breakthroughs . . . in [its] strategic deterrence capability."<sup>234</sup> Unfortunately, the vast information that is available on the specifics of various Chinese weapon systems does not translate equally into data on its force size. This is because China, just like India and Pakistan, is highly secretive about its nuclear forces; outside analysts have to deduce the number of deployed systems based on fragmentary information, including any that may be sporadically released by U.S. or other intelligence services. Even data compiled by respectable institutions like the International Institute for Strategic Studies (IISS) in its annual *Military Balance* assessments are incomplete and confusing because the information sometimes refers to number of launchers as opposed to missiles and because conventional and nuclear variants of various delivery systems are often conflated.

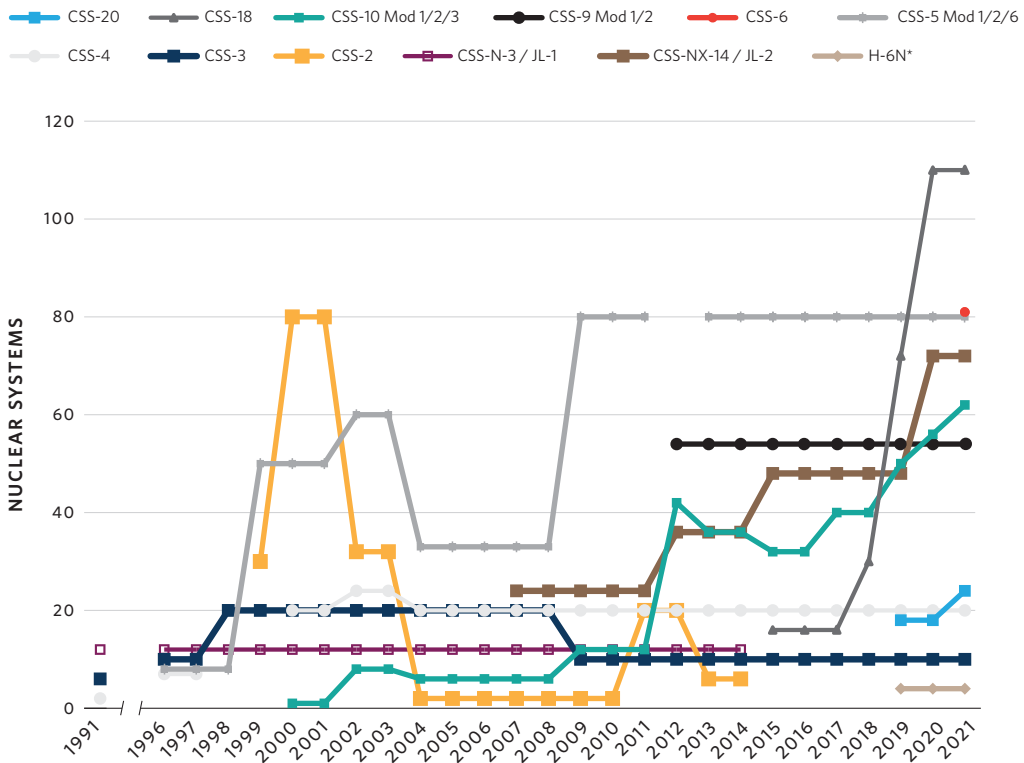
Given the paucity of reliable information, Figure 1 must be treated as merely illustrating some broad trends over time. It depicts the evolution of China's nuclear missile force since 1998 based on data from various issues of the *Military Balance*. Figure 2 summarizes China's nuclear force structure in 2021, drawing on the remarkable work that Hans Kristensen and Matt Korda have done over the years at the *Bulletin of the Atomic Scientists*, as well as Ma Xiu's work at the China Aerospace Studies Institute.<sup>235</sup>

Despite the limitations of the *Military Balance* data noted above, the most striking fact about China's nuclear forces historically have been their low numbers. If the JL-1 SLBM is excluded from the reckoning because its Xia launch platform was never functionally operational, the principal Chinese long-range missiles, such as the CSS-3 and early CSS-4s, existed in, at most, a couple of tens of systems for well after the Cold War ended. The numbers of CSS-5 MRBMs, especially in their nuclear variants, did increase progressively over time. But the spike in their numbers around 2009, per Figure 1, was the result of counting launchers rather than the missiles themselves: although the missiles still exist in significant numbers, the conventional variants far exceed their nuclear counterparts as the latter are being progressively retired.

As noted previously, the conspicuous aspect of China's nuclear force transformation after 2009 is the growth of long-range systems in numbers that far exceed previous norms. The induction of Jin-class submarines into the Chinese deterrent has increased the number of long-range missiles in the force. And the remarkable expansion of the CSS-10 segment after 2018–2019 will be complemented in the future by more CSS-10 variants in mobile and possibly siloed variants. The growth of the CSS-18 missiles will also certainly continue, with the sharply ascending slopes in Figure 1 suggesting that they will eventually be deployed in the low hundreds of launchers (although most will be allocated primarily for conventional operations). Whether the nuclear CSS-18 variants will grow further in number is unclear right now. The IISS data until 2020 do not indicate any CSS-20 missile launchers, but



**FIGURE 1**  
**CHINESE NUCLEAR SYSTEMS, 1991-2021**



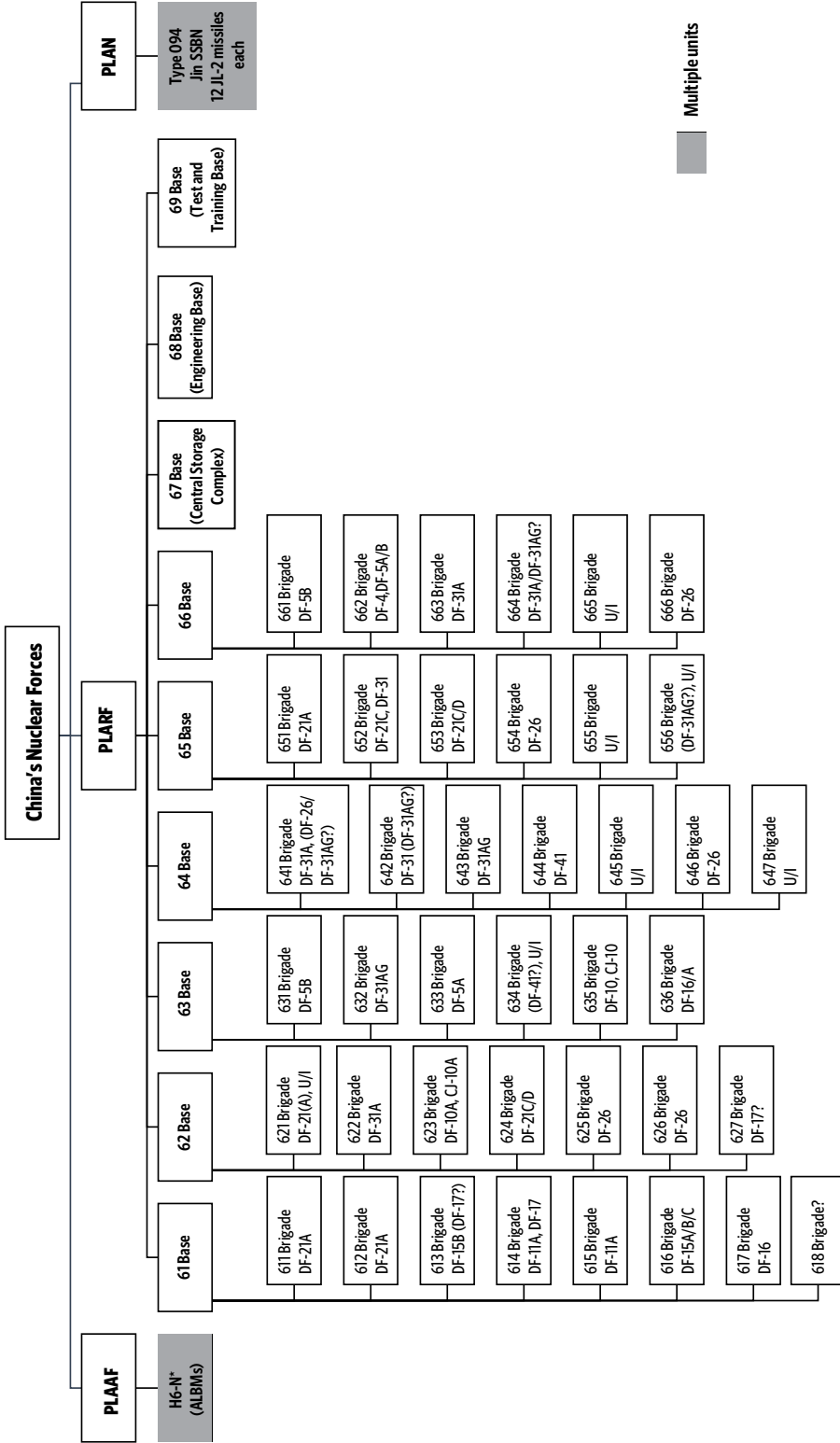
\*predecessor nuclear aircraft circa 1991 with nuclear roles that have now retired

Source: International Institute for Strategic Studies, *The Military Balance 1999-2021*, twenty-six editions (Washington, DC: International Institute for Strategic Studies, 1997-2022).

Kristensen suggests that perhaps eighteen are already operational. The number of CSS-20 missiles will also increase in the future, including possibly in siloed versions.

Although China is pursuing the most comprehensive missile program in the world—with more systems under development than any other nation—the bulk of its missile inventory still consists of conventional weapons intended for warfighting in the context of various contingencies on its periphery. The nuclear missile inventory is a smaller subset of this larger effort, and it seems that China will settle for about six different types of systems in the medium term for purposes of deterrence: the siloed CSS-4, the mobile CSS-10 and CSS-20 (with possibly siloed variants as well), and the sea-based JL-2/3 for intercontinental missions, plus the CSS-18 and the CH-AS-X-13 systems for regional deterrence. It is unclear at the moment whether China will deploy a nuclear-armed version of its new hypersonic glide vehicle-equipped CSS-22 MRBM. In any event, once these systems are procured in

**FIGURE 2**  
**CHINA'S NUCLEAR FORCE STRUCTURE, 2021**



Source: Hans M. Kristensen and Matt Korda, "Chinese Nuclear Weapons, 2021," *Bulletin of the Atomic Scientists*, November 15, 2021, <https://www.tandfonline.com/doi/full/10.1080/00963402.2021>, and Ma Xiu, "PLA Rocket Force Organization - Executive Summary," China Aerospace Studies Institute, November 29, 2021, <https://www.airuniversity.af.edu/CASI/Display/Article/2849664/pla-rocket-force-organization-executive-summary/>.

the numbers desired, it is likely that two older nuclear systems—the CSS-3 and the CSS-5—will be retired. The nuclear force in its totality will thus be a mix of siloed and mobile missiles; will be both solid and liquid fueled; will carry either single or multiple warheads with high and medium yields, respectively; and will be equipped with different kinds of penetration aids to enable them to defeat the missile defense systems that may be deployed by China’s adversaries. In time, they will be complemented by newer systems that perhaps deploy even more advanced payloads such as maneuvering reentry and hypersonic glide vehicles.

Based on Kristensen and Matt Korda’s assessment, the Chinese nuclear missile inventory today could consist of close to 260 nuclear missiles: ninety-six modern land-based mobile missile launchers each with one missile; twenty-six land-based siloed missiles; and seventy-two sea-based missiles, for a total of some 194 long-range systems, complemented by sixty or so nuclear missiles (including ALBMs) for theater missions.<sup>236</sup> Even if these numbers are not entirely accurate in their internal composition, they do depict a Chinese nuclear force that is much larger than it has been historically and one that is projected to increase in size anywhere from two to four times its current level by the end of this decade or slightly beyond. If China does in fact build up its nuclear deterrent to levels where it possesses some 1,000 missiles (if not more), this would bring it much closer to current U.S. and Russian nuclear forces than it has ever been, although significant qualitative disparities would continue to persist.

### **Command and Control, Operational Posture, and Force Employment**

The growing size of China’s nuclear deterrent has already been reflected in important changes in its force organization. As part of a larger, more sweeping restructuring of the Chinese military, the older Second Artillery Force, which controlled all of China’s land-based missile systems, was elevated in 2015 to an independent service and renamed the PLA Rocket Force. In its new embodiment, the PLARF controls all of China’s land-based conventional and nuclear missiles though, contrary to earlier expectations, it appears that the Chinese navy will control the sea-based nuclear forces and the Chinese air force will control the air-delivered nuclear weapons in whatever forms they may appear after the air-launched ballistic missile. The PLARF is also now complemented by the PLA Strategic Support Force, which centralizes the space-, cyber-, and electronic-warfare capabilities that would be required for both nuclear and conventional operations.<sup>237</sup>

The PLARF headquarters has both organizational and command responsibilities with respect to the land-based nuclear forces: it oversees everything from establishing force requirements to procuring the desired weapons to training, manning, and operating the missile systems that are finally deployed. Given the strong civilian—meaning CCP—control over all of

China's military forces but especially its nuclear weapons, the political commissar of the PLARF has preeminent authority in ensuring that the service's mission is thoroughly subordinated to political objectives of the party's CMC and, in particular, the preferences of the chairman, currently Xi Jinping. Although the Second Artillery Force was treated as an autonomous entity historically—because its activities pertained to the operation of special weapons—the PLARF today is integrated into China's theater command structure.<sup>238</sup> Although specific details of this integration are obscure, it appears that PLARF officers at the appropriate level are part of the theater command's joint operations command centers but with responsibility solely for the direction and employment of the conventional missile units.

However, the nuclear Bases and brigades, while coordinating as appropriate with the theater command elements especially for force support, remain tightly controlled by the CMC, which, through its Joint Operations Command Center, retains the option of promulgating orders either through the PLARF headquarters to its successive subordinate formations or directly to these units by skipping their intermediate echelons when required.<sup>239</sup> Whether these procedural systems evolve in the direction of permitting the top civilian leadership to launch at least some nuclear weapons directly is worth watching. As Bruce Blair described, the Soviet Union had “developed and tested a command link meant to give the top political leadership push-button launch control over a portion of their ICBM force, bypassing even the General Staff, in order to shave off a few minutes of launch reaction time.”<sup>240</sup> If China moves similarly, as the demand for more rapid retaliation intensifies under Xi Jinping's direction, Blair's earlier judgement in the Soviet context, that “such short-cuts are obviously dangerous in the extreme,”<sup>241</sup> would apply to Beijing as well.

The revolutionary character of such a transformation is best appreciated by understanding the organizational structure of the PLARF and its changing operational rhythm. The largest operational unit in the PLARF is the missile brigade, which usually deploys and operates one specific missile system (which sometimes includes different variants). A few brigades may operate more than one type of missile, but that is not the norm. The missile brigades in turn are composed of subordinate battalions, with the number of missile launchers allocated to each brigade varying considerably. As China's nuclear force distends in size, the number of launchers possessed by individual brigades will also rise but not necessarily in any uniform way. As a recent U.S. Department of Defense report on Chinese military power revealed, the PLARF “appears to be doubling the numbers of launchers in some ICBM units.”<sup>242</sup> The more conspicuous development, however, has been the dramatic increase in the number of missile brigades in recent years. At the end of the Cold War, China probably fielded about twelve nuclear missile brigades, which were subordinated in turn to six army-level Bases, with a seventh dedicated to logistics and support.<sup>243</sup> These apex formations, sequentially numbered from 51 Base to 56 Base (with the 57 Base for logistics), served as the nodal administrative organizations, each with two to three missile brigades under their control.

The number of army-level Bases with maneuver elements has stayed constant since 1991, though they have been renumbered since 2015 from 61 Base to 66 Base. The 67 Base now controls the units responsible for handling China's nuclear warheads. Two additional bases born out of the consolidation of older facilities, 68 Base, responsible for overseeing engineering operations, and 69 Base, responsible for testing and training, have also been identified. It is possible that these superordinate Bases will slowly increase in number as China's land-based missiles become more numerous—and especially as the new siloed missile sites are integrated into the larger force structure—but, for the moment, the subordinate missile brigades mainly appear to have multiplied. Some forty-one such brigades have currently been identified as operational (Figure 2), but these formations are also certain to increase further as the Chinese nuclear arsenal continues to expand.<sup>244</sup> Most of the PLARF's missile brigades deploy either nuclear or conventional missiles exclusively. Probably half the force deploys only nuclear missiles; of the balance, a little more than half seems to possess only conventional missiles. Rather interestingly, the remainder appear to possess a mix of nuclear and conventional missiles in the same unit—clearly a new development within the PLARF and one that has given rise to fears that such a colocation of weapons could lead to inadvertent escalation in a crisis.<sup>245</sup>

The changes in the PLARF's force organization, manifested by the growing number of missile brigades—both those uniquely nuclear formations as well as those deploying either conventional missiles or both nuclear and conventional missiles in a single brigade (though almost certainly not in the same battalions)—is occurring in tandem with important changes in China's nuclear posture. These transformations are manifested in a gradual shift from the previously centralized storage of China's nuclear weapons to more decentralized sequestration driven largely by the more consequential evolution toward faster retaliation (in comparison with the more languid responses that were acceptable in the past).<sup>246</sup>

The only element of China's nuclear posture that has not changed, and shows no signs of changing, is its centralized command system. The authority to alert, mate, and use nuclear weapons resides exclusively with the CMC of the CCP, which is little other than a mask for the ultimate decisionmaking power residing with the party's senior civilian leaders. In practical terms, this means that all nuclear decisionmaking resides ultimately with the general secretary of the CCP and his civilian successors, however they are advised by their military colleagues in the CMC. This is almost certainly the case where Xi Jinping is concerned. Civilian control over nuclear alerting and use decisions thus remains absolute in China and is intended to ensure that the armed forces can only employ these weapons in accordance with the decisions of the highest ranks of the party's leadership. Consequently, all consequential orders pertaining to nuclear operations originate only from the apex authorities of the CCP—powers that are not delegated to any subordinate political bodies or military formations.

These civilian prerogatives are now reinforced by multiple physical security measures as well as technical access controls on China's nuclear weapons, complemented by other procedural constraints such as personnel oversight conducted by political commissars at different levels throughout the PLARF.<sup>247</sup> The ultimate peacetime safeguard over China's nuclear forces traditionally consisted of their de-mated posture: warhead components maintained unassembled (or at low states of assembly) and separated from their delivery vehicles, which, in turn, were separated from their transporter launchers. This pattern broadly persists to this day. But because some nuclear systems such as siloed missiles could have their warheads attached routinely while other mobile systems, including canisterized missiles, could be integrated more frequently when required by the demands of "combat readiness duty,"<sup>248</sup> the importance of some kind of permissive action links has only increased. As China's SSBNs and air-delivered nuclear weapons continue to be integrated into the national deterrent, such technical safeguards will inevitably be expanded to these systems as well. In all cases, China is slowly evolving toward a system where its nuclear weapons will be unable to launch without affirmative technical authorization from the very top. And, in time, Beijing could actually enable its most senior civilian leaders to exercise direct operational control over at least some nuclear weapons launches if required in extremis.

This assertive model of command, which existed from the very beginning even when technical controls were absent, is driven by a priority on negative control, meaning that nuclear weapons can never be used except when explicitly directed by national authority. And it found striking reflection in China's traditional emphasis on storing its nuclear weapons in a single centralized site, where they could be both protected against misuse and safeguarded against attack. The deeply buried nuclear weapons storage site at Taibai, originally designated the 22 Base and now redesignated the 67 Base, functions as the central facility for storing China's nuclear warheads, which are separated from the delivery systems maintained at the various brigade bases dispersed throughout the country.<sup>249</sup> As a rule, the brigade bases host the maneuver elements: the missile airframes, the transporters (if applicable), and the associated equipment necessary for launch operations. The support, communications, training, and assembly regiments—the last of which are responsible for assembling the nuclear warheads and mating them with the missile delivery systems prior to dispersal (if appropriate) and launch—remain subordinated to the army-level Bases. The army-level Bases thus contain the critical enabling resources required by the brigade-level bases to execute their nuclear missile launch missions. Consequently, each army-level Base is connected to some regional nuclear storage facilities, which are usually some distance away from where the maneuver elements are located.<sup>250</sup> All Chinese nuclear weapon storage sites, irrespective of their role in the integration sequence, are deeply buried facilities. Military planners judged early on that hardening and deep interment remains the best defense against enemy nuclear attacks prosecuted even with high-yield weapons.<sup>251</sup>

When the Chinese leadership received strategic warning of a conflict that required the generation of its nuclear forces, the unassembled nuclear warheads that were routinely stored at the central site at Taibai were released to the regional nuclear storage facilities where they would be assembled, checked, and integrated with their reentry vehicles. The completed weapons would then be moved to the brigade-level facilities where they would be mated to the missile airframes before the latter were then loaded on their launchers and either stored at the facility itself or dispersed to camouflaged field locations where they would await their launch orders.<sup>252</sup> A similar sequence applied to most silo-based missile systems in the past as well.

Because China traditionally did not maintain a ready nuclear force—a posture driven by the need to ensure the safety and security of its nuclear weapons, its no-first-use policy, and the presumption that sufficient strategic warning would be available to prepare for nuclear operations—readying Chinese nuclear weapons for retaliatory operations in accordance with its “three-tier alert system” was by necessity a lengthy affair.<sup>253</sup> It required the nuclear weapons components to be transferred by road or rail (and only rarely by air) across considerable distances from the central depository to the Base storage facilities and, thereafter, the assembled weapons to be transferred, again by road or rail, to the brigade bases before the completed missile systems were either bivouacked or moved to their prepared field hides or launch sites. Although China operated on the assumption that this entire process would be completed prior to absorbing any nuclear attack, that depended largely on the extent of strategic warning available. Consequently, the generation of China’s retaliatory forces could have occurred possibly before, during, or even after China absorbed an adversary’s nuclear strikes, depending on the circumstances. Given the uncertainties, one authority has noted that China required its missile forces to survive 3–5 days of attack because more rapid nuclear retaliation may have proved to be difficult in the context of a major nuclear war.<sup>254</sup>

This traditional posture is undergoing important changes as the Chinese nuclear deterrent continues its modernization. For starters, the expanding number of Chinese nuclear weapons implies that stockpiling them solely or mainly at Taibai is likely to become a relic of the past. It must be anticipated, therefore, that Beijing will build more national depositories in different parts of the country that are well connected by road and rail to the various Base and brigade locations where the final integration of China’s nuclear weapons will occur. Already, the creation of the Chinese nuclear triad has propelled the diversification of China’s major storage sites: the SSBN base at Yalong on Hainan Island in the south, for example, stores China’s naval nuclear warheads, which in time could also be stored at the North Sea Fleet’s Jianggezhuang Naval Base if China chooses to either base future SSBNs there or deploy them at Bohai Bay.<sup>255</sup> The raising of the nuclear bomber force will similarly create a demand for additional weapons storage sites, depending on the eventual size of the air-breathing leg and its basing patterns.

What is even more likely because of China’s continuing nuclear expansion is that Beijing will store its nuclear weapons components not only at some central facilities but also at

its Base storage sites on a routine basis. This had occurred in the past, but somewhat episodically.<sup>256</sup> The possibly normal sequestration of nuclear weapons at Base storage sites, however, does not necessarily entail them being maintained in fully assembled form. It only implies that the unassembled weapons will be dispersed over a larger number of sites to sustain the more rapid force generation that China's decisionmakers believe is necessary for effective deterrence especially against superior nuclear powers such as the United States. If this evolution occurs, China will be able to bring its nuclear forces to full readiness much faster because the distances between the Base storage sites and the brigade facilities are obviously smaller than the distances (and times) involved in moving components from the central depositories to the Base storage facilities and finally to the brigade sites, as occurred traditionally. A shift of this sort is inevitable given the changes now occurring in China's nuclear doctrine at the operational level.

Further, and again consistent with the changes in China's operational doctrine, Beijing has shifted toward maintaining at least some land-based missile units at elevated levels of readiness even in peacetime, in order to be able to prosecute nuclear retaliatory operations quicker than before.<sup>257</sup> It appears that one battalion in each strategic missile brigade (or perhaps only in some brigades) is committed to such "high alert duty," which requires it "to be ready to launch, and rotat[e] to standby positions as much as monthly for unspecified periods of time."<sup>258</sup> Given China's traditional conservatism about managing its nuclear forces, it is possible that these alerted elements will not stand up with fully integrated weapon systems—that is, with the warheads and delivery systems completely mated and ready to fire (even if they are otherwise safeguarded by technical controls). But because preparing China's nuclear deterrent for retaliation is ordinarily a lengthy enterprise—requiring days, not hours, to ready even its most modern mobile missiles—Beijing seems intent on shortening the preparatory time for at least a rotating subset of these systems. Consequently, if it chooses not to maintain fully integrated weapons, it will at least seek to complete the testing of all subsystems, assemble the nuclear warheads, integrate them with the reentry vehicles, and mate the reentry vehicles with the missile airframes, while waiting on loading the completed missile canisters onto their launch vehicles. Alternatively, China could simply settle on maintaining those systems designated for high alert duty as fully integrated weapons, relying on its technical controls to prevent unintended or inadvertent launches. Either way, Beijing seems intent on maintaining at least some rotating units that are capable of more rapidly launching their weapons—as the PLARF has apparently sought since at least 2015<sup>259</sup>—in the aftermath of a nuclear attack.

How much more rapidly is unclear, but the totality of the evidence suggests that China does seek to compress the window for retaliation to a few hours rather than days (or longer), which seemed to be acceptable previously. The response window could, in fact, be further compressed to minutes, but this would likely depend on whether the relevant missile batteries were already dispersed to their prepared field launch sites rather than being merely bivouacked on heightened alert at their brigade bases. It is likely that at least a few modern



Chinese missiles, such as the DF-31, can be launched from any location, “without a pre-surveyed site,”<sup>260</sup> but whether the PLARF would accept the deterioration in missile accuracy that could result from such launches is unclear. If China’s siloed ballistic missiles have self-calibrating guidance systems and are deployed routinely with their warheads, they would be able launch within minutes of receiving valid launch orders.

In any event, the evolution toward faster retaliation is given further credence by the characteristics of China’s newest mobile missiles, the technical upgrades to its strategic communications network—primarily new buried fiber-optic cable and mobile satellite communications systems—and the induction of new mobile command posts utilizing automated decision tools, which all together indicate that China seeks the capabilities to execute nuclear retaliation more rapidly than it could do before.<sup>261</sup> Because of the importance of this task, it is likely that China will also deploy a dedicated and more resilient nuclear C3 system in the future rather than continuing with the prevailing system that utilizes the networks used by its conventional forces and is, accordingly, vulnerable even to non-nuclear attacks in times of war.

The emerging Chinese capacity for quick retaliation will only increase when China’s SSBNs begin routine deterrence patrols with ready nuclear-tipped ballistic missiles on board. Assuming that the safety of its fully assembled weapons is not at issue, China will likely preserve negative control in such circumstances through a combination of shore-transmitted release codes, permissive action links, and the institution of a two-key firing system with one key retained by a political commissar aboard the vessel.<sup>262</sup> If China goes in this direction, as is likely over time, its capacity to retaliate faster after a nuclear attack will only increase, presuming of course that its SSBNs escape possible attacks by trailing adversaries and that its shore-based very low frequency (VLF)/extremely low frequency (ELF) communications facilities survive. Whether Chinese SSBNs routinely deploy with ready weapons or are provided completed weapons only once a certain alert threshold is crossed, the decision to maintain an SSBN force ensures that the PLAN will possess independent custody of nuclear weapons but not the capacity to launch them without affirmative authorization. The same will be true for the PLAAF as its ALBM-equipped bomber force steadily matures.

Finally, the capacity for faster retaliation in the aftermath of a nuclear attack will be decisively enhanced once China’s new tactical warning systems are fully in place. For the longest time, China was content to structure its nuclear posture on the assumption that strategic warning of a possible attack was sufficient for effective deterrence. On the receipt of such warning, China would initiate the process of integrating its strategic systems and dispersing them, ready to retaliate after it had absorbed an adversary’s first strikes. As part of its continuing nuclear modernization, however, Beijing has more recently invested in new tactical warning and attack assessment systems. These capabilities reside in modern land-based sensors such as large phased-array radars and in a suite of space-based sensors for missile warning.<sup>263</sup> China has constructed at least four large phased-array radars to sustain a radar

surveillance fence across its entire periphery and its infrared detection satellites in geosynchronous orbit are intended to observe ballistic missile launches early in their trajectory in support of tactical warning of any impending attacks.<sup>264</sup>

Once these investments are completed, China will have the capacity to detect nuclear missile launches, track the trajectory of incoming missiles, and locate and report any nuclear detonations on its territory. The ability to secure tactical warning and characterize adversary missile tracks and/or nuclear attacks in real time will enable China to either sustain missile defense operations aimed at neutralizing these attacks (if possible), or to marginally improve the dispersal of its offensive systems (which will likely be flushed from their garrisons prior to such attacks), or to engage in launch-on-warning or launch-under-attack retaliatory strikes (assuming that it is confident about the quality of its tactical warning systems in the context of an intense crisis).

Some Chinese thinking about launch on warning or launch under attack has already surfaced, with discussions about how such options could be reconciled with the no-first-use policy being especially prominent.<sup>265</sup> The U.S. Department of Defense has stated that “China seeks to keep at least a portion of its force on a LOW [launch-on-warning] posture.”<sup>266</sup> This inference is derived from China’s commitment to deploying a large number of silo-based missiles, which may not survive as second-strike weapons, coupled with its new practice of maintaining at least some mobile ICBM battalions (and possibly silo-based missiles in the future) on “high alert duty.” Both these developments are read as suggesting that Beijing will move toward a nuclear posture where it is actually able to launch its readied weapons, especially its silo-based systems, as soon as it receives warning of an impending attack and well before any adversary weapons actually detonate on Chinese soil.

Some close observers of China’s nuclear forces, however, are skeptical that Beijing would ever shift toward a launch-on-warning or a launch-under-attack posture. As Philip Saunders has noted:

The CCP has always insisted on tight political control over strategic military capabilities and on making military decisions with important political consequences itself. Given the heightened risks of escalation or accidental nuclear conflict and some degree of civilian distrust of the military, CCP leaders are unlikely to pre-delegate launch authority to the CMC or even to the sole authority of the CCP General Secretary.<sup>267</sup>

There is much that is persuasive in this critique given China’s still significant conservatism when it comes to managing nuclear weapons. Because of the risks involved in any launch-on-warning or launch-under-attack strategy—dangers that would only increase in an environment where adversary or third-party computer network operations could put even otherwise reliable warning systems at risk—it is likely that Beijing will eschew this option *even if it appears to be preparing for it*. When all is said and done, China’s nuclear

transformation is still oriented fundamentally toward shoring up deterrence rather than warfighting. Consequently, it makes sense for Chinese decisionmakers to eventually adopt a posture that conveys a willingness to launch their nuclear weapons as soon as they receive information about a possible attack to deter their adversaries from contemplating any first strikes to begin with, although they would probably not execute such operations in any case even in extremis.

Even more to the point, any launch-on-warning or launch-under-attack options are also arguably unnecessary except in the case of all-out nuclear attacks launched by an adversary on the entirety of China's nuclear deterrent. It is hard to imagine that Chinese policymakers believe that such a contingency is in fact likely: the history of their attitude toward nuclear weapons suggests otherwise. And even though they are preparing for dangerous rivalry with the United States, the expansion and transformation of their own nuclear deterrent makes the prospect of all-out nuclear counterforce attacks on China even more unlikely—if not entirely absurd. Yet it is only in this scenario that the incentives for launch on warning or launch under attack become attractive. Consequently, the maturation of China's tactical warning and attack characterization capabilities, when combined with the availability of some offensive missiles that are maintained at elevated readiness, would be most useful for shortening the timeframe within which nuclear retaliation could be unleashed while also

perhaps helping to increase force survivability on the margins.

***As long as China's current conservatism about nuclear weaponry persists, it is likely that Beijing's shift toward rapid retaliation will be used primarily to underwrite strategies of deterrence.***

Notwithstanding anything that has just been said, the acquisition of launch-on-warning and launch-under-attack capabilities will undoubtedly provide Beijing with new instruments that could be used either to strengthen deterrence or, in the extreme, to even support diverse strategies of coercion.

In the past, China has refrained from engaging in any explicit nuclear blackmail.<sup>268</sup> Whether that reticence will persist in the future as its nuclear capabilities expand and diversify remains an open question. Much will depend on how China's nuclear doctrine itself evolves. As long as its current conservatism about nuclear weaponry persists, especially its emphasis on treating nuclear weapons as political instruments for countering coercion, it is likely that China's shift toward rapid retaliation will be used primarily to underwrite strategies of deterrence. Pressing its emerging launch-on-warning and launch-under-attack capabilities toward that end, however, will require new technical innovations for success: because launching nuclear missiles early in response to tactical warning of an adversary's incoming strike is a highly risky strategy, China could equip its principal offensive systems with self-destruct capabilities as a form of insurance to avoid catastrophe in case of mistaken authorized launches. If Beijing moves in this direction, as the United States now appears to be doing,<sup>269</sup> it will constitute significant evidence that despite the weak operational neces-

sity for such a posture China does in fact contemplate executing launch-on-warning and launch-under-attack missions under some extreme circumstances.

The huge Chinese investments in tactical warning that are now underway clearly make such responses plausible. These investments also come at a time when China has embarked on substantial ballistic missile defense acquisitions.<sup>270</sup> Tactical warning capabilities are, in fact, most valuable for missile defense. Although China was an early skeptic about active strategic defenses, its research, development, and procurement efforts in this area have increased tremendously in recent years. Thanks to other efforts in its space and counterspace programs, China appears well on its way to procuring a modest ballistic missile defense capability, which consists of a nationwide warning network that buttresses the active defense of several key targets, such as important economic and population centers. In support of this objective, Beijing has acquired several advanced surface-to-air missile systems from Russia—primarily SA-10s and SA-20s supplemented by its own indigenous CSA-9 series systems—all of which, though optimized for anti-aircraft targeting, have a secondary anti-tactical ballistic missile defense capability.<sup>271</sup>

China's longer-term objectives, however, are focused on the development and deployment of a dedicated multilayered ballistic missile defense system. Toward that end, it is integrating its new ground- and space-based sensors to support the new generation of upper- and lower-tier interceptors it currently has under development.<sup>272</sup> These embryonic missile defenses, however, do not suggest an acceptance of a defense-dominant nuclear regime today or in the future. To the contrary, the modernization of China's offensive forces—an effort undertaken with even greater vigor than missile defense—suggests that Beijing expects the offense-dominant global nuclear regime will survive indefinitely.<sup>273</sup> Consequently, at least in the near future, missile defenses in the Chinese calculation appear to be aimed mainly at defeating regional rivals such as India while providing secondary levels of protection against mature nuclear adversaries, but without functioning as full-fledged substitutes for nuclear deterrence against both kinds of threats.<sup>274</sup>

## **TAKING STOCK**

This survey of key developments in China's nuclear weapons program since the end of the Cold War confirms the proposition that although there is significant continuity in its broad approach to nuclear weapons, there are also important transitions that are worthy of notice. The most important enduring element is Beijing's steadfast conviction that the fundamental utility of nuclear weapons lies in deterring nuclear attacks and nuclear coercion rather than nuclear warfighting. This central principle has survived even amid the expectation that the United States, a superior nuclear power, will be China's most dangerous geopolitical adversary for many decades to come. Partly because of its belief that nuclear weapons have primarily political rather than military utility and partly because of the fact that China is

reasonably secure vis-à-vis all its competitors (including the United States), Beijing still hews to an unconditional no-first-use policy at the declaratory level. Although there are suspicions about the veracity and the durability of this commitment, China's operating routines suggest that it takes this commitment seriously. There is as yet no evidence that China has integrated nuclear weapons use into its conventional military operations; the PLARF still trains and operates on the assumption that the country would absorb a first strike before retaliating, even though it is en route to acquiring the capacity to launch its weapons before any nuclear detonations occur on Chinese soil; and there are no obvious incentives for China to use nuclear weapons first in the context of various regional warfighting contingencies including those that involve the United States. To be sure, China already possesses the latent capacity to manipulate the readiness of its nuclear reserves for purposes of strategic signaling, but its history and its larger beliefs about the utility of nuclear weapons do not suggest any easy shift toward actual nuclear first use. At the end of the day, this prognostication is grounded fundamentally in the reality that China is a powerful and reasonably secure state.

Beijing undoubtedly fears the threats posed by its adversaries' nuclear and conventional systems to its strategic deterrent. Consequently, it has responded by sharply increasing the size of its nuclear force and investing heavily in its survivability through, among other things, expanded deception and denial, increased mobility of its land-based missile systems coupled with the introduction of a full-fledged nuclear triad, and more robust command-and-control architectures. The growing size of China's nuclear forces compared to its historic levels is eye catching and will likely challenge regional competitors like India more than it would the United States, because even if Beijing's nuclear inventory quadruples—as is possible over this decade and after—its nuclear deterrent would still be smaller than that maintained by Washington. Perhaps more significant than even the incipient increases in force size is the steady change in China's nuclear force posture: the old disposition of preserving a pervasively de-mated force that was oriented fundamentally toward slow retaliation has now given way to at least a small subset of the deterrent being maintained at higher levels of readiness routinely. As a consequence, Beijing will be able to inflict much quicker retaliation in the aftermath of suffering any nuclear attack than was possible during the Cold War.

For all these alterations, however, China still seeks to avoid making nuclear competition a centerpiece, even in the new era of great power rivalry with the United States. Beijing today does not seem to be aiming for quantitative parity with U.S. nuclear forces nor is it pursuing a nuclear strategy aimed at securing counterforce dominance. It also exhibits scant interest in utilizing nuclear weapons to achieve operational objectives on the battlefield. Instead, China's nuclear ambitions revolve primarily around acquiring the credible capacity to retaliate in response to any nuclear attacks upon itself—thereby preventing such attacks to begin with. In this prophylactic quest, however, China currently is not satisfied to settle merely for some kind of an existential deterrent. Rather, it seeks the capability to certifiably inflict extensive punishment even on major nuclear adversaries, depending on the scale of

the damage China itself suffers in their attacks, with the aim of enforcing speedy war termination. To that end, Beijing intends to induct a diverse and large enough nuclear force—without mimicking in size or sophistication the capabilities maintained by its principal rival—that can deter and, if necessary, retaliate against nuclear aggression at varying levels much more rapidly than has been the case historically. This capability to inflict discrete and targeted punishment all the way to extensive and guaranteed destruction arguably suffices for effective deterrence even against its advanced nuclear competitors while implicitly bequeathing it with nuclear superiority against regional nuclear adversaries such as India.



## CHAPTER 2

# INDIA

### THE REMARKABLE PERSISTENCE OF STRATEGIC CONSERVATISM

Unlike China, which moved relatively quickly from dismissing the importance of nuclear weapons to acquiring them, India's path to nuclearization was long, convoluted, and delayed. Homi Bhabha, the father of the Indian nuclear program, understood the significance of nuclear weaponry very early, even as efforts to develop them were underway in the United Kingdom and the United States during World War II. After the Hiroshima and Nagasaki bombings confirmed their power, Bhabha became even more convinced that India might one day need such capabilities. Consequently, soon after India became independent in 1947, Bhabha wrote to the country's then prime minister, Jawaharlal Nehru—who was also a champion of science and technology—seeking funds to begin an atomic energy program in India.

Arguing that “it [was] reasonable to believe that within the next couple of decades, atomic energy would play an important part in the economy and the industry of countries and that, if India did not wish to fall even further behind industrially advanced countries of the world, it would be necessary to take more energetic measures to develop this branch of science and appropriate larger sums for the purpose,” Bhabha secured the resources to begin the atomic energy program that he headed until his untimely death in 1966.<sup>275</sup> This endeavor was intended to provide India with full mastery over the entire nuclear fuel cycle. Because India lacked natural uranium in the quantities required to sustain a large power generation program but possessed an abundance of thorium, Bhabha devised the ambitious and path-breaking “three-stage plan” that guides the Indian civilian nuclear program to this day.<sup>276</sup>



Simply described, Bhabha's approach focused on transmuting India's relatively small holdings of natural uranium to produce plutonium as a byproduct in pressurized heavy water reactors (PHWRs) in the first stage. This plutonium would then be used to breed uranium-233 (U-233)—an excellent fissile material capable of being used as fuel—in fast neutron reactors that incorporated a thorium blanket in the second stage. The U-233 thus produced would finally be combined with thorium in advanced heavy water reactors in the third stage to generate about two-thirds of the reactors' power output from thorium itself.<sup>277</sup> Since India possesses about 25 percent of the world's thorium reserves, in contrast to its negligible natural uranium holdings, its uranium constraints for electricity production would lose much of their salience over the long term as the second and third stages of Bhabha's envisaged plan came to maturity.

This remarkable design, which then required many technologies not yet in existence, was intended by Nehru and all his successors until Rajiv Gandhi principally for peaceful purposes.<sup>278</sup> Even now, many of the elements required to realize the promise of the three-stage plan remain elusive. For example, the high breeding ratios required to make the fast breeder program attractive are yet to be achieved.<sup>279</sup> Furthermore, the challenges of recycling the extremely radiotoxic U-233—essential to accomplish the fully self-sustaining thorium–U-233 cycle associated with India's third stage—have still not been overcome because, as one analysis points out, “there are [as yet] no technically and economically proven processes and equipment that have been developed and demonstrated for remotely-operated recycle fuel fabrication within a fully shielded and contained facility, especially at the large industrial scale that would be needed,”<sup>280</sup> anywhere in the world.

Although these persisting technological challenges remain a subset of the obstacles that India has had to surmount over the years, the political aims of its nuclear program have remained focused largely on advancing economic growth, with the national security benefits relegated to the periphery. The overriding objective in the early decades after India's independence was accelerating development. Cheap and plentiful electricity, something that the economic theory of the day emphasized as vital for growth, made atomic energy *the* technology to master.<sup>281</sup> By utilizing international cooperation—especially with the United States and its Atoms for Peace program as well as through other partnerships with the United Kingdom, Canada, and France—India secured access to nuclear technology and steadily built up its own domestic expertise sufficiently to develop a national nuclear power program that focused simultaneously on generating electricity and developing a range of new advanced technologies required by the second and third stages of Bhabha's ambitious plan—and, in time, a nuclear weapon as well.<sup>282</sup>

Because the first stage of his endeavor produced plutonium as a consequence of irradiating natural uranium fuel in a pressurized heavy water reactor, the Indian nuclear power program embodied a built-in weapons option since the recovered plutonium could be used flexibly either as fuel for its second-stage reactors or as a fissile material in the core of its

nuclear weapons. Both Bhabha and Nehru were aware of this potentiality. In fact, as early as 1948, barely a year after India's independence, Nehru would acknowledge in an address to the Constituent Assembly (which was preparing drafts of the Indian Constitution) that India might one day be forced to contemplate developing nuclear weapons. As he noted,

Of course if we are compelled to use [atomic energy] for other purposes, possibly no pious sentiments of any of us will stop the nation from using it that way. But I do hope that our outlook in regard to this atomic energy is going to be a peaceful one . . . and not one of war and hatred.<sup>283</sup>

Bhabha, in contrast to Nehru, had fewer inhibitions. In the aftermath of the first Chinese nuclear test in 1964, he became a strong advocate for developing nuclear weapons, but was unable to convince then Indian prime minister Lal Bahadur Shastri to embark on such a quest. What he got instead was a reluctant permission to begin exploring the technical requirements for “peaceful nuclear explosions,” which were then the object of considerable international attention.<sup>284</sup> This exploration would in time lay the foundation for the development of India's first nuclear device tested in 1974.

Although this nuclear explosion ostensibly marked India's entry into the nuclear club, it was far from real membership because its 1974 experiment was not a real “nuclear weapon test explosion”—in other words, it did not demonstrate a usable nuclear weapon.<sup>285</sup> In fact, India's moral inhibitions about procuring nuclear weaponry, its fears about the high costs of a nuclear weapons program, and its assessment that China, despite possessing nuclear weapons of its own, constituted more of a conventional than a nuclear threat, all combined to convince New Delhi that it should eschew the development of a nuclear arsenal. Despite the oddity of its one-off nuclear test in 1974, the desire for a peaceful nuclear program would thus survive in India for some forty years, from 1952, when Nehru unveiled the first four-year plan to develop India's nuclear infrastructure, to 1992, when India, facing the prospect of a nuclear Pakistan, finally began to weaponize the device designs that it had first begun to explore in the aftermath of China's initial nuclear test.<sup>286</sup>

This delay would have important consequences. Especially, it meant that China got off to a head start in developing nuclear weapons despite Mao's initial dismissal of their significance. In contrast, India appreciated the importance of nuclear weapons from the very beginning—in fact, even before the country became independent, if Bhabha's early activities are any indication. But India's refusal to develop nuclear weapons prior to 1967 implied that when it finally settled on nuclearization, it did so at a time when it could not be recognized as a legitimate nuclear-weapon state under the terms of the NPT as China was. Even worse, India had to pursue its nuclear weapons program in the face of the growing international opposition to proliferation that intensified in the aftermath of India's 1974 “peaceful nuclear explosion.”<sup>287</sup>

Accordingly, India's nuclear weapons development, which accelerated from 1988 until the second round of nuclear tests a decade later, all occurred largely invisibly, hidden by dense secrecy, as New Delhi sought to develop its deterrent in the face of strong global obstruction and stringent technology controls that constrained not just its nuclear program but all its other strategic endeavors, such as those pertaining to space and other high technology areas as well.<sup>288</sup> As a recognized nuclear-weapon state, China faced no comparable pressures and, hence, could persist with improving its nuclear capabilities openly and without any legal constraints.

***India's nuclear weapons development, which accelerated from 1988 until the second round of nuclear tests a decade later, all occurred largely invisibly, hidden by dense secrecy.***

That the Indian nuclear weapons program spun off from its civilian nuclear power generation efforts highlights a further contrast between India and China. From the very beginning—and to this day—peaceful nuclear science in its myriad applications remains the heart and soul of India's nuclear activities: it employs the majority of India's nuclear scientists, receives the bulk of the

funding from the Indian Department of Atomic Energy (DAE), and attracts the best minds in the Indian nuclear establishment. The weapons program comes in a poor second on all counts. In contrast, China initiated its nuclear investments fundamentally with an eye to producing weapons and only expanded into nuclear power long after its arsenal had matured; exhibiting exactly the opposite direction, India focused on nuclear power production far before it was reluctantly pushed into developing nuclear weapons. This dissimilarity also explains why the Chinese weapons program initially utilized uranium-based nuclear weapons designs, since Beijing's early gaseous diffusion technology was intended purely to produce highly enriched uranium for its weapon cores. From the beginning, Indian weapons used—and still use—plutonium as their principal fissile material. The plutonium for India's weapons program has been produced primarily in its research reactors, first the Canada India Reactor Utility Services (CIRUS) and now the Dhruva, although these reactors also support other research activities associated with the country's power program and various nuclear science applications.<sup>289</sup>

For all the differences in the origins, emphasis, and capabilities of their respective nuclear programs, however, the Chinese and Indian approaches to nuclear deterrence share important similarities. Perhaps most important is their common conviction that nuclear weapons are primarily political instruments useful to deter nuclear attacks and nuclear coercion by other nuclear powers rather than being useable tools of war.<sup>290</sup> As such, their efficacy derives primarily from possession rather than from use—in sharp contrast to other military paraphernalia whose significance derives mainly from how they might be employed in operational terms. As discussed in Chapter 1, despite China's nuclear weapons increasing in numbers and improving in diversity and quality, Beijing still holds on to the notion that

nuclear weapons are pure deterrents. India does too, with even greater intensity, thus placing its nuclear doctrine—indeed, even more emphatically than China’s—squarely at the deterrence end of the “deterrence-defense continuum” that Glenn Snyder illuminatingly explored almost sixty years ago.<sup>291</sup>

The fervency of the Indian belief about nuclear weapons being solely political instruments is grounded in multiple sources. For starters, it is anchored in the perception that even small nuclear weapons of the sort that India possesses are capable of inflicting horrendous damage on an adversary’s core assets, namely its population and industrial centers and some types of military targets—damage that invariably would exceed all the rational ends of politics in the real world. The experience of the Cold War left Indian policymakers convinced that fighting a nuclear war, let alone winning one, is an absurd enterprise; hence, the only sensible purpose of such weapons is to deter either their actual or their threatened use by others.<sup>292</sup> This conclusion has been strengthened by the implicit judgment that, both today and for the foreseeable future, India is likely to remain a “subaltern” nuclear state in the realist, not postcolonial, sense: it is unlikely to enjoy the freedom to wage nuclear war as the United States and the Soviet Union imagined they could when both states lay at the apex of the international system. India’s choices are much more constrained both by the interests of the other great powers and the deepening tradition of the non-use of nuclear weapons, thus strengthening its conviction—also shared with China—that the benefits of deterrence will continue to derive more from possession than actual use.<sup>293</sup>

The constancy of this assessment bestows upon India the further advantage of enabling it to bridge its long-standing opposition to nuclear weaponry, which was manifested in its vociferous Cold War campaign for nuclear disarmament, with its new acceptance of nuclear weapons as essential to its security. If these instruments are more valuable to protect security than to underwrite ambitious political aims—an especially inevitable consequence when both India and its rivals possess nuclear weapons—their possession becomes more easily tolerable because they are ultimately defensive instruments and hence justifiable in a situation where New Delhi has no other choices.<sup>294</sup>

Finally, treating nuclear weapons as purely political rather than military instruments—a judgment Indian leaders believe accords with reality—enables them to resolve other internal dilemmas that come with their possession. For example, it justifies the maintenance of a relatively modest—and, by implication, cheaper—arsenal if India settles for a strategy of inflicting unacceptable levels of punishment by holding at risk a small number of vital targets at a time when its economic development and conventional military requirements are still far from being satisfied thanks to constrained resources. It also permits New Delhi to preserve its extant system of “assertive” control exemplified by absolute civilian supremacy over the military.<sup>295</sup> If nuclear weapons are political rather than military tools, the involvement of the armed services in nuclear operations can be minimized to the extent necessary for effective retaliatory operations, in contrast to the more extensive divestiture of civilian

authority that would be required were these weapons to be conceived as flexibly available for nuclear warfighting.

These considerations historically converged to shape India's nuclear doctrine in distinctive ways at both the declaratory and the operational levels of policy.

## INDIA'S NUCLEAR DOCTRINE

### The Declaratory Level

The declaratory doctrine was articulated in two iterations in the aftermath of 1998 nuclear tests: first in draft form by the National Security Advisory Board in 1999 and, because of controversies involving this document, later in more authoritative but laconic form by the Cabinet Committee on Security in 2003.<sup>296</sup> Although the latter modified the former in interesting respects, the logic of the draft nuclear doctrine essentially survived because it comported fundamentally with the Indian state's core intuition about nuclear weapons being primarily political instruments.

Although neither version of India's publicly articulated doctrine formally separated the declaratory from the operational component, it is possible to prescind the two analytically into three elements each. The declaratory component encompassed India's commitment to build and maintain a "credible minimum deterrent," bind itself to a policy of "No First Use," and signal that it would respond to any nuclear attacks on itself or its military forces with "massive" retaliation "designed to inflict unacceptable damage" on an aggressor.

#### A Credible Minimum Deterrent

The doctrinal declaration that India would build and maintain a credible minimum deterrent was intended to convey that New Delhi had no interest in developing a larger nuclear arsenal than was necessary to service the objective of inflicting intolerable costs on any adversary that might employ nuclear weapons against India or its armed forces. Since India's nuclear weapons in their diverse variants were presumed to be inordinately destructive, they were not needed in enormous numbers for successful deterrence.<sup>297</sup> Although India, like China, would not publicly quantify the number of weapons that would constitute "minimum" deterrence, Indian policymakers did indicate what their force levels would *not* entail: the Indian deterrent would not necessarily be pegged to the size of an opponent's nuclear force nor would it be large enough to underwrite any concepts of nuclear warfighting as, for example, U.S. and Soviet forces were during the Cold War. Rather, India's minimum deterrent would only be as large as was necessary to enable its residual fraction—the force components that survive an adversary's first strike—to hold a sufficient number of the enemy's key assets at risk.<sup>298</sup>

Because the most valuable national possessions, such as population and economic centers and perhaps some kinds of military assets, are all relatively large and soft targets, retaliation did not require thousands of nuclear weapons. Thus, Indian policymakers envisaged a small nuclear force, although there was no way to fix its maximum size a priori. Even though the number of targets India sought to interdict would not increase dramatically over time, the survivability of its own weapons could fluctuate depending on the evolution of an adversary's offensive capabilities and its own targeting strategies.<sup>299</sup> Consequently, prudence required keeping the size of the Indian deterrent open—especially when Chinese and Pakistani nuclear forces were also expanding—but without deviating fundamentally from the core objectives of avoiding nuclear arms races and shunning nuclear warfighting strategies.

After their 1998 tests, Indian policymakers envisaged a modest deterrent. Without publicly revealing any desired size, they calculated that the small number of adversary targets that needed to be held at risk for successful deterrence, the small (albeit growing) inventory of weapon-grade fissile materials in their possession, and the prospect of some kind of fissile material cutoff regime coming into effect would combine to permit only the maintenance of a modest but sufficient deterrent. The secrecy over the size of the anticipated force was itself viewed as contributing to successful deterrence because India's adversaries, unsure about what kind of capabilities they faced, would find it harder to mount splendid first strikes that could denature the Indian nuclear reserve. The Indian strategic community, however, attempted to concretize the meaning of a minimum deterrent. Toward that end, they offered different conceptions that ranged from sixty to some 300 weapons delivered by different kinds of delivery systems.<sup>300</sup>

Whatever their preferred arsenal involved, however, both the Indian government and its policy elites agreed that their deterrent had to be “credible.” Deterrence credibility is an amorphous concept, and it subsumes different elements, including the technical effectiveness of the nuclear weapons, their survivability and that of the associated command-and-control systems, the character of the retaliatory threats levied, and the perceived willingness of the leadership to actually strike back in the aftermath of absorbing a nuclear attack. All these factors combine in different ways to convince an adversary that its nuclear strike would not go unanswered and, hence, was not worth undertaking in the first place.

India has made various efforts to improve its deterrent over the last two decades. Various aspects of this endeavor will be reviewed in greater detail later, but the key point worth emphasizing is that New Delhi has not been obsessively concerned about credibility as the two superpowers were during the Cold War. Being a late nuclearizer, India has completely internalized the lessons of the nuclear revolution on this count: it believes that nuclear weapons are devastating instruments irrespective of their quality or yield, and that they are fundamentally unusable as normal implements of war.<sup>301</sup>

Given their expectation that the non-use of nuclear weapons will only be further entrenched in time, Indian policymakers do not believe that New Delhi needs to make extraordinary efforts to convey credibility: the fact that India possesses nuclear weapons, has demonstrated that at least some of them do work, expects that its viable weapons can exact a heavy toll on an attacker, and believes that no adversary can be confident about its ability to destroy the entire Indian nuclear force so as to thwart retaliation completely all coalesce to make even a modest Indian nuclear force sufficiently credible to deter nuclear attacks or nuclear coercion directed against the Indian homeland or its armed forces.<sup>302</sup> Toward that

end, New Delhi has systematically developed an extensive physical and procedural infrastructure to ensure the survival of its second-strike capabilities and the ability to direct their use when required for punitive purposes. India's approach to the challenge of credibility thus mimics China's entirely and within the context of regional politics seems reasonable.

***Given their expectation that the non-use of nuclear weapons will only be further entrenched in time, Indian policymakers do not believe that New Delhi needs to make extraordinary efforts to convey credibility.***

Furthermore, because Indian leaders seek no benefits from nuclear weapons beyond the deterrence of homeland attacks (which implicitly subsume threats of nuclear coercion), and because they are committed to employing their nuclear reserves only in retaliation, they view any concerns that may arise about their willingness to retaliate—an important concern during the Cold War—as completely misplaced.<sup>303</sup> Given the physical (and reputational) costs that would be imposed on India by any nuclear attack, New Delhi judges that its adversaries would have to recognize that it had no choice but to respond with nuclear use of its own either to avenge the damage suffered, or to punish the adversary for crossing the nuclear threshold, or to enforce speedy war termination. In Indian consciousness, credibility is thus inextricably linked to its decision to maintain a viable nuclear deterrent.

#### A No-First-Use Policy

The commitment to deploy a credible minimum deterrent is complemented by the second element of India's declaratory doctrine: the pledge to eschew the first use of nuclear weapons. The draft nuclear doctrine issued by the National Security Advisory Board emphasized this element clearly when it declared that India's deterrent forces were intended for "retaliation only." India would never use its nuclear weapons first in any circumstances since their "fundamental purpose . . . is to deter the use and threat of use of nuclear weapons by any State or entity against India and its forces." Moreover, India would also not use nuclear weapons or threaten their use against any non-nuclear state and against states that are "not aligned with nuclear weapon powers." This pledge constitutes the essence of India's no-first-use policy, which, mirroring China's own declarations, promises

that Indian nuclear use will only materialize in the form of “punitive retaliation should [nuclear] deterrence fail.”<sup>304</sup>

The official Indian doctrine issued some three years after the draft reaffirmed the commitment to no first use by noting that “nuclear weapons will only be used in retaliation against a nuclear attack on Indian territory or on Indian forces anywhere,” and that nuclear weapons would not be used “against non-nuclear weapon states.”<sup>305</sup> But it qualified the unconditional no-first-use pledge articulated in the draft doctrine by noting that “in the event of a major attack against India, or Indian forces anywhere, by biological or chemical weapons, India will retain the option of retaliating with nuclear weapons,” meaning that India might use its nuclear weapons first in the case of such contingencies.<sup>306</sup> This caveat provoked controversy because it seemed like a dilution of what was previously advertised as evidence of India being a responsible nuclear power. Consequently, the skepticism about India’s no-first-use pledge, which, like all similar declarations elsewhere, suffers from the logical limitation of being unverifiable a priori, received further credence especially in Pakistan, which, thanks to its traditional animosity toward India, is highly suspicious of the latter’s intentions in any case.<sup>307</sup>

While the official formulation of India’s no-first-use pledge thus arguably permitted nuclear first use under some conditions, further clarifications offered by senior Indian officials at the time to the U.S. government suggested that the practical import of this new caveat was less significant than it appeared at first sight.

In diplomatic consultations in 2003, senior Indian officials involved in the management of nuclear policy noted that any Indian first use to a chemical or biological attack would be *contemplated* only if the effects of that attack had *mass casualties as a consequence*.<sup>308</sup> In other words, what could provoke a nuclear response was not simply chemical or biological attacks but rather those events that mimicked nuclear weapons in producing catastrophic consequences for the Indian population or its armed forces. Further, the option to use nuclear weapons first in such circumstances obviously applied only to attacks emanating from states and would be irrelevant against non-state actors.

The caveat about possibly using nuclear weapons first—not the commitment to use them first—in response to calamitous chemical and biological attacks was judged to be necessary because India’s acceptance of the Chemical Weapons Convention (CWC) and the Biological Weapons Convention (BWC) had had the effect of preventing New Delhi from being able to respond symmetrically. By accepting the disarmament obligations associated with the CWC and the BWC, India effectively gave up the possibility of retaliatory attacks in kind, or, at least, would be incapable of doing so after it had given up its chemical and biological weapons stockpiles as required by these agreements. In circumstances where punishment through conventional means was not an adequate option, Indian policymakers felt that nuclear weapons remained their only plausible instruments of retribution were their country to become a victim of chemical or biological attacks by foes that might cheat



on their disarmament obligations. Even so, they emphasized that preemptive or preventive nuclear use was emphatically not what was being entertained, only punishment for serious transgressions committed by an adversary.

In adopting this new caveat, India viewed itself as simply emulating the U.S. position of the day as it was articulated in then president George W. Bush's administration's 2002 Nuclear Posture Review. This review was followed closely in New Delhi and proved particularly persuasive to India given its own fears about the potential for dishonesty or breakout on the part of countries like Pakistan and China.<sup>309</sup> Even in these cases, Indian policymakers emphasized that their effort to invoke nuclear first use as the ultimate sanction against chemical and biological attacks ought to be viewed only as a prudential antidote in admittedly remote contingencies. Indian government officials did not believe then (or now) that chemical and biological attacks were the most pressing strategic problem facing their country and, hence, cautioned against making more of the new caveat in the Cabinet Committee of Security's statement than was necessary. As one senior Indian official privately phrased it, "the Indian effort to counter mass destruction attacks involving chemical and biological weapons through nuclear threats should be viewed more as a chapeau designed to deal with uncertainty than as an active principle guiding current Indian nuclear strategy."<sup>310</sup>

For all these reasons, it is plausible to argue that the Indian commitment to no first use remains meaningful even though it cannot be verified in any tangible way. Obviously, the most fundamental justification for considering this commitment to be credible is not its utterance but because it comports with India's deepest strategic interests. As former Indian national security advisor Shivshankar Menon has summarized it, because India does not face the problem of "deter[ing] conventional and nuclear aggression against exposed allies confronting local conventional inferiority" and its "geographic and strategic situation [implies] that nuclear weapons [are] not seen as the answer to problems of conventional defense,"<sup>311</sup> a no-first-use policy is a sensible response to the principal challenges—avoiding nuclear attacks and nuclear coercion—that India faces today and in the future. Because this solution is "dictated not by passivity or idealism but a deep realism, an understanding of the limited purpose that nuclear weapons can play in the strategy of any nuclear weapon power, but particularly that of one such as India,"<sup>312</sup> it should not be dismissed as subterfuge because its underlying logic is still impeccable and, even more importantly as subsequent discussion will elaborate, it continues to inform the management of India's nuclear posture.

### The Threat of Massive Retaliation

The third element of India's declaratory policy pertains to the nature of the retaliation that New Delhi would unleash were deterrence to fail. The draft doctrine addressed this issue by stating simply that India "will respond with punitive retaliation" in the event of nuclear attacks.<sup>313</sup> The official statement issued years later changed the adjective "puni-

tive,” declaring instead that “nuclear retaliation to a first strike [on India] will be massive and designed to inflict unacceptable damage.”<sup>314</sup>

This shift from punitive to massive retaliation was prompted by the desire to strengthen what New Delhi views as the critical firebreak between conventional and nuclear conflict. As far as strategic planning is concerned, India focuses its military investments on warding off threats primarily from China and Pakistan. China’s nuclear capabilities vastly outstrip India’s, while Pakistan’s nuclear capabilities are comparable or marginally superior. India, however, enjoys significant conventional military advantages against both adversaries.<sup>315</sup> Consequently, while Indian leaders desire to avoid all wars to the degree possible, they can more comfortably countenance conventional operations when necessary because their leverage is most pronounced in these encounters. Any nuclear exchange, on the other hand, would exact a high and intolerable toll on India, irrespective of the damage inflicted on the adversary.

Not surprisingly then, India seeks to deter all forms of nuclear attack: because even token nuclear employment by an adversary would open the door to more expansive escalation, New Delhi seeks to deter *any* nuclear use even amid conventional conflicts. In practical terms, this signaling was directed more toward Pakistan than toward China because when India enunciated its official doctrine in early 2003, it assumed that Pakistan was the more reckless and risk-acceptant state as its long history of aggressiveness toward India (only further exemplified by the 1999 conventional conflict at Kargil) had amply confirmed.<sup>316</sup> Even the new pugnacity now displayed by China, however, is unlikely to change this element of India’s declaratory doctrine; New Delhi would still seek to avert any kind of Chinese nuclear attacks on India in the context of either a major or a limited conventional conflict—although it is readily acknowledged by Indian security elites that, despite the growing troubles in the Sino-Indian relationship, nuclear interactions between the two Asian great powers have been conspicuously stable.<sup>317</sup>

In any case, the rhetoric of massive retaliation is also intended to avoid another problematic outcome from India’s perspective: giving the impression that it is willing to consider the possibility of nuclear warfighting in different guises in order to shore up deterrence. Consequently, India has consistently rejected ideas such as demonstration shots, limited nuclear use, or graduated escalation as undermining the goal of preventing any nuclear use. These alternatives are deeply unsettling to India—just as they appear to be in the case of China—because they would undermine its intention to maintain a minimum deterrent, subvert its currently assertive nuclear command-and-control system that institutionalizes civilian supremacy, and threaten its belief that orderly nuclear exchanges are impossible. Just like their Chinese counterparts, Indian policymakers believe that what happens after any nuclear first use is difficult to predict and, hence, all nuclear powers should exert themselves entirely to preventing all kinds of nuclear use to begin with. Even as Pakistan’s efforts to develop tactical nuclear weapons have come to light,

India's belief that the nuclear threshold cannot be crossed without provoking dangerous and unanticipatable consequences has not changed one whit. Consequently, its threat to respond "massively" to any nuclear attack on its territory or its armed forces has also remained unchanged.<sup>318</sup> (The ongoing Indian debate about this approach is reviewed later in this chapter.)

## The Operational Level

If India's declaratory doctrine thus encompassed the quest for a credible minimum deterrent, a commitment to no first use of nuclear weapons, and the threat of massive retaliation if India or its armed forces are attacked by nuclear weapons, its nuclear doctrine at the operational level incarnated these convictions through the institutional structure, the deployment practices, and the procedural systems that characterize its evolving deterrent.

### Maintaining a Force-in-Being

The first element of India's traditional nuclear policy at the operational level consisted of maintaining its nuclear deterrent as a force-in-being governed by an assertive command system centered on strict civilian authority. A force-in-being is essentially a de-mated deterrent where the different components—fissile cores, weapons assemblies, and delivery systems—are preserved separately and under the control of different custodians depending on the type of delivery system in question. The Chinese nuclear deterrent to this day is routinely maintained largely as a force-in-being and the Indian nuclear posture since its 1998 nuclear tests has also conformed to this model, albeit with adjustments, despite the transformations that will occur once India's SSBNs are fully operational.<sup>319</sup>

The reason for maintaining Indian nuclear capabilities as a force-in-being derived principally from the judgment that New Delhi did not need instantaneous retaliation for purposes of effective deterrence. Rather, like China, India assumed that bolt-out-of-the-blue nuclear attacks—the one contingency that was greatly feared by both the United States and the Soviet Union during the Cold War—were unlikely in the post-Cold War era and were certainly not plausible in the political interactions of subaltern nuclear powers. Because the threats of nuclear use or coercion were likely to emerge only in the context of serious political crises, sufficient strategic warning would be available to integrate the various components of the separated nuclear force into usable and deliverable weapons when required in a supreme emergency.

Similar to China again, India also sought to preserve strict civilian control through such a posture: civilian organizations like the Department of Atomic Energy and the Defense Research and Development Organization (DRDO) retained control over the fissile cores and the weapon assemblies, while the uniformed military managed and maintained the delivery systems.<sup>320</sup> When authorized by India's national command authority—meaning

the prime minister and the Cabinet Committee on Security (or their designated successors in case of any successful decapitating attack)—the various components of India's nuclear deterrent would be integrated in conformity with a predesigned four-stage alert sequence. Because preserving negative control was imperative, these weapons would be launched only after their use was expressly authorized by the apex authorities which, in accordance with India's declaratory doctrine, would occur only in the aftermath of an adversary's first strikes.

At the time of the 1998 nuclear tests, the Indian arsenal consisted principally of gravity bombs to be delivered by aircraft such as the Mirage 2000 and missile warheads that could be delivered primarily by the liquid-fueled Prithvi short-range ballistic missiles. The solid-fueled Agni missiles, which represent a key component of India's nuclear deterrent today, were then still in development (as some versions still are).<sup>321</sup> Although it was unclear at the time, India probably also allotted a few ship-based Prithvi variants, the Dhanush, for nuclear missions in an effort to both improve the survivability of its small nuclear force and to be able to target Pakistan from a seaward axis.<sup>322</sup> Although India had enough WGPu for about fifty nuclear weapons in 1998,<sup>323</sup> it is unlikely to have had more than two dozen or so machined cores since an arsenal of this size was judged in the preceding decade to be sufficient to deter Pakistan, which was then viewed as India's most important nuclear adversary.

The small number of Indian nuclear weapons and the short range of both India's tactical aircraft and its liquid-fueled missile delivery systems around 1998 highlighted the primacy of Pakistan over China in India's nuclear calculations at the time. To prevent any easy first strikes by Islamabad, India's unassembled nuclear weapon components were routinely stored at secure sites under civilian control spread deep around the Indian landmass. The Indian air and missile bases, which were located closer to the border, usually had underground shelters where the nuclear components delivered from rearward locations could be received prior to their assembly and checkout, after which they would be mated with the military-controlled delivery systems.<sup>324</sup>

This model of managing India's nuclear arsenal, at least where its land-based systems were concerned, was judged sufficient for effective deterrence because it preserved civilian control durably, minimized the possibility of accidents, and, as long as adequate strategic warning was available, enabled New Delhi to constitute its deterrent in an orderly way. Even if India was subjected to surprise nuclear attacks, a possibility that Indian policymakers viewed as highly improbable, this response regimen would arguably have been adequate so long as India's covert nuclear repositories and its delivery systems survived the first strikes. In such circumstances, India's nuclear deterrent would have had to be reconstituted in a messier environment. But as long as its leadership, its weapons, and at least some delivery systems survived, its retaliatory response would have been inevitable—and this, Indian policymakers believed, was sufficient for deterrence.

The process of transforming the Indian force-in-being into an employable deterrent is by definition a lengthy one: it involves orchestrating several organizations and marrying potentially widely dispersed assets. Ideally—assuming strategic warning—the entire alerting and integration sequence would be completed prior to the outbreak of war, but, even if not, at least *before* India absorbed any nuclear attacks. Whenever its nuclear forces were readied, however, India's no-first-use doctrine implied that some kinds of nuclear operations, such as launch on warning and launch under attack, were axiomatically excluded for technical as well as prudential reasons. Being realistic, Indian decisionmakers recognized that in some situations their deterrent force might come to full readiness only slowly; hence, their early post-1998 thinking encompassed different possibilities that included integration after, during, or before nuclear attacks on India.

In practice, however, and whenever strategic warning has been unavailable—as was demonstrated first during the Kargil crisis—India proceeded to constitute a small number of its nuclear weapons and prepare a few nuclear delivery vehicles for possible retaliatory operations in parallel with the conventional military operations that proceeded autonomously.<sup>325</sup> Again, this is not surprising. Even in the midst of the most intense crises that New Delhi has faced since 1998, Indian policymakers did not expect extensive (or even any) nuclear attacks, but sought to be prepared to respond as quickly as possible if their expectations were to prove false.

#### Accepting Delayed Retaliation

The uncertainties involved in the process of alerting and integrating nuclear forces shaped the second element of India's traditional nuclear doctrine at the operational level, which consisted of an acceptance that its nuclear retaliation, while assured in response to any attack, might have to be delayed.<sup>326</sup> The extent of the delay would obviously depend on a variety of factors such as the availability of strategic warning and the scale of the nuclear attacks upon India, their targets, and their effectiveness. Since these variables could not be assessed with confidence in advance, Indian leaders accepted the possibility that their nuclear riposte might take time to execute but without in any way indicating what the tolerable interval for their retaliatory response might be. The similarity here with China's historic approach is noteworthy, though it is unlikely that New Delhi would have settled for the lengthy delays that Beijing seemed prepared for during the Cold War—unless it was compelled to by circumstances. In all likelihood, India would have preferred that its retaliation occur within hours to days of suffering an attack rather than weeks to months, as the Chinese strategist quoted earlier had argued would suffice in the case of Beijing.

Since the rapidity of the Indian retaliation would ultimately have been determined by the manner in which a conflict evolved rather than by any a priori leadership preferences—even if India had maintained a ready arsenal as opposed to a force-in-being—Indian decisionmakers emphasized more its inevitability than its timing.<sup>327</sup> They judged sensibly that the

survivability of the Indian deterrent was far more important than the alacrity of retaliation and, should the two objectives ever come into tension, they would have settled for protecting their deterrent in order to assure retaliation to any attack over increasing the speed of their reprisals.

### The Threat of Punishment

The anticipated targets of any Indian retaliation were also left unidentified for obvious reasons. But given the broader Indian understanding of the utility of nuclear weapons, the third prong of India's nuclear doctrine at the operational level involved securing deterrence through the threat of punishment, which in turn implies holding at risk those targets whose "destruction . . . the aggressor will find unacceptable."<sup>328</sup>

This emphasis on punishment, as opposed to denial, derives equally from technical and political considerations. For countries that possess small nuclear arsenals with relatively low-yield weapons, interdicting soft targets such as population and economic centers and perhaps some kinds of critical infrastructure offer maximum bang for the buck: it allows even weaker nuclear states such as India to punish stronger adversaries such as China in horrific ways that ultimately strengthen deterrence. The destruction of any countervalue targets constrains national regeneration after a conflict and enables war retardation far more successfully than attacks on either hardened nuclear weapon sites or military forces, both of which may require either large numbers of or high-yield nuclear weapons and highly accurate delivery systems.<sup>329</sup>

Consequently, if the political objective is to punish nuclear aggression, attacking countervalue targets is most effective among other things because it inflicts the most pain on an adversary and can be prosecuted even with small nuclear arsenals of the sort that India possessed. What such a targeting strategy consciously excludes, therefore, are counterforce attacks on an adversary's nuclear weapons, its nuclear storage sites, and its command-and-control network, because successful operations require potentially more nuclear weapons of higher yield and accuracy.<sup>330</sup> A countermilitary targeting strategy aimed at interdicting assets such as land, air, and naval bases, logistic facilities, and fielded formations is also undesirable—although it can be executed in token form—because it potentially requires numerous weapons for operational success and cannot match the pain inflicted by a smaller number of countervalue attacks.<sup>331</sup>

While India's emphasis on punishment, therefore, has never excluded retaliation on countermilitary targets, especially because punishing the Pakistani armed forces (and in particular the army) must have lain prominently in Indian consciousness if it ever became a victim of nuclear attacks unleashed by Islamabad, inflicting "unacceptable" pain through comprehensive countermilitary targeting would require hundreds to thousands of nuclear weapons and, hence, cannot be an attractive strategy for a small nuclear force. If administering token

or proportionate punishment is all that is desired, however, countermilitary targeting offers attractive possibilities because it enables India to punish what may be limited nuclear use by an adversary while still holding the prospect of unleashing more costly countervalue attacks in reserve.

Because such a response inevitably conveys a willingness to engage in a limited nuclear war, it is not surprising that Indian security managers, just like their Chinese counterparts, have never discussed such possibilities publicly. Nor are they ever likely to do so despite the frequent calls for clarity about India's nuclear strategy issued by academics both in India and in the United States. Given the overarching objective of preventing any nuclear use to begin with, Indian policymakers believe—correctly—that a studied silence about their retaliatory options contributes more toward effective deterrence than engaging in any public discussions about their possible responses to various nuclear emergencies. On this count, they believe that India's possession of nuclear weapons by itself should induce greater caution on the part of its adversaries, whereas any exhaustive statements about its planned retaliation could increase the prospects of deterrence breakdown if it stimulates rivals to test those commitments.

## Recent Doctrinal Debates

The Indian nuclear doctrine at the declaratory and operational levels elaborated above has dominated New Delhi's thinking since its 1998 tests. The details substantiate its essentially conservative disposition—quite like China's in many respects—and serve as a baseline to examine whether India is in fact dramatically shifting away as some recent commentary has alleged.<sup>332</sup> That the doctrine, which has focused on protecting India from nuclear dangers without making nuclear weapons the all-encompassing centerpiece of its national defense, has episodically come under pressure is understandable. It was developed and articulated when India was making the transition from a covert to an overt nuclear power, when foreign nonproliferation pressures on New Delhi had not abated, and when there were widespread expectations in India that its mere acknowledgement of possessing nuclear weapons would automatically enhance regional stability. While this last hope did not materialize in the manner that India had anticipated, its nuclear doctrine has nonetheless survived with minimal modifications because, despite the changes occurring in the Chinese and Pakistani nuclear programs and behaviors over the last two decades, India's strategic circumstances do not require a more ambitious nuclear doctrine for enhanced security.<sup>333</sup>

The larger transformations that have occurred within Southern Asia over the last twenty years—namely, the continuing expansion of the Chinese and Pakistani nuclear arsenals and the persistence, perhaps even the increase, in Pakistani-backed terrorism against India while Islamabad shelters under its own nuclear umbrella—have, however, forced discussions among Indian elites about whether some aspects of their nuclear doctrine should be revised. The two most significant issues in this regard at the level of declaratory policy are

Indian deliberations about the viability of its no-first-use commitment and the wisdom of persisting with its strategy of massive retaliation.

Other aspects of the doctrine have also been occasionally questioned, but without meaningful significance. For example, the first element of India's declaratory doctrine, the commitment to a "credible minimum deterrent," is sometimes doubted in different ways. One prominent Indian commentator, Brahma Chellaney, for example, has argued that the former Indian government headed by prime minister Manmohan Singh was undermining India's nuclear deterrent as part of the subversive concessions offered to the United States under the U.S.-India civil nuclear cooperation agreement. Citing the formulation used by the then defense minister Pranab Mukherjee, who labeled India's arsenal a "minimum credible deterrent" instead of using the official phraseology—a "credible minimum deterrent"—Chellaney argued that the Singh government had engineered a major policy shift surreptitiously to justify weakening India's nuclear weapons capabilities.<sup>334</sup>

The speciousness of this claim, which was based solely on Mukherjee's linguistic infelicity, did not escape more careful observers.<sup>335</sup> But it does highlight parenthetically another problem that frequently recurs in nuclear discussions in India: most Indian policymakers who speak on these issues are not well versed in the arcane terminology of nuclear deterrence theory that emerged in the West during the Cold War. Consequently, their more casual use of language often requires careful "hermeneutical" interpretation to assess their true meaning and intentions. Literally appropriating what may sometimes be poor linguistic formulations can be a terribly misleading guide to India's strategic direction.<sup>336</sup>

In any event, most allegations of a dramatic shift in India's nuclear doctrine have emerged from the opposite direction, with several commentators claiming that its evolving nuclear forces are now breaking the bounds of "minimum deterrence." A good example is provided by Yogesh Joshi and Frank O'Donnell, who have argued that India's expanding nuclear force suggests that New Delhi now prizes "credible" over "minimum" deterrence as evidenced by "recent development projects—such as multiple independently targetable reentry vehicle (MIRV) warheads, the 700 kilometer-range Shourya nuclear missile, and the potentially nuclear-capable short-range Prahaar, Brahmos and Nirbhay missiles—[which] indicate Indian interest in a war-fighting capacity."<sup>337</sup> Both the facts and the inference are problematic in this instance: some of the missiles referred to are not necessarily intended to carry nuclear weapons. If they do—an issue explored later—they are in some cases intended as replacements for more obsolete systems that will soon exit the Indian inventory. And even if some systems eventually come to have nuclear missions—the Brahmos and the MIRVs being prominent examples—the conclusion that they are designed for nuclear war-fighting, as opposed to supporting the traditional mission of nuclear retaliation, is neither obvious nor accurate.<sup>338</sup>



The discussion about credible versus minimum deterrence thus runs the risk of becoming little other than casuistry because neither concept has precise entailments. As Lieutenant General B. S. Nagal, a former commander of the Strategic Forces Command, has rightly noted, India's force size and structure will inevitably be "dynamic because the adversaries' arsenals are increasing by the year."<sup>339</sup> This conclusion only echoes the early judgment offered by Jaswant Singh in the aftermath of the 1998 nuclear tests when, in response to U.S. demands that India quantify in "concrete terms" the size and character of its minimum deterrent, he declared that New Delhi's force levels were "not a fixity."<sup>340</sup> Since the notion of a minimum deterrent is thus inherently elastic with respect to the number of nuclear weapons, it is not surprising that Indian policymakers have not felt compelled to renege upon or revise their declaratory commitment to a credible minimum deterrent.

As long as India's nuclear deterrent is sized in ways that permit it to maintain the smallest secure second-strike force capable of inflicting unacceptable punishment on an aggressor, its nuclear deterrent would by definition be both minimum and credible. The likelihood of satisfying this requirement greatly increases if the surviving weapons are of high-enough yield to make successful attacks on the desired number of area targets both easy and unpreventable. Understanding what this encompasses in terms of specific numbers and types of weapons depends on political judgments that incorporate force exchange calculations but ultimately cannot be reduced to them. The strategic environment facing a country and the degree of risk a leadership is willing to accept both have an important bearing on the issue of "how much is enough." As the experience of the Cold War demonstrates, the number of nuclear weapons judged to be sufficient by all sides varied with circumstances, with the United States and the Soviet Union reaching for weapons in the tens of thousands while the United Kingdom, France, and China ended up with inventory sizes in the low hundreds.<sup>341</sup> Where the smaller nuclear powers were concerned, their nuclear arsenals were, at any rate, much larger than the number of targets they sought to hold at risk, which were far fewer in comparison to the number of weapons in their national deterrents.<sup>342</sup>

At the end of the day, what is most striking about India's continued adherence to the pursuit of a credible minimum deterrent is not the non-official debates about the term, but rather New Delhi's disinclination to rapidly expand its arsenal despite the advances demonstrated by its rivals. As the subsequent discussion about force capabilities will suggest, New Delhi has not ramped up the production of nuclear warheads dramatically since its 1998 tests even though it has the capacity to do so. This fact alone suggests the continuing dominance of the minimum deterrence paradigm in the consciousness of India's security managers: whether this will change because of China's expanding arsenal or Pakistan's nuclear diversification, only time will tell. But the evidence thus far suggests that India's nuclear expansion since its 1998 tests has been slower than that of its rivals and can still be defended as subsisting within the bounds of minimum deterrence.

In contrast to the sophistic disputation about what constitutes a credible minimum deterrent, the episodic Indian controversies about its no-first-use doctrine have potentially more serious consequences. In the aftermath of the Cold War, China was also locked into a similar debate over its no-first-use policy, but with two important differences in comparison to India. The Chinese debate about no first use occurred fundamentally in the context of threats anticipated from more powerful adversaries such as the United States, and the discussion was conducted entirely by strategic elites with no involvement by political leaders. In the Indian case, the doubts about no first use have been precipitated oddly by the actions of a weaker but more risk acceptant adversary, Pakistan, and involves utterances, however uncalculated, by senior government officials in addition to discussions within the wider strategic community.

The driving force underlying the Indian no-first-use debate has been the persistence of Pakistani-supported terrorism against India, which acquired renewed lease of life with Islamabad's acquisition of nuclear weapons. Confounding the early Indian expectation that Pakistan's nuclear weapons would bring peace because they would mitigate Islamabad's traditional fears about its security, nuclear weapons instead seem to have had exactly the opposite effect. Protected by their nuclear capabilities against the threat of conquest and major war, the Pakistani military and intelligence services ("Rawalpindi") have sought to exploit this immunity by supporting insurgencies within India in order to weaken it continuously through costly subconventional warfare. The persistent frustration with Pakistan's ability to "bleed India through a thousand cuts" under the cover of its nuclear weaponry<sup>343</sup>—which deters Indian conventional retaliation because of the fear of provoking a nuclear holocaust—has provoked some Indian elites to argue that the no-first-use policy should be reconsidered because this assurance ostensibly "frees Pakistan of the uncertainty and angst that India might contemplate the pre-emptive use of nuclear weapons to deal with terrorist attacks or limited conventional strikes by Pakistan."<sup>344</sup>

In the aftermath of any significant terrorist attacks within India, the sentiment for change often intensifies. The Bharatiya Janata Party (BJP) promised in its 2014 election manifesto to "study in detail India's nuclear doctrine, and revise and update it, to make it relevant to challenges of current times," an assurance that was viewed as presaging a change in India's no-first-use policy.<sup>345</sup> Leading Indian politicians have sometimes argued for such a shift directly. Thus, for example, India's then defense minister, Manohar Parrikar, asked in 2016, "Why should I bind myself? I should [only] say [that] I am a responsible nuclear power and [that] I will not use [nuclear weapons] irresponsibly. This is my [personal] thinking."<sup>346</sup> In a similar vein, his successor, Rajnath Singh, more recently stated, "Till today, our nuclear policy is 'No First Use'. What happens in [the] future depends on the circumstances."<sup>347</sup>

Just as in China, such statements have been dismissed by the Indian government as subjective ruminations that signify no change in its official no-first-use policy.<sup>348</sup> Thus, as recently as October 2020 and despite the acute crisis with China along the country's northern

borders, India's permanent representative to the Conference on Disarmament reaffirmed India's commitment "as per its nuclear doctrine, to maintain credible minimum deterrence with the posture of no-first-use and non-use against non-nuclear States."<sup>349</sup> Given the consistent official admissions, including by Parrikar himself, that India's existing no-first-use policy "has not changed in[side the] government,"<sup>350</sup> there is little doubt that the stray invectives against the no-first-use policy have been precipitated fundamentally by the continuing frustration with Pakistan. More problematically, however, they are driven by the belief that altering New Delhi's no-first-use policy would actually serve to deter Pakistan's subconventional wars against India.

That senior Indian policymakers now raise doubts about the no-first-use commitment indicates two things beyond their obvious resentment of Pakistan's behavior: (1) the increased freedom with which various officials in India now speak on nuclear issues, a perceptible change from the previous era prior to the conclusion of the U.S.-India civil nuclear cooperation agreement, when external nonproliferation pressures imposed a high degree of discipline when commenting on nuclear matters; and (2) the unsettling lack of understanding about nuclear deterrence on the part of many senior Indian leaders who, driven more by the imperatives of political messaging and sometimes domestic politics, inadvertently expose their ignorance of the implications for strategic stability. The latter is sometimes also true of Indian military officers who write about nuclear issues.<sup>351</sup>

The expectation that changing India's no-first-use policy would deter Pakistan's campaign of terrorism against India or enable India to more resolutely defeat Pakistan's subconventional wars is a prime example of the failure to understand what nuclear weapons actually deter, including in India's specific circumstances. It exemplifies an incomprehension of the "stability-instability" paradox and, by presuming that altering nuclear weapons policy can produce an effective antidote to terrorism, it also misunderstands the limited utility that nuclear weapons have in preserving Indian security.<sup>352</sup> As former Indian national security advisor Menon has astutely noted,

It seems to me that rather than seeking answers in our nuclear weapons to all the threats that India does or may face, it is important that we maintain the fundamentals of our doctrine, treating our nuclear weapons as political instruments that deter nuclear attack and attempts at coercion. The clearer and simpler the task of our nuclear weapons, the more credible they are. And the more credible they are, the stronger will be their deterrent effect. As for non-nuclear threats, there are other ways of dealing with them that are not beyond Indian ingenuity and capability to discover.<sup>353</sup>

Given this sensible judgment, it does not take much to conclude that threatening Indian nuclear first use against Pakistan would not produce the requisite "uncertainty and angst" that would cause it to desist from supporting terrorist attacks against India:<sup>354</sup> the destruc-

tive power of nuclear weapons is so great that any such threats would be simply astounding and therefore easily dismissed by Rawalpindi. As one scholar assessing the utility of nuclear weapons concluded, their value “as coercive instruments for other than mutual deterrence purposes [is] limited and rather ineffective.”<sup>355</sup> Not surprisingly then, the postwar record suggests that both “defenders and challengers rarely have found nuclear threats for limited objectives credible,”<sup>356</sup> even when one of the rivals has possessed absolute nuclear superiority. Because nuclear weaponry appears to be most potent not for compellence or coercion but only for deterrence against all-out attacks mounted on the homeland, an Indian renunciation of its no-first-use pledge will do little to stanch Rawalpindi’s low-intensity wars against New Delhi even as it would prove costly for India on many other counts within Southern Asia and beyond.

If abandoning the no-first-use policy buys India little where deterring subconventional conflict is concerned, it also proves to be just as inutile for countering any imminent—even limited—nuclear use by Pakistan. One retired Indian military officer, for example, offered the following scenario to suggest why Indian nuclear first use should be justified: “Let us imagine a scenario of a repeat of [a] 26/11-like attack. Our satellites detect Pakistan moving its F-16s to forward bases and begin arming of its missiles! Are we then to wait for the first nuclear bomb to fall on Delhi before we retaliate?”<sup>357</sup> Variations of this contingency animate those Indian commentators who are opposed to the no-first-use doctrine, which then leads them to epigrammatically declaim that “It ought to be made clear to Pakistan that India will not be the first to use nuclear weapons, but also not be second!”<sup>358</sup> The benefits of responding preemptively to any looming Pakistani nuclear attacks thus constitutes the second reason in the Indian debate for abandoning the country’s traditional pledge of not using its nuclear weapons first.

In this context, a few sentences in Menon’s book *Choices: Inside the Making of India’s Foreign Policy* fueled the speculation that India’s no-first-use policy had either changed or was on the cusp of change. In a chapter that otherwise provides an extensive defense of India’s no-first-use doctrine, Menon noted that:

There is a potential grey area as to when India would use nuclear weapons first against another NWS (nuclear weapons state). Circumstances are conceivable in which India might find it useful to strike first, for instance, against an NWS that had declared it would certainly use its weapons, and if India were certain that adversary’s launch was imminent. But India’s present public nuclear doctrine is silent on this scenario.<sup>359</sup>

These remarks have provoked allegations by some scholars, among whom Christopher Clary and Vipin Narang are the most prominent, who have maintained that India’s nuclear doctrine has, in fact, shifted (or is, at least, drifting) and now permits India to strike first with nuclear weapons if a nuclear attack was, indeed, imminent.<sup>360</sup> Other commentators,

based on Clary and Narang's assertions, have consequently claimed that India has now effectively transitioned toward a nuclear first use policy, even though its traditional nuclear doctrine on abjuring first use remains unchanged formally.<sup>361</sup>

These assertions are assessed in greater detail in Chapter 4 when different aspects of strategic stability in Southern Asia are examined. For the moment, however, it suffices to note that the claims about India's nuclear doctrine having incorporated first-use possibilities is dubious on diverse counts. Obviously—and by definition—any no-first-use commitment is impossible to verify a priori, so the promise that India would never use its nuclear weapons first would only be disproven when it actually does. The real question, consequently, is not whether any Indian first use is possible—it always is—but whether the expectation of nuclear first use by New Delhi is *reasonable* given both the circumstances that might provoke it and the capabilities that India possesses to make such (possibly preemptive) nuclear use effective. On both these counts, there are sufficient reasons for doubt (elaborated at some length in Chapter 4), but the problem highlighted by Menon about the challenges posed to India by any imminent nuclear attack must be addressed right away because it speaks directly to the question of whether the second element of India's traditional declaratory doctrine, no first use, is changing or whether the new revisionists are engaged in little other than what one Indian scholar has caustically labelled “ghost hunting.”<sup>362</sup>

While Menon is, indeed, correct that India's public doctrine is silent about how India would respond if faced with the contingency of impending nuclear attack, knowledgeable Indian security managers thought long and hard about this scenario in the years surrounding the 1998 nuclear tests. At that time, they concluded—rightly—that even when an adversary's nuclear first use loomed visibly, it still made sense for India, as the doyen of India's strategic thinkers, K. Subrahmanyam, put it then, to hew to “a totally uncaveated policy, with no reservation whatsoever on no first use.”<sup>363</sup>

The reasons for affirming this position are still unassailable. First, any information about an imminent attack will always be inherently ambiguous until the moment that nuclear detonations actually occur on Indian soil, because which adversary delivery systems have nuclear warheads and what their targets are could be uncertain; even if reliable information exists on these counts, preparations for launch can always be countermanded right up to the last second, thus making any preemptive Indian nuclear attacks on an adversary's prepared weapons potentially very costly. Second, unless it is presumed that India can preemptively attack *all* the adversary's nuclear weapons successfully—an impossible proposition for reasons discussed later in Chapter 4—simply striking that subset appearing to be prepared for imminent launch *with nuclear weapons* only ensures that a nuclear attack on India, “which was only probable up to that point, actually [becomes] inescapable.”<sup>364</sup> The consequences of any Indian nuclear first strike would then be either massive or graduated escalation by an adversary—both of which would then take India right into the nuclear war that its weapons were fundamentally intended to deter.

Of course, any nuclear first use by an adversary, which implies the ultimate failure of nuclear deterrence, would provoke Indian retaliation. But, in this instance at least, the deterrence breakdown would not have resulted from India having breached its no-first-use commitments. If anything, averting such a scenario requires India to pay more attention to ensuring the survivability of its nuclear deterrent rather than playing fast and loose with its no-first-use policy, because New Delhi should aim never to find itself in a position where it feels “compelled to use its nuclear weapons first merely because the vulnerability of its strategic reserves produces enormous differences between the expected costs of striking first and those of striking last.”<sup>365</sup>

If India’s retaliatory capabilities are survivable, the threat of an adversary’s nuclear first use dissolves into irrationality because it not only ensures that Indian retribution becomes inescapable but also renders nugatory all incentives for any Indian first use. As Lieutenant General Prakash Menon, who served as the military advisor to national security advisor Shivshankar Menon, noted in response to the controversy provoked by the passing remarks in the latter’s book:

*though India’s no first use [commitment] does not envisage pre-emption under any circumstances, it is possible that misjudgment, misperception, miscommunication, and/or sheer accident can set in motion a chain of events that manifests as a first strike. The lesson here is that one must avoid the situation where nuclear weapons are alerted. In fact, post the Cuban missile crisis, political leaders of nuclear weapon states have embraced caution in their strategic behavior, even if it was preceded by aggressive rhetoric. The no first use posture of India is likely to endure even as the pressure for change may linger on.*

The credibility of the no first use policy depends on survivability of the nuclear arsenal and its command and control system. Survivability, coupled with retaliation under the framework of credible minimum deterrence (CMD), is therefore the main challenge for India’s nuclear strategy (emphasis added).<sup>366</sup>

Confirming this assessment—and in a striking rebuttal of the claims that India has changed its no-first-use policy—Shivshankar Menon would reveal that, despite being reviewed thrice by various Indian governments since 2003, the no-first-use commitment has survived because “it actually serves India’s interests.”<sup>367</sup> Prime Minister Narendra Modi’s government too conducted a review of India’s nuclear doctrine as soon as it arrived in office in May 2014 and concluded that the no-first-use declaration merited continued retention. Because India’s interests ultimately consist of avoiding nuclear attacks of any sort, there is *no* Indian nuclear first use that ever advances that goal *even in circumstances when an adversary’s nuclear attack might be imminent*. Since New Delhi’s nuclear weapons can always punish an adversary’s first use by painful countervalue or even some countermilitary attacks at any time, there is never any need for India to use its nuclear weapons before its opponent does so. India is unlikely to ever face the prospect of conventional defeat that requires nuclear weap-

ons to correct such reverses. Furthermore, it cannot eliminate an adversary's entire nuclear reserves even by the first use of its nuclear weapons; consequently, any Indian nuclear first strikes on some adversary weapons that are presumably being readied for attack would ultimately be strategically futile because they would only invite further attacks by the enemy's surviving weapons.

Could New Delhi's no-first-use policy change in the future? It could. Even now, it is only an assurance that is unverifiable. But as long as India enjoys sufficient conventional force advantages over its adversaries and lacks nuclear weapons in the numbers, yields, and accuracies as well as the requisite intelligence to make so-called splendid first strikes on its adversaries' nuclear forces viable, the no-first-use commitment remains rational for India. It is the combination of political interests and technical inadequacies that makes India's no-first-use pledge realistic and not merely its public assurances. But because neither these interests nor these inadequacies are likely to change dramatically in the foreseeable future—as the discussion in Chapter 4 elaborates—India's no-first-use policy is likely to persist so long as its nuclear forces continue to evolve along their present trajectory.

Unlike the debate about no first use, which arose largely thanks to frustrations at the Indian end about Pakistani behavior, the discussion about the third element of India's declaratory policy—the wisdom of its commitment to massive retaliation—arose mainly because of the changes in Pakistan's nuclear capabilities. When Pakistan's nuclear inventory consisted solely of “strategic” weapons—meaning weapons with yields of about 12 kilotons intended mainly for countervalue attacks on India—the Indian doctrine of massive retaliation was plausible because it promised unacceptable pain if Islamabad were to ever cross the nuclear use threshold. Over a period of time, however, and in response to fears that New Delhi was developing strategies of punitive conventional retaliation against Pakistan's subconventional wars, the Pakistani military began to develop lower-yield nuclear weapons that were intended for limited use against India's conventional military forces.<sup>368</sup>

Once Pakistan shifted toward its version of “flexible response,” implying possibly limited nuclear first use against Indian military forces (operating either in Indian or Pakistani territory), the question of whether New Delhi's doctrine of massive retaliation remained credible became a new issue of contention within India. This debate is one that the United States is familiar with. The U.S. doctrine of “massive retaliation,” which was first articulated when Washington enjoyed significant nuclear superiority over Moscow but lacked the conventional force levels required to successfully protect its weaker European and Asian allies, evolved toward a doctrine of “flexible response” once the Soviet Union acquired a substantial arsenal of its own and could retaliate against any massive U.S. nuclear punishment with comparable attacks.<sup>369</sup>

In the Indian case, however, the incredibility of massive retaliation derived not from the fact that Pakistan acquired more larger-yield weapons but rather some smaller ones, which

it now threatened to use in various limited ways. Any massive Indian retaliation to such use would only have the effect of prompting equally massive Pakistani “third strikes,” thus nullifying the value of the Indian punishment to begin with. Once again, these concerns made sense because it was widely assumed in India that New Delhi’s retaliation would be directed mainly at either countervalue (or, at best, countermilitary) targets. Consequently, Pakistan would still have sufficient nuclear weapons of high enough yield to punish India’s nuclear retaliation by inflicting high (and presumably equally unacceptable) levels of damage to make the Indian punitive response relatively senseless.

This conundrum has provoked a variety of responses from Indian analysts. One approach has been to deny that “massive retaliation” is in fact the Indian doctrine because, as Rajesh Rajagopalan has argued, the official formulation “actually does not use this phrase, saying instead that ‘nuclear retaliation to a first strike will be massive and designed to inflict unacceptable damage.’”<sup>370</sup> This effort to distinguish between “massive retaliation” and “retaliation that will be massive” may be linguistically accurate, but it certainly has not been read that way by India’s most important nuclear adversary, Pakistan (which is perhaps where it matters most). Reading India’s doctrine as threatening massive retaliation, Lieutenant General Khalid Kidwai, the longtime director of Pakistan’s Strategic Plans Division, for example, has dismissed it as “very unrealistic” and one that has “not been thought through.”<sup>371</sup>

Another Indian scholar, Gopalan Balachandran, who has worked closely with the Indian government on many strategic issues, has offered a different defense. He argued that the notion of massive retaliation makes sense fundamentally in the context of punishing the “first strike” that India’s official doctrine explicitly refers to. In other words, the threat of massive retaliation is only invoked in response to a comprehensive counterforce strike levied by an adversary, thus leaving India to respond as it sees fit to any lesser forms of nuclear use without being constrained by the obligation to unleash all-out retaliation.<sup>372</sup> This defense is undoubtedly artful, but whether it is persuasive is another matter.

Whenever officially inspired articulations have materialized, however—as, for example, that offered by Shyam Saran, a former Indian foreign secretary, who delivered a notable defense of the conventional understanding of India’s nuclear doctrine—the emphasis on massive retaliation has only been reaffirmed. As Saran, in an address encouraged by the Indian leadership, argued:

India will not be the first to use nuclear weapons, but . . . if it is attacked with such weapons, it would engage in nuclear retaliation which will be massive and designed to inflict unacceptable damage on its adversary. As I have pointed out earlier, the label on a nuclear weapon used for attacking India, strategic or tactical, is irrelevant from the Indian perspective. A limited nuclear war is a contradiction in terms. Any nuclear exchange, once initiated, would swiftly and inexorably escalate to the strategic level. Pakistan would be prudent not to assume otherwise as it sometimes



appears to do, most recently by developing and perhaps deploying theatre nuclear weapons. It would be far better for Pakistan to finally and irreversibly abandon the long-standing policy of using cross-border terrorism as an instrument of state policy and pursue nuclear and conventional confidence building measures with India which are already on the bilateral agenda.<sup>373</sup>

Given the problems of credibility that afflict all formulations of massive retaliation in situations where rivals possess more-or-less significant (even if not symmetrical) capacities to harm, it is not surprising that several Indian analysts have, therefore, called for revising India's threats of massive retaliation to something lower, perhaps even reverting to the doctrine of "punitive" retaliation as was suggested in the draft doctrine.<sup>374</sup>

After extensive internal deliberations, the Indian government has chosen to avoid revising its declaratory doctrine for several reasons. For starters, the importance of retaining the threat of massive retaliation was judged essential to emphasizing that the firebreak that mattered most to India was the divide between conventional and nuclear war. The moment an adversary crossed into the latter, India *could* respond with essentially unlimited nuclear use, the threat of which was intended to prevent any nuclear excursion in the first place. The importance of retaining massive retaliation was also justified by what India expected would be the end result of even a limited nuclear response: further nuclear attacks of uncertain intensity by the adversary that could provoke more Indian nuclear retaliation. Because India wants to avoid both nuclear use and protracted nuclear war, whether through graduated responses or otherwise, it was judged that retaining the threat of massive nuclear retaliation offered the best promise of deterring all nuclear use to begin with, even if India chose to actually respond with less-than-maximal reprisals in any given instance.<sup>375</sup> The Modi government's early review of India's nuclear doctrine reaffirmed this conclusion, which had already been reached by its predecessor.

Other considerations also intervened to justify reiterating the original formulation when it could have been altered. The Indian government wanted to avoid modifying its nuclear doctrine every time there occurred some change in its strategic environment. Repeated doctrinal alterations could undermine the core message that India's declaratory affirmations were intended to convey: that any use of nuclear weapons against India would open Pandora's box and, hence, was not worth the risk for an adversary. Although Pakistan's shift from strategic to tactical nuclear weapons was obviously significant and could have justified revision of India's nuclear doctrine—as has occurred in other states when faced with comparable changes in their strategic environment—the Indian decision to reject change was ultimately grounded in a realistic view of the limitations of nuclear doctrine itself.

Indian policymakers are justifiably convinced that, at the end of the day, prewar nuclear doctrines—no matter what they say or do not say—do not deter; only nuclear weapons do. Hence, irrespective of their utterances or the inadequacies of their formulations, what

makes successful deterrence possible is simply nuclear weapons, their survivability, and the possibility of their use. As long as these elements subsist, the impact of doctrine is assessed to be marginal in the final analysis for successful deterrence. This judgment echoes the penetrating comment once offered by former U.S. secretary of defense James Schlesinger who, at the height of the Cold War, in testimony before Congress, soberingly observed, “Doctrines control the minds of men only in periods of non-emergency. They do not necessarily control the minds of men during periods of emergency. In the moment of truth, when the possibility of major devastation occurs, one is likely to discover sudden changes in doctrine.”<sup>376</sup>

Finally, even as Indian decisionmakers rejected the possibility of diminishing their doctrinal threats of massive retaliation, they have, in fact, developed nuclear options that permit varying levels of retribution. No responsible nuclear power would do otherwise. As Shivshankar Menon phrased it, “India’s nuclear doctrine has far greater flexibility than it gets credit for.”<sup>377</sup> This remark has been interpreted to mean, by noted Indian defense journalist Ajai Shukla for example, that India could conduct counterforce strikes on Pakistan’s nuclear arsenal *after* absorbing any limited attacks involving either its tactical or its other nuclear weapons.<sup>378</sup> A limited Indian counterforce strike is plausible at this juncture, if it can in fact be successfully executed. But Menon’s statement has little to do with nuclear warfighting, given that the entirety of his argument about nuclear weapons in *Choices: Inside the Making of India’s Foreign Policy* emphasizes their utility solely as deterrents for India. In this context, he amplifies what his later reference to “greater flexibility” means when he declares explicitly that:

There is nothing in the present doctrine that prevents India from responding proportionately to a nuclear attack, from choosing a mix of military and civilian targets for its nuclear weapons. The doctrine speaks of punitive retaliation [*sic*]. The scope and scale of retaliation are in the hands of the political leadership. . . . [Nuclear weapons] are weapons of mass destruction whether one chooses to call them tactical or strategic, and with its no-first-use doctrine, India has reserved the right to choose how much, where, and when to retaliate. This is an awesome responsibility for any political leader, but it is the price of leadership and cannot be abdicated to a mechanical or mathematical formula or a set of strategic precepts.<sup>379</sup>

Given this clarification, it is perplexing that Christopher Clary and Vipin Narang have interpreted Menon’s characterization of India’s nuclear doctrine possessing “greater flexibility than it gets credit for” as somehow insinuating the prospect of “preemptive [nuclear] counterforce options.”<sup>380</sup> Neither this inference nor Narang’s earlier claim—that “There is increasing evidence that India will not allow Pakistan to go first. And that India’s opening salvo may not be conventional strikes trying to pick off just Nasr batteries in the theater, but a full ‘comprehensive counterforce strike’ that attempts to completely disarm Pakistan of its nuclear weapons so that India does not have to engage in iterative tit-for-tat exchanges

and expose its own cities to nuclear destruction<sup>381</sup>—can be derived either from Menon’s remarks or the evidence about India’s nuclear capabilities. Rather, the totality of Menon’s remarks could be construed at worst as insinuating the possibility of India’s nuclear first use (in violation of its prewar commitments). But deriving from that possibility the claim that New Delhi is likely to mount a comprehensive nuclear counterforce first strike against the entirety of Pakistan’s strategic assets is more than what Menon’s language or independent evidence substantiates. The challenges of strategic stability in Southern Asia, thus, need not be compounded by what Dhruva Jaishankar has correctly dismissed as “a non-controversy.”<sup>382</sup>

In any event, what Menon’s cryptic remarks suggest is that the judgment offered soon after the 1998 nuclear tests about India’s eventual incorporation of limited retaliation alternatives—but without advertising them—has come true. As was argued then:

while Indian decisionmakers may certainly execute massive retaliation—especially if they either absorbed an immense first strike that left them with little other choice or sought to punish a weaker state like Pakistan on the presumption that they possessed the capability for escalation dominance—it is possible that in many other circumstances India would settle for a limited or proportionate retaliation that, while embodying retribution and perhaps signaling its inherent capabilities, threatens to escalate to even higher levels of violence in the hope of enforcing a speedy termination of conflict. Of course, since an adversary cannot be confident that India would respond in this measured fashion and no other, the emphasis on deterrence by punishment is likely to suffice as an effective antidote to adventurism. Indian policymakers, in turn, will only seek to reinforce the robustness of this strategy by refusing to clearly specify their nuclear employment policy *a priori* in any detail and, if they do, will tend to emphasize its overwhelmingly painful consequences, even if at the moment of truth they find it counterproductive to carry out their own prewar ultimatums.<sup>383</sup>

Consequently, “prewar Indian declaratory policy will certainly continue to insinuate the prospect of sure ‘massive’ retaliation because security managers in New Delhi would seek to deny both Islamabad and Beijing the hope that they could pursue nuclear aggression while accommodating some low and manageable levels of Indian retribution.”<sup>384</sup>

## One Meaningful Operational Evolution

This brief survey of India’s nuclear doctrine suggests that it has survived without fundamental changes since its 1998 nuclear tests. Where the declaratory policy is concerned, the desire for a credible minimum deterrent has persisted despite the changes occurring in the nuclear arsenals around India. The character of India’s nuclear program has only comported with this aim. Although the size of the envisaged Indian deterrent will expand given the changes in China’s and Pakistan’s nuclear forces, New Delhi still seeks to build only those

capabilities necessary for effective retaliation rather than attempting to mechanically match the combined arsenals of its two rivals or comprehensively develop the capabilities for deterrence by denial that emphasize nuclear warfighting. New Delhi's no-first-use doctrine also remains durably in place despite the pressures for revision that have occasionally surfaced. Although several Indian public figures have questioned its viability, the fact that it coheres with India's core interest in avoiding all nuclear threats and attacks ensures its viability for some time to come—which is only reinforced by India's still-poor counterforce capabilities and its prevailing disinterest in improving them. Finally, India's nuclear doctrine still hews publicly to threats of massive retaliation in order to deter any nuclear use by an adversary, but it has acknowledged the capabilities for flexible retaliation—which it always inherently possessed anyway—to permit different levels of reprisal as judged appropriate depending on circumstances.

Despite these marginal shifts, India's conservative declaratory doctrine has survived largely because its leaders believe that the dangers of actual nuclear use against their

country are still remote and whatever capabilities they possess already suffice to parry any realistic nuclear threats. The broad persistence of India's nuclear doctrine at the operational level confirms these intuitions: except for changes that are similar to China's in regard to the desired speed of retaliation, India has stayed the course by routinely maintaining its land-based weapons in de-mated form, albeit with fewer degrees of separation, and by focusing its nuclear capabilities to support principally a strategy of punishment. New Delhi still deploys its air-delivered and land-based missile-delivered nuclear weapons primarily as a force-in-being with unyielding assertive control vested solely in its apex civilian authority and oriented toward avoiding any unauthorized use.

The willingness to accept delayed retaliation also persists, though, like China, India has moved toward a disposition that enables faster retribution than was envisaged at the time of the 1998 tests. By moving toward a posture that requires a few weapons—not the entirety of India's nuclear deterrent—to be brought to readiness relatively quickly for retaliatory operations after crossing the appropriate alert level, New Delhi seeks to defeat any expectations on the part of an aggressor that it could launch nuclear attacks on India and exploit the delays that might characterize Indian retaliation to bring international political pressures to obviate reprisals. This element represents the most meaningful modification in India's nuclear doctrine at the operational level but, as subsequent discussion about its nuclear posture will indicate, the speed at which New Delhi can actually retaliate after an attack will depend, among other things, on the nature of the nuclear aggression that India suffers to begin with.

***India's conservative declaratory doctrine has survived largely because its leaders believe that the dangers of actual nuclear use against their country are still remote and whatever capabilities they possess already suffice to parry any realistic nuclear threats.***

Finally, India's nuclear capabilities are still oriented toward servicing strategies of punishment, though what this implies in any given retaliatory action will depend fundamentally on political circumstances. Although India's nuclear weapons can be used against diverse targets, their technical characteristics optimize them principally for countervalue and, to a much lesser degree, countermilitary attacks. This too represents a continuation of the situation that existed in 1998.

## **INDIA'S NUCLEAR ARSENAL**

The discussion that follows substantiates the broad conclusions about India's nuclear doctrine summarized above. Like the review of Chinese capabilities in Chapter 1, it assesses successively India's fissile material stockpile and potential; its nuclear warheads, the delivery systems in (or entering) the arsenal, the command-and-control arrangements and the operational posture; and finally the role of strategic defenses and the character of the integration between nuclear and conventional forces with an eye to elucidating any significant changes that have occurred over the last two decades.

### **Fissile Material Production and Stockpiles**

An appraisal of India's fissile material stockpile is necessary because it sheds light on the size of the deterrent that New Delhi either possesses or can build over a given period of time under certain assumptions. It also helps to clarify the kinds of nuclear materials that India has and illumines, by implication, the types of nuclear weapons it has either developed or could build in the future. This survey is particularly relevant because unlike China, which has ostensibly stopped producing weapons-related fissile materials, India continues to produce the same for its weapons program. Because India has been a late nuclearizer and because its primary focus has been power generation rather than weapons production, India feels compelled to persist with producing fissile materials in order to build up the stockpile necessary to create its credible minimum deterrent. China, in contrast, could afford to contemplate terminating the production of weapons-grade materials because it had amassed a large enough inventory to build many hundreds of weapons by the 1980s. Whether it actually ended production remains an open question. In any event, India's stockpile of weapons-grade materials is much smaller than China's. And because New Delhi has to contend with two major nuclear adversaries simultaneously, China and Pakistan, both of which are expanding their nuclear forces, it is not surprising that New Delhi has not yet terminated its weapons-related fissile material production.

During early discussions about the Fissile Material Cutoff Treaty in Geneva, Indian diplomats indicated that India would be ready to stop producing fissile materials for weapons as soon as a global cutoff came into force—on the condition that New Delhi would not have to reveal its past stockpile.<sup>385</sup> This caveat suggested that India believed then that it would

have had enough material for its weapon program by the time a treaty came into force. Although the universal termination of fissile materials production for weapons is nowhere in sight today, it does imply that New Delhi concluded about twenty years ago that a “small” nuclear inventory of perhaps 100–150 weapons would suffice for its deterrent—if it is assumed that India had enough material for about fifty weapons in 1998 and that the global termination of fissile materials was possible within the next two decades.<sup>386</sup>

Whether this judgment holds today is unclear, but the slow pace of producing weapons-grade fissile materials in India even now is striking. This is all the more remarkable because India possesses a large nuclear infrastructure, but this capability is predominately focused on power generation and other civilian applications of nuclear energy. Weapons production remains largely secondary (despite occasional allegations to the contrary<sup>387</sup>). India currently operates twenty-three nuclear power reactors, with another seven under construction, and many more either announced or approved. Nineteen of the operational units are pressurized heavy water reactors, using natural uranium as fuel and capable of producing plutonium as a byproduct; the remaining four operational reactors are boiling water and pressurized water reactors, which use low-enriched uranium as fuel and are not significant sources of plutonium.<sup>388</sup> Of the twenty-three operational reactors, fifteen units are under International Atomic Energy Agency (IAEA) safeguards and, consequently, the pressurized heavy water reactors within that subset do not produce plutonium for India’s weapons program.<sup>389</sup>

The other eight reactors, which India kept outside of safeguards after the conclusion of the U.S.-India civil nuclear cooperation agreement, can in principle be used to produce weapons-grade plutonium. As discussions during the civil nuclear agreement indicated, however, the spent fuel from these reactors was intended as feedstock for India’s future breeder reactors, which compose the second stage of Homi Bhabha’s three-stage plan. The first of these, the Prototype Fast Breeder Reactor (PFBR), has been constructed and is likely to be commissioned in 2022, though the schedule for commissioning has slipped steadily in the past.<sup>390</sup> If India chooses to use this PFBR to produce plutonium for its weapons program, rather than using it to breed more plutonium for the additional breeder reactors envisaged by the three-stage plan, India could rapidly expand its stockpile of WGPu at far higher rates than have been the norm historically.<sup>391</sup> Indian policymakers traditionally disavowed such intentions. In fact, as part of the civil nuclear agreement, they negotiated a reprocessing agreement with the United States on the calculation that the future fuel imports for their power as well as their breeder reactors would be used entirely for power production rather than nuclear weapons.

Thus, although India could use the eight power reactors currently outside of safeguards to produce large quantities of WGPu, it has chosen not to do so.<sup>392</sup> It is likely that India produced some WGPu in its power reactors in the past, but this experimental effort seems to have been driven largely by the desire to test India’s capacity to accelerate the production of weapons-grade materials should a Fissile Material Cutoff Treaty suddenly appear to be

on the cusp of a rapid conclusion.<sup>393</sup> Today, these pressures have abated. Although India can use its unsafeguarded pressurized heavy water reactors to produce WGPu in copious quantities,<sup>394</sup> avoiding the costs associated with the increased fuel requirements as well as minimizing the wear and tear on the refueling machines when these reactors operate in a low-burnup mode will likely deter India from using its power reactors for this purpose—given the tight fiscal margins that the power program operates on and its continuing focus primarily on electricity production. The quantity of WGPu produced in India’s power reactors in the past is unknown, but it would hardly have been the dominant contributor to India’s fissile material stockpile.<sup>395</sup> Consequently, even though India’s power reactors can produce WGPu, and do so naturally as their fuel loadings begin their initial burnup, New Delhi has continued its traditional practice of producing plutonium for its weapons principally from its research reactors: the 40-megawatt (MW) CIRUS reactor that operated from 1954 until 2010 and the still operational 100-megawatt Dhruva, which went critical in 1985 and is likely to remain in service at least until 2025 (if not longer).

Prior to the 1998 tests, India is believed to have produced 12–16 kilograms of WGPu annually from both these research reactors.<sup>396</sup> The lower bound of this range was probably the more accurate figure; one well-informed Indian source noted that, given the two reactors’ capacity factors at the time, the CIRUS produced 4 kilograms and the Dhruva 8 kilograms of WGPu each year.<sup>397</sup> After the 1998 tests, when India set out to overtly build its nuclear deterrent, the annual production rate likely increased, but the retirement of the CIRUS reactor in 2010 left the Dhruva with the principal burden of India’s continuing production of WGPu. Assuming capacity factors of between 65 and 75 percent, the Dhruva reactor produces 16–20 kilograms of WGPu annually—clearly an improvement over India’s historical rate of accumulation but nowhere near the vast acceleration that the critics of the U.S.-Indian civil nuclear cooperation agreement often feared.<sup>398</sup>

The best available data suggest that whatever the annual rate of increase may have been, India’s fissile material stockpile in 2020 consisted of 450–750 kilograms of WGPu.<sup>399</sup> (One other authority claimed, more improbably, that India could have possessed as much as 850 kilograms of WGPu in 2014.<sup>400</sup>) Although these figures involve a substantial range—given the inherent uncertainties about India’s production efficiencies—they do suggest that the Indian WGPu inventory derives mainly from the output of its research reactors because these totals would be dramatically larger if India’s power reactors had been committed to the production of WGPu since the U.S.-Indian nuclear deal. If India’s fission weapons are assumed to use about 6 kilograms of plutonium-239—a crude but not unrealistic assumption<sup>401</sup>—a fissile materials inventory of this size would yield a stockpile of some 75–125 weapons. If the same amount of plutonium-239 was used in the primary of India’s thermonuclear weapons, the number of weapons that could be produced would be smaller still since the “spark plug” would require additional plutonium beyond that used in the primary.

If India continues to add another 20 kilograms of WGPu to its stockpile annually for the next ten years, it could enlarge its total inventory of WGPu to some 630–930 kilograms by 2030. This would enable it to have a warhead stockpile of about 105–155 simple fission weapons or a smaller number of thermonuclear equivalents. Even if it were assumed that India did possess 850 kilograms of WGPu in 2014, its stockpile growing at the higher-end rate of some 20 kilograms annually would consist of some 1,170 kilograms of WGPu by 2030. This would enable New Delhi to produce about 195 simple fission weapons (at 6 kilograms of WGPu per device), or a somewhat smaller number of thermonuclear devices depending on how much additional plutonium was required for the spark plug. A comparison would, therefore, suggest that the largest number of weapons that India may be expected to have in 2030 would still be smaller than the size of the current Chinese nuclear inventory, if the 2019 estimation of its being in the low 200s is correct. If the current Chinese nuclear inventory consists of some 350 warheads—as is entirely probable—then Beijing will continue to possess numerical superiority over India’s nuclear forces even more resolutely, in addition to the advantages it already enjoys in terms of the sophistication and the yield of its weapons.

Obviously, India could erase this Chinese numerical superiority quickly if it began to produce WGPu in its power reactors, and it could erode China’s qualitative advantages as well were New Delhi to resume nuclear testing. Whether current Chinese nuclear advantages produce political benefits for Beijing is a different matter; Indian policymakers do not appear to believe that their smaller and less sophisticated nuclear force makes much of a difference vis-à-vis China in the real world of politics today. Their military planners, however, may judge otherwise. Yet whatever their assessments may be, both arms of the Indian state will have to live with the weapons they have, while waiting for an opportunity for New Delhi to resume nuclear testing when circumstances permit.

The crude calculations above help to illustrate the size of India’s minimum deterrent on the assumption that India will persist with its current practice of using mainly its research reactor(s) for producing weapons-grade materials. Even if it does so, there is no assurance that India will machine all its available fissile material into useable warheads. In the past, India maintained a much larger stockpile of weapons-grade materials than it had warheads. Assessing its “actual” number of weapons, therefore, requires correlating the quantity of available WGPu with the number of delivery systems. Since the quantity of gravity bombs that India currently possesses is unknown but is unlikely to be growing significantly, the small numbers of missiles deployed today (plus the few score bombs already built) suggest that the total Indian deterrent is still modest. The small but slowly increasing number of delivery systems implies that New Delhi will likely continue the practice of maintaining a much larger inventory of weapons-grade materials than it does weapons, something that is likely to persist even if, or after, India finally terminates the production of fissile materials.



Although the discussion thus far has focused entirely on WGPu because of its desirability as a fissile material, India also possesses reactor-grade plutonium and HEU that could be used in its nuclear weapons. The large Indian civilian nuclear power program that has been underway for decades has bequeathed the country with a huge stockpile of reactor-grade plutonium. Given the number of Indian power reactors that have been operational since the program's inception, it is reasonable to expect that New Delhi's reactor-grade plutonium inventory must consist of several tens of thousands of kilograms, with the largest fraction deriving from unsafeguarded reactors because almost all of India's nuclear power plants were unsafeguarded prior to the U.S.-India civil nuclear cooperation agreement.<sup>402</sup>

Consistent with this expectation, David Albright and Serena Kelleher-Vergantini calculated that New Delhi possessed close to 32,000 kilograms at the end of 2014, a stockpile that has obviously grown larger since.<sup>403</sup> Most of this reactor-grade plutonium resides in spent fuel discharged from India's power reactors and is largely unseparated. India traditionally had rather limited plutonium separation capabilities and its plants rarely operated at full capacity. They may explain partly why India has not aggressively pursued plutonium separation from its spent reactor fuel, but the fact that India's PFBR—for which the reactor-grade plutonium is intended—has taken so long to come online probably better explains the languid pace of reprocessing. Since India's ambitious three-stage plan envisages several breeder reactors being built over time, the bulk of the reactor-grade plutonium currently contained in India's spent fuel is intended to fuel these units when they are finally constructed. Because these follow-on reactors are nowhere in sight, the need to separate all the plutonium in India's spent fuel is not particularly urgent. The International Panel on Fissile Materials has estimated that India's stockpile of separated reactor-grade plutonium consisted of anywhere between 4,300 and 11,300 kilograms in 2020.<sup>404</sup>

The question of whether this separated reactor-grade plutonium could be used to expand India's nuclear weapons inventory thus remains. This is an issue of some significance because the unique properties of plutonium make even its reactor-grade variant, which has a higher proportion of the undesirable plutonium-240 isotope, useable in a nuclear weapon.<sup>405</sup> Since India already has large quantities of reactor-grade plutonium, New Delhi could, in principle, therefore rapidly expand its weapons stockpile by using this material as a supplement, or even as a substitute, for weapons-grade plutonium in both its fission and its boosted-fission designs. Reactor-grade plutonium could also be used in the secondary stage of India's thermonuclear weapons, substituting in part for other materials in the pusher/tamper.<sup>406</sup>

Although it is likely that India has explored such possibilities either out of experimental inquisitiveness or in support of contingency planning for a rapid expansion of the weapons inventory, it is doubtful that reactor-grade plutonium would ever become the primary solution for expanding India's weapons stockpile. India is alleged to have experimented with reactor-grade plutonium for weapons during the 1998 nuclear tests.<sup>407</sup> But it could not become the preferred material for India's nuclear weapons given its current device designs.

Simple fission weapons that use reactor-grade plutonium in lieu of weapons-grade plutonium can overcome the problems of preinitiation—the threat of “a divergent chain reaction just as the nuclear core becomes critical”<sup>408</sup>—as well as the difficulties created by increased heat and radiation either by reducing the amount of reactor-grade plutonium used in the pit or by relying on fast assembling designs to limit the chances of a pre-detonation.<sup>409</sup> India is capable of exploiting both these pathways in its present fission weapon designs, but it appears that employing reactor-grade plutonium of the kind produced in India’s Canada Deuterium Uranium (CANDU)–type reactors would have the highest probability of producing yields of mostly between 1 and 5 kilotons, with progressively lower probabilities of producing yields that approach the 20 kilotons demonstrated in the fission weapon used at Nagasaki.<sup>410</sup>

These results indicate why utilizing reactor-grade plutonium as the primary solution for expanding its arsenal would not be an attractive option for India: it would require New Delhi to bear the extra costs of producing both the firing sets required by the additional weapons and their associated delivery systems for what would be only subpar increases in lethality. The biggest technical constraint that currently confronts India’s nuclear strategy of deterrence by punishment is the small yields of its existing weapons. Enlarging the nuclear inventory with more even smaller-yield devices does little to correct the biggest visible deficiency that presently afflicts its nuclear arsenal. Of course, the pre-initiation risks of reactor-grade plutonium could be circumvented by utilizing it in boosted weapon designs: such devices can produce yields that are comparable to those using weapons-grade plutonium and, in fact, much bigger yields than the ~12 kilotons produced by India’s fission weapon in the 1998 tests.<sup>411</sup> Thus far, however, India has not demonstrated a capacity for successful boosting if the evidence from its last test series is anything to go by (an issue discussed further below). Consequently, utilizing reactor-grade plutonium in its boosted weapons is risky in the absence of further hot testing.

If the opportunities for field testing were available, India could validate all its device designs that use reactor-grade plutonium to produce more substantial yields, including by boosting. In their absence, though, only WGPu can confidently generate the higher and more reliable yields sought by Indian designers. It is possible that blending some reactor-grade plutonium into the weapons-grade variant would marginally enlarge the Indian weapons inventory, but if inventory expansion was the goal, India would clearly be better off increasing its production of WGPu by also utilizing its unsafeguarded power reactors if necessary. The bottom line, therefore, is that the large quantities of reactor-grade plutonium that India possesses are best reserved for fueling its breeder reactors as India currently intends, rather than by using it for weapons where its benefits are either meager or uncertain.

In fact, given the priority that the breeders enjoy in the Indian nuclear power program, New Delhi is unlikely to conceive of its reactor-grade materials as being useful *primarily* for its weapons program where they would serve to produce admittedly more nuclear weapons but

of questionable yield in the absence of field testing. Because the quantities of reactor-grade plutonium used in weapons, however, are minuscule compared to the quantities required to fuel India's breeder reactors, it is possible that New Delhi's weapon designers will find some use for reactor-grade plutonium in its existing devices. But their driving calculation cannot be expanding the size of the inventory, given the ease with which they can produce large amounts of weapons-grade plutonium in their power reactors.<sup>412</sup> Rather, the utilization of reactor-grade plutonium would be most likely spurred by design curiosity and could find its greatest utility in some of India's boosted-fission weapons or in the secondaries of its thermonuclear devices.

India is also unlikely to use its inventory of enriched uranium for expanding its weapons stockpile. Although it has operated a large centrifuge facility called the Rare Materials Project (or more colloquially the Mysore Rare Materials Plant) at Rattehalli since 1990, this plant was dogged by technical difficulties for many years.<sup>413</sup> Unlike Pakistan, which moved quickly to invest in uranium centrifuge technology after the return of A. Q. Khan from the Netherlands in the early 1970s, India ignored enriched uranium production because it did not fit into Bhabha's three-stage plan. The Rare Materials Plant, therefore, began as an experimental effort, suffering many hiccups along the way, but more recently has shifted to industrial scale enrichment. The bulk of the enriched uranium produced at Rattehalli is LEU with concentrations of less than 20 percent of U-235 and is intended primarily to fuel India's current and planned nuclear submarines.<sup>414</sup> Beyond this defense-related need, India has also used the Rare Materials Plant to produce different grades of enriched uranium for research purposes as well as for experimenting with alternative fuels for its civilian pressurized water reactors. India currently is constructing a new gas enrichment facility at Chitradurga in southern India, but this plant is intended to produce LEU as fuel for the new civilian light water reactors that India plans to import as supplements to the pressurized heavy water reactors that otherwise constitute the mainstay of its power program.<sup>415</sup>

None of India's nuclear weapon designs employ enriched uranium as a fissile material and hence the production of highly enriched uranium for weapons, that is, uranium with a concentration of greater than 90 percent of U-235, does not enjoy priority in Indian strategic planning.<sup>416</sup> Consequently, the claim advanced by the International Panel on Fissile Materials that India has between 3,800 and 6,600 kilograms of HEU must be understood appropriately.<sup>417</sup> Although this inventory apparently consists of uranium that is enriched to between 30-45 percent—and is thus technically HEU—it is highly unlikely that such uranium would be used in a nuclear weapon. More importantly, though, both the quantity of HEU that India supposedly possesses and the level of enrichment characterizing this stockpile are highly speculative. They derive from uncorroborated presumptions about the number of centrifuges present at the Rare Materials Plant, their separative efficiency, and their duration of operation, none of which can be discerned with any confidence from the outside. India's uranium enrichment capabilities are undoubtedly expanding, with New Delhi investing in more or larger facilities, but there is no evidence that it is concentrating

on the production of HEU at the enrichment levels required for its use in nuclear weapons. For all practical purposes, therefore—and despite some claims to the contrary<sup>418</sup>—India's enriched uranium stockpile can be excluded as irrelevant to the expansion of its nuclear weapons inventory.

Obviously, India continues to produce other materials relevant to its weapons program such as deuterium-tritium, lithium deuteride, beryllium and polonium, but whether it has overcome the traditional constraints on the production of some of these materials is unclear.<sup>419</sup> If it has not, the large numbers of nuclear weapons that India could hypothetically produce, including through its power reactors, become even more notional. Any constraints, for example, on lithium enrichment would affect the ability to produce thermonuclear weapons, even if large quantities of WGPu are otherwise available. Because India persists in its conviction that a huge nuclear arsenal is unnecessary for deterrence, the smaller quantities of special materials necessary for nuclear weapons likely remain within reach. At any rate, the expansion of India's nuclear estate has in general been slow. For example, India has not yet begun constructing the new research reactor that was supposed to replace the Dhruva, which will have been operational for forty years in 2025.<sup>420</sup> The reliance on reactor life extension, coupled with the continuing focus on a minimum deterrent, will end up with India making do with what it has or at best settling for marginal solutions until such time as additional research reactors are constructed either at Trombay or more likely as planned at Vishakhapatnam on India's eastern coast.<sup>421</sup> The scale of India's fissile material production for weapons thus far suggests that New Delhi genuinely believes that its modest deterrent will be ipso facto credible even at low force levels as long as its weapons are survivable. The quality of India's nuclear device designs also seems to be compatible with this belief.

## Nuclear Weapon Designs

Unlike China, which raced through the transformation of its nuclear device designs, moving from simple fission to boosted to thermonuclear weapons within a space of some three years, India's nuclear weapons designs have been at best in slow evolution. India's first nuclear test in 1974 was fundamentally a science experiment: it involved a huge fission device that lacked the portability to serve as a weapon. Built around an implosion system that incorporated a solid sphere of 6 or more kilograms of Pu-239 with a polonium initiator and high explosive lenses, it was a primitive device by the standards of modern nuclear weaponry but would serve as the archetype for the most reliable Indian nuclear weapons even today. The 1974 test was advertised by the Indian atomic energy establishment as producing a yield of 12 kilotons, but in actuality it was far lower, producing probably somewhere between 2 and 4 kilotons at best.<sup>422</sup>

During the 1980s, when the Indian weapons program was restarted after a political hiatus, this fission design was improved to reduce weight and incorporate better firing sets; by the mid-1990s, it resulted in more variants that also incorporated different kinds of levitated

pits.<sup>423</sup> The fission weapon was one of the two designs tested in 1998: it produced the bulk of the yield detected in that test, which has been judged by the most reliable estimates at coming in somewhere between 9 and 16 kilotons (with the mean estimate set at approximately 12 kilotons).<sup>424</sup> Since the fission weapon tested in 1998 was ostensibly from the stockpile, it can be concluded that it remains India's most reliable weapon and is capable of producing a yield of ~12 kilotons at most. This maximum attributed yield of ~12 kilotons derives from the assumption that the thermonuclear device, which was also tested simultaneously, produced no meaningful yield whatsoever. If it is assumed, however, that the thermonuclear device produced a fizzle yield of somewhere between 2 and 8 kilotons, then the fission weapon's yield would be even lower, coming in at anywhere between 4 and 10 kilotons. Whatever the specific yield of the fission weapon therefore actually was, the range of possibilities only confirms that India's most dependable nuclear weapon has relatively low explosive power and could be even smaller than the early nuclear weapons used at Hiroshima and Nagasaki.<sup>425</sup> All the same, this design, which was first configured for aircraft-delivered gravity bombs, has spawned variants that equip other delivery systems now present in the Indian armory.

Some variants of this evolved design are probably boosted to produce larger yields notionally, but even these weapons hardly represent the state of the art today. Given the failure of the boosted-fission primary during the 1998 test, they must still be considered unproven. India has pursued the development of boosted weapons since the 1980s, driven, at least partly, by the desire for enhanced yields and to reduce the weight of its physics packages.<sup>426</sup> Successful boosting would also have enabled India to utilize supplementary fissile materials such as reactor-grade plutonium in its basic fission design without sacrificing yield. At any rate, the descriptions emerging after the 1998 test suggested that India did use solid lithium deuteride as the boost material in its primary, which was intended to drive the secondary stage of India's thermonuclear device, the second weapon sought to be validated on May 11, 1998. Although Indian scientists denied it at the time, the thermonuclear device clearly failed. It is likely that this failure resulted not so much from problems in the secondary—as has been claimed<sup>427</sup>—but because the boosted-fission primary failed to produce the double-digit yield necessary to drive the fusion reactions in the second stage.

There could have been many reasons why this boosted-fission primary fizzled, but the description offered by one source provides an important clue: If the Indian primary “use[d] solid fuel in the form of lithium deuteride (LiD) to produce tritium in situ,” on the assumption that this approach “is used in most current fusion weapon designs,”<sup>428</sup> the failure to boost would, in this instance, have derived from a poor understanding of the limits of lithium deuteride itself. Successful solid boosting, which is challenging in any case compared to gas boosting, requires not simply lithium deuteride but rather lithium deuteride-tritide as fuel; in the case of gas boosting, “deuterium and tritium gas are present in the hollow plutonium shell at the time of implosion,”<sup>429</sup> because, as Gregory S. Jones has pointed out, “whatever the form [of boosting involved], tritium is an essential component, since at low

energies the DT [deuterium-tritium] fusion cross section is about one hundred times larger than the DD [deuterium-deuterium] cross section.”<sup>430</sup> This is one more example where India’s lack of extensive prior nuclear testing may have prevented it from overcoming the design challenges that other nuclear powers have surmounted by repeated experimentation.

It is unclear what proportion of India’s current warheads are boosted-fission devices, but how New Delhi could have confidence in the reliability and effectiveness of these weapons, given the failure in 1998, is not obvious. No doubt, India’s weapon designers have been hard at work since their last nuclear tests, and it is likely that they have focused both on correcting the problems associated with their solid boosted-fission designs and on incorporating gas boosting in their newer primaries. In the absence of demonstrated success through hot testing, however, India cannot be justifiably credited with possessing such capabilities, even though some Indian scholars have all too glibly contended that the 1998 tests had already proven that the country possessed “an effective “tritium-boosted” fission design of 40 kilotons as the primary for a fusion weapon.”<sup>431</sup> If such yields had, in fact, been attained, it is possible that the Indian thermonuclear test might have been successful, but the *combined* yield of all three nuclear tests conducted on May 11, 1998, was way below the yield supposedly produced by the boosted-fission primary alone.

The skepticism about the effectiveness of India’s boosted-fission weapon extends a fortiori to the third type of device in the armory: the two-stage thermonuclear weapon. Because the first stage of this device sputtered during the 1998 test, it could not drive the second stage appropriately—irrespective of whether this stage contained all the thermonuclear material required along with the appropriate spark plug or merely a small test capsule as a substitute.<sup>432</sup> The reports emerging after 1998 indicated that the thermonuclear device had a complete secondary even though the limited depth of the test shafts prevented Indian designers from testing it to the maximum yield that the design theoretically permitted. In any event, and even if this device was only a “weaponizable design” but not a weapon then existing in the stockpile, it has been widely judged to have been a failure.<sup>433</sup> This has not prevented India’s nuclear scientists and other Indian commentators, however, from claiming that New Delhi can build thermonuclear weapons of yields “up to 200 kilotons without any problem.”<sup>434</sup> Sometimes even higher yields—of 200–500 kilotons<sup>435</sup>—are alleged to lie well within India’s capacity, despite the fact that the specifics of India’s thermonuclear design are unclear nor have such yields been experimentally demonstrated.

In any case, since the first decade of this century, India proceeded to fabricate thermonuclear weapons that were intended to arm both the missiles and the air-delivered systems in the Indian deterrent.<sup>436</sup> Whether Indian nuclear scientists were able to discern and subsequently rectify their design errors or whether they were inducting their thermonuclear devices mainly on the strength of corroboration provided by computer simulations is not known. India has a very sparse history of testing nuclear weapons—six tests, at most, since 1974—and, hence, it certainly does not possess the design codes to either validate or improve its

weapons, especially its staged designs, without further hot testing. China, in contrast, has undertaken forty-seven nuclear tests of multiple device designs with clearly demonstrated high yields unlike India.

Consequently, the credibility of India's thermonuclear weapons is still suspect, even if Indian nuclear planners have proceeded to introduce these unproven devices into their arsenal.<sup>437</sup> It is not surprising, therefore, that late in 2009, a group of senior Indian nuclear scientists, including many who were actively involved in the weapons program, called upon their government to conduct an "in-depth analysis of our real capabilities," given "the grave situation we are in regarding our Thermonuclear (H-bomb) capability," with an eye to undertaking "resolute, speedy and comprehensive corrective action."<sup>438</sup> When India's primary nuclear threat consisted of Pakistan alone, unreliable thermonuclear devices in the inventory may not have had serious consequences—but when China has emerged as a daunting strategic danger, persisting with the deployment of these defective warheads is a risky proposition. In fact, the best thing that India could do would be to withdraw its thermonuclear weapons from the active stockpile and replace them with its more reliable fission devices, while waiting for the opportunity to return to hot testing in order to demonstrably validate its advanced nuclear designs. After all, nothing could be worse for India's security and credibility than employing faulty thermonuclear weapons in extremis that not only fail to inflict the punishment desired but also subsequently leave the country open to even greater intimidation.

The developments pertaining to India's nuclear device designs leading up to and beyond the 1998 tests thus confirm the impression that while New Delhi has pushed the envelope where civilian nuclear science endeavors are concerned, the sophistication of its weapons design base has lagged in comparison. In large measure, this is because both the Indian state and its nuclear community have not prioritized weapons development in the face of their still significant deficits in hydrodynamics expertise. They have been satisfied with the absolute power of nuclear weapons rather than pursuing cutting-edge sophistication in their weapons designs.<sup>439</sup> To the degree that they have pursued improvements, these have been focused mainly on improving the firing sets and the permissive action links on their nuclear weapons. This is eminently sensible because, assuming that the survivability of their fission weapons is not at issue, ensuring their reliability and preventing their unauthorized use advances effective deterrence.

As a complement to these efforts, India has also focused on increasing its weapon yields, which explains the continuing quest for thermonuclear capabilities. These higher-yield devices, with their "one-bomb, one-city" destructive potential, have been sought primarily because they make deterrence possible at relatively low force levels. But more significantly, India has not gone in the opposite direction: consciously designing and building highly portable, low-yield, tactical nuclear weapons for general warfighting because of the view "that a nuke is a nuke and the use of even a tactical one is a strategic strike."<sup>440</sup> This, too, is entirely a consequence of its convictions about nuclear weapons being political instruments.

International nonproliferation pressures, however, have prevented India from testing its nuclear weapons repeatedly to validate those design characteristics that strengthen New Delhi's capacity to maintain the smallest possible deterrent. Consequently, the yield of its weapons, their reliability under operational (as opposed to test) conditions, and even their safety in a field environment all remain open questions.

The variable quality of Indian manufacturing, including the techniques used to fabricate its weapons, and the risks associated with the chemical explosives used in the implosion assemblies exacerbate problems that are inherent even in simpler designs. Unlike Pakistan's nuclear devices, most of which are designed to incorporate insertable pits for reasons of both safety and security, India's nuclear weapons are "sealed pit warheads" that are intended to "reduce the size and weight of [the payloads], which is important for land-mobile missiles, and even more so for SLBMs—India's two chosen modes for missile deployment."<sup>441</sup> Although in such designs, "nuclear safety is achieved by finely balancing the quantities of fissile and [high explosive] materials so that nuclear yield would not result if the triggering assembly accidentally ignites,"<sup>442</sup> this benefit does not obtain in the Indian case because its nuclear weapons utilize hexamine nitramene (HMX) as the high explosive, which "has a very high detonation velocity."<sup>443</sup> Although HMX-based explosives and their derivatives make India's (and Pakistan's) nuclear weapons smaller and lighter, their use indicates that "neither country may have adopted either insensitive high explosive or fire resistant pits,"<sup>444</sup> thus leading one scholar to correctly conclude that, in the quest to avoid weight and size penalties, neither Indian nor Pakistani nuclear weapons are one-point safe; as such, "if they are deployed, there may be a risk of accidental detonation."<sup>445</sup>

A lengthier nuclear testing regime would have helped India address such issues systematically. This would have included exploring the incorporation of low adjustable-detonation-velocity plastic-bonded explosives or other advanced materials such as 1,3,5-triamino-2,4,6-trinitrobenzene (TATB) as the high explosive charge in its nuclear weapons. TATB has been described as a material "whose thermal and shock stability is considerably greater than that of any other known material of comparable energy"<sup>446</sup> and is used, for example, in British nuclear weapons. Additional hot testing would also have enabled India to experiment with other alternative physics packages that could be better than those utilized in its current device designs. However, political constraints have denied New Delhi this freedom.<sup>447</sup>

Even if the benefits of larger yields cannot be realized immediately because of these constraints, the challenges relating to safety can be mitigated, however, by procedural solutions: sequestering the pit from its high explosive detonators, as India initially intended when the early models of its force-in-being were devised, offers one way out at least in peacetime. Alternatively, the physics packages can be maintained completely within the warhead containers without the latter being inserted into the delivery system until the alerting process requires their full integration. As the degrees of separation between various components of the Indian nuclear force diminish, however—a development driven by the desire to bring to



full readiness at least a few nuclear weapons quickly to enable speedier retaliation—the risk of accidents, including detonations, only increases, especially when field dispersal of land-based missiles encounters hostile conditions, particularly shock, that could adversely impact

***Only a diverse and extensive test regime can produce weapons that satisfy the desire for reliable high yields and enhanced safety simultaneously.***

the warhead. Only a diverse and extensive test regime can thus produce weapons that satisfy the desire for reliable high yields and enhanced safety simultaneously.<sup>448</sup>

Since India cannot avail itself of such an advantage currently, it appears to have settled for building enough weapons as are necessary for a small but slowly growing force,

while waiting for the chance to return to nuclear testing when renewed opportunities—perhaps provoked by resumed testing by others—present themselves. Until that time, New Delhi must make do with a stockpile consisting of a few types of low-yield fission weapons largely capable of producing ~12-kiloton yields, although yields of 20–30 kilotons, 90–150 kilotons, and even as much as 300 kilotons have more improbably been asserted.<sup>449</sup> Indian scientists have also rather confidently claimed that their thermonuclear design can produce an assured yield of up to 200 kilotons, but these assertions, too, are unfortunately utterly at variance with what has been demonstrated.

None of this, however, seems to faze Indian policymakers because of their conviction that effective nuclear deterrence does not depend on the technical sophistication of a nuclear weapon or even the presence of high yields (especially if an adversary cannot be sure what the yields of India's weapons might be in the first place). To be sure, high-yield weapons would be preferable if these could be obtained without undermining other national interests, but until the point when India develops and demonstrates these capabilities publicly, low-yield weapons will have to suffice. At the end of the day, as K. Subrahmanyam and V. S. Arunachalam—reflecting the dominant views of Indian policymakers—have argued, “nuclear deterrence is essentially a mind game. A potential aggressor will be deterred if he is persuaded that the nuclear retaliation that will be delivered by the survivable nuclear force of the victim will cause unacceptable damage, totally incommensurate with any strategic, political, economic or any other objective that drives him to go for the first strike.” Consequently, India's “small” nuclear weapons are deemed to be effective because “even with 25 kiloton fission bombs, the damages [that India can inflict] are going to be far more and extensive than what Hiroshima and Nagasaki suffered given the higher population densities in the cities of China and South Asia and the urban development of recent years. Therefore, the Indian deterrent posture will not lose its credibility if India is compelled to rely on fission weapons only.”<sup>450</sup>

## India's Evolving Delivery Systems

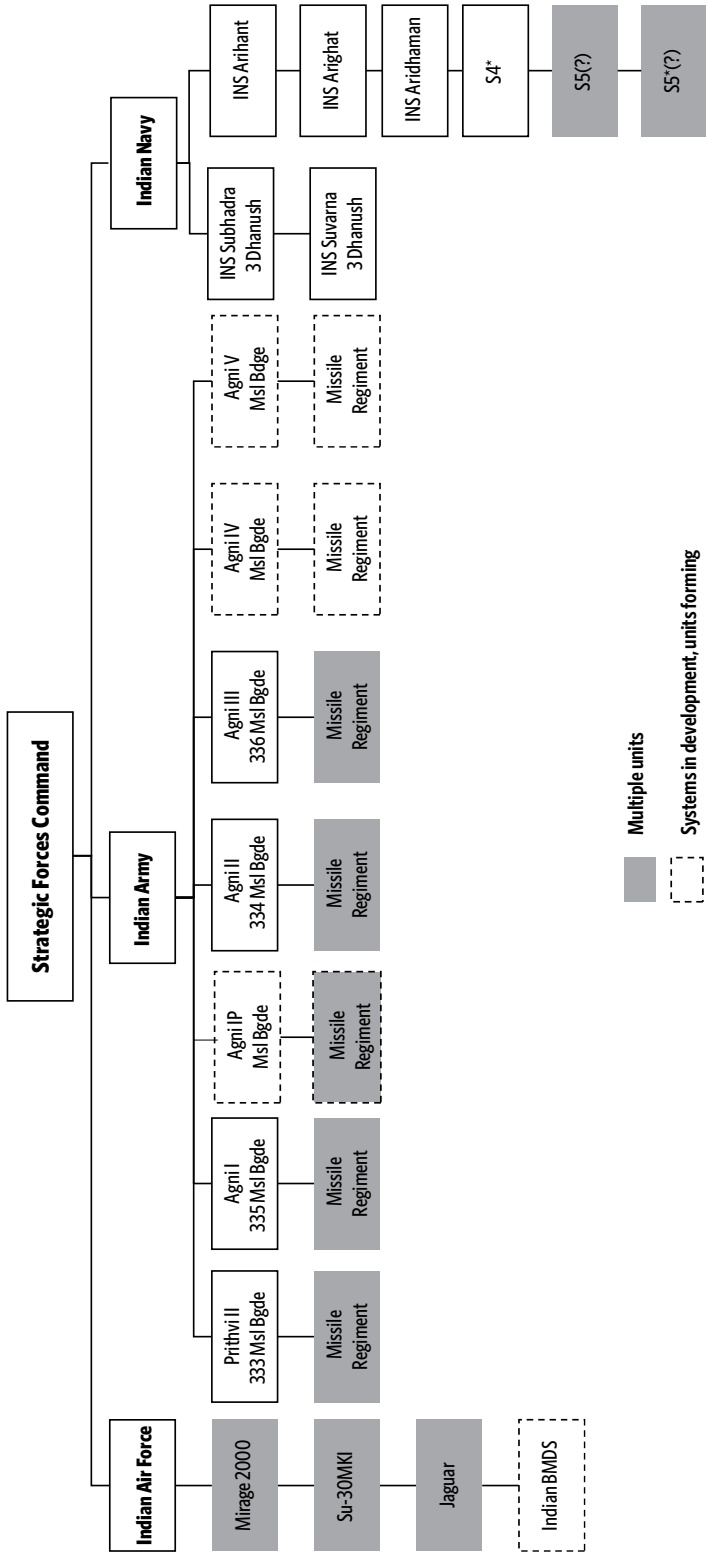
Within these constraints, India has continued to modernize and expand its nuclear delivery systems to service multiple goals. Increasing its retaliatory reach to target distant high value centers, especially in northeastern China, has driven the pursuit of progressively longer-ranged delivery systems, especially missiles, in the Indian arsenal. New Delhi has also been compelled to look for solutions that could partly compensate for the yield limitations of its nuclear devices: possibly increasing either the number of missiles or, eventually, the number of warheads on certain strategic missiles to allow India to inflict higher levels of punishment despite the presence of low-yield and possibly unreliable warheads. India has also focused on improving the technical quality of its missile systems by incorporating composite materials in its airframes, better heat shields and guidance systems in its reentry vehicles, and, with an eye to the future, developing different kinds of penetration aids as well as hypersonic glide vehicles to ensure that its missiles can reach their targets despite any adversary attempts at intercepting them. Finally, the slow expansion of the nuclear force is intended to increase the survivability of the deterrent as a whole. This objective has taken India toward greater diversity in delivery systems: it is now concentrating on building a genuine triad (Figure 3) because of its conviction that submarine-based nuclear weapons are not only the most survivable elements of the deterrent but also could potentially reduce the damage that India would suffer if its opponent executes counterforce attacks in war.

### Air Systems

Although India has moved systematically toward longer-ranged land-based missiles in recent years (with long-ranged sea-based missiles also on the horizon), New Delhi still retains a significant inventory of air-delivered nuclear weapons. The air-breathing leg of the force, originally consisting of Mirage 2000 and Jaguar fighters, is not simply a legacy component. Admittedly, it was developed mainly to deter Pakistan on the assumption that India would enjoy sufficient air superiority to make penetrating retaliatory missions viable.<sup>451</sup> If Indian nuclear use materialized toward the end of a high intensity conventional war, this presumption would likely have proven correct because the Pakistani air defense net would have been sufficiently degraded by then. Retaliatory operations earlier in a conventional campaign, however, could prove more taxing on Indian Air Force (IAF) resources, especially if the estimates that India would need about sixty aircraft for the success of each mission are true.<sup>452</sup> Even if this number seems unduly high, India's punitive strike at Balakot in 2019 demonstrated that numerous aircraft are, in fact, required to support relative small strike operations, thus making the challenge of successfully completing any air-delivered nuclear retaliation quite significant early in a conflict.

Given such burdens, India has pursued supplemental alternatives to gravity bombs, though the latter remain prominent in the Indian stockpile. Consistent with the judgment offered by one Indian scholar, the late Gurmeet Kanwal, that "aircraft carrying nuclear glide

FIGURE 3  
**INDIA'S NUCLEAR FORCE STRUCTURE, 2021**



bombs are also essential” for the success of India’s air-breathing leg,<sup>453</sup> the DRDO has developed two different systems, the 30-kilometer-range Garuda and the 100-kilometer-range Garuthma.<sup>454</sup> Both glide bombs carry a 1,000-kilogram payload, which would suffice to deliver India’s nuclear weapons, an intention clearly suggested by the intimate involvement of the Terminal Ballistics Research Laboratory and the Research Center Imarat in their development.<sup>455</sup> The ability to deliver nuclear weapons through standoff systems gives the IAF’s penetration mission an increased probability of success even in the early stages of a war when an adversary’s integrated air defenses may not have been fully suppressed.

That the air force takes this role seriously is further corroborated by the fact that it has now allocated its most formidable strike-fighter, the Su-30MKI, to the nuclear delivery mission, whether that involves carrying gravity or glide bombs. The number of combat aircraft earmarked for this purpose is unknown, but Hans Kristensen and Matt Korda plausibly suggest that close to one-third of India’s current nuclear weapons inventory is allocated to air-breathing delivery systems such as the Mirage 2000 and Jaguar aircraft (though, curiously, the Su-30MKIs are not identified by them for this mission).<sup>456</sup> Yogesh Joshi and Frank O’Donnell have reported that India has assigned one squadron of Mirage 2000s, two squadrons of Jaguars, and forty Su-30MKIs for the nuclear role. In another study, O’Donnell and Alexander Bollfrass suggested that some two squadrons of Jaguars and one squadron of Mirage 2000s have been certified for nuclear missions. If true, India will have reserved some fifty-odd aircraft for the nuclear delivery role.<sup>457</sup> Whatever the precise numbers may be, the Jaguar is unlikely to have a nuclear role anymore except in emergencies; this mission today and for the foreseeable future is likely to be executed principally by the Mirage 2000 and the Su-30MKI because their sophisticated self-protection suites, advanced avionics and defensive weapons, aerial refueling capability, and basing locations in proximity to India’s nuclear weapons storage sites all combine to make them best suited for the nuclear retaliatory mission.

## Land Systems

Although the numbers of both nuclear warheads and nuclear-certified aircraft found in the literature are speculative, they do confirm the importance that air-delivered nuclear weapons still enjoy in India. The missile force, however, is where the future of the Indian deterrent lies because of the benefits it bestows in range, penetrativity, and likely pre-launch survivability. The earliest Indian missile delivery system, the Indian Army’s 150-kilometer-ranged liquid-fueled Prithvi-I short-range ballistic missile (SRBM), has now been retired from service. Its somewhat-longer-ranged sibling, the 350-kilometer liquid-fueled Prithvi-II, still remains in the force with nuclear and conventional roles. Some thirty of these missiles are purportedly equipped with nuclear warheads, although their overall number is obviously larger.<sup>458</sup> Because liquid-fueled missiles are cumbersome to operate, India moved to supplement its Prithvi series with solid-fueled systems and the 700-kilometer single-stage solid-fueled Agni-I came to serve as the main short-range nuclear-tipped missile designed

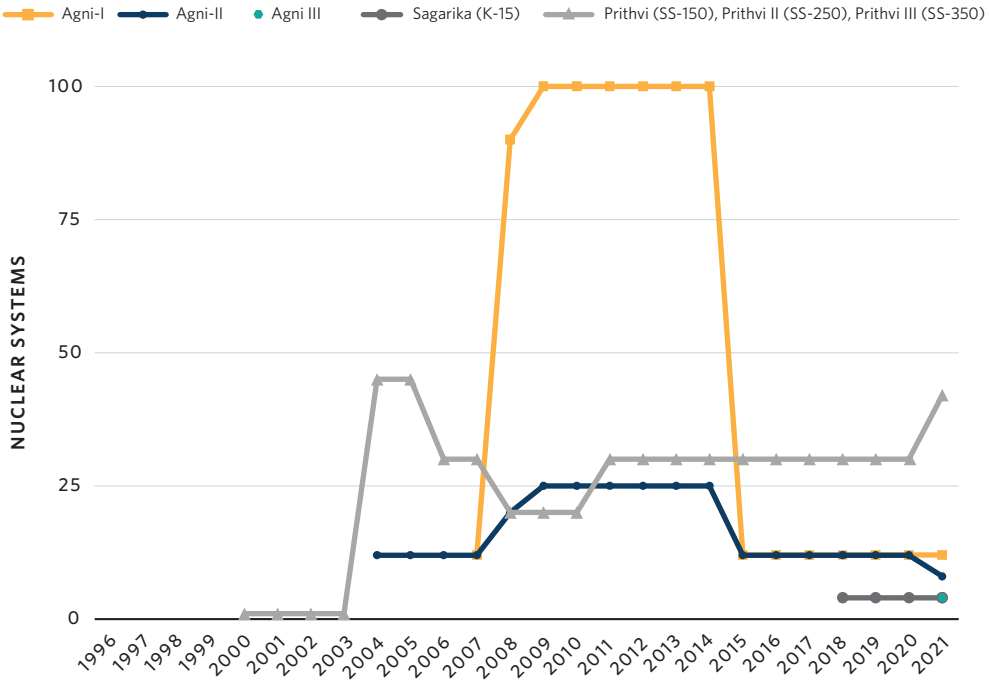
for retaliatory operations against Pakistan. The Agni-I's longer range allows it to be deployed farther in the rear—unlike the Prithvi, which has to operate closer to the India-Pakistan border—and the smaller number of vehicles in its ground support train further enhance its survivability.

For reasons that are not completely clear, India appears to have had reliability problems with the Agni-I missile, but whether these are connected to the missile's solid rocket motor—the DRDO has had a history of difficulties with casting solid rockets—or its other ground support elements is uncertain.<sup>459</sup> At any rate, it is likely that both the Prithvi-II and the Agni-I missile will be progressively retired from the Indian inventory during this decade and will be replaced by the new 1,500-kilometer, two-stage, solid-fuel Agni-IP medium-range ballistic missile, which, like its predecessors, will be road mobile as well.<sup>460</sup> The Agni-IP is one of a new class of canisterized Indian missiles, which have been designed for greater reliability, responsiveness, and operational flexibility. Utilizing new composites and a better guidance and control system, it will be the lightest and most accurate ballistic missile in the Indian arsenal when operational.<sup>461</sup> The fact that the Agni-IP is canisterized—meaning that it is routinely stored in an enclosed, temperature-regulated, launch tube carried by a transporter-erector-launcher (or a mobile-erector-launcher)—coupled with its higher accuracy (an ambitious CEP of 10 meters has been suggested), has given rise to widespread speculation that these missiles will not only be “stored with their warheads in peacetime” but also that they would be oriented toward counterforce targeting and, accordingly, deployed in “a strike posture that leaves an opponent with short warning times.”<sup>462</sup>

This mythology has been endlessly repeated in recent times, but as the discussion on India's nuclear posture later in this chapter will clarify, these claims misunderstand both the intent and the nature of canisterization. The discussion in Chapter 4 demonstrates further that even more accurate missiles, such as the Agni-IP (assuming that it does achieve the small CEP attributed to it), are unlikely to be able to execute the damage-limiting attacks that Western critics of India's supposed shift toward counterforce often fear.

In any event, while missiles like the Agni-I and Agni-IP will find primary utility vis-à-vis Pakistan, India has concentrated on developing even longer-ranged solid-fueled missiles for deterrence against China. These include the Agni-II, India's first MRBM with a range of up to 2,000 kilometers, and the Agni-III IRBM, capable of reaching up to perhaps 3,500 kilometers. Both the Agni-II and Agni-III are rail-mobile systems and were intended to carry India's thermonuclear weapons. The range of the Agni-II makes it suitable for targeting Pakistan from northern and western India, while the Agni-III, despite its longer reach, has to be based (or operate) in northeastern India or its environs if it is to reach critical Chinese targets at depth.<sup>463</sup> Although both missiles have been inducted into the Indian Army, they have been deployed thus far in relatively small numbers. Kristensen and Korda estimate that India has twelve Agni-II launchers and eight Agni-III launchers in service.<sup>464</sup> Though the number of missiles in the force could be higher, they probably consist of at most a few more missiles beyond the identified number of launchers.

**FIGURE 4**  
**INDIAN NUCLEAR SYSTEMS, 1998–2021**



Source: International Institute for Strategic Studies, *The Military Balance 1999–2021*, twenty-six editions (Washington, DC: International Institute for Strategic Studies, 1997–2022).

Figure 4, which illustrates the evolution of India’s nuclear forces and is drawn from the IISS’s *Military Balance*, is subject to all the errors and uncertainties that were earlier flagged in the discussion on China. All the same, even the crude data illustrated above highlights the proposition that India has been content with a relatively modest nuclear force so long as its delivery systems are survivable. The Prithvi-II, Agni-I, and Agni-II missiles currently dominate India’s nuclear missile force, albeit in relatively small numbers. While the total size of the Indian inventory will grow over time, the Agni-II and Agni-III missiles may end up as interim systems until the even-longer-ranged Agni-IV and Agni-V enter the force in sufficient strength. The Agni-IV IRBM, with its ~3,500-kilometer range, is intended to be road mobile: it appears to have entered production, but it remains unclear whether it has been inducted into the Indian Army’s missile brigades already. Because of its range limitations, if it is intended for use against critical Chinese targets as far away as Beijing, it too will have to be based (or operate) nearer the Indian northeast. The road-mobile, canisterized Agni-V missile, which has entered low-rate production and which the Indian Army anticipates is a few years away from formal induction into its field formations, will represent the mainstay of the long-range land-based Indian nuclear force. Its ~5,000-kilometer range

will allow New Delhi to strike at distant targets even beyond Beijing from as far away as southern India. If this missile proves to be satisfactory, it could be deployed in a rail-mobile version as well; if so, it would supplement and eventually replace the Agni-III in that deployment mode.<sup>465</sup>

The Indian missile program's activities in the aftermath of the 1998 nuclear tests indicate that India's future long-range, land-based missile force will eventually consist solely of solid-fueled systems that are deployed in both road- and rail-mobile versions. With India's vast road and rail network, each mode offers different kinds of flexibility where dispersal is concerned. These missiles are also likely to be based deep within the Indian landmass and their longer range would allow them to reach their preferred targets without lengthy transits to their launch points, although these pre-surveyed sites would be located some distance from their peacetime storage garrisons in order to enhance their survivability. India's road-mobile missiles, for instance, are stored in highly secure, isolated, and protected facilities with easy road access to both their field hides and launch points. The rail-mobile missiles, on the other hand, are carried on wagons that are generally indistinguishable from the Indian freight trains used for commercial purposes. Because road- and rail-mobility is viewed as critical for the survivability of India's long-range missile force, it is almost inevitable that most missiles that were initially designed for one form of transportability will spawn variants that are deployed in another mode.

Beyond the Agni-V—which, at ~5,000 kilometers, is India's longest-range missile to date—New Delhi, of course, also has the capability to develop true intercontinental-ranged ballistic missiles, like China has, with ranges of 5,500 kilometers or greater. In the past, such systems were not pursued because of fears of unnerving the United States. These concerns have now abated and there has been frequent speculation that India is developing an Agni-VI missile with a range of 5,500 kilometers or greater, which would be capable of carrying three or more MIRVs.<sup>466</sup> At the moment at least, no such weapon has appeared, perhaps because it is unnecessary. The Agni-V missile, which India carefully configured to reach just under ICBM range, provides it with both extensive reach vis-à-vis China and huge dispersal flexibility. Consequently, except for prestige and status, there is no operational necessity that justifies the deployment of an ICBM, given that India's sole nuclear adversaries, China and Pakistan, can be more than adequately reached with IRBMs such as the Agni-V.

Since the serial production of some late-generation Indian missiles such as the Agni-IP and the Agni-V remains some time away, neither the eventual nor the stable size of India's future missile force can be estimated right now. Much will depend on the character of the strategic environment faced by New Delhi. Yet it makes sense for India to rationalize its land-based missile force, which currently consists of diverse systems, some of which are deployed only in small numbers. A sensible long-term force can be structured on three types of canisterized missiles deployed in larger numbers: the Shaurya can serve as the road-mobile replacement for the current Prithvi-II and Agni-I short-range ballistic missiles; the Agni-IP can

replace the Agni-II and be deployed in both road- and rail-mobile variants to cover the medium-range requirement; and the Agni-V, deployed in both road- and rail-mobile versions, can replace the Agni-III and Agni-IV missiles entirely in the intermediate-range class, while bestowing on New Delhi significant basing flexibility. Deploying fewer missile types would provide significant logistical and operational benefits to India.

In any event, and whatever its choices, India will likely equip some of its missiles with maneuvering reentry vehicles (MaRVs) and others possibly with multiple reentry vehicles (MRVs), to include MIRVs. The original Agni technology demonstrator program tested a maneuvering reentry vehicle,<sup>467</sup> and it is likely that some of the new developmental systems—such as the Agni-IP, which has been tested with a MaRV payload—will be equipped with such a warhead when operational.<sup>468</sup> If so, it would join the Agni-II missile, which already has a MaRV payload.<sup>469</sup> Multiple independently targetable (or maneuvering) reentry vehicles would obviously help to defeat emerging Chinese ballistic missile defenses, and they would also enable India to enhance the destructiveness of its retaliatory attacks if its small-yield nuclear weapons are employed for “cookie-cutter” targeting of major countervalue targets.<sup>470</sup> In the absence of proven high-yield thermonuclear weapons, multiple numbers of smaller nuclear warheads delivered by a single missile (or by multiple single-warhead missiles) might serve as an adequate interim substitute for purposes of deterrence.

It is highly likely that any Indian MIRV-equipped missiles in the future will be intended primarily to increase the size of the surviving fraction of the Indian nuclear deterrent and, when retaliation is at issue, to maximize the casualties that can be inflicted by distributed targeting of large soft targets rather than being used for counterforce attacks as is sometimes claimed.<sup>471</sup> These contentions, which sound plausible in the abstract, fail to appreciate the limits of India’s nuclear capabilities and thus deduce exaggerated implications rather than the more prosaic purposes for which its multi-warhead missiles would be most useful. In any event, it is worth noting that none of India’s current ballistic missiles are armed with multiple warheads of any kind nor do their reentry vehicles possess any terminal guidance packages.

Furthermore, many claims about the accuracy of Indian missiles are highly exaggerated. For example, the Agni-V missile, India’s longest-range offensive weapon, has been declared by DRDO officials to possess “pinpoint, single-digit accuracy.”<sup>472</sup> If such claims are taken at face value, it is easy to see why expectations of a counterforce capability might arise. But a simple comparison puts things into perspective: the most sophisticated U.S. strategic missiles intended for hard-target counterforce missions, such as the Minuteman III and the Trident D5, with their advanced inertial measurement units (supplemented in the latter by stellar correction), have accuracies that run into many tens of meters. It is unreasonable to expect that Indian guidance and control systems will do much better (at a proportional range). More to the point, however, Indian policymakers have not demanded extreme accuracies of their strategic missile systems because they have never envisaged—and still do not



envisage—nuclear counterforce campaigns. One Indian analyst, even when cheering the increasing accuracy of India's missiles, aptly summarized this perspective by noting that “for a nuclear role, very high accuracy is not required.”<sup>473</sup> Consequently, while it is possible that Indian long-range ballistic missiles enjoy smaller CEPs than their Chinese counterparts—most of which have accuracies that run into hundreds of meters—there is no reason to believe that India's current systems, which lack terminal guidance packages, possess accuracies in the few tens of meters to make routine counterforce operations possible.<sup>474</sup>

Finally, what also seems clear thus far is that New Delhi has shown no interest in arming its close-range ballistic missiles with nuclear weapons. Numerous Indian commentators, often aped by their Western counterparts, frequently characterize many Indian systems, such as the Pinaka, Pralay, Nirbhay, Brahmos, or Shaurya, as “nuclear capable.”<sup>475</sup> Since the Shaurya is the land-based clone of the K-15 Sagarika submarine-based ballistic missile, it could easily carry the same nuclear warhead currently aboard the latter. The virtue of deploying another nuclear-tipped 750-kilometer-ranged land-based missile is not obvious, though it could better serve as a replacement for the Agni-I and the Prithvi-II if New Delhi seeks to maintain a short-range nuclear capability even after the Agni-IP is inducted into the force. Developing a nuclear-tipped version of an improved Brahmos or Nirbhay cruise missile would be more challenging—although possible in principle—because of the volume and weight constraints of their payload spaces. If such systems were to eventually emerge in nuclear variants, however, they would be intended principally to diversify the arsenal for enhancing survivability, defeating emerging Chinese missile defenses, and supplementing the strategic targeting coverage that is otherwise the primary responsibility of the ballistic missile force.<sup>476</sup> Because of both the design of its warheads and its doctrinal preferences, tactical nuclear delivery systems hold little interest for India. Consequently, weapons like the Pinaka, Pralay, and Prahaar, being close-range battlefield systems, will not be equipped with nuclear warheads, leaving these so-called nuclear-capable platforms merely potentialities rather than real nuclear delivery vehicles.

### Naval Systems

Unlike the land-based missile systems, which have been in slow evolution since even before the 1998 tests, the most dramatic transformation in India's nuclear delivery capabilities has been the shift toward a submarine-based deterrent. From the beginning of its overt nuclearization, India committed itself to developing a triad.<sup>477</sup> This commitment was not driven by any assessed vulnerability of its land-based components but rather by the conviction that a submersible nuclear force is most secure simply by definition. India, in fact, moved to operationalize a sea-based deterrent as soon as it could. The earliest effort consisted of deploying two or three nuclear-armed Prithvi-class missiles aboard each of two Sukhanya-class offshore patrol vessels.<sup>478</sup> These ships are still operational, though their survivability in conflict is questionable because their 350-kilometer-range Dhanush missiles would bring them in close proximity to Pakistan's shores. Their small fission warheads would also not

add much to the firepower already present in India's land-based missilery, but the benefits of threatening Pakistan with retaliation from nonconventional directions were judged to be worth the cost.<sup>479</sup>

Given New Delhi's interest in true sea-based deterrence, the Dhanush could only serve as an interim solution; it would not be long before India shifted its Advanced Technology Vessel project, which previously was focused on developing nuclear attack submarines, toward the construction of an SSBN.<sup>480</sup> Through a combination of Russian assistance and indigenous efforts, the first of the Arihant-class SSBNs, INS *Arihant*, was commissioned in 2016. Although this vessel does not yet represent the mature design that the Indian Navy seeks—it is, for example, underpowered relative to its desired performance—it has nonetheless been pressed into service as a testbed while also simultaneously serving as an interim deterrent. The *Arihant* has four launch tubes, each carrying three solid-fueled K-15 Sagarika SLBMs, for a total of twelve missiles with a relatively short range of some 750 kilometers. Although more survivable than the Sukhanya-class patrol boats, the *Arihant* nevertheless is effective only against Pakistan because of the modest reach of its missile battery.<sup>481</sup>

In time, the twelve K-15 missiles will be replaced by four K-4 missiles of 3,500-kilometer range, which will enable the Indian SSBNs to range most of China (but still falling short of Beijing) from the central Bay of Bengal. If these vessels launch their K-4s from the northern portion of the bay, most of China, including Beijing, comes within reach. Indian technologists are currently developing an even-longer-ranged 5,000–6,000-kilometer missile, the K-5, which will bring almost all of China within reach from launch points adjacent to the SSBNs' homeport at Rambilli on the east coast of India. The K-5 is likely to carry four MIRVed warheads on the calculation that each Indian SSBN must host a significant fraction of the country's nuclear reserves since the submarines are likely to remain the most survivable components of India's nuclear deterrent.<sup>482</sup> Given the desired range—and, by implication, the size—of the K-5, it is unclear whether this missile would be deployed on the last two Arihant-class SSBNs or only aboard the follow-on vessels.

India plans to deploy four Arihant-class SSBNs by 2025—with successive enlargements in the vessels' size and in the number of missile tubes in each two-hull flight—though this schedule is certain to slip if the past record is any indication. Depending on the number of missile tubes on each submarine, and assuming that each SSBN carries K-4- or K-5-class missiles, the Indian sea-based deterrent could consist of as many as forty-eight SLBMs by the time the sixth vessel in the Arihant series is completed. It is also expected that India will launch a larger SSBN either late in this decade or sometime in the next, possibly powered by a larger 190-megawatt nuclear reactor. If the DAE and DRDO's efforts come to fruition quickly—though India has experienced significant difficulties in designing naval nuclear reactors—this design could form the basis for the fifth and sixth boats of the Arihant class, which would then carry “12 SLBMs with ranges of 6,000 km and with multiple independently targetable re-entry vehicle (MIRV) capability.”<sup>483</sup> Depending on the number of sub-

marines finally procured, and the number of MIRVed missiles aboard them, the proportion of Indian sea-based nuclear weapons will commensurately increase.

The Indian SSBN force has attracted some criticism in the West because of what are perceived as the dangers accompanying ready nuclear forces at sea.<sup>484</sup> The challenges of effectively communicating with submerged platforms, the risks of loss in the context of an adversary's anti-submarine operations (with the attendant prospect of use-it-or-lose-it fears), and the dangers of accidents have all been highlighted. Obviously, these are not imaginary problems, but it is easy to overstate them. At any rate, India has begun to focus on these issues. The challenges of communication, for example, are already being addressed. India has begun construction of an ELF site in addition to its existing VLF stations. However, because both types of facilities (which are collocated) could become victims of an adversary's nuclear attacks, the navy has already begun to review the fallback solutions that might be necessary for the transmittal of nuclear launch orders. The deployment of trailing ELF communications antennae from India's maritime patrol aircraft or long-endurance unmanned aerial vehicles (UAVs) is one such emergency communications system that is being considered.<sup>485</sup> This work is still in its infancy, but it will progress as the SSBN fleet and its operations mature and as India moves toward maintaining continuous SSBN deterrent patrols.

The dangers of adversary attacks as a threat to SSBN survivability are more remote because, at least for now, Chinese and Pakistani submarine-based ASW capabilities are relatively primitive.<sup>486</sup> Where China is concerned, the constraints of geography will also prevent its submarines from enjoying any easy subsurface ingress into the Bay of Bengal, where most Indian SSBNs will likely conduct their deterrent patrols. Pakistani submarines, too, will not have an easy time operating in these waters where Indian air, surface, and subsurface ASW platforms will be present in strength. The dangers of accidents are obviously hard to evaluate. Unfortunately, Russian nuclear submarines have been disproportionately hazard-prone, an issue that matters given Russian design influence on the Arihant program and the quality control problems of Indian manufacturing.<sup>487</sup> Be that as it may, India has no choice but to mitigate these dangers as best it can given its determination to maintain a sea-based deterrent. The risk of accidents did not prevent other nuclear powers from building SSBNs because of their potentially higher survivability, and India will not prove to be an exception to this rule either.

Even as it persists with its SSBN program, concentrating along the way on increasing both submarine safety and the lethality of its missiles, India must build the quietest SSBNs it can simply in order to lower the risks of successful detection and attack in wartime. SSBNs, unlike land-based missile platforms, represent highly concentrated firepower; any losses, whatever their cause, would diminish India's retaliatory capacity disproportionately.<sup>488</sup> Should such diminutions occur, however—despite the efforts made to avoid them—the saving grace is that they are unlikely to precipitate any use-or-lose scenarios as is often feared. The purpose of maintaining a triad is precisely to obviate these contingences to begin with, and

Indian policymakers believe—correctly—that any nuclear attacks that make use-it-or-lose-it scenarios realistic would require the massive and comprehensive nuclear attacks on India that are simply implausible in all foreseeable circumstances.<sup>489</sup>

## Strategic Defense Capabilities

This brief survey of India's evolving nuclear capabilities suggests that New Delhi is continuing to invest resources in expanding its offensive capabilities through the construction of a nuclear triad that is oriented primarily toward preserving deterrence through the threat of retaliation. Like China, however, and in continuing contrast to Pakistan, New Delhi has also initiated a modest strategic defense program. This effort is nowhere as comprehensive as China's is today. Yet it is aimed at erecting a two-layered defensive system around the national capital and perhaps a handful of other major Indian economic centers (depending on the resources available) as an antidote to accidental, unauthorized, or limited missile attacks originating from both Pakistan and China. India's progress in this area has been painfully slow. It has focused its efforts thus far on developing and integrating terrestrial sensors for long-range search, cueing and fire control; testing new interceptors for upper-, medium-, and lower-tier intercepts; and developing the command-and-control structure for managing ballistic missile defense operations. When this system matures, India will be capable of defending small enclaves (that include point targets) against limited attacks, but this thin defense system will not provide either nationwide protection or an antidote to substantial strikes.<sup>490</sup>

Expanding coverage to larger areas will require a space-based sensor segment and the development of a genuinely integrated air and missile defense system that fits into the existing Indian air defense architecture. New Delhi will probably move in this direction over time but even when such a system is finally ready—which is likely to be more than a decade out—India will not have shifted to a defense-dominant nuclear regime in any way.<sup>491</sup> Rather, like China, the bulk of its attention and investments will focus on expanding the offensive components of its nuclear deterrent. In time, this may come to include greater incorporation of cruise missiles and possibly hypersonic delivery vehicles and MRV/MIRVs aboard its ballistic missiles, all oriented toward holding strategic targets at risk. Because India believes that strategic defenses have not matured—and will likely never mature—to the point of making offensive nuclear systems obsolete, it will continue to concentrate first and foremost on modernizing its nuclear triad, while treating its emerging thin defenses as secondary insurance to deal with more remote contingences such as limited attacks. The persistent Indian emphasis on strengthening deterrence and warding off nuclear attacks has also resulted in a conspicuous lack of interest in integrating offensive nuclear operations with strategic defense—a posture that is also unlikely to change in the foreseeable future.<sup>492</sup>

## Command and Control, Operational Posture, and Force Employment

The transformations in nuclear weapons design that were on display in 1998 and the evolution of India's delivery systems since have garnered most of the public attention in the two decades following India's last nuclear tests. Yet the changes—for most part outside of the public eye—in the supporting infrastructure and in the procedural systems associated with nuclear operations have been equally, if not more, significant. When the government of prime minister Atal Bihari Vajpayee departed office after its surprise defeat in 2004, its national security leadership was fearful that the incoming government, led by Congress prime minister Manmohan Singh, might be less than committed to staying the course that the BJP had embarked upon. These concerns derived from the fact that the Congress Party was not entirely enthusiastic about the 1998 nuclear tests, with many of its leaders viewing them as a political effort at boosting the BJP's domestic fortunes.<sup>493</sup> In any event, the record confirms that the Singh government, taking its bearings from what India's national interests demanded, faithfully sustained the Indian nuclear deterrent when it was in power from 2004 to 2014, systematically enlarging and improving the supporting infrastructure necessary for the conduct of retaliatory operations.<sup>494</sup>

The diverse initiatives undertaken here included expanding the number of secure sites throughout the country that could be used for the storage of nuclear weapons and/or their components as well as their delivery systems. These facilities, which range from above-ground to underground structures and incorporate measures to disguise their purpose and location—what one former chief of India's Chiefs of Staff Committee metaphorically called “hardened silos”<sup>495</sup>—are critical to ensuring the survivability of India's nuclear deterrent. By protecting critical elements, such as the nuclear weapons themselves and key delivery systems like missiles, at sites far away from the usual and known military bases, Indian decisionmakers have sought to ensure that a sufficient fraction of their deterrent capabilities can survive even in the event of a surprise attack that prevents them from readying, integrating, and dispersing their forces beforehand.<sup>496</sup>

All the components of the Indian nuclear deterrent, both the land-based elements that are still maintained as a force-in-being as well as the SSBNs, which will eventually be deployed as a ready arsenal, are now connected by a dedicated and secure communications network.<sup>497</sup> Soon after the 1998 tests, many Indian commentators argued that the diverse Indian communications systems already in existence, both military and civilian, would suffice to connect the different components of the Indian nuclear force.<sup>498</sup> While these extant defense and civilian networks obviously remain useful backups, India's planners decided that a dedicated strategic communications network was essential for the effectiveness of their deterrent. Accordingly, they integrated many previously existing elements such as long-range high-frequency radios and various large and small, fixed and mobile, satellite communications systems into a new network that also uses an extensive set of buried fiber-optic lines for the terrestrial transmission of data and orders where appropriate.<sup>499</sup>

Connecting the various nodes of the Indian deterrent to one another and to the leadership enables the synchronization that is necessary when the national command authority determines that its nuclear forces should be assembled and made ready for retaliatory operations. Ensuring the survival of the leadership itself is critical for this purpose: although India has formalized a system of succession and devolving authority in a so-called Red Book,<sup>500</sup> to ensure continuity of government and the possibility of issuing legitimate orders for nuclear release even in the event of a decapitation of the senior leadership, it has complemented this procedure by building several secret underground command facilities for both civilian and military leaders to enable successful nuclear retaliatory operations in the event that the principal peacetime command center at South Block in New Delhi is destroyed by an adversary attack.<sup>501</sup> All these command posts are linked by voice and electronic communications, which feed a computerized decision support system that aids the leadership in choosing from among various nuclear options when appropriate.

While India, therefore, has undertaken all the key physical investments necessary to ensure effective nuclear retaliation consistent with its stated doctrine, it has not made developing a dedicated tactical warning and assessment system a priority yet. Some such capabilities already reside in its integrated air defense system and in its civilian space capabilities, but sensors specifically for early warning of ballistic missile launches as well as for trans- and post-attack assessment have not been deemed essential because of the assumption that Indian nuclear retaliation does not have to be instantaneous.<sup>502</sup> Consequently, there would be enough opportunities to assess the scale and the extent of any nuclear attack through diverse national sensors (even if not in real time), coupled with corroboration by friendly foreign partners as well as other local sources. India's capability for tactical warning will improve once its ballistic missile defense systems, and especially their associated space detection sensors, slowly become operational, but it is likely that New Delhi will put off investing heavily in real-time tactical warning and assessment capabilities in favor of other requirements, such as improving its delivery systems and increasing its force survivability, because of their larger and more important contributions to the success of deterrence.

As these different elements of supporting physical infrastructure have fallen into place—with many activities still ongoing—the procedural systems that make the Indian nuclear posture viable have also been rationalized since the 1998 tests. The formation of the Strategic Forces Command (SFC) in 2003 was a critical step in transforming the effectiveness of the Indian deterrent, which until then consisted of informal procedures for developing, maintaining, and deploying the deterrent force. The creation of a Strategy Program Staff within the national security advisor's office, tasked with coordinating between the SFC and the

***The formation of the Strategic Forces Command in 2003 was a critical step in transforming the effectiveness of the Indian deterrent, which until then consisted of informal procedures for developing, maintaining, and deploying the deterrent force.***

civilian leadership, also brought greater coherence to the business of planning future forces, advising civilian authorities on political and technical matters affecting the deterrent, and providing oversight in regard to the SFC.<sup>503</sup> Thanks to these two institutions, there is now a systematic process in place for assessing requirements, debating alternatives, planning for future capabilities, and systematically executing the myriad tasks associated with nuclear force generation once India's civilian leaders initiate the alerting process. The mechanics of force generation are now formally codified in the so-called Red and Blue Books.<sup>504</sup>

The SFC is central to the management of India's nuclear forces. Headed by a three-star officer, with the position rotating between the army, navy, and air force, the commander-in-chief of the SFC and his staff are responsible for India's nuclear operations. This includes: assessing requirements pertaining to nuclear weapons and delivery systems; coordinating with the two civilian agencies responsible for India's nuclear weapons, the DAE, which produces the fissile cores, and the DRDO, which, among other things, produces the high explosive charges and the safing, arming, fusing, and firing systems for the warheads, develops the delivery systems, and oversees and controls all the strategic storage sites associated with the nuclear deterrent; creating the nuclear targeting and employment plans and securing their approval from the national command authority; and, finally, identifying the relevant force components and overseeing their training, readiness, and disposition for nuclear missions. The formation of the SFC has thus been a critical element in the evolution of the Indian nuclear deterrent from what was initially almost entirely a civilian enterprise, with the military role restricted mainly to weapons delivery, to a fused civilian-military endeavor today, with the military playing a greater role in the planning, organization, and operation of the deterrent but with still significant civilian participation by the DAE and the DRDO at critical points in the process.<sup>505</sup>

While the SFC thus manages India's overall deterrent, it exercises differential control over the various force components in peacetime. Those elements that have exclusively nuclear missions, like the Indian Army's nuclear missile brigades and the Indian Navy's SSBN fleet, remain under the persistent operational command of the SFC.<sup>506</sup> The dual-use components in contrast, such as the IAF's strike-fighters, which are capable of carrying nuclear weapons and are tasked for executing retaliatory missions when required, fall under the SFC's operational control when necessitated by the appropriate stage of the alerting sequence; prior to that transition, they remain under IAF command and could be employed flexibly for conventional operations. In any case, the Indian armed services continue to man and maintain all the delivery systems routinely, irrespective of their mission. In coordination with the SFC, they are also responsible for developing the concepts of operations and the operating procedures that govern the physical employment of their delivery systems. The SFC's ability to seamlessly control these forces in peacetime and war is made possible by the three two-star officers (and their staffs) who are seconded from each of the three armed services to oversee the different strategic force "vectors" within the SFC. In this capacity, they are responsible for liaising with their parent headquarters to ensure that the nuclear components

are capable and ready for action as required. The presence of these service-level deputies, sometimes but not yet authoritatively identified as “chief staff officers,”<sup>507</sup> serves to avoid oscillating changes in operational control where the dedicated nuclear delivery systems are concerned, and it ensures that the shifting control of the dual-use delivery vehicles from the services to the SFC occurs when required without undue prejudice to either conventional or nuclear operations.

Beyond the delivery systems, the nuclear weapons themselves are preserved separately and their disposition entails multitiered arrangements. The production facilities where the fissile cores are manufactured, the Bhabha Atomic Research Center at Trombay, and the high explosive production facilities, most likely the Terminal Ballistics Research Laboratory at Chandigarh, lie at the base of the edifice.<sup>508</sup> India’s nuclear weapons components are usually aggregated at Trombay; once tested and certified, they are transported for stowage at several “central storage locations,”<sup>509</sup> where they are preserved either in component form or as assembled weapons depending on the demands of their maintenance cycles, the threat environment obtaining at any given point in time, and their designated allocation for integration with particular delivery systems. The identity and location of these national depositories is unknown except to the Indian civilian and military leadership involved in managing the deterrent, but the sparse descriptions that have emerged suggest that they include underground facilities that may even take the form, in some cases, of “mountain tunnel complexes.”<sup>510</sup> In any event, these sites, which are heavily disguised and scattered throughout the country far from conventional military establishments, feed a large number of equally opaque “forward support facilities,”<sup>511</sup> which likely exist in some proximity to, if not actually at, the air, missile, and naval bases hosting the delivery systems designated for nuclear operations.<sup>512</sup>

The nuclear warheads and/or components at Trombay and at the national depositories remain in the custody of civilian authorities: the DAE in the case of the former and the DAE and the DRDO in the case of the latter. The weapons at the forward facilities, which are now largely maintained in assembled form because of India’s desire for expeditious retaliation, are controlled through similar arrangements—meaning in the custody of civilian stewards—even if the facilities themselves are located on military bases.<sup>513</sup> The ironclad determination to maintain civilian custody over all of India’s nuclear weapons until retaliatory operations are plausible has resulted in the DRDO becoming the pivot for day-to-day control over key elements of India’s nuclear deterrent: it maintains the nuclear storage sites, oversees the special security units employed for protection duties, and, in partnership with the DAE, manages the transportation, assembly, and mating of the nation’s nuclear warheads. These arrangements represent a fundamental continuity with the procedural system that was in place during the 1998 tests.

What has changed since then is that the overall storage infrastructure has expanded significantly and the protocols for transferring nuclear weapons from production to central



to forward sites, and from forward sites to the military operators of the delivery systems, have been refined and systematized.<sup>514</sup> Furthermore, most Indian nuclear weapons, which, prior to 1998, were maintained with high degrees of separation—that is, with the pit stored separately from the rest of the weapon assembly—are now stored at the forward facilities fully assembled. Many, though probably not all, devices sequestered at the rearward central storage sites are also likely to be maintained assembled because of New Delhi’s desire to retaliate as quickly as possible after suffering a nuclear attack.<sup>515</sup> But even this judgment, which reflects public comments offered by senior SFC officials,<sup>516</sup> must be treated with caution: depending on the levels of threat, the features of a particular storage site, the availability of DAE and DRDO personnel therein, and the maintenance associated with any given weapon, India’s nuclear devices could subsist routinely at different states of assembly. Consequently, it must not be assumed that all Indian nuclear weapons, irrespective of their location, are readily available for nuclear operations routinely.

In any event, maintaining some weapons at high assembly states—that is, with the nuclear pit and high explosive system fully integrated and fitted into the warhead canister—enables land-based and air-delivered systems to be quickly mated with their lethal payloads when so ordered by India’s national command authority.<sup>517</sup> Where aviation delivery systems are concerned, therefore, the assembled nuclear devices at the forward site (possibly located at the airbase itself) would merely require the completion of their final technical checks before being fitted on to the alerted aircraft prior to executing the retaliatory mission. Where land-based missiles are concerned, however, the assembled weapons in their warhead containers would, after completing their final checks, have to be inserted into the reentry vehicle shell and mated to the missile airframe, which could be stored at the forward site itself (or at some other proximate facility), before the missiles are then loaded on to their transporters for possible dispersal before launch. Whether the delivery system involves aircraft or missiles, the mating of the warheads with their carriers occurs only “in the third stage” of India’s four-step alert sequence, which is when civilian custody of India’s nuclear weapons also comes to an end.<sup>518</sup>

Once the appropriate mating is completed, both the rail- and road-mobile missiles can be launched from either their garrisons or after dispersal from pre-surveyed launch points at some distance from their peacetime storage sites. The former is feasible only if the garrisons are above ground. Since most of India’s key missile systems, however, are now preserved in underground facilities, the latter launch mode has inevitably become the default and is obviously preferred because it preserves the locational opacity of the complex wherein the weapons and missiles are stored. The actual integration sequence prior to Indian missile launches is thus likely to be more complex, depending on the extent of separation between the assembled warhead and the missile and the type of missile systems in question and where they are based, but the simplified description above, which captures the essential details, underscores the critical point that India’s land-based nuclear missiles (and, for that matter, its nuclear aircraft) cannot be launched “within minutes” from a standing start.<sup>519</sup>

The canisterization of some Indian missiles, such as the Agni-IP and the Agni-V, has created confusion because it has led to the belief, as Vipin Narang has expressed, that “the warhead is likely pre-mated to the delivery vehicle and kept hermetically sealed for storage and transport,” a posture that then enables India to maintain “some subset of the force within minutes of readiness” to launch.<sup>520</sup> Bharat Karnad has advanced a similar—misleading—claim when he asserts that “the ongoing process of canisterising Agni missiles . . . provides the country not only with a capability for launch-on-warning but also for striking pre-emptively should reliable intelligence reveal an adversary’s decision to mount a surprise attack.” This capability supposedly derives from the fact that “nuclear missiles in hermetically sealed canisters are ready-to-fire weapons and signal an instantaneous retaliatory punch to strongly deter nuclear adventurism.”<sup>521</sup>

The reality, however, is somewhat more complicated. The move toward the canisterization of some Indian ballistic missiles was driven by the fact that the composite propellant used in the Agni series as a whole—a formulation that combines hydroxyl-terminated polybutadiene (HTPB) with ammonium perchlorate (AP) and aluminum (Al) powder—is overly sensitive to the temperature and humidity variations that are common at the strategic storage sites dispersed throughout the Indian subcontinent.<sup>522</sup> At higher temperatures, AP/Al/HTPB motors have lowered tensile strength and can develop cracks, deformation, and debonding at the interface between the propellant and the liner. Storing the missile in optimum temperature- and humidity-controlled conditions is, therefore, essential to avoiding propellant failures.

Instead of maintaining the entire storage facility (which could be quite large) as a single environmentally controlled unit—a costly solution that the DRDO experimented with—protecting individual missiles in low temperature- and humidity-controlled canisters has proven to be a better solution. Since canisterization also permits cold launch, where the missile is ejected by compressed gas from the container before motor ignition, it has the further benefit of protecting the transporter-erector-launcher from thermal damage. Furthermore, because the missile body is maintained at the optimum temperature within the canister during storage, it does not have to undergo a lengthy period of adjustment to the ambient temperature outside the receptacle when being prepared for launch—a problem that handicaps all non-canisterized missiles in India (and Pakistan) that use AP/Al/HTPB propellant. As a result, although canisterized missiles can be brought to readiness far more quickly for military operations, this should not be confused with the capability for *prompt* nuclear launches—even though DRDO scientists have boasted of such in their public remarks.<sup>523</sup>

Protecting the missile inside a canister has little to do with whether it is deployed with its warhead and, as Gaurav Kampani has correctly noted, “there is no firm evidence . . . yet” that canisterization entails the missiles being mated with nuclear weapons routinely in peacetime.<sup>524</sup> Yogesh Joshi has adamantly declared that “even with the canisterization of India’s missile force, there exists a physical separation between the warhead and the delivery

vehicle.”<sup>525</sup> This view is consistent with the standard operating procedures governing India’s nuclear forces, which require DAE and DRDO personnel based at the storage site to prepare the nuclear devices in their custody and insert the warhead containers into the missile airframes only at the third stage of the four-step alert sequence, after which the completed system is released to the military units for dispersal or firing.<sup>526</sup>

The conflation of canisterization with a prompt nuclear launch capability also fails to appreciate the pattern of Indian missile operations. Even if India’s canisterized missiles routinely contained nuclear warheads, they cannot be launched from a standing start—as, for example, U.S. and Russian silo- and sea-based missiles can. Most of India’s land-based strategic missiles are dispersed and stored in underground hides that are some distance from their pre-surveyed launch points. Even if these systems are customarily maintained with their attached warheads, they cannot be launched until their system checks are completed in situ and they are dispersed to their launch sites when authorized to do so. Even canisterized missiles that supposedly have their warheads routinely attached may not be mounted constantly on their transporter-erector-launchers; if not, attaching the canister to the transporter, connecting the umbilical cables, and completing the assembly checkout could take over an hour. To this must be added the time required for the assembled system (and its accompanying support vehicles) to travel to their field hide or launch site (since it is highly unlikely that any missile would be launched from just outside its storage facility except perhaps in an emergency). Thereafter, the process at the launch site for aligning the launcher’s azimuth, stabilizing the trailer, erecting the missile canister, establishing communications with the launch control vehicle and higher command echelons, loading and/or confirming the targeting data, and completing the final checks prior to firing only extend the timelines way beyond the metaphorical “within minutes” response time that canisterized missiles are supposed to achieve. After India’s land-based missiles reach their wartime field hides or their launch locations, they can be fired as quickly as their alignment and launch sequences permit—but at that point, *whether they are canisterized or not is entirely irrelevant*.

The only time canisterization would make a difference to India’s ability to unleash instantaneous attacks is if these weapons could launch from their peacetime locations with little to no notice. Since this is physically impossible, given that India’s most valuable nuclear missiles are currently bivouacked underground, canisterization only speeds up the time it takes the missiles (assuming that they are constantly mated with their nuclear warheads) to deploy to their launch locations, because it minimizes the environmental adjustments and “also gives the missile a longer shelf life [while] protecting it from the harsher climatic conditions.”<sup>527</sup> This certainly constitutes an advantage over non-canisterized systems, but it does not permit any instantaneous launch from a standing start, the assumption that seems to underly the claims advanced by Narang and others that “some portion of India’s nuclear force, particularly those weapons and capabilities designed for use against Pakistan, are now kept at a high state of readiness, capable of being operationalized and released within *seconds or minutes in a crisis*” (emphasis added), which then “enables India to possibly release

a full counterforce strike with few indications to Pakistan that it was coming (a necessary precondition for success).<sup>528</sup> Canisterization, for all its advantages, does not permit such an alacrity of response. But, even more importantly, there is no subset of the Indian nuclear deterrent—whether oriented toward Pakistan or China—that is customarily maintained at such a high level of readiness so as to permit it to prosecute combat operations within “seconds or minutes” of the issuance of alert orders.

For all the adjustments that have occurred since 1998, India’s land-based nuclear forces in peacetime are still postured as a force-in-being rather than as a ready arsenal. Many of the nuclear weapons themselves are already assembled, especially at the forward sites. But these weapons, irrespective of their assembly state, are controlled and remain under the sole custody of their civilian guardians, the DAE and DRDO technicians who oversee them at the various storage facilities. Only when the alerting sequence evolves are these weapons mated to the delivery systems, which remain under military control and receive their lethal payloads solely when retaliatory operations are conceivable. That this force posture has survived robustly is a testament to the Indian belief that nuclear weapons are, in the final analysis, still political tools of deterrence rather than military instruments of warfighting.

As was anticipated some two decades ago, the force-in-being model of India’s nuclear deterrent has been transformed most by the development of its ballistic missile submarine force.<sup>529</sup> But even here, India has thus far been relatively cautious. Nuclear-armed ballistic missiles are not yet deployed persistently on either its ships or its submarine(s); rather, these weapons are only loaded aboard the host vessels when required at the appropriate stage of the alerting sequence and before they put to sea on their deterrence patrols. As Yogesh Joshi has noted, “As far as the operationalization of the SSBN force is concerned, it is unlikely that India’s SSBNs will carry any nuclear payload during peacetime.”<sup>530</sup> In other words, nuclear-tipped ballistic missiles are not deployed aboard the submarines (or the surface vessels) routinely, at least right now. When they are so deployed in anticipation of a deterrence patrol or during a crisis, they will likely be removed from their host vessels when the latter return from at-sea operations and stored at their shore bases until the next patrol. Whether these missiles are then sequestered with or without their nuclear warheads is largely irrelevant—this choice is likely to be determined more by maintenance requirements than anything else—because they cannot be fired from their storage sites in any case.

What the sequencing processes above indicate is the importance of India’s four-stage alerting system. During peacetime, India’s nuclear weapons, even if many are stored fully assembled at various rear and forward facilities, are ordinarily not mated to their delivery systems. The mating of weapons to their carriers occurs as the alerting sequence evolves—a process that finally eventuates either with a retaliatory mission or with a progressive return to the peacetime condition as a distributed capability. The air-breathing leg of the deterrent now probably conforms to what was described two decades ago as posture VI: weapons maintained at a high stage of assembly and awaiting only mating with their delivery aircraft.

The land-based missiles conform either to posture V—that is, assembled warheads are integrated with the missile, which is separated from its launcher—or to a variation of posture V, where the assembled warhead is either separated from the reentry vehicle or is integrated with it, with the final mating of this payload to the missile occurring when required at the third stage of the alerting sequence.<sup>531</sup> Only aboard surface ships and in submarines would complete Indian nuclear weapons and delivery systems be maintained in ready-to-use condition, and only then when these vessels are on designated deterrent patrols.

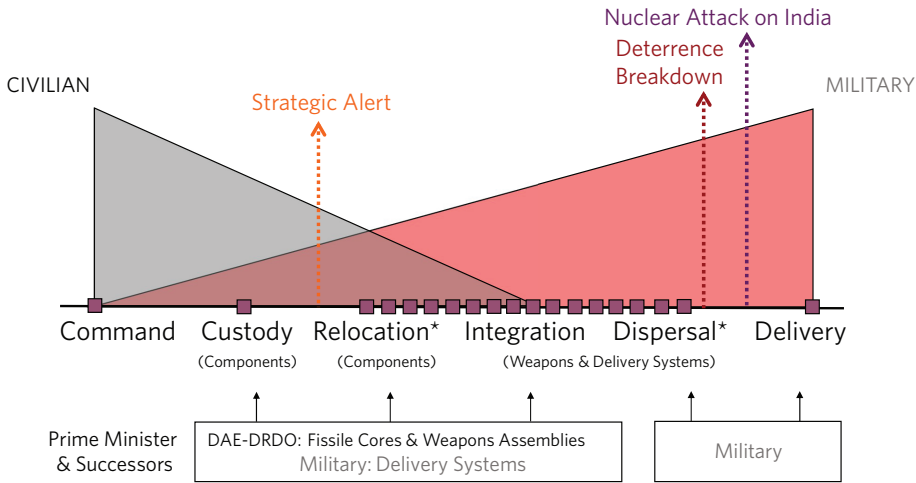
The SFC oversees all the changes associated with these evolutions. As noted earlier, the SFC has administrative control over the entire Indian nuclear deterrent. But it enjoys persistent command only over the dedicated nuclear delivery vehicles; it acquires command over the dual-use systems once the strategic alert is sounded, but in neither instance does it have physical possession of India's nuclear warheads, which remain in the custody of civilian stewards until the integration of India's nuclear forces is underway. As the alerting process advances in the aftermath of receiving strategic warning of a possible conflict, the SFC's control over all the land-, air-, and sea-based nuclear systems extends to completing their integration, implementing their possible dispersal, and, eventually, executing the nuclear strike operations that may be ordered by the civilian leadership.<sup>532</sup>

However these processes play out, the timelines pertaining to the integration and readiness of India's nuclear forces have changed significantly. Whereas at the time of the 1998 tests, India seemed content to integrate its deterrent after it had suffered a nuclear attack, the importance of overcoming the “discounting problem” referred to in Chapter 1 has now resulted in India—just like China—planning to accelerate the integration of its nuclear force in order to shore up deterrence, especially against more risk-acceptant adversaries such as Pakistan. This shift, too, was anticipated two decades ago.<sup>533</sup> As Figure 5 illustrates in schematic form, India now plans to begin the process of relocating weapons and delivery systems (if required) and completing the mating of its nuclear weapons to their delivery systems, together with any other activities necessary to increase force readiness, immediately on arrival of strategic warning, which could materialize (ideally) prior to a conventional war or could coincide with its initiation. While India is unlikely to generate all its nuclear reserves, it seeks to have a small subset of its weapons ready for operations well before it suffers any nuclear attacks so that its retaliatory actions can be mounted swiftly thereafter.

This sequencing model obviously applies mainly to the land-based forces and to the naval surface deterrent; if the SSBN force is already on patrol before a crisis breaks out, it would be ready for retaliatory operations on very short notice. If India does not deploy nuclear-tipped missiles on its SSBNs persistently and the vessels are not at sea during the onset of a crisis, the force generation sequence illustrated in Figure 5 would apply here as well with the appropriate modifications.

Preparing missile-based nuclear systems that are not configured for instantaneous response inevitably involve lengthy procedures. Although aircraft could possibly be readied in a few

**FIGURE 5**  
**INDIA'S NUCLEAR FORCE GENERATION**



\*If necessary

Note: The military will have a role in supporting the relocation of nuclear weapon components and systems if appropriate.

hours, missile forces on land and surface ships (as well as on submarines not on patrol) would require many hours, and possibly up to a few days, to reach complete launch readiness. The importance of generating a strategic alert as early as possible during the evolution of any major crisis thus becomes self-evident. Because India's nuclear capabilities are growing, are diverse, and are deployed across a huge landmass, New Delhi is unlikely to authorize the integration of its entire nuclear deterrent all at once. But how much of the force is to be readied, integrated, and dispersed will depend on who the adversary is and the nature of the crisis. It is, therefore, probable that some fraction of the force will be primed and generated for retaliatory operations while other elements may continue to remain dormant, even if alerted. The number of systems that are actually prepared for war could vary considerably; consequently, one of the SFC's tasks is to prepare emergency action plans that permit different levels of force generation depending on the contingency.

Amid all the evolution since the 1998 tests, four cardinal features of the Indian nuclear deterrent have not changed whatsoever.

First, the command of the force remains vested solely with civilian authorities and only the prime minister and his designated successors can order the use of nuclear weapons. The national security advisor—aided by the Strategic Program Staff, other military advisors, and members of the Strategic Policy Group as appropriate—will play a key role in these deliberations, but the decisions with respect to nuclear use remain firmly in the hands of civilian leaders.<sup>534</sup> The same is true today, even where the development of India's strategic

weapons is concerned. Although senior officials of the DAE, DRDO, and Strategic Forces Command all play a critical role in developing proposals pertaining to the acquisition of new capabilities, the (civilian) Cabinet Committee on Security is the final decisionmaking body. While the DAE and the DRDO have enormous latitude in pursuing various research and development endeavors independently, whether their fruits are finally incorporated into the Indian nuclear deterrent depends on the political decisions made entirely by civilian politicians. Whether the latter always appreciate the consequences of their choices is a different matter, but the decisions at least are effectively theirs alone.<sup>535</sup>

Second, the control of India's nuclear weapons also remains fundamentally with civilians to this day. It is safeguarded partly through procedural solutions, which involve civilians from the DAE and the DRDO preserving custody of both the assembled weapons and the disaggregated fissile cores and weapon assemblies at the various storage sites in peacetime. Civilian technicians from the DAE and the DRDO also control the weapons maintenance, assembly, and mating process until their handover to the military, which then deploys the delivery systems either on missions or for dispersal and possible launch. The Indian armed forces, therefore, do not yet have routine custody of India's nuclear warheads or their components, even when these may be sequestered in facilities that are located on military bases. They acquire such custody only after the third stage of the four-step alert sequence evolves, when their civilian overseers hand the assembled weapons over to the military operators as required by the exigencies of dispersal and potential use. Because completed nuclear weapons will end up in the custody of the uniformed military at the terminal stages of the alert process, or could be persistently in military hands when India begins continuous SSBN deterrent patrols, the standing procedural controls that define peacetime custody are now supplemented by technical controls on *all* Indian nuclear weapons which prevent their launch in the absence of deliberate actions by India's civilian authorities.<sup>536</sup> These controls involve a two-channel process: civilian authorities possess the permissive enable system (PES) codes that the warheads' firing systems must receive first before the uniformed operators' permissive action links (PAL)—codes that are distributed to the military at some stage in the alerting process—can be rendered active in order to enable the warheads to arm.<sup>537</sup> Even with these technical controls, which now govern all of India's nuclear weapons irrespective of how they are delivered, India also requires that the PAL codes be keyed in by two individuals separately, thus institutionalizing, in Shyam Saran's words, "a two-person rule for access to armaments and delivery systems."<sup>538</sup>

Third, India continues to resist any pre-delegation of nuclear launch authority to its military services. In part, this rejection is grounded on the expectation that large-scale nuclear attacks against India are highly unlikely, but in order to protect against just such a contingency, New Delhi has invested heavily in ensuring leadership survival and the success of its succession mechanisms. Hypothetically, if all these insurance mechanisms were to fail, Indian leaders would yet prefer no retaliation over the hazards of inadvertent nuclear war. Consequently, their command-and-control system, designed to fail safe rather than

fail deadly, indicates that they still—and very sensibly—continue to privilege negative over positive control where nuclear weapons are concerned.<sup>539</sup> This preference is reflected clearly by the fact that command authorities do not distribute the launch codes for nuclear use until late in the alert sequence and civilian officials will not key in their PES codes before Indian nuclear retaliation is actually deemed necessary. Given the possibilities of accidents, as evidenced most recently by the inadvertent launch of a conventional Indian Brahmos cruise missile into Pakistani territory,<sup>540</sup> the importance of such technical safeguards cannot be overemphasized.

Fourth, and finally, India's nuclear weapons are not integrated into conventional warfare in ways that attempt to advance operational warfighting aims. They are linked to conventional operations only insofar as nuclear force alerting and preparations are likely to proceed in tandem with conventional force mobilization, but only during serious political crises. The Indian armed forces obviously take nuclear threats into account when planning conventional operations principally with an eye to protecting the viability of their military assets. But Indian nuclear weapons, being distinct instruments of deterrence and intended primarily for retaliation, are not amalgamated into conventional force planning in order to secure any battlefield goals. On this count, China and India are very similar, in contrast to Pakistan.

## **TAKING STOCK**

This survey of India's nuclear evolution since the 1998 tests indicates that its initial conceptions of deterrence, which were articulated early in their aftermath, have survived quite robustly more than two decades later. The commitment to no first use still endures despite endless debates because it comports well with the extant balance of capabilities vis-à-vis Pakistan and China and fits the interests of a status quo power like India. The quest for a minimum credible deterrent still continues with all the available evidence suggesting that New Delhi has not built the largest-possible arsenal of warheads and delivery systems that it is capable of. The threats of massive retaliation in case of attack have been retained at the declaratory level, but Indian nuclear planning contains enough flexibility to permit flexible or proportionate retaliation as required by the end objective of securing speedy war termination.

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India's nuclear weapons are best suited for countervalue punishment. They could be used for discrete countermilitary and even for some modest counterforce targeting, but such strikes would not inflict the "massive" damage that attacks on countervalue targets would exact (and which India's declaratory policy calls for). As long as India is not victimized by true



bolt-out-of-the-blue nuclear attacks, it will seek—and this is one significant change since 1998—to integrate its nuclear capabilities—of which the most important components are still routinely controlled by civilian entities—on receipt of strategic warning rather than after an attack, and it will aim to retaliate as quickly as possible in the aftermath of absorbing an adversary’s nuclear strikes. The extent of the force mobilized, however, will depend on the nature of the crisis, and the alacrity of India’s retaliation, too, will depend on the scale of the damage suffered due to the enemy’s nuclear first use. All this confirms the proposition that India’s nuclear deterrent is still maintained largely as a force-in-being rather than as a ready arsenal. The new SSBNs that are being inducted into the fleet will change this disposition eventually, but how and to what extent remains unclear right now. In any event, the sea-based leg of the deterrent could remain the exception to the way that the larger nuclear force is managed and operated. India’s overall nuclear force posture will thus remain quite variegated. On balance, therefore, and in some ways similar to China, the continuities in the Indian nuclear program remain significant and its persistent conservatism very striking. This provides a useful benchmark for assessing the differences that mark Pakistan’s nuclear program and the changes occurring therein.

## CHAPTER 3

# PAKISTAN

### RACING AGAINST ITS FEARS AND AMBITIONS

Ever since its birth in 1947, Pakistan has been consumed by a relentless quest for security. This preoccupation derived in the first instance from the contentious processes of Partition. Because Pakistan was imagined as the new homeland for the Muslims of the Indian subcontinent, creating it required cleaving the erstwhile British Raj to separate those contiguous areas containing Muslim majorities from those that did not. This process of agglomeration produced a new state with an awkward geography: Pakistan was born composed of two parts, with its western and eastern wings separated by a thousand miles of Indian territory. To make things worse, the unfriendly separation that produced this topographic oddity was suffused by the threat of communal violence. It precipitated a massive exchange of populations—where some 15 million individuals crossed the new borders between India and Pakistan to reach territories where their co-religionists made up the majority—with anywhere between 200,000 and 2 million people losing their lives in the process.<sup>541</sup>

The creation of Pakistan was thus a bloody affair that left deep scars not only on its own psyche but also on that of its rival, India. The leaders of the Indian freedom movement then had reluctantly acquiesced to their country's division as the price to be paid for rapid independence and Britain's speedy exit from the subcontinent. They imagined at the time that an autonomous Pakistan would not survive for long and that a reunion of the two countries was inevitable, especially given that India inherited not only the bulk of the Raj's administrative, economic, and military assets but also its international rights and standing. In contrast, Pakistan acquired the mantle of a secessionist state, possessing an unnatural and disunited geography, and securing only a meager share of the Raj's resources. Its western

wing had weak administrative institutions, and the local economy of West Pakistan suffered from being sundered from its natural markets which now lay inside India. Worst of all, the ideational, cultural, and linguistic ties between West and East Pakistan were so tenuous, if not downright antipathetic, that not even the common bond of religion would in time suffice to keep them together.<sup>542</sup>

Pakistan, therefore, came into being “maimed, mutilated and moth-eaten”<sup>543</sup>—as its founder, Mohammad Ali Jinnah, had famously worried it might—and, to make things worse, found itself disorganized, fearful, and at odds with its larger neighbor India. The poisoned atmosphere that surrounded Partition was most clearly vivified by the disputes that broke out immediately upon Pakistan’s founding as both India and Pakistan laid competitive claims to several princely states, including Hyderabad, Junagadh, and Jammu and Kashmir. The struggle over Jammu and Kashmir would, in fact, provoke the first Indo-Pakistani war: this conflict began within weeks of the two nations’ independence and was precipitated by Pakistan’s efforts to use militant proxies to annex the contested kingdom and incorporate it into Pakistani territory.<sup>544</sup>

The failure to do so, however, highlighted the painful reality that Pakistan would begin life without one of the most elementary attributes of statehood, namely stable international borders. India’s refusal to cede Jammu and Kashmir to (West) Pakistan along its eastern frontiers at about the same time that the Afghan government reopened the dispute about the Durand Line serving as (West) Pakistan’s western frontier left the new state with fundamental uncertainties about its physical boundaries.<sup>545</sup> As these crises evolved, Pakistan’s national leadership, which was dominated by émigrés arriving from India, was also challenged simultaneously by economic dislocation, administrative chaos, and the burdens of integrating both the recalcitrant provinces, which ended up being part of West Pakistan despite their disinterest in joining the new country, and a distant eastern wing, which was more populous and shared only thin political ties with the expatriate leadership that came to reside in the west.<sup>546</sup>

With such travails—many of which have left their residue to this day—it is not surprising that Pakistan remains obsessed with security. At key moments in its seventy-odd-year history, it has experienced convulsive internal disintegration as well as severe external threats. Consequently, whether civilian or military governments are in office, national preservation remains the perennial preoccupation.<sup>547</sup> This concern is only obsessively magnified when the generals take power, as they have done for much of Pakistan’s history.<sup>548</sup> But the fear about security, which is usually but not always exclusively driven by concerns relating to India, remains a permanent feature of Pakistan’s consciousness, especially for the Punjabi and Pathan elites who dominate Pakistani politics and who, having historically enjoyed disproportionate representation in the army, have become the standard bearers of its myriad grievances against India.<sup>549</sup>

While India's larger size and its substantial economic and military advantages would have sufficed to make Pakistan nervous about national security in any case, Islamabad's perception of Indian attitudes only exacerbates the problem. Believing that India has never been reconciled to the creation of Pakistan, state managers in Islamabad are convinced that India is, and has been, constantly seeking to "undo" the Partition that brought their country into being. The ongoing conflict over Jammu and Kashmir, a Muslim-majority province that most Pakistanis believe is rightfully theirs, confirms their deepest suspicions that India has never accepted Pakistan's existence itself. This anxiety has intensified the animosity toward India and has pushed the Pakistan Army toward relentless conflicts—despite successive defeats—with its larger neighbor.<sup>550</sup>

The intensity of Pakistan's fears about India made it a natural candidate for acquiring nuclear weapons from the very beginning. By the time Pakistan was created, the awesome destructive power of nuclear weapons had already been demonstrated and the international system was slowly coming to understand that this "absolute weapon" would have great—if not the greatest—utility for deterrence.<sup>551</sup> For beleaguered states such as Pakistan, nuclear weapons offered hope for enduring security.<sup>552</sup> Yet the early years of Pakistan's independent life were marked by a conspicuous disinterest in nuclear weaponry, or, for that matter, any nuclear applications—quite in contrast to India, where both Jawaharlal Nehru and Homi Bhabha intuitively understood the significance of nuclear weapons both for international politics and as exemplars of modernity.<sup>553</sup>

Despite the pressures on Pakistan's security, its early indifference to nuclear weapons had much to do with the pressing problems then facing the country. Managing refugee resettlement after the chaotic Partition, ensuring leadership succession after Jinnah's early death, reconstituting the economy in a poor and geographically divided state, and laying the foundations for development in a population that was still largely agrarian and uneducated all prompted Pakistan to look in the direction of the United Kingdom, the erstwhile colonial power, for assistance in rebuilding its conventional military forces for defense against India rather than in the direction of nuclear weapons, which, whatever their potency, were still relatively exotic and required massive financial and industrial capabilities that were beyond Pakistan's reach at the time.<sup>554</sup>

From 1947 to 1954, therefore, Pakistan did not exhibit any interest in nuclear matters whatsoever. That changed after U.S. president Dwight D. Eisenhower articulated his Atoms for Peace proposal in 1953. In an effort to resolve "the fearful atomic dilemma," Eisenhower offered to share nuclear technology with the rest of the world for the collective benefit of humanity.<sup>555</sup> To access this bequest, Pakistan set out in 1954 to create new institutions that would oversee atomic research for scientific and industrial uses. From then on, it also sent scientists abroad for training in nuclear sciences while setting up research centers at home to explore nuclear applications in agriculture, health, and industry. These initiatives proceeded at a languid pace for most of the 1950s, but by 1963, Pakistan had established both

the Pakistan Atomic Energy Commission (PAEC) to manage the development of nuclear energy within the country as well as a nuclear research center, the Pakistan Institute for Nuclear Science and Technology (PINSTECH) near Islamabad, to induce the scientists trained abroad to return to Pakistan rather than to remain in the West.<sup>556</sup>

While nuclear science was thus beginning to develop in Pakistan, the intentions at this juncture were entirely peaceful, with Pakistan remaining an advocate of nuclear disarmament just like India. To the degree that Pakistan was looking for novel solutions to its security predicament, these would not be found in nuclear weapons but in the Western security alliances that had become a prominent feature of the Cold War. From 1954 on, Pakistan looked outward for security. It first signed a mutual defense assistance agreement with the United States and later joined the Southeast Asia Treaty Organization (SEATO) and the Central Treaty Organization (CENTO), which were U.S.-supported institutions intended to contain the spread of communism in Asia. Pakistan's interest in these alliances, however, was driven entirely by its concerns about India rather than communism. Alliance membership provided Pakistan with advanced conventional weapons on favorable terms, and it was expected that the Western powers would rush to Pakistan's defense in the event of conflicts with India.<sup>557</sup>

The Pakistani nuclear establishment slowly expanded between 1963 and 1971. Pakistan acquired its first research reactor, the Pakistan Atomic Research Reactor-1 (PARR-1), a small, 5-megawatt safeguarded facility under the Atoms for Peace program in 1965. That same year, it also signed an agreement with Canada for a larger safeguarded pressurized heavy water reactor, the Karachi Nuclear Power Plant-1 (KANUPP-1), which was a variant of the same design that Canada had sold to India and to this day remains the mainstay of both the Indian power and weapons programs. Pakistan also initiated plans to construct a plutonium reprocessing facility with British and French assistance around this time.<sup>558</sup>

While the scientific and power generation ambitions were thus steadily being realized, other geopolitical developments were stimulating change in the orientation of Pakistan's nuclear program. The 1962 Sino-Indian border war, which resulted in India's defeat, opened the door for new engagement between China and Pakistan as a result of their common animosity toward India. This rapprochement began despite Pakistan's existing membership in the Western anti-communist alliances and would, in time, yield important gains for Pakistan's nuclear weapons program. The immediate consequence of India's humiliation in 1962, however, was an intense debate in New Delhi about the need to shift the Indian nuclear program toward the production of nuclear weapons as a deterrent against China—a discussion that pushed Pakistan for the first time to contemplate the possibility of a weapons program of its own.<sup>559</sup>

This reconsideration only acquired impetus when the United States chose not to aid Pakistan during its 1965 war with India, responding instead with an arms embargo on both

countries. This early failure of the Western alliances to come to Pakistan's aid—as Pakistani leaders imagined they would—set the stage for Pakistan to reassess its reliance on outside powers for security.<sup>560</sup> Not long after the 1965 war, Pakistan's then foreign minister, Zulfikar Ali Bhutto, responding to the suspicion that India might seek the bomb even as the West was proving unreliable, publicly declared: “If India builds the bomb, we will eat grass or leaves, even go hungry, but we will get one of our own. We have no alternative.”<sup>561</sup>

Bhutto would soon get his opportunity. Fears about India's nuclear direction had resulted in Pakistan refusing to sign the NPT in 1968. Although Pakistan, following India's lead, had disavowed nuclear weapons, it nonetheless sought to preserve the option of developing them if required by necessity. The third Indo-Pakistani war in 1971 consummated this change in Islamabad's intentions. Pakistan's conclusive defeat in that conflict not only led to its vivisection—transforming the former East Pakistan into the new independent state of Bangladesh—but it proved once again, just as in 1965, that Pakistan's alliance partners would not bail it out of crises that were of its own making and did not involve communist aggression. For Pakistan, these caveats were irrelevant: if its alliances failed to deliver security, Islamabad would have to look elsewhere. Consequently, soon after its defeat in the December 1971 war with India, Bhutto, who had by then become prime minister, would convene a secret meeting in Multan in January 1972 to direct the PAEC to begin developing nuclear weapons as the last durable safeguard of Pakistan's security.<sup>562</sup>

This objective would only be reinforced by India's demonstration of its own nuclear capabilities through its May 1974 test, which left Pakistan with no choice but to accelerate its efforts to produce a nuclear deterrent. Pakistan's initial effort centered on plutonium separation, based on the assumption that it would construct its own unsafeguarded pressurized heavy water reactors eventually. Toward that end, Islamabad reached an agreement with France for the construction of a reprocessing plant, which would eventually be canceled under heavy U.S. pressure in 1977 but not before technical designs were transferred. Separately, Pakistan began negotiating with a Belgian company, Belgonucleaire, for reprocessing designs and training in the reprocessing of spent fuel. These activities would lay the foundations for the construction of the New Labs reprocessing facility, which Pakistan would later use to separate plutonium from its unsafeguarded heavy water reactors that were still some two decades away.<sup>563</sup>

In the meanwhile, however, A. Q. Khan arrived from the Netherlands in 1974 with stolen designs for uranium enrichment technology.<sup>564</sup> Using a shady international network of suppliers with the full support of the Pakistan government, Khan made the Kahuta Research Laboratory (later renamed the Khan Research Laboratory, or KRL) the center for producing HEU, which served as Pakistan's first fissile material for nuclear weapons. Even as Khan was beginning to build his infrastructure for producing HEU in Pakistan, Bhutto signed a secret agreement with Mao Zedong in June 1976 for Chinese assistance in developing nuclear weapons.<sup>565</sup> Bhutto's overthrow in a military coup in 1977 marked the moment

when Pakistan's nuclear weapons development program, hitherto a civilian venture, conclusively passed into the hands of the Pakistan military, where it has remained since.<sup>566</sup> In any event, China finally made good on Mao's commitment after the 1979 Soviet invasion of Afghanistan when, in exchange for previous access to Khan's more advanced European centrifuge technology, Beijing transferred sometime in 1981 both a detailed nuclear weapons design and some 50 kilograms of weapons-grade uranium to aid Pakistan in developing the nuclear deterrent that could protect it against both Soviet intimidation and Indian threats.<sup>567</sup> The effort to indigenously produce fissile materials for that purpose reached fruition by about 1986, when the KRL could finally deliver sufficient quantities of HEU to sustain the steady enlargement of a Pakistani nuclear weapons stockpile.<sup>568</sup>

Pakistan would obliquely reveal these new capabilities for the first time during the 1986–1987 “Brasstacks” military crisis with India, when Khan told a visiting Indian reporter in January 1987 that “What the CIA has been saying about our possessing the bomb is correct.”<sup>569</sup> Despite the embarrassment this interview caused the United States, which had been aiding Pakistan militarily for its role in the anti-Soviet campaign in Afghanistan on the fiction that Islamabad was not developing nuclear weapons, Pakistan persisted with its nuclear weapons program, continuing even after Washington began to levy renewed sanctions on Islamabad in 1991. In fact, even as Khan was declaring Pakistan's capacity to field nuclear weapons employing HEU as fissile material, Islamabad was on the cusp of constructing—again with Chinese assistance—a dedicated unsafeguarded 40-megawatt plutonium production reactor, Khushab-1, which would be run by the PAEC and began operating in early 1998.<sup>570</sup>

The determination to pursue both the uranium and plutonium paths to nuclear weaponry highlighted the importance of these devices for Pakistan's security after alliances were eschewed as instruments of political safety. China's role only became more prominent in this regard; from 1988 onward, Beijing began to steadily transfer short-range ballistic missiles, such as the M-11, as well as various components and technical expertise for different elements of the Pakistani nuclear weapons program.<sup>571</sup> By the time Pakistan tested its nuclear weapons openly for the first time, following India's renewed nuclear tests in May 1998 and amid bizarre fears of a possible Israeli air attack on Pakistan (and perhaps its nuclear capabilities),<sup>572</sup> Islamabad had accumulated enough indigenously produced HEU for perhaps two dozen weapons, brought online a new plutonium production reactor, acquired short- and medium-range ballistic missiles as complements to its aircraft for nuclear delivery, and was poised to enlarge its fissile material production through the expansion of its enrichment and reprocessing facilities. Following India's claims of having successfully detonated a thermonuclear device, Pakistan also began to pursue even more sophisticated nuclear weapons in comparison to the devices that were directly derived from the Chinese design it had received in the early 1980s.<sup>573</sup>

While Pakistan's declaration of its overt nuclear status was an inevitable byproduct of its May 1998 tests, the years immediately following were consumed by formalizing its command-and-control system, revamping its nuclear security protocols—especially after A. Q. Khan's proliferation activities became public in 2003–2004—and expanding its nuclear arsenal to counter both the threats perceived from India and increasingly from the United States.<sup>574</sup> Concerns about the United States first spiked in the aftermath of the September 11, 2001, al-Qaeda attacks on New York and Washington, which, stimulated by western reporting, gave rise to new fears in Islamabad that Washington might feel compelled to neutralize the Pakistani nuclear arsenal if it were ever to be at risk of seizure by terrorist groups operating inside Pakistan.<sup>575</sup> These worries pushed Pakistan to expand the number of its weapon storage facilities and to contemplate increasing the size of its nuclear inventory.

The dam burst on the latter count after the conclusion of the 2005 U.S.-India civil nuclear cooperation agreement. This “nuclear deal,” as it was popularly described, strengthened the Pakistani impression—one that was fostered by U.S. and international critics of the agreement—that India would now pursue a runaway expansion of its own nuclear weapons program because it would no longer be constrained by a shortage of natural uranium.<sup>576</sup> On this assumption, Pakistan concluded in 2006 that a further expansion of its nuclear arsenal was necessary. The almost year-long Indo-Pakistani crisis in 2001–2002 had pushed New Delhi toward developing new plans for quick conventional retaliation in the event of Pakistani terrorist attacks against India. These evolving Indian plans, in turn, provoked the Pakistan military to consider new tactical nuclear weapons to deter such contingencies. Before long, Pakistan embarked on the simultaneous expansion and diversification of its nuclear arsenal coupled with the formalization of a revised conventional war doctrine dubbed a “new concept of warfighting” that was aimed at further shortening Pakistan's force mobilization time and enhancing army and air force coordination.<sup>577</sup>

While these developments were focused primarily on India, other events in Pakistan's west would also converge to take its nuclear weapons program in new directions. The September 11, 2001, attacks in the United States provoked Operation Enduring Freedom, which brought U.S. military power in strength into Afghanistan and, for the first time, to Pakistan's doorstep. Although U.S.-Pakistan cooperation in the Afghan war was fraught from the very beginning, both sides maintained productive collaboration in the operations against al-Qaeda. Combating the Taliban, however, proved to be a more complicated matter as Islamabad's interests in protecting these proxies collided with Washington's objective of extirpating them.<sup>578</sup> After 2006, when the Taliban, regrouping with Pakistan's assistance, began prosecuting intensified attacks on the U.S.-led North Atlantic Treaty Organization (NATO) and Afghan forces inside of Afghanistan, tensions between the United States and Pakistan rose significantly as Washington pressed the Pakistan Army to prosecute counterinsurgency operations against Taliban safe havens in the volatile tribal regions adjacent to the Afghan border.<sup>579</sup> Pakistan's reluctance to conduct this mission, partly for fear of



inflaming its restive domestic politics, would in time bring U.S. threats of conducting unilateral counterterrorism operations inside Pakistan, increase tensions between U.S. forces in Afghanistan and their Pakistan Army counterparts, and on several occasions even result in exchanges of fire along the Afghanistan-Pakistan border that led to Pakistani military casualties.<sup>580</sup>

By 2008, many Pakistani national security commentators, civilian and military, were identifying the United States, usually under the euphemistic label of “extra-regional forces,” as a direct political and military threat to Pakistan—a danger that oftentimes was judged as materializing in collusion with other adversaries such as India and even Israel. Before long, Pakistani military journals carried numerous discussions about the need to develop strategic solutions to this emerging peril.<sup>581</sup> Surveying the challenges, one Pakistan Army officer, for example, offered a wide range of solutions: these ranged from “deter[ing a] war by posing [the] threat of heavy casualties by guerrilla tactics and [the] employment of WMDs [weapons of mass destruction]” to “pos[ing a] continuous threat of launching nuclear warheads on ERF [extra-regional force] forces, [the] adversary’s ports, sensitive installations and vital economic targets” to prosecuting anti-access measures aimed at preventing the “enemy’s deployment . . . by posing [the] threat of use of WMDs [weapons of mass destruction] on [its] bases/carrier groups.”<sup>582</sup>

Although this particular analysis was exceptional because of its transparency, it only reflected the wider, intensifying concern in Pakistan that the United States now embodied a major threat to its security. This fear was finally brought home in the most vivid way by the successful covert U.S. raid to kill Osama bin Laden in Abbottabad in May 2011. Because Operation Neptune Spear was undertaken in complete secrecy vis-à-vis Pakistan, it accentuated Islamabad’s paranoia about “unilateral military actions by the United States in the future both in terms of taking out the so-called militant ‘safe havens’ and, when necessary, Pakistan’s nuclear assets,”<sup>583</sup> thus reinforcing the belief among Pakistani military planners that Washington must now be treated as a nuclear threat in some contingencies as well.<sup>584</sup> This conviction would bolster Pakistan’s ongoing investments in physical hardening as well as deception and denial where its nuclear weapons storage was concerned, while also leading

to enhanced efforts at diversifying its naval nuclear systems and developing a nuclear intercontinental ballistic missile.

Altogether, these developments in the first two decades of the twenty-first century deepened the importance of nuclear weap-

ons in Pakistan’s strategic consciousness. The persistent quest for security that has marked Pakistan’s independent life, which took it for a long time in the direction of seeking external protection through alliances, has now resulted in a sturdy reliance on nuclear weapons. Because of Pakistan’s phobia of India and its more deeply disguised fears about the United

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States (and often Israel), Islamabad is unlikely to ever give up its nuclear weapons even if a global movement to abolish these devices were to one day prove successful. Unlike China and India, which have conventional military solutions to their security threats in principle, civilian and military decisionmakers in Pakistan are convinced that they have absolutely no alternatives to nuclear weaponry—if the survival of their historically bruised state is to be assured.

Given the deep internal cleavages within Pakistan, its nuclear weapons also remain one of the few issues that enjoy great support across the political spectrum. They are objects of national admiration, exemplifying perhaps Pakistan's only technological achievement of global impact. It is, indeed, ironic that the nuclear weapons program, which was initiated by Zulfikar Ali Bhutto to immunize Pakistan against external threats while at the same time intended as an instrument for preserving civilian supremacy over the military, is now firmly—and almost exclusively—under military control.<sup>585</sup> As long as the Pakistan Army remains the embodiment and motor of Pakistan's resistance toward India, its nuclear program is destined to expand and diversify because the military has brought to this task significant resources, bureaucratic effectiveness, and scopic ambitions. The military's belief that Pakistan's nuclear weapons have already deterred India from aggression on numerous occasions since the late 1980s only further entrenches their importance in the nation's security calculus.<sup>586</sup>

Nuclear weapons in Pakistan have thus become versatile instruments of statecraft. They serve as deterrents to nuclear attack by other states, protect against conventional aggression at all but low levels of violence, and, as such, serve to ward off major military defeats that might result from Pakistan's conventional force weaknesses against larger adversaries like India (and possibly the United States). They also function as useful “instruments that permit and facilitate low-intensity conflict against India,”<sup>587</sup> while immunizing Pakistan against significant Indian retaliation in return. And they serve a host of political functions as well, such as symbolizing Pakistan's technological prowess both within the Muslim world and in the larger international community, signaling its determination to preserve its national unity at all costs, ensuring the dominance of the military over its nominal civilian superiors, and underwriting the nation's autonomy in the face of coercive pressures that may arise from abroad.<sup>588</sup>

## **PAKISTAN'S NUCLEAR DOCTRINE**

How Pakistan has sought to secure these goals is reflected in its nuclear doctrine and, more importantly, in the evolution of that doctrine from 1998 to the current day. Like China—but in contrast to India—Pakistan has been reticent to articulate its nuclear doctrine clearly. This reluctance is driven by the understandable fear that a transparent formulation could subject Pakistan to uncomfortable tests by its adversaries who might seek to probe its ambi-

guities and weaknesses to Islamabad's disadvantage. Because Pakistan is always conscious of its relative weakness vis-à-vis India (and others such as the United States), it has sought to secure the benefits of deterrence flowing from its acknowledged ownership of nuclear weapons rather than by issuing any formal statements that describe the type of nuclear arsenal it seeks or how that might be employed.<sup>589</sup> Pakistan has, indeed, gone to some lengths to clarify its nuclear command-and-control system, but this transparency is intended mainly to underscore that it takes its responsibilities as a nuclear power seriously and that it has the procedural systems in place to use its nuclear weapons, if required, to deter aggression effectively.

Senior Pakistani officials, however, have spoken on numerous occasions about nuclear weapons, their utility for Pakistan's security, and the circumstances that might entail their use. It is in these pronouncements that the substance of Pakistan's nuclear doctrine at the declaratory and operational levels is conveyed, even if a public document remains absent. Any systematization of the ideas found in these remarks is necessarily a reconstruction, but it can contain enough verisimilitude given the totality of the information available about Islamabad's nuclear weapons program. Pakistani policymakers, too, would not want it any other way: they desire to convey through their diverse, often elliptical, statements enough information to deter but without binding themselves to any specific course of action a priori.

## The Declaratory Level

With these caveats, Pakistan's declaratory policy after the 1998 tests could be conceived as consisting of three components.

### The Commitment to Restraint

First, like India and China, Islamabad committed itself in 1999, in the words of then prime minister Nawaz Sharif, to seeking only "minimum credible deterrence," meaning, deploying a force structure that would be marked by "nuclear restraint."<sup>590</sup> The emphasis on restraint was colored by the desire to communicate that Pakistan, being compelled to acquire nuclear weapons to protect its security in the face of geographic disadvantages, conventional force asymmetries, and the threat of strategic coercion from larger neighbors such as India, would aim to maintain the smallest possible arsenal consistent with its defensive aims. Recognizing that deploying a nuclear force would burden Pakistan and potentially undermine its development goals, both the civilian and the military leaderships around the time of the nuclear tests were convinced that a modest and finite deterrent would suffice to protect Pakistan against what was considered to be the most dangerous threat: an invasion by India's superior military forces aimed at "destroying or otherwise overwhelming the country."<sup>591</sup> Maintaining a small but effective nuclear force held out the promise of deterring this worst-case eventuality and would obviate the need for "any nuclear competition or [an] arms race" with India.<sup>592</sup>

For understandable reasons, the size of Pakistan's minimum deterrent could not be "quantified in static numbers" nor could it be frozen permanently; rather, it would be determined by circumstances yet restrained by the desire to avoid any open-ended buildup of the kind that had occurred during the Cold War.<sup>593</sup> Although Pakistani officials were tight lipped about the number of nuclear weapons Pakistan had in 1998, credible Western sources suggested that Islamabad then possessed enough fissile material for some sixteen to twenty weapons.<sup>594</sup> In any event, Samar Mubarakmand, the leader of Pakistan's nuclear test team and a member of the PAEC, revealingly stated in an interview soon after the nuclear tests that a force size of some sixty to seventy warheads would suffice to deter India.<sup>595</sup> Brigadier Naeem Ahmad Salik, then with Pakistan's Strategic Plans Division, in public remarks in 2006 after his retirement, also suggested that some sixty-eight to seventy weapons would be deemed consistent with a theoretical notion of minimum deterrence, although "the actual size of the arsenal would however depend on the number of targets actually identified as critical, the faith in the performance of one's weapons and delivery systems, and whether the objective is just to deter and not to totally devastate the opposing country."<sup>596</sup> It is highly likely, therefore, that Pakistan's internal judgments about the desired size of its minimum deterrent coalesced toward some sixty to seventy weapons in the aftermath of its nuclear tests. The expansion of its fissile material production base would have permitted it to achieve this target early in the following decade. While the precise architecture of its deterrent still remained publicly unspecified, these weapons would inevitably have armed a small number of aircraft (likely F-16s) with an increasing fraction allocated to the growing number of short- and medium-range missiles (the M-11 SRBMs and Ghauri MRBMs) that were in the national inventory at the time.

### The Emphasis on Stabilization

Second, the declared objective of deploying a modest nuclear force was the "stabilization of strategic deterrence in the South Asian region."<sup>597</sup> Soon after Pakistan's 1998 nuclear tests, Nawaz Sharif would emphasize that "stabilization,"<sup>598</sup> along with nuclear restraint and minimum credible deterrence, was one of the three foundational elements of Pakistan's nuclear policy. The emphasis on stabilization was meant to convey that Pakistan's power weaknesses vis-à-vis India would no longer exacerbate the dangers of invasion and the threats of coercion potentially emanating from its larger and more powerful neighbor. Nuclear weapons had effectively erased the inherent inequality between India and Pakistan, freeing Islamabad from the need for external alliances while simultaneously guaranteeing the permanent security that Pakistan had sought since its inception.<sup>599</sup>

The "stabilization" that would immunize Pakistan "against all forms of external aggression" obviously required "an effective combination of conventional and strategic forces at adequate levels within the country's resource constraints" as well as the requisite investments to prevent its "adversaries from attempting a counter-force strategy against its strategic assets."<sup>600</sup> If aggression occurred despite these preparations, Pakistan would be willing

to threaten the use of, or actually use, nuclear weapons first, even if the adversary had not comparably done so. This threat to use nuclear weapons first to ward off adversity sharply distinguished Islamabad's declaratory policy from New Delhi's. Given India's greater national capabilities, a no-first-use nuclear policy made eminent sense because it had other instruments capable of effectively protecting its security. Pakistan's relative weaknesses, in contrast, compelled it to hold out the threat of possible nuclear first use, ideally to deter any military aggression to begin with but, if that were unsuccessful, to follow through by threatening to use, or by actually using, nuclear weapons first depending on the circumstances. The threat of nuclear first use, in contrast to both Chinese and Indian declaratory doctrine, thus functioned as Pakistan's solution for ensuring the stabilization of regional deterrence. In this context, Islamabad, strictly speaking, did not commit to using nuclear weapons first; rather, it simply affirmed that its adversaries could not count on its forbearance if the first use of nuclear weapons was required to ensure national self-preservation.<sup>601</sup>

### The Imperative of Deterring India

Third, Pakistan's declaratory doctrine in 1998 continually emphasized that its emerging nuclear capabilities were intended to deter only India and India alone. When Pakistan first began to contemplate acquiring nuclear weapons during the 1960s, then foreign minister Zulfikar Ali Bhutto advanced the idea of an "Islamic bomb" in the hope of mobilizing political and financial resources from the Muslim world to support Pakistan's quest for nuclear weaponry.<sup>602</sup> Bhutto's successor, General Muhammad Zia-ul-Haq, a fervent Islamist, held on to the notion. Over time, this would lead the Pakistani state to turn a blind eye to some of A. Q. Khan's efforts to proliferate nuclear weapons technologies to other Muslim countries in order to "redress the 'international balance,'"<sup>603</sup> as many Pakistani politicians thought desirable during the 1970s. (Khan's proliferation activities involving non-Muslim states, such as North Korea, were motivated by the more straightforward desire for military technology—the medium-range No Dong-1 missile in particular, which would extend Pakistan's delivery range at a time when Islamabad only possessed short-range ballistic missiles.<sup>604</sup>) Even though the public scandal over Khan's activities was still a few years away, Pakistani leaders after Ghulam Ishaq Khan (1989–1992) had steadily given up on imagining that their nuclear weapons would serve anything but the objective of self-preservation. An opaque nuclear relationship with Saudi Arabia still persists despite denials by both states,<sup>605</sup> but Islamabad clearly recognized at the time of the nuclear tests that its nuclear weapons program would be more easily tolerated internationally as long as it remains focused on protecting national security in contrast to any conceit about providing a nuclear umbrella for other Muslim states or arming the latter in their struggles against various foreign threats.<sup>606</sup>

The challenges posed by India sufficed to keep Pakistan preoccupied, and the 1987 and 1990 crises with New Delhi only confirmed India's centrality in Pakistan's calculations. Although Pakistan would continue to remain uncomfortable with Israel and was often fearful of the United States, its nuclear weapons then were not seriously conceived as deterring either of

these more distant powers—India dominated Pakistan’s attention. After the 1998 nuclear tests, Islamabad—partly in order to secure international acceptability and wholly because it was true—emphasized that it was compelled to acquire nuclear weapons and even test them reluctantly only because of the dangers embodied by India. As Nawaz Sharif summarized in his speech to the United Nations General Assembly in September 1998, “Pakistan’s nuclear tests were conducted not to challenge the existing non-proliferation regime, nor to fulfil any great power ambition. They were designed to prevent the threat or use of force against Pakistan. Our tests in response to India thus served the cause of peace and stability in our region.”<sup>607</sup> As Khurshid Mahmud Kasuri, formerly Pakistan’s foreign minister, described the conviction that animated the nation’s program in 2003, “Pakistan’s nuclear weapons are India-specific.”<sup>608</sup>

## The Operational Level

The operational dimension of Pakistan’s nuclear doctrine, which steadily became visible in the aftermath of the 1998 nuclear tests, flowed directly from its declaratory policy.

### Usable Military Instruments

To begin with, and in sharp contrast again with both China and India, Pakistan’s nuclear weapons were explicitly conceived as military instruments that might have to be employed in extremis for purposes of ensuring national safety. Because India and China have large conventional forces that enjoy operational advantages over their adversaries, their nuclear weapons were viewed primarily as political instruments whose utility derived mainly from their presence per se and whose value lay largely in functioning as pure deterrents against possible blackmail and coercion. Both Indian and Chinese doctrine, accordingly, treat nuclear weapons as symbolic instruments to shape the calculations of an adversary in competitive international politics. Pakistan’s conventional military weaknesses vis-à-vis India, in contrast, compelled it to think of its nuclear weapons as usable military instruments whose utility derived not merely from their presence but from the real possibilities of their employment in the event of major conflicts. Consequently, Pakistan’s nuclear weapons at the operational level had to satisfy two antinomic demands satisfactorily: tight negative use control in peacetime (meaning protection against unauthorized use) and effective positive control (meaning they are readily available for effective operational use) in times of crisis and war.<sup>609</sup> All nuclear states are confronted by these requirements, but Pakistan even more so because the value of its nuclear weapons derive fundamentally from its willingness to actually use them first in the face of conventional threats alone.

When Pakistan would actually use nuclear weapons thus became the subject of significant analytical interest. Lieutenant General Khalid Kidwai, then director general of Pakistan’s Strategic Plans Division, offered his now well-known but deliberately imprecise criteria: Pakistani nuclear use was plausible “if the very existence of Pakistan as a state is at stake”

either because India conquers a large part of Pakistani territory, or if it destroys a substantial portion of Pakistan's land and air forces, or if it successfully strangles Pakistan economically through coercive means, or if it destabilizes Pakistan internally to the point of implosion.<sup>610</sup> These criteria for Pakistani nuclear use have been parsed endlessly since they were first articulated in 2002. Their nuances are of lesser concern here, but from the viewpoint of understanding the first component of Pakistan's nuclear doctrine at an operational level—nuclear weapons as usable military devices—as it was conceived in the early years after the 1998 nuclear tests, three elements are worthy of note.

First, Pakistan treated its nuclear weapons seriously as military tools and planned for their deliberate use in various contingencies that its professional military believed to be credible. Second, any nuclear use would occur only if the very survival of the nation itself was judged to be at stake: as then president Pervez Musharraf emphasized in 2002, these were truly weapons of last resort to be contemplated only “if Pakistan is threatened with extinction,” which is when “the pressure of our countrymen would be so big that this option [of nuclear first use], too, would have to be considered.”<sup>611</sup> Third, and finally, the expectation that these first-use-in-last-resort weapons might have to be employed in extremis also implied that nuclear forces and their conventional counterparts would be minimally integrated. The nuclear elements functioned as strategic reserves; they would not alter the character of conventional military operations, which would be fully employed to mount the best defense they could. Pakistani conventional military success was, in fact, highly desirable because it would preclude the use of nuclear employment altogether—with all its attendant risks. But if an effective conventional defense could not be mustered, nuclear weapons remained available for use as instruments of either signaling or punishment.

#### Threatening Unacceptable Damage

If the first component of Pakistan's operational doctrine thus consisted of treating nuclear weapons as military instruments for possible use in war—but ideally to deter all conflict to begin with—the second component at the operational level focused on the ends to which Pakistan's nuclear use would be directed. This element was shaped both by Pakistan's larger strategy of deterrence and by the technology of the day. As previous discussion indicated, Pakistan conceived of its possible nuclear use only late in a major conflict—meaning only after its conventional forces proved incapable of resisting significant aggression by India or when the country was on the cusp of collapse because of Indian coercion. Assuming that Indian aggressiveness continued unabated despite Pakistani nuclear signaling and the threats of possible use, the only logical objective of Islamabad's nuclear first use in these circumstances would be punishing Indian belligerence. This required inflicting “unacceptable damage to the enemy,”<sup>612</sup> destruction that causes the adversary to pause and consider whether continuing the conflict is worth the costs of suffering further nuclear attacks or continued nuclear exchanges. If India were—in violation of its own no-first-use commitments—to have attacked Pakistan with nuclear weapons first either as part of a damage

limiting strategy in the face of anticipated Pakistani first use or simply to destroy Pakistan conclusively, Islamabad's incentives to retaliate with nuclear attacks that inflict "unacceptable damage" would be all the greater.

In any event, the capacity to inflict "unacceptable damage" was critical to the Pakistani calculus of deterring Indian aggression, averting conclusive defeat, and warding off strangulation or implosion. This requirement inevitably implied focusing on countervalue targets because the loss of major population and economic sites embodies the intolerable damage that would retard India's national reconstitution most decisively. Because Pakistan's largest nuclear weapons in 1998 and immediately thereafter could produce yields in the region of some 12 kilotons at most—the upper limit of the largest weapon demonstrated during the May tests<sup>613</sup>—retaliatory attacks on Indian population targets held the most promise for inflicting unbearable punishment. While these weapons could obviously be used in a counter-military role as well—for example, against infantry and armored divisions or against capital ships—such damage would be proportionately less significant. Consequently, as Lieutenant General Kamal Matinuddin correctly argued, "It would be very difficult for India to strike first if it recognizes that a massive retaliation on its cities would be the response from Pakistan."<sup>614</sup> Both strategy and technology then converged to make countervalue targeting the best punitive strategy for Pakistan, given that it expected to use its nuclear weapons first, albeit late, in a conflict and only when pushed to the wall and fearful for its own survival. Since Pakistan's nuclear arsenal was also imagined as not exceeding sixty to seventy weapons at this time,<sup>615</sup> inflicting maximum punishment through the smallest expenditure of relatively scarce nuclear weapons made countervalue targeting the most sensible strategy for an emerging nuclear power (without ruling out the possibility of token strikes on other targets as part of a graduated nuclear response).

### Speedy War Termination

The third and final component of Pakistan's operational doctrine around the time of its 1998 nuclear tests was one that did not receive extensive articulation but was implied by its first-use-in-last-resort nuclear strategy: the imperative of war termination. Pakistan's nuclear weapons were intended, first and foremost, to deter all kinds of conflict that threatened its political survival as a state. Yet policymakers in Islamabad could not presume that merely possessing nuclear weapons would give India pause if, in an acute crisis, New Delhi calculated that it could either overwhelm Pakistan rapidly before any nuclear use could be executed or because Pakistan's nuclear weapons could be suppressed by Indian damage-limiting strategies of different kinds. Given these contingencies, Islamabad had to invest extensively in ensuring the survival of its nuclear weapons so that they would be available for use in the event of its threatened collapse, given that Pakistan had by now ruled out all reliance on foreign allies as a result of its painful history.<sup>616</sup>



Any Pakistani nuclear use in the event of an existential threat to its survival could have appeared in one of two manifestations: executing a so-called Samson option—meaning accepting the possibility of Pakistan’s own destruction if that were the only way to destroy an obdurately belligerent India—if India refused to desist from completing its campaign of aggression against Pakistan, or unleashing sufficient punishment to enforce speedy war termination so as to enable at least Islamabad (and possibly New Delhi as well) to pick up the pieces and learn new ways of coexisting after such a catastrophic conflict.<sup>617</sup> Although Pakistan’s policymakers would hold out the threat of executing a Samson option in order to strengthen deterrence, they would nonetheless have preferred the second choice if these were the only two alternatives available.<sup>618</sup> The desire to avoid using nuclear weapons at all—or, at worst, to use them only when they had no other alternatives—implied that any Pakistani nuclear first use would be directed not at correcting the military disadvantages in order to better prosecute the war but rather to terminate it conclusively so as to allow the nation to survive the aggression.

The arresting character of any nuclear weapons use, including the prospect of further escalation or the possibility of great power pressures on the antagonists, all combined to make speedy war termination the most sensible objective of any imagined Pakistani nuclear employment. Although this aspect did not receive widespread discussion in Pakistani writings—because their focus centered disproportionately on justifying the need for a nuclear force to preserve deterrence—senior Pakistani officials, both civilian and military, in the aftermath of the nuclear tests simply presumed that, given the catastrophic damage that could be inflicted even by a small number of nuclear weapons (not to mention the shock of exploding the nuclear taboo by actually using such weapons), war termination—not protracted nuclear war, and still less extended nuclear exchanges aimed at producing a “victory” of some sort—remained the most obvious end to which their weapons would be employed.<sup>619</sup>

## **New Doctrinal Shifts at the Declaratory Level**

When these elements of Pakistan’s nuclear doctrine at the declaratory and operational levels are reviewed some twenty-odd years after Islamabad tested nuclear weapons, the changes are significant, in some ways dramatically so. In fact, when the doctrinal changes in China, India, and Pakistan are considered synoptically, the transformations in Pakistan are not only the most extensive but also arguably the most consequential from the viewpoint of strategic stability.

### **From Minimum to Full-Spectrum Deterrence**

The first and most obvious shift at the level of declaratory policy has been the change in emphasis from credible minimum deterrence to so-called full-spectrum deterrence. Although the notion of credible minimum deterrence has not been jettisoned formally, it has been

eclipsed by the newer vision of full-spectrum deterrence, which was first announced in 2011.<sup>620</sup> This shift presages both a larger arsenal than was envisaged around 1998 and a more diverse nuclear inventory that is intended to play multiple political and operational roles. The early conception of minimum deterrence centered on possessing a relatively small arsenal of between sixty and seventy weapons capable of producing broadly Hiroshima- and Nagasaki-type yields of some 12 kilotons (perhaps 15 kilotons at most) and was intended primarily for countervalue targeting as a last resort if Pakistan's survival was judged to be at mortal risk. The notion of full-spectrum deterrence in contrast appears to be open ended in regard to arsenal size: although each nuclear planning cycle in Pakistan presumably sets specific numerical targets and as such implies "finite limits,"<sup>621</sup> the expansive character of the missions now sought to be serviced by nuclear weapons suggests that the natural ceiling on arsenal size previously emplaced by the demands of interdicting Indian cities—targets that do not dramatically increase in number over short time spans—has broken down as Pakistan's current declaratory goal of full-spectrum deterrence potentially requires targeting a large number of diverse military assets across the spectrum.<sup>622</sup>

As Lieutenant General Khalid Kidwai elaborated, this new conception of deterrence involves possessing the "full spectrum of nuclear weapons in all three categories—strategic, operational and tactical, with full range coverage of the large Indian landmass and its outlying territories." It aims to bring "every Indian target into Pakistan's striking range" and as such requires "appropriate weapons yield coverage and the numbers to deter the adversary's pronounced policy of massive retaliation." This emphasis on being able to interdict a large number of "countervalue, counterforce, and battlefield" targets inevitably requires a much bigger nuclear force than was previously imagined, with the consequence that Pakistan's potential "counter-massive retaliation punishment [against India] will be as severe if not more" violent than India's own nuclear use.<sup>623</sup>

The doctrinal shift in emphasis from minimum deterrence to full-spectrum deterrence is thus portentous. In seeking to replicate a simulacrum of NATO's nuclear strategy during the 1960s—the doctrine of flexible response, which required numerous and diverse nuclear weapons to allow graduated nuclear use across an unbroken spectrum starting at the tactical level, then escalating to the theater level, and finally eventuating in strategic nuclear exchanges—Pakistan has embarked on a course of action where the size of its arsenal will not be constrained by any limitations imposed by its previously modest target set.<sup>624</sup> Unlike Indian cities, which are relatively few in number and thus curb the quantity of weapons required for their destruction, countermilitary targeting requires plentiful weapons because the typical targets—infantry and armored formations, ships and submarines, and air and missile bases—are hard and exist in larger numbers. In fact, the force requirements for countermilitary targeting are usually even more expansive than those required for counterforce targeting because, in general, the number of adversary nuclear weapons and their associated targets are fewer than the conventional force assets that nuclear countermilitary targeting aims to hold at risk.<sup>625</sup>

Although it is unlikely that Pakistan will deploy the thousands of weapons that will be required to interdict all such Indian military assets—among other reasons because it would run up against both fissile material and command-and-control constraints—the fact remains that it is now seeking to neutralize a much wider set of conventional targets, which deprives it of the customary brakes on force size that were imposed by its previous interest in mainly targeting Indian cities. This evolving Pakistani shift toward full-spectrum deterrence has been driven primarily by its conviction that India’s so-called Cold Start doctrine—New Delhi’s threat to mount limited conventional attacks in retaliation for terrorism originating in Pakistan against India—requires a nuclear response because of its fears that India’s military superiority could quickly overwhelm its conventional defenses and thereby pose a risk to the nation’s survival itself.<sup>626</sup> Alternatively, the fears that India could execute Cold Start operations focused on securing “limited objectives”—either operational successes or territorial gains—below Pakistan’s nuclear use threshold and thereby potentially undermine its ability to use nuclear weapons to deter *any* Indian military action has taken Pakistan toward the same end: expanding and diversifying its contemporary nuclear arsenal. This ambition is intensified by the suspicion that India’s nuclear weapons stockpile is actually larger than is generally believed in the West, or could potentially be so because of India’s huge stock of unsafeguarded fissile materials and its vast unsafeguarded capacity to produce such materials (which has been formalized by the U.S.-India civil nuclear cooperation agreement).<sup>627</sup>

***The diversity of nuclear weapon systems within each leg of the Pakistani triad, however, is striking and is consistent with the conviction that Islamabad must possess unique devices that are appropriate to countering different types of threats.***

Whatever the reasoning, the result has been unambiguous. The shift to full-spectrum deterrence now legitimizes a substantial transformation of Pakistan’s nuclear weapon inventory, which, like China’s and India’s, also seems to be open-ended despite being characterized by incremental growth (at least in the case of the latter). Pakistan’s numerical expansion, again mimicking China’s and India’s, is now formally mani-

festated through its desire to develop a triad of air-delivered as well as land- and sea-based nuclear weapons, all intended to hold at risk a variety of targets ranging from military forces all the way to the population centers of an adversary. The number of nuclear weapons that Pakistan could eventually deploy in support of full-spectrum deterrence would likely be larger than India’s (and could rival even China’s) inventory over time, although this expectation is fraught with considerable uncertainty because the precise targets of the current Indian and Chinese nuclear expansions are unknown.

The diversity of nuclear weapon systems *within* each leg of the Pakistani triad, however, is striking and is consistent with the conviction that Islamabad must possess unique devices that are appropriate to countering different types of threats in each of the three warfighting realms: land, air, and sea. The ambition to ensure that India has “no place to hide,”<sup>628</sup> as well

as Islamabad's desire "to plug the gaps" in all potential escalation sequences,<sup>629</sup> almost guarantees that Pakistan will field a highly variegated nuclear arsenal, with each unique weapon being designed for a specific operational role.

The Indian nuclear inventory does not come anywhere close. But the Chinese arsenal could mimic Pakistan's in this regard over time, even though both China and India still conceive of their nuclear reserves as having largely a deterrent role intended to counter nuclear threats or punish any nuclear first use by an adversary if deterrence fails. Only India, however, has thus far eschewed developing differentiated nuclear systems that would enable it to target its adversaries' national capabilities in a seamless way, with unique systems designed to interdict varying targets from battlefield formations to operational reserves to symbolic centers to economic concentrations and eventually population hubs. Pakistan's quest for full-spectrum deterrence has already taken it in this direction—though China could follow—thus making Islamabad truly exceptional within the Indian subcontinent, at least right now.

#### New Tools for Stabilizing Deterrence

The distinctive aspect of full-spectrum deterrence beyond the mere expansion in force size—the development of various low-yield nuclear weapons for specific battlefield uses in addition to maintaining higher-yield weaponry for countervalue targeting—raises questions about its implications for the second element of Pakistan's declaratory doctrine, namely the emphasis on stabilizing general deterrence within Southern Asia. The focus on stabilizing deterrence, it may be recalled, derived from Pakistan's desire to immunize itself against the ill consequences of power inequality vis-à-vis India. Pakistan's nuclear weapons held out the possibility of nullifying India's conventional military advantages, thereby reducing its capacity to coerce or subjugate Pakistan. Islamabad's implied willingness to use its nuclear weapons first only reinforced its capacity to neutralize India's military superiority. But, in the traditional conception, this benefit was sought to be procured principally by using nuclear weapons against Indian countervalue targets in the last resort, thereby bringing the conflict to a halt.

The new conception of full-spectrum deterrence does not fundamentally change the previous objective of stabilization. It still remains oriented toward erasing India's power advantages and, by implication, its capacity to coerce Pakistan. But instead of deriving this power solely from the ultimate threat of countervalue attacks, Islamabad now seeks to develop lower-yield weapons that could be used to interdict substrategic targets before progressively escalating to more valuable objects such as cities. The reason for developing the capacity to strike lower-end and intermediate targets first is to increase Pakistan's options when faced with the prospect of imminent nuclear use. Since India's nuclear doctrine threatens "massive retaliation"—an eventuality that appears more certain if all that Pakistan could strike were Indian cities even if only as a last resort—Islamabad's full-spectrum deterrence attempts to avert this possibility by lengthening the nuclear fuse.<sup>630</sup>

It provides Pakistan the option to employ nuclear weapons in more limited ways and, although it cannot conclusively guarantee that India will eschew massive retaliation even if Pakistan's initial nuclear employment is limited, it offers Pakistan a better chance of avoiding this outcome than the alternative of striking Indian cities first. In any event, even if Pakistan were compelled to use low-yield weapons demonstratively on Indian military targets perhaps on its own soil to begin with, the aim nonetheless remains the same: Islamabad seeks to stabilize strategic deterrence—that is, to prevent New Delhi from exploiting the extant power asymmetry by prosecuting various types of non-nuclear military operations where Pakistan may be at a disadvantage.

### Targeting Beyond India

If the second element of Pakistan's declaratory doctrine, stabilizing strategic deterrence, has not been fundamentally transformed by its new shift to full-spectrum deterrence, even though the instruments employed toward that end have changed dramatically, the third component—building a nuclear force directed only at India—has undergone more subtle changes. While most observers traditionally would agree with the judgment that “the Pakistani concept of nuclear deterrence is India-specific and aims, first and foremost, to deter Indian conventional as well as nuclear aggression,”<sup>631</sup> Adil Sultan, a military officer when working in Pakistan's Strategic Plans Division, noted in 2012 that “the cardinal principle of Pakistan's nuclear policy remains hinged to deter all forms of aggression, *mainly* from India” (emphasis added).<sup>632</sup> *Mainly*, but no longer *solely*: this subtle shift in direction, which was slowly gathering steam because of growing fears about “extra-regional forces” during the first decade of this century, appeared increasingly visible after the U.S. raid on Abbottabad in 2011. This event signaled the new Pakistani turn toward thinking about nuclear deterrence vis-à-vis other adversaries beyond India. Pakistani civilian and military officials are quick to dismiss such possibilities in public conversations because it serves their interest to keep the international community's focus fixed on India, but within Pakistan, the belief that its nuclear weapons should deter other adversaries as well is quite widespread.

Israel and the United States are the two countries often considered in this regard. Although Pakistan and Israel still do not have diplomatic relations because of their differing positions on the Israeli-Palestinian conflict, Islamabad has been very pragmatic about how it manages its unofficial ties with Jerusalem.<sup>633</sup> For all the sub rosa engagement between the two countries, however, Pakistani leaders have been unable to entirely dismiss the idea that Israel constitutes a threat to their country and to their nuclear program in particular. These anxieties have been fueled by the numerous speculative news reports emerging since the early 1980s about Israeli planning for attacks on Pakistan's nuclear weapons infrastructure, sometimes in supposed collaboration with India.<sup>634</sup> The development of Pakistan's own nuclear deterrent, which was initially packaged as a so-called Islamic bomb, raised concerns that Israel, a Jewish state supposedly at war with the Muslim world, might come to view Islamabad's

nuclear capabilities as a latent threat. As one scholar summarizing these perceptions, which are held most strongly by Islamist political parties in Pakistan, noted:

While Pakistan's nuclear deterrent is aimed at countering India, Pakistan as an Islamic state has responsibilities to the broader Muslim *umma*. No matter how much Pakistani officials disavow any military role in the continuing Palestinian-Israeli conflict . . . Pakistan's nuclear weapons will inevitably be seen as a threat by Israel, and therefore Pakistan must include Israel in its defense planning.<sup>635</sup>

These sentiments rarely find echoes in official Pakistani statements, but the close Indian-Israeli relationship is unsettling to Pakistan; it is often commented about privately and sometimes publicly.<sup>636</sup> In any event, and whether intended or not, Pakistan's increasing missile range, exemplified most obviously by its Shaheen-III IRBM, brings Israel within reach for the first time, a fact that has not escaped the attention of Israeli security analysts.<sup>637</sup> Given the residual fears about Israel still present in Pakistan, it is not surprising that Islamabad's nuclear planners view their emerging capabilities as providing insurance against *any* possible threat, although for both rhetorical and real reasons they are unlikely to publicly identify dangers other than India.

This argument applies a fortiori to the United States, even though Islamabad's concerns about Washington are more acute. Although both capitals were close security partners at different points in times past, the steady erosion in bilateral ties—produced by mutual grievances over alliance guarantees, nuclear proliferation, and, most recently, the global war of terror and U.S. stabilization efforts in Afghanistan—has pushed Pakistan to consider the United States as a new focus of its deterrence efforts amid persistent fears that Washington might one day feel compelled to neutralize Islamabad's nuclear weapons. These worries have intensified since the U.S. raid at Abbottabad and still animate Pakistan's security elites.<sup>638</sup> In an attempt to counter this threat, Pakistan is expanding its naval planning to deter U.S. power projection from the sea, developing new nuclear weapons that can be flexibly used to target both U.S. and Indian naval forces, and, even more ambitiously, setting out to develop with Chinese assistance an intercontinental ballistic missile that could eventually hold at risk the U.S. homeland itself.<sup>639</sup> Amid public criticisms from the U.S. Congress, the administration of president Barack Obama strongly pressed Pakistan to terminate its ICBM program. If past history is any indication, however, Islamabad is unlikely to have really done so given the depth of its anxieties about the United States and its growing fears about U.S.-Indian collusion in strategic matters.<sup>640</sup> Thus, the last element of Pakistan's declaratory doctrine has subtly mutated from an India-specific objective into an India-plus nuclear ambition.

## New Doctrinal Shifts at the Operational Level

While Pakistan's declaratory doctrine has changed in some clear ways since its 1998 tests, shifts in its operational dimensions are, for the moment at least, more ambiguous.

### Deeper Conventional-Nuclear Integration?

In the first dimension, namely, Pakistan's conception of nuclear weapons as military instruments, there is fundamental continuity but with important potential alterations on the horizon. The view that nuclear weapons are usable military antidotes to political coercion, conventional aggression, and nuclear attacks has not changed. This conviction previously led Pakistan to emphasize negative and positive control equally: nuclear weapons cannot be used without authorization but must be ready for employment when required by its leadership. The equal priority placed on these two potentially conflicting demands led Pakistan to sequester its nuclear weapons from conventional military operations.<sup>641</sup> This separation made operational sense because it allowed field commanders to plan their conventional defense without having to worry about how nuclear weapons would impact their force organization and deployment on the battlefield. The challenges here are, in fact, significant; even the United States and NATO never satisfactorily resolved them during the Cold War.

The original Pakistani concept, therefore, revolved around its aircraft- and missile-delivered nuclear weapons playing no active operational role whatsoever during conventional operations. They were positioned far away from the expected battlefields and their employment would be contemplated only in last resort when operational reverses threatened the existence of the Pakistani state. This sequestration of nuclear and conventional forces was only aided by bureaucratic factors: the Strategic Plans Division, which oversaw the development and production of Pakistan's nuclear weapons, was highly autonomous and saw its role as producing the strategic weaponry that Pakistan's leaders could employ for retaliatory missions against rearward Indian targets in the event of successful conventional aggression by New Delhi.

In recent years, however, as Pakistan's minimum deterrent has steadily transmuted into full-spectrum deterrence, Islamabad has begun to think about how to integrate its nuclear forces into its conventional operations under the aegis of its "new concept of war fighting."<sup>642</sup> Not that it is actually required to do so because, as the next chapter indicates, Pakistan actually enjoys significant conventional force advantages along the border with India on a day-to-day basis, thereby averting the possibility of any dramatic defeat early in a conventional conflict.<sup>643</sup> In fact, the Pakistan Army's Azm-e-Nau series of military exercises during General Ashfaq Kayani's tenure as chief of army staff repeatedly proved the viability of Pakistan's conventional defenses against the feared Indian threat embodied by Cold Start.<sup>644</sup> This led one prominent Indian military officer to conclude that the Pakistani claim that "it is in a position to deploy fast enough to the borders to give Indian attacks a bloody nose . . . challenges India's expectation that Pakistan would choose to lose cheaply than resoundingly at the next higher level."<sup>645</sup>

All the same, Pakistani military planners have begun to focus on the challenges of integrating conventional and nuclear operations more seriously. A series of Pakistani tabletop and field exercises during the last decade witnessed Strategic Plans Division personnel collaborating with their conventional force counterparts to explore the implications of synergistic conventional and nuclear force employment on Pakistan's warfighting strategies. As part of this effort, battlefield nuclear weapons of various kinds have made an appearance in exercises, and experiments pertaining to command-and-control procedures in case nuclear weapons are to be dispersed in the field have also been undertaken.<sup>646</sup>

While these developments are still a work in progress—and it is uncertain whether Pakistan will succeed where the United States and NATO previously failed—it raises an as yet unanswered question about whether Pakistan is moving toward a posture of “early nuclear use” in contrast to its previous emphasis on employing nuclear weapons only in “last resort.”<sup>647</sup> If Pakistan is nudging forward in this direction, does it also imply that Islamabad has now prioritized positive control over negative control? And, if the former—which seems inherent in any decision to distribute tactical nuclear weapons in frontline formations early in, if not before, a conflict—is Pakistan now willing to accept the risk of weakening its conventional defenses (by either diverting forces for nuclear weapons security or dispersing its defensive formations for possible nuclear exchanges on the battlefield)? Or will it still seek to preserve a robust conventional defense (by either risking nuclear security or attempting to preserve it solely through opacity or deception on the assumption that India will not target its nuclear retaliation on Pakistan's frontline formations)?<sup>648</sup>

None of these questions can be satisfactorily answered yet because, despite the explorations currently underway in the Pakistan Army, it is possible that the military leadership could end up concluding it has no better solutions to the problems of nuclear-conventional integration than the United States found during the Cold War. If that be the case, Pakistan could withhold its battlefield nuclear weapons from early dispersal to frontline formations, preserving them for last resort commitment, dispersal, and employment, and only when its conventional defenses appear to be fatally faltering. If Pakistan settles for the latter—safer—course, the integration of nuclear weapons with its conventional forces would take radically different forms than those required by the need for early dispersal and early nuclear use. Whether Pakistan can, therefore, develop the appropriate organizational routines to marry its new and diverse tactical nuclear weaponry with its traditional deterrence posture remains to be seen. For the moment, however, the previous commitment to sequestering nuclear weapons of every kind apart from the conventional forces remains in place.

#### From Unacceptable Damage to Nuclear Warfighting?

Yet the possibility of change pertaining to conventional-nuclear integration only highlights the question of whether the second component of Pakistan's previous operational doctrine—the emphasis on inflicting unacceptable damage through countervalue targeting—



might also be undergoing dramatic alteration. Taken at face value, the induction of tactical nuclear weapons symbolizes this transformation already because it suggests that Pakistan's willingness to use such weapons first signals possibly graduated escalation where sub-strategic targets, such as Indian military formations, are interdicted initially—either discretely or on a large scale—but long before Islamabad begins to attack Indian cities, which would be the ultimate manifestation of all-out nuclear war if such strikes were extensive.

Clearly, Pakistan had the option of executing pseudo-tactical attacks even under its previous operational doctrine if it chose to employ its strategic weapons selectively on military targets and manipulated their lethal effects by altering their heights of burst. Pakistan's new tactical nuclear weapons significantly expand the possibilities for attacking such targets because their smaller yields, which could range from less than a kiloton to single-digit kiloton(s), allow it to maintain a dedicated and possibly larger force. Thus, Pakistan's shift to specialized low-yield weapons *may* not represent a fundamental discontinuity with its past strategies, but it does epitomize a qualitative refinement that lends itself to more dangerous possibilities for earlier (or limited) nuclear use. The critical issue then is whether the incorporation of tactical nuclear weapons in the Pakistani arsenal now indicates a new commitment to nuclear warfighting—in sharp contrast to the previous emphasis on attacking countervalue targets in the last resort for purposes of inflicting unacceptable damage.

One Pakistani scholar has argued that Islamabad's desire to use its increasingly diversified nuclear arsenal to counter Indian capabilities at every rung of the military ladder effectively implies a strategy of “escalation dominance.”<sup>649</sup> An American scholar, Peter Lavoy, who also served as a senior official in the U.S. Department of Defense, concurs: he too has argued that “the close connection of conventional military force and nuclear force in Pakistan's deterrence strategy” is aimed at realizing “escalation dominance at all rungs of the military ladder—from low-intensity conflict to conventional war and all the way to nuclear war—[which] is deemed absolutely essential for the weaker power to survive.” In essence, Islamabad simply cannot “allow India to seize the advantage at any level of violence” because New Delhi would then exploit those gains and “all will be lost” to Pakistan.<sup>650</sup> This assessment intuitively grasps Islamabad's logic correctly, but its conceptualization as escalation dominance is misleading.

Escalation dominance in the classic sense refers to “the ability of a state to maintain such a markedly superior position over a rival, across a range of escalation rungs, that its rival will always see further escalation as a losing bet.”<sup>651</sup> Pakistan's emerging full-spectrum deterrence, to include the induction of tactical nuclear weapons, is not intended currently to secure escalation dominance in this sense. It is not designed to defeat India on the battlefield at every step of an evolving conflict through effective nuclear use at the operational level of war; nor is it intended to deter further Indian escalation by the threat of inflicting greater punishment on India than India could comparably impose on Pakistan.

Islamabad may pursue such objectives in the future, but achieving them would require many more nuclear weapons than Pakistan is likely to possess even at the end of its current expansion—at least on present trends—and it would require manifestly superior nuclear weapons in larger numbers than India’s as well. Because it is unclear whether these characteristics obtain now or will obtain in the future, the nuclear weapons use predicated by Pakistan’s full-spectrum deterrence doctrine—even if it produces steadily graduated nuclear employment—is oriented fundamentally not toward true escalation dominance but rather the manipulation of risk: holding out the threat that its initial nuclear responses could precipitate an escalatory sequence that really gets out of control fast and that Pakistan, despite its obvious weaknesses, could still inflict enough pain on India to make the continuation of its aggression not worth the cost.<sup>652</sup> An American scholar, Christopher Clary, summarized this calculus correctly, when he noted, “Pakistan’s strategy appears designed to manipulate the risk of use so that it increases with the severity of the conflict.”<sup>653</sup>

A strategy of manipulating threats and risks can be successfully executed even by a weaker nuclear power; as such, it is not the threat of escalation dominance—which flows from nuclear superiority—that produces war termination but rather the dangers of a widening conflict that promise

***A strategy of manipulating threats and risks can be successfully executed even by a weaker nuclear power.***

unacceptable pain even for the stronger power. Pakistan’s possible tactical nuclear weapons use, therefore, whether early or late in a conflict, is not intended to resolve operational quandaries on the battlefield, as NATO’s tactical nuclear weapons were for a while at the height of the Cold War; instead, it serves as political triggers—“warning shots”<sup>654</sup>—that presage further escalation and, thereby, hopefully freeze the conflict and prevent it from evolving further.<sup>655</sup> Consequently, Pakistan’s full-spectrum deterrence strategy, although appearing as if it entertains nuclear warfighting, is at least for the moment still some ways away from that eventuality.

### The Persistence of Speedy War Termination

As long as this condition holds, Pakistan’s shift toward full-spectrum deterrence does not change the third component of its operational doctrine, the desire for speedy war termination in the event of any significant deterrence breakdown. Pakistan’s threatened use of low-yield weapons initially—with implied dangers of further escalation leading up eventually to national suicide as an inherent possibility—is still fundamentally focused on deterring all Indian conventional attacks to begin with. The entire aim of Pakistan’s nuclear program and its now maddeningly diverse weapons inventory is centered on denying India any benefits from initiating a conventional (or nuclear) war. But if deterrence were to ever collapse, seeking speedy war termination would still subsist as Pakistan’s next best outcome.<sup>656</sup>

In and around 1998, Pakistan's interests in war termination were driven largely by the imperatives of political survival, since it was assumed that Pakistan's nuclear first use would occur only at the tail end of serious conventional defeat—and since it was plausible that Pakistan would not respond even in this situation with all out nuclear strikes if lesser nuclear use could arrest the aggression conclusively. Today, when Pakistan has the capacity for graduated escalation with lower-yield weapons, it has to be even more seriously attentive to the demands of *physical* survival as well. This is because many of its lower-yield, short-range nuclear weapons would find use on Pakistani soil, unlike the situation obtaining in 1998 when Pakistan had largely “strategic” weapons and long-range delivery systems intended to attack Indian targets in depth. Consequently, when Pakistan can suffer serious physical destruction and high human casualties as a result of its own nuclear first use—the inevitable consequence of employing short-range land-based low-yield weapons on its own territory—the operational goal of speedy war termination must include ensuring physical as well as political survival in ways that were not necessarily salient before.<sup>657</sup>

Pakistani policymakers, however, are still reticent about discussing speedy war termination as a critical objective in the event of their nuclear use. This cageyness, which was as visible two decades ago as it is today, is driven largely by their desire to avoid giving India the impression that any potential conventional aggression against Pakistan would entail only modest nuclear risks, which New Delhi might choose to absorb in its pursuit of ambitious political aims.<sup>658</sup> Islamabad is well aware of its relative vulnerabilities vis-à-vis India: its current nuclear expansion is intended to develop the capabilities to punish India more extensively but, even if it were successful on this count, its greater relative vulnerability cannot be fundamentally erased. Pakistan's asymmetric disadvantage here stems from its weaker capacity to reconstitute in the aftermath of any nuclear conflict as a result of its possessing both a smaller landmass and weaker economy.<sup>659</sup>

Given this fact, Pakistani strategists are compelled to hold out the prospect of widespread destruction in their effort to deter all aggression to begin with—even if, when faced with the moment of truth, such actions would be counterproductive to their own interests. Consistent with this approach, they are building up their nuclear capabilities to support a “victory denial” strategy against India,<sup>660</sup> while remaining silent about all issues pertaining to war termination. It is, in fact, in their interest to insinuate that “any failure of deterrence would mean an all-out war, with little or no room for escalation control” precisely because such a declaratory posture best advances their aim of securing sturdy deterrence despite the existing power asymmetry with India.<sup>661</sup>

Islamabad's new doctrinal innovation, full-spectrum deterrence, thus simply exploits the reality that any introductory nuclear use, so long as it is modest, always contains the inherent threat of further nuclear destruction, which will invariably be costlier than the iteration before, thus making speedy war termination the most sensible objective when conventional deterrence breakdown occurs in a nuclear environment. Whether this strategy requires the diverse nuclear inventory that Pakistan is now pursuing is debatable. But to the degree that it pursues any

other end beyond conveying “the threat that leaves something to chance,”<sup>662</sup> Pakistan’s initial, possibly limited, nuclear weapons use—or the threats thereof—would be directed at securing external intervention by foreign powers in restraining India from continuing the conflict.<sup>663</sup>

In other words, Pakistan would seek war termination through a combination of implied threats of further expanded violence coupled with stimulating “catalytic” pressures for great power intervention.<sup>664</sup> This latter calculation is shaped by the fact that Pakistan remains a subaltern power in the international system and is still weaker than India on many counts. Hence, relying on outside powers to protect its survival by ensnaring their intervention through even threats of limited nuclear use, let alone actual nuclear use, is a sensible strategy for Islamabad. If such external intervention were to occur, it would not materialize because Pakistan’s cause is necessarily just. Rather, it would arise because the dangers of the threatened (or actual) demise of the nuclear taboo and the high negative externalities of possibly extensive nuclear escalation in Southern Asia imperil the great powers’ own strategic interests.<sup>665</sup> Given such expectations, it is ironic that Pakistan’s nuclear weapons, which were supposed to free it from dependence on external sources for security, will have now brought foreign intervention back in again to serve as a critical restraint on Indian action in the context of any future subcontinental conflict.

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## **PAKISTAN’S NUCLEAR ARSENAL**

The steady evolution of Pakistan’s nuclear doctrine during the last two decades exemplifies the efforts of a weak, and even paranoid, power at producing security. The ambition to build a large and diversified nuclear arsenal, capable of stymieing aggression at varying levels, would obviously find its greatest utility against India because other potential nuclear threats, such as the United States and Israel, may not be deterred either by Pakistan’s graduated escalation strategy or its steadily expanding nuclear armory—though the latter would certainly give even major nuclear powers sufficient pause, which is just what Islamabad intends. The following discussion elaborates this proposition by assessing Pakistan’s fissile materials production capabilities, its nuclear weapons and delivery systems, and its command-and-control arrangements as they continue to evolve.

### **Fissile Material Production and Stockpiles**

The quantity of fissile material that Pakistan possesses functions as a binding constraint on the number of nuclear weapons it can build. This is obviously true for all nuclear powers,

but it has a special meaning in the case of Pakistan. In comparison to China and India, which have identified reserves of uranium ore of some 344,000 and 259,500 tons, respectively (as of 2019),<sup>666</sup> Pakistan is believed to have much smaller reserves. Reliable data pertaining to Pakistan's ore endowments, however, are hard to come by. In the 2020 edition of the standard reference work, the IAEA and Nuclear Energy Agency's so-called Red Book, there is no information about Pakistan's reserves. A rare public source dating back to 1980 reported that the country possessed in 1976 about 150,000 tons of uranium ore containing 0.1 percent of U<sub>3</sub>O<sub>8</sub> (or yellowcake uranium) on the assumption that there was no past production.<sup>667</sup> All information about Pakistan's uranium reserves, both its endowments and its annual production, remain a national security secret.

The issue of Pakistan's natural uranium endowments is important, however, because unlike China and India, which have access to the global market for uranium, Islamabad does not enjoy a similar privilege. As a recognized nuclear-weapon state under the NPT, China can purchase natural uranium from the international market without constraint and use the same, if it so wishes, to produce nuclear weapons. Under the terms of the 2005 U.S.-India civil nuclear cooperation agreement, India, while not enjoying the same freedom as China, nonetheless enjoys meaningful access to the international market: New Delhi can purchase natural uranium from abroad for use in its safeguarded nuclear reactors—which represent the largest proportion of its fuel consumption anyway—while utilizing domestically mined uranium for its weapons, research, and fast breeder programs lying outside international safeguards. Pakistan, in contrast, must use its smaller uranium ore reserves to fuel its research and power reactors without access to imported fuel, all its plutonium-producing weapons reactors, and its weapons-related HEU-producing enrichment program, thus encumbering it to a far greater degree than India.

Pakistan today has five operational power reactors: the Canadian-supplied KANUPP-1 and the four Chashma nuclear reactors (CHASNUPP 1–4) built with Chinese collaboration. Three other power reactors are under construction with Chinese assistance—two at Karachi and one more at Chashma. In addition, Pakistan has two small research reactors, PARR-1 and PARR-2, the latter of which was also built with Chinese assistance. All these facilities are under safeguards, but China provides the uranium fuel required to run only Chinese-origin reactors in Pakistan under a bilateral agreement.<sup>668</sup> Consequently, Pakistan must fuel the small PARR-1 research reactor, the KANUPP-1 power reactor, the four plutonium-producing weapons reactors at Khushab, and the HEU production facilities at Kahuta, Gadwal, and possibly elsewhere entirely from its domestically mined ores.

The analytical question then is whether Pakistan's annual production of uranium—believed to currently stand at some 45 tons—can support these diverse uranium-consuming activities simultaneously.<sup>669</sup> This is a matter of interest given that Pakistan was described not too long ago as having “the world's fastest-growing nuclear stockpile,”<sup>670</sup> and was supposed to be on track to possessing the third-largest nuclear force globally by 2025.<sup>671</sup> Making

sense of these claims requires understanding the quantities of domestic uranium consumed by Pakistan's civilian and weapons-related programs. The KANUPP-1 reactor nominally requires 30 tons of natural uranium for its full operation annually.<sup>672</sup> The four Khushab reactors, which are dedicated to producing weapons-grade plutonium, have different thermal capacities. Khushab-1 is rated at 40 megawatts thermal (MWt). Each of its successors, despite outward similarities, have progressively higher thermal ratings, though the precise differences between them are not known. Some scholars have innovatively attempted to quantify these differences, but whether their assessments are accurate is unclear.<sup>673</sup> For simplicity's sake, if the output of the four Khushab reactors is assumed to be 50 megawatts thermal uniformly, their average discharge burnup is assumed to be 1,000 megawatt-days per metric ton of uranium (MWD/MTU), and they are assumed to operate at a 70 percent capacity factor, they could require a little over 51 tons of natural uranium fuel annually. Between the KANUPP-1 power reactor and the Khushab weapons reactors alone, Pakistan's annual domestic production of uranium is thus spoken for. The feeds required to run the two or more enrichment plants that produce HEU for the weapons program could add upwards of another 15–20 metric tons of natural uranium annually, thus making the uranium deficit even more pronounced.

Pakistan presumably has managed to overcome these constraints so far because it has been mining uranium ores since 1977 at Bagalchore and has expanded uranium mining since then to four other sites.<sup>674</sup> It continues to feverishly search for new deposits, given its growing economic and strategic requirements, but without notable success thus far. In any case, thanks to the five mining sites, Pakistan has steadily accumulated a stockpile of natural uranium, which, starting at an annual production level of 23 tons in 1980, is now believed to have leveled off at about 45 tons. If the data in the Red Book series over the years is collated and extrapolated, Pakistan would have accumulated 1,709 tons of natural uranium by 2020.<sup>675</sup> This figure is probably squishy given the secrecy surrounding Pakistan's uranium mining activities, but it is a useful benchmark to explore the question of Pakistan's uranium constraints. This stockpile has been gradually utilized over the years for fueling the KANUPP-1 power reactor, the four unsafeguarded reactors at Khushab that produce plutonium for Pakistan's weapons program, and the uranium enrichment facilities that produce HEU for weapons purposes.

The fuel requirements of the small PARR-1 research reactor can be disregarded here, but even so, the drawdowns occurring as a result of the consumption by the other facilities raises questions about how long Pakistan will be able to enlarge its nuclear arsenal if it cannot add to its existing natural uranium stockpile. The following crude calculation suffices to underscore this point. If the KANUPP-1 reactor, which started using domestic fuel from 1980 until the end of its design life extension in 2012, had produced about 1,850,000 megawatt-days, assuming that the average fuel burnup during this time was 7,400 MWD/MTU, its total uranium consumption would have been about 250 metric tons. After 2012, the reactor was operated at lower levels for reasons of safety: assuming a fuel burnup of

6,000 MWD/MTU between the years 2013 and 2018, the reactor would have consumed about 9 metric tons of natural uranium annually for a total of 63 metric tons during this period. In 2019, the reactor's capacity factor dropped drastically to 4.9 percent, thus requiring only 1 metric ton of fuel that year. It was effectively nonoperational in 2020 and was formally closed in August 2021,<sup>676</sup> thus consuming some 314 metric tons of natural uranium over its lifetime from the 1,709 tons that Pakistan has cumulatively produced until 2020.

The four Khushab reactors, operating on the assumptions noted earlier and depending on their commencement dates, will have been in service for a total of fifty reactor-years by 2020: assuming that they consume 12.8 tons of fuel annually, they account for another 640 tons of natural uranium. Between the power and the weapons reactors, therefore, fully 954 tons of uranium will have been consumed from the notional Pakistani total of 1,709 tons by 2020. This leaves 755 tons of natural uranium available for producing the HEU required by Islamabad's weapons program. The best academic judgments of Pakistan's HEU production suggest that Islamabad had produced 3,500–4,300 kilograms as of the beginning of 2020.<sup>677</sup> Using standard separative work calculations, it takes 218 kilograms of natural uranium to make 1 kilogram of 90 percent enriched uranium at 0.3 percent tails. (The "tails" here refer to the quantities of depleted uranium produced in the enrichment process, which appear as waste.) If 0.2 percent tails are assumed, it takes 176 kilograms of natural uranium to produce the same 1 kilogram of 90 percent enriched uranium. By these benchmarks, Pakistan's 2020 stockpile of 3,500–4,300 kilograms of HEU would require somewhere between 616 and 757 metric tons of natural uranium (if 0.2 percent tails are assumed), or between 763 and 937 metric tons of natural uranium (if a greater wastage at 0.3 percent tails is assumed).

This simple calculation suggests that if Pakistan's enrichment process produces lower levels of depleted uranium waste (i.e., 0.2 percent tails), it will barely have had the requisite stockpile of natural uranium—the residual 755 tons of natural uranium deduced above—to produce the 3,500–4,300 kilograms of HEU that it is postulated to have possessed in 2020. At 0.3 percent tails, Pakistan could not have produced even the lower end of the HEU stockpile range and certainly not the higher. While all these numbers should be treated with caution because they convey a precision that may not apply in reality, they do suggest, even as rough approximations, that Pakistan is operating very close to the margins of its uranium reserves and that its post-2020 production levels of HEU and weapons-grade plutonium would be curtailed if it cannot increase its annual production of natural uranium beyond the 45 tons attributed to it by the Red Book.

Obviously, Pakistan can supplement this feedstock by recovering uranium from the depleted tails for further enrichment or by recycling uranium recovered from spent Khushab reactor fuel for sustaining its weapons program. It is highly probable that Pakistan has experimented with one or both courses already, but neither of these solutions arguably can eliminate the constraints that Islamabad would likely face in practice if it cannot increase

the quantities of natural uranium available.<sup>678</sup> Clearly, recycling uranium recovered from the spent fuel at Khushab seems better than trying to use old tails because the latter are probably not enriched beyond 0.4% or at best are enriched to 0.5%. Moreover, they are a finite resource. Recycled uranium from spent reactor fuel in contrast offers better prospects since such uranium probably has an enrichment level of about 0.6% at a 1,000 MWD/MTU burnup and is a recurring resource. It appears that if Pakistan possesses depleted tails of some 0.3% and recycles all of the spent uranium from the four Khushab reactors, Pakistan's natural uranium requirements actually fall to some 42 to 43 metric tons per year—well within the 45-ton constraint referred to earlier. The catch with increasing uranium supply through the recycling of spent reactor fuel, however, is that such uranium is never fully decontaminated, and its use will pollute the enrichment cascades employed for this purpose. Segregating contaminated from noncontaminated centrifuges is burdensome and expensive since the former will eventually have to be replaced. Consequently, uranium recycling from spent reactor fuel is unlikely to be Pakistan's preferred solution to address its hypothesized constraints, thus leaving Islamabad with a serious problem if its annual natural uranium output is in fact capped at 45 tons.

Again, a back-of-the-envelope calculation suffices to establish the scale of the problem. If Pakistan is to produce about 45 kilograms of WGPu from its four Khushab reactors annually—probably the maximum level it can realistically produce at a 70 percent capacity factor assuming an average burnup of 1,000 MWD/MTU—it would require some 51 tons of natural uranium annually. Producing 130 kilograms of HEU annually—which academic analysis suggests has been the recent output<sup>679</sup>—would require another 23–28 tons of natural uranium (depending on the tails) for a total of some 74–79 tons of natural uranium every year. With an annual production level of 45 tons, Pakistan then faces a yearly deficit of about 29–34 tons of natural uranium. If Pakistan settles for producing a smaller quantity of weapons-grade plutonium annually from the four Khushab reactors—say, only 40 kilograms from reactors operating at a 70 percent capacity factor and with an average burnup of 1,000 MWD/MTU, as academic analysis suggested it may have recently<sup>680</sup>—it will require close to 46 tons of natural uranium annually. This implies that Pakistan would need about 69–74 tons of natural uranium each year to produce 130 kilograms of HEU plus 40 kilograms WGPu annually—the output it is supposed to have maintained in recent years.

In other words, Pakistan must either correct the deficit of some 24–29 tons of natural uranium annually (by some combination of recycling the tails, recovering uranium from spent Khushab fuel, or covert unsafeguarded natural uranium imports) if it is to maintain these production levels, or its annual output of HEU and WGPu is actually smaller than the academic assessments suggest, or it has actually been producing more than the 45 tons of natural uranium feedstock annually that have been attributed to it.<sup>681</sup> At the HEU and WGPu production levels now attributed to Pakistan, it will also have more or less exhausted the residual 755 tons of natural uranium from its cumulative production.



Whether Pakistan has already hit a fissile material production constraint or will hit such a ceiling at some point depends entirely on what its overall uranium ore reserves and annual production levels actually are. Lacking information about these facts, the only conclusion that can be drawn for now, based largely on the steadily increasing number of nuclear weapons and delivery systems, is that Islamabad is already mining more than 45 tons of natural uranium annually and can extract these higher levels for some time to come. However, it may not have great room to endlessly expand its weapons-grade fissile material production and, by implication, to acquire the world's "third-largest arsenal behind the United States and Russia" as was expected not too long ago.<sup>682</sup> Obviously, this conclusion will have to be amended if new information comes to light: if Pakistan dramatically increases its natural uranium production because of the discovery of new viable deposits of uranium ore domestically or because it was able to procure natural uranium through clandestine means from either international sources or friendly suppliers, such as China, which have a vested interest in its continued production of nuclear weapons, the impact on the size of Islamabad's nuclear arsenal could be substantial.

If Pakistan were to pursue foreign suppliers clandestinely, it would not face any meaningful financial constraints because the current costs of natural uranium on the international market are relatively low. The weighted-average price of uranium ore in 2019 was approximately \$35.59 per pound.<sup>683</sup> Pakistan, therefore, could purchase an extra 29–34 tons of natural uranium to more than cover its presumed annual deficit for somewhere between \$2.3 to \$2.7 million—a quite paltry sum even given Islamabad's economic difficulties. Pakistan's constraints, accordingly, are not pecuniary but legal: because of its continuing formal status as a non-nuclear-weapon state, it cannot purchase uranium on the international market. Hence, it must rely either on black market acquisitions or on covert transfers from its friends, although there is no evidence that Islamabad has pursued either of these two options to expand its fissile material production thus far.

If Pakistan does, in fact, continue to expand its fissile material inventory in the post-2020 era, and does so without covertly accessing foreign natural uranium supplies, it can only mean that Pakistan's domestic production of natural uranium has increased beyond the 45 tons per annum that it was previously credited. It is almost certain that this has been the case for some time—thus also explaining why Pakistan has invested in markedly expanding its fissile material production facilities, at least in comparison to what existed in 1998. Around the time of the nuclear tests, Pakistan had one major uranium enrichment plant, the Khan Research Laboratory facility at Kahuta, and possibly two or three smaller pilot-scale facilities, through the latter are still speculative. Over the years, the original plant at Kahuta, which has a four-stage cascade with some 6,000 centrifuges, has been expanded considerably and is now joined by a second enrichment plant at Gadwal.<sup>684</sup> These two facilities enrich uranium solely for the weapons program. Additional facilities may appear over time, with the planned National Fuel Enrichment Plant being intended to provide LEU for Pakistan's Chinese-supplied civilian power reactors. Based on the large (and expanded) size

of the Kahuta plant and the secondary facilities at Gadwal, it is certain that Pakistan has the number of P-2 gas centrifuges necessary to produce a much larger quantity of HEU than the 130 kilograms or so per annum with which it is currently credited.<sup>685</sup> If Pakistan has not done so, however, it is probably because of some combination of inconsistent natural uranium mining output, technical inefficiencies at its enrichment facilities, and the steady shift toward emphasizing plutonium production after 2005.

The interest in producing plutonium for nuclear weapons predates the 1998 tests and was evident from the fact that Pakistan began constructing its first weapons reactor at Khushab with Chinese assistance sometime in 1987. Today, the Khushab complex consists of four heavy water reactors whose plutonium output is dedicated solely for weapons. While all four reactors are currently operational, they have rarely functioned at maximal or optimal capacity factors consistently, thus producing a smaller stockpile of plutonium than would be the case in theory. Again, operating inefficiencies and possibly erratic natural uranium supplies may have contributed to this outcome, though it is also possible that Pakistan has concentrated on tritium production at the expense of maximizing the output of WGPu.

The biggest chokepoint in Pakistan's plutonium production program originally was its reprocessing capacity because its New Labs reprocessing facility, which was nominally completed in 1982, was hampered by technical problems for many years. It began operating consistently only after 2000, when spent fuel from the Khushab-1 reactor became available. Even so, it probably could not reprocess all the spent fuel produced by the reactor—a problem that would only intensify as the later Khushab reactors came online. The New Labs reprocessing facility has undergone periodic expansions, first in 1998 and again more recently, and its separation capacity has been estimated at anywhere between 8 and 20 kilograms of WGPu annually.<sup>686</sup> Concurrently, a second and larger reprocessing plant at Chashma—the Kundian Nuclear Complex—was also constructed. If these two facilities together permit Pakistan to separate about 40 kilograms of WGPu annually, they would suffice to reprocess the current output of the Khushab reactors. If Pakistan's plutonium production increased much beyond this level, however, additional reprocessing capacity would be required. Pakistan may, in any case, invest in new reprocessing plants simply as insurance against operational bottlenecks that may arise in its older facilities.

***That Pakistan has invested in an expansive fissile materials production infrastructure suggests that its domestic mining operations have yielded greater fruit than is commonly believed.***

In any event, today—and against the odds—Pakistan has developed a mature capacity to produce both highly enriched uranium and weapons-grade plutonium for its weapons program. If anything, it has the infrastructure in place to produce even larger quantities of HEU and more WGPu as well if technical inadequacies did not intervene and if larger

quantities of natural uranium feedstock were available. That Pakistan has invested in an expansive fissile materials production infrastructure suggests that its domestic mining operations have yielded greater fruit than is commonly believed or that it has acquired natural uranium from abroad through clandestine means though this seems unlikely.<sup>687</sup>

While future evidence will clarify this appraisal, the current Pakistani stockpiles of HEU and WGPu provide some sense of what its current weaponry inventory might look like even if its potential growth appears unclear. If Pakistan is judged to possess between 3,500 and 4,300 kilograms of HEU as of the beginning of 2020, it would be credited with some 175–215 notional weapons, assuming that each fission weapon utilizes about 20 kilograms of HEU. If the 410 kilograms of WGPu attributed to the Pakistani stockpile in 2020 is added to the calculation, then Pakistan could be credited with another 68 weapons on the assumption that each plutonium-based device utilizes 6 kilograms of fissile material.<sup>688</sup> On such premises, Pakistan's nuclear arsenal in 2020 would consist of between 243 and 283 nuclear devices. If it is assumed that Pakistan can annually produce 130 kilograms of HEU and 45 kilograms of WGPu consistently for another ten years, its nuclear arsenal in 2030 would consist of 383–423 weapons; if it is assumed that Pakistan is instead annually producing 40 kilograms of WGPu over this period, as it has perhaps done in more recent years, its nuclear arsenal in 2030 would consist of 375–415 weapons. Such force levels underlay the expectations that Pakistan could become the world's third-largest nuclear-weapons power sometime during this decade, although China's more recent nuclear expansion threatens to eclipse these older predictions about Pakistan's global standing.

The 2021 edition of the Federation of American Scientists' Nuclear Notebook lists Pakistan's nuclear inventory as consisting of some 165 weapons, but this figure is derived from judgments about the number of visible delivery systems rather than from calculations based on the fissile material stockpile.<sup>689</sup> As such, the Nuclear Notebook's numbers are likely to be biased downward because the number of discernable delivery systems are fewer than the number of weapons (and because the numbers of delivery systems identified may not be accurate in any case). In contrast, the number of weapons derived from fissile material stockpiles depend on crude estimates about the amount of fissile material needed to produce simple fission weapons by a country with relatively low design capabilities; as such, they could be biased in either direction depending on the amount of material judged to be necessary for a particular device design. It is, for example, highly probable that many of Pakistan's uranium-based weapons use less than the 20 kilograms of fissile material that are notionally assumed above; its smaller plutonium-based weapons, especially those that arm its cruise missiles and tactical nuclear devices, in all probability also use less than the 6 kilograms conjectured earlier. If so, Pakistan's current nuclear weapons inventory could be even larger than is commonly assumed. The uncertainties surrounding this issue are significant enough that *all* numbers about Pakistan's nuclear arsenal must be treated with great caution. But if the impressions of knowledgeable U.S. and European government officials are anything to go by, Islamabad's current nuclear weapons inventory is probably larger than the estimates appearing in the most recent version of the Nuclear Notebook.<sup>690</sup>

## Nuclear Weapon Designs

The little that is known about Pakistan's device designs unfortunately does not offer much more clarity. At the time of the 1998 tests, Pakistan's weapons were derived directly from the Chinese CHIC-4 uranium-based design that Islamabad received in the early 1980s.<sup>691</sup> The CHIC-4 design turned out to be a gift that kept on giving: Pakistan's nuclear scientists scaled its implosion system to create a few variants of different sizes and yields, which were packaged either as gravity weapons or as warheads mounted atop M-11 SRBMs and Ghauri MRBMs, the latter having just entered into service. Although there was great skepticism in India about Pakistan's nuclear design capabilities during the 1998 tests, Pakistani scientists proved to be remarkably resourceful, cleverly adapting and improving the original Chinese design to reduce its weight and volume while varying the size of the fissile core to produce different yields. The active competition that existed between the Khan Research Laboratories, the Pakistan Atomic Energy Commission, and the National Development Complex throughout the 1980s and 1990s only stimulated this innovation, which was finally proven during the 1998 nuclear tests.<sup>692</sup>

Although Pakistan claimed that its tests on May 28 and May 30, 1998, involved the detonation of five weapons in the first round and a sixth in the second round, it is almost certain that Pakistan tested only a pair of devices over those two days. The number of claimed tests was designed to establish parity with India, but the few nuclear weapons in the Pakistani inventory at the time—probably not more than between 16 and 20 weapons—made it improbable that any large fraction would be expended in testing. Both devices tested, at any rate, were uranium weapons and likely involved the largest and smallest devices then existing in the stockpile: the yield of the largest weapon was pegged at about 8–12 kilotons and the smaller device was judged as yielding 4–6 kilotons.<sup>693</sup> Conversations in Pakistan soon after the 1998 tests suggested that the largest device utilized about 20 kilograms of HEU, with the quantity of material employed in the second device remaining unclear. Since the 1998 tests and spurred on by Indian claims about its own thermonuclear devices, Pakistan has engaged in an active effort to develop boosted-fission and thermonuclear devices of its own. Given this interest, it must be expected that Pakistan also consistently produces tritium to support the production of its advanced nuclear weapons.<sup>694</sup> Pakistani scientists, arguably attempting to emulate India, claimed that boosted-fission—and even plutonium-based—weapons were tested in 1998, but this is undoubtedly hyperbole.

There has been considerable progress on this score since the 1998 tests and it is likely that Pakistan has by now developed boosted-fission and thermonuclear weapons. Emulating India, Pakistan has long sought such capabilities, but whether such devices will become standard in its inventory without full-up hot testing is uncertain.<sup>695</sup> The development of such advanced devices obviously complicates the effort at calculating the number of nuclear weapons straightforwardly from the fissile material stockpile because Pakistan's usage of highly enriched uranium per weapon might increase or decrease depending on their design.

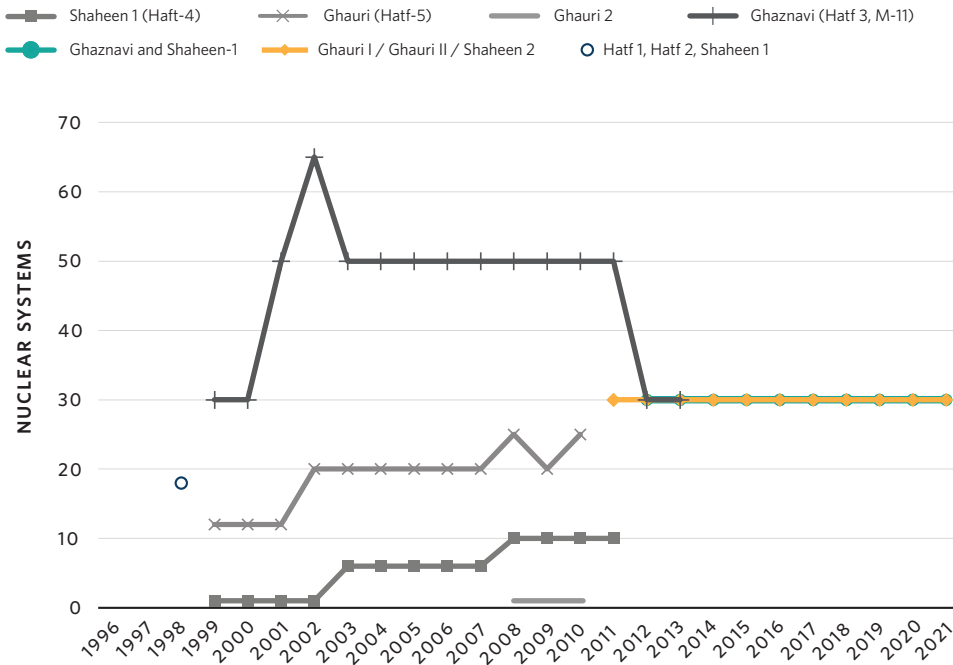
The introduction of plutonium-based weapons adds further complications in that Pakistan can now produce additional plutonium-only weapons—whose numbers can be more easily judged in principle—as well as composite core weapons, which makes assessing the likely number of weapons in the inventory impossible in the absence of information about the ratio of WGPu to HEU utilized in these devices. The interest in composite core weapons has many roots. It is driven in part by a desire to exploit the best properties of HEU and WGPu synergistically, to optimize the use of the inventory of each fissile material, and to reduce the size of the warhead mass for either Pakistan’s substrategic systems or to support the introduction of multiple warheads on, while improving the range of, its advanced ballistic missiles.<sup>696</sup>

Whatever the reasoning, Pakistan could be thus credited with possessing at least five different types of warheads currently: fission devices based on uranium-only, plutonium-only, and composite core designs of varying yields as well as boosted-fission and thermonuclear weapons. The maximum yield of the fission devices probably remains around 12 kilotons, the value demonstrated during the 1998 tests, though it is possible that Pakistan has increased this yield marginally as a result of improvements (to include the systematic regime of cold testing as well as subcritical and hydronuclear tests) it has pursued since.<sup>697</sup> The yields of Pakistan’s boosted-fission and thermonuclear devices are unknown, but like similar Indian weapons, their reliability is an open question because they have never been subjected to full-up hot tests. Whether they would be treated as standard devices in the Pakistani arsenal remains, therefore, unclear. It is possible, however, to conclude that, compared to the situation obtaining in 1998, the character of Pakistan’s nuclear devices has been transformed dramatically. The previous relatively large, solely uranium-based weapons have now been complemented by plutonium and composite core weapons of widely varying yields together with likely experimental boosted-fission and thermonuclear devices as well.

### **Pakistan’s Evolving Delivery Systems**

The diversity of Pakistan’s device designs in terms of the materials used, the yields sought, and the explosive principles exploited is only matched by the growing numbers and the diversity of its delivery vehicles and systems. On this count, too, Pakistan’s progress has been quite remarkable, especially when compared to its capabilities in 1998. Consequently, arguments suggesting that “Pakistan simply lacks enough nuclear-capable launchers to accommodate 285 to 342 warheads” should be treated cautiously.<sup>698</sup> Islamabad may not have the number of launchers required to carry nuclear weapons in these precise numbers, but it can deploy a much larger nuclear force than it is usually credited. The number of nuclear weapons that Pakistan possesses admittedly cannot be confidently judged from the outside, but the kinds of weapons it has developed make any inference based primarily on counting delivery systems problematic—and the data offered by respectable public sources, as evidenced by Figure 6, are highly muddy.

**FIGURE 6**  
**PAKISTANI NUCLEAR SYSTEMS, 1998-2021**



Source: International Institute for Strategic Studies, *The Military Balance 1999-2021*, twenty-six editions (Washington, DC: International Institute for Strategic Studies, 1997-2022).

Figure 6 collates the number of Pakistan’s nuclear systems from 1998 to 2020. It is drawn from various annual editions of the *Military Balance*. The limitations of such data should be obvious. Each delivery system is assumed to have only one warhead, a reasonable assumption for most missiles but not necessarily for aircraft. Pakistan’s diverse substrategic weapons do not feature in the count. And the number of missiles included in the tally may not be accurate. With the exception of the Abdali close-range missile and the Shaheen-2 medium-range ballistic missile, all other Pakistani delivery systems seem to have ceased growing in numbers after about 2015.<sup>699</sup> The best that such a compilation can suggest, therefore, is that Pakistan’s nuclear delivery systems (and, by implication, its weapons) have been growing at different rates since 1998, with all other details about their composition being somewhat speculative. Given the larger trends in Pakistan’s security environment, the post-2015 freeze in nuclear growth is odd and must be treated simply as a defect in the data.

In any event, the post-1998 growth in Pakistan’s nuclear forces has been shaped obviously by its continuing fears of India, its exaggerated perceptions of current Indian nuclear

***Although Pakistan has admittedly been expanding its nuclear inventory, its strategic planners have insisted that Islamabad's program "is not open ended."***

program "is not open ended" and that the currently planned force levels are likely to remain stable for ten to fifteen years of incremental acquisitions.<sup>700</sup> This prognosis offered in 2015 seems consistent with the development and acquisition efforts since, and the best assessment of Pakistan's ballistic missile production suggests that although it could produce up to twelve solid-fueled missiles of all kinds annually, the actual production rate is lower.<sup>701</sup> If the Pakistani fissile material stockpile is presumed to grow by 130 kilograms of HEU and 40 kilograms of WGPu annually, the thirteen or so notional warheads that could be produced would then be easily distributed between the ballistic and cruise missiles and various other tactical weapon systems.

What is striking about the development and expansion of Pakistan's nuclear delivery systems thus far is the absence of technological determinism—that is, the absorption of new capabilities into the nuclear arsenal merely because technological innovations autonomously materialize. In other words, technological determinism would imply, to use Alex Roland's succinct description, that Pakistan's "weapons [are] not tailored to strategy, but rather the strategy [is] shaped to suit the weapons."<sup>702</sup> It is hard to find evidence that Pakistan's nuclear evolution is driven in this way today. To be sure, Pakistan undoubtedly benefited from the early rivalry between the Khan Research Laboratories and the Pakistan Atomic Energy Commission/National Development Complex where fissile material production and weapons manufacturing was concerned. But with the formation of the Strategic Plans Division in 2000, the body tasked with overseeing Pakistan's nuclear deterrent, the three main complexes now involved in the nuclear weapons program—the National Engineering & Scientific Commission (which oversees Pakistan's weapons programs to include the National Defense Complex and the Air Weapons Complex), the Pakistan Atomic Energy Commission (which oversees uranium mining and processing as well as all plutonium-related programs and the nuclear reactors), and the Khan Research Laboratories (which focuses primarily on uranium enrichment)—are heavily coordinated and supervised from above ultimately by the National Command Authority.<sup>703</sup>

Where the development of both nuclear warheads and nuclear delivery systems are concerned, the Strategic Plans Division controls and directs the innovation process by establishing requirements, defining the technical capabilities required, their timelines for delivery, and the organizational changes to accommodate them, as well as supervising their testing, certifying their acceptance, and, finally, piloting their integration into the combat force. The development of new capabilities is thus based primarily on the Strategic Plans

capabilities, and its anxieties about India's nuclear production potential, especially in the aftermath of the U.S.-Indian civil nuclear cooperation agreement. Although Pakistan has admittedly been expanding its nuclear inventory in response, its strategic planners have insisted that Islamabad's pro-

Division's vision of strategic necessity, though whether its conception of necessity would be shared outside of Pakistan (or sometimes even within) is obviously debatable. However, there is little evidence that Pakistan's dozen or so distinct, and often opaque, engineering complexes that support its nuclear weapons program today in all its diversity have independent development programs that are driven either by profit considerations, nationalism, or mere technical possibility to generate products that are thereafter offered to the Strategic Plans Division as candidates for possible induction into the nation's nuclear arsenal.<sup>704</sup> The frequent claims made by Pakistan's security managers that their nuclear program is both centrally and purposefully directed are thus credible.

Against this backdrop, the following survey of Pakistan's nuclear delivery systems illustrates the remarkable fecundity of its research and development endeavors.

### Air Systems

At the time of the nuclear tests, Pakistan's principal nuclear delivery system consisted of manned aircraft, the F-16 and possibly Mirage III/V fighters, which carried only uranium-based gravity bombs based on some version of the Chinese CHIC-4 design. The main missile system operational then was the M-11 SRBM, though Pakistan has just begun testing the Gauri MRBM that had been clandestinely acquired from North Korea. Both missiles carried different versions of the uranium warhead based on the CHIC-4. The shift to missile-delivered nuclear weapons gathered steam throughout the 1990s because of fears that Pakistan's air-breathing delivery systems would be neutralized by India's superior air force in wartime. These concerns, coupled with the bureaucratic primacy of the Pakistan Army in national security decisionmaking, soon made land-based weapons the core of the Pakistani nuclear deterrent, but service prerogatives—combined with the desire to emulate India's emerging triad—finally ensured that Pakistan's air-delivered nuclear weapons would not be retired, thus remaining an integral part of the nation's nuclear arsenal.<sup>705</sup>

The Pakistan Air Force (PAF), accordingly, still has nuclear responsibilities and continues to maintain at least F-16 and Mirage V aircraft for the nuclear delivery role.<sup>706</sup> The fear about India checkmating Pakistan's air nuclear missions through defensive counterair operations, however, has not disappeared. Rather, it has pushed the PAF to supplement its inventory of older gravity bombs with new powered and unpowered standoff weapons, of which the Ra'ad air-launched cruise missile is best known.<sup>707</sup> PAF planners consider nuclear-tipped standoff weaponry to be a viable antidote to India's air defense operations, especially in the early phase of a conflict when the Indian Integrated Air Command and Control System may not have been sufficiently degraded. If Pakistani airpower is tasked with conducting nuclear strike operations in these circumstances, air-launched standoff weapons remain the best instruments particularly "when paired with lightweight low-yield nuclear warheads" that promise "a high level of 'distributed lethality.'"<sup>708</sup>



This calculation alone ensures that Pakistan will continue to develop and acquire a range of nuclear air-delivery systems that can be launched from outside the weapon engagement zones of defending Indian fighters or surface-to-air missile batteries. Even though using air-delivered warheads early in a conflict is not particularly optimal for Pakistan, the PAF's desire to maintain its nuclear capability, the Air Weapons Complex's ability to develop new and exotic nuclear delivery vehicles, and the conviction that full-spectrum deterrence requires suitable weapons for every imaginable contingency at every phase of a conflict all combine to ensure that the air-breathing leg of the Pakistani nuclear triad will continue to expand, including through new platforms such as the JF-17, well into the future. The evolving Pakistani investments, especially in aerial standoff weaponry, are directed toward enhancing the survivability of their launch aircraft even if they are committed to nuclear missions only in the second wave of nuclear strikes—after Pakistan's missiles are unleashed—but they would obviously have their greatest value for first-wave nuclear operations.

### Land Systems

The increasing expansion and diversification of Pakistan's air-delivered nuclear weapon carriers reflect a trend that is even more visible where its land-based nuclear systems are concerned. The two ballistic missiles that were present in the arsenal in 1998—the M-11 SRBM and the Ghauri MRBM—are still in service, but they have been complemented by many more systems that span diverse delivery ranges. The close-range delivery systems—that is, systems that can reach up to 300 kilometers—have received heightened attention in recent years because these, in Pakistani parlance, “short-range, low-yield nuclear weapons” are seen as offering graduated response options in the event of an Indian military attack.<sup>709</sup>

By developing low-yield nuclear weapons that can be used either at the line of contact with the enemy or behind the adversary's front line at tactical and operational depths, Pakistan is obviously emulating some aspects of NATO's nuclear strategy from the 1960s. At a time when fissile materials were plentiful and readily available to Western powers, NATO made the fateful shift toward tactical nuclear weapons, which were conceived as good substitutes for expensive conventional forces.<sup>710</sup> The United States alone stockpiled some 7,000–8,000 of these weapons by the 1970s, with land-based systems including nuclear artillery shells, atomic demolition munitions, short-range ballistic missiles, and even a nuclear recoilless gun! The yield of these weapons ranged from .02 kilotons at their smallest to usually a few tens of kilotons, though some, such as the W89 warhead, had a yield as high as 200 kilotons.<sup>711</sup>

Pakistan's tactical weapons, in contrast, likely produce only single-digit yields; since they exist in much smaller numbers, they cannot genuinely neutralize battlefield threats as NATO's nuclear countermilitary targeting was intended. All the same, Pakistan has pursued the development of various kinds of devices—just as the United States did earlier—with the Nasr and Abdali close-range ballistic missiles being best known. The Nasr (Hatf-IX)

missile, which is deployed in a quad-canister launcher (making it a “Multi-tube Ballistic Missile” system<sup>712</sup>) has a 60-kilometer range and likely uses one of Pakistan’s new compact plutonium warheads.<sup>713</sup> The Abdali, an early Pakistani nuclear missile, supposedly had a range of up to 200 kilometers. Although it was both tested and claimed to be nuclear capable, it is not clear whether it remains in the operational inventory.<sup>714</sup> Pakistan has also developed a nuclear artillery shell that is fired from its M110A2 howitzers at even closer ranges of some 30 kilometers, as well as atomic demolition munitions that could be employed at the forward line of contact with advancing Indian armored echelons.<sup>715</sup>

While Pakistan has thus invested significant resources in building up its close-range and tactical nuclear stockpile with diverse systems, the short-range component of the Pakistani nuclear armory has expanded as well. The original Chinese M-11 missile that was clandestinely transferred in the late 1980s is now manufactured in Pakistan; named the Ghaznavi (Hatf-III), it is deployed with both conventional and nuclear warheads. Although initially advertised as capable of a 300-kilometer range in order to satisfy Missile Technology Control Regime requirements, it can reach much greater distances depending on the payload. At any rate, since 1998, Pakistan has supplemented the Ghaznavi with longer-range nuclear-tipped SRBMs, the 600-kilometer Shaheen-1 (Hatf-IV), and an extended range variant, sometimes dubbed the Shaheen-1A, that reaches up to 1,000 kilometers.<sup>716</sup>

Pakistan’s quest for medium-range ballistic missiles was realized even before the 1998 nuclear test with the arrival of the 1,000-kilometer-range liquid-fueled Ghauri MRBM (Hatf-V). The Ghauri is a variant of the North Korean No Dong-1 missile and was acquired through A. Q. Khan’s efforts to procure a system with a longer range than the 300-kilometer M-11 SRBM then in Pakistan’s possession. The Ghauri provided Pakistan with its first capacity to target India in depth (beyond the normal reach of the F-16), and although it is a liquid-fueled system, it can be brought to readiness much faster than some of Pakistan’s other solid-fueled missiles.<sup>717</sup> Moreover, the large volume of its post-boost vehicle enabled Pakistan to deploy its larger and heavier early uranium-based warheads.<sup>718</sup> The Ghauri thus served Pakistan well, but the desire for a long-range solid-fueled missile that would be more easily dispersible pushed Islamabad to develop, again with Chinese assistance, the two-stage Shaheen-2 (Hatf-VI) with a maximum range of some 2,000 kilometers.<sup>719</sup> The relatively large size of the Shaheen-2’s post-boost vehicle suggests that it too can carry Pakistan’s early uranium-based weapons. The Shaheen-2 has also been modified to produce the Ababeel, a three-stage missile with a 2,200-kilometer range, which apparently carries three reentry vehicles and is designed to defeat India’s emerging ballistic missile defenses.<sup>720</sup>

For the longest time, Pakistan sought the capacity to range the entire Indian landmass with missile-borne nuclear weapons. This desire only intensified after the U.S.-India civil nuclear cooperation agreement, when Pakistan embarked on an expansion of its nuclear arsenal, the introduction of tactical nuclear weapons, and the enlargement of its missile reach. The two-stage, solid-fueled, Shaheen-3, with a range of some 3,000 kilometers,

is Pakistan's first intermediate-range ballistic missile. It was ostensibly developed to target India's Andaman and Nicobar Islands, which Pakistani strategists feared might be "developed as strategic bases" where "India might think of putting its [nuclear] weapons."<sup>721</sup> Although Pakistan carefully advertised the missile's range as being precisely 2,750 kilometers, this system would have to be based perilously close to Pakistan eastern border with India to satisfy the requirement of targeting the latter's island territories. Private conversations with Pakistani military officers, however, suggest that the Shaheen-3 has a greater range than Islamabad has publicly admitted, exactly to avoid such risks, which also has the effect of comfortably bringing Israel within reach. The Shaheen-3, which has not yet been deployed, continues to be developed further and will spawn either longer-ranged systems or more specialized variants.

Pakistan's land-based ballistic missile program has also been complemented by ground-based nuclear cruise missile development. Here, Pakistan has focused on inducting the Babur (Hatf-VII) cruise missile in at least two variants with ranges of 350 to 700 kilometers and multiple sophisticated guidance systems.<sup>722</sup> Even longer-ranged variants of the Babur are certain to appear in time, as Pakistan accelerates its effort to defeat future Indian ballistic missile defense systems.

The ambition to develop an intercontinental-range ballistic missile continues to simmer and speculation about Pakistan's plans for a Taimur missile persists,<sup>723</sup> despite Islamabad supposedly suspending its development efforts under U.S. pressure during the Obama years. Because the overt development, not to mention deployment, of a Pakistani ICBM would be viewed as highly provocative by the United States, Pakistan's activities in this regard are likely to persist covertly. Given Pakistan's other priorities, however, it is unlikely that Islamabad is currently in a rush to develop an ICBM to deter Washington. To the degree that this objective remains desirable, it makes sense for Pakistan to either utilize its faltering space program to develop space-launch vehicles that could double as ICBMs in case of an emergency or to explore how its longest-ranged current missiles, such as the Shaheen-3, might be employed with reduced payloads and atypical launch angles to hold at risk outlying U.S. territories as part of a deterrence strategy. Such possibilities are relevant, however, mostly over the long term.

### Sea Systems

While Pakistan has thus developed a diverse land-based missile program—consisting of close-to intermediate-range ballistic missiles (with ambitions of reaching even farther) and complemented by ground-based cruise missiles—these terrestrial nuclear forces, which constitute the primary arm of its nuclear deterrent, are increasingly supplemented by sea-based nuclear systems in both shore-based and offshore variants. In 1998, Pakistan had no sea-based nuclear capabilities. But it was not long before Islamabad, following New Delhi's example, sought a full-fledged triad with naval nuclear weapons as well. India was first out of the gate, using its

standing ties with Russia's Rubin Design Bureau to develop the Arihant-class nuclear ballistic missile submarine, the first two of which are now nominally operational.

Pakistan has followed suit and is developing a nuclear-powered submarine of its own, possibly with Chinese assistance, which has already been incorporated in the Yuan-class air-independent propulsion–equipped diesel-electric submarines now being constructed at Karachi.<sup>724</sup> As Lieutenant General Khalid Kidwai described this Pakistani quest:

I would say it's a work in progress. It's a work in progress where different elements, and different segments will come, are coming in stages. And there will be a time when there will be a platform as well. There will be a time when there will be a weapon. There will be a time where there will [be a] communications part of it coming into place. I can say with confidence that we are not too far away from it. So, comprehensively speaking I think this capability will come into play in the next few years.<sup>725</sup>

The Pakistani program to develop a nuclear submarine will inevitably prove to be a long and slow process, but the Pakistan Atomic Energy Commission's efforts since 2001 “to design and manufacture a miniaturized nuclear power plant for a submarine” suggests that its strategic planners are committed to acquiring such a capability eventually.<sup>726</sup> Given the origins and timing of this decision, it is unlikely to have been shaped by concerns about the vulnerability of Pakistan's land-based systems, some arguments to the contrary notwithstanding.<sup>727</sup> Rather, it was probably driven by abstract convictions about the strategic advantages of concealed submerged platforms for deterrence stability, coupled with the desire to push the technological envelope in ways that would ultimately benefit Pakistan.

In any event, because a nuclear submarine is years, if not decades, away from commissioning, Pakistan has in the interim focused on developing nuclear warheads for the tactical weapons currently in naval service. Similar to the efforts associated with the air arm, Pakistan seeks to maintain an inventory of diverse nuclear weapons that could be carried by different naval platforms. For example, the Babur cruise missile variant called the Harbah, employed for both anti-ship and land-attack missions, is currently deployed aboard the Pakistan Navy's surface attack craft, but extended range variants will be deployed aboard Pakistan's submarines as well.<sup>728</sup> The Harpoon anti-ship missile, a U.S.-supplied conventional weapon that Pakistan covertly modified and mated with nuclear warheads for the land-attack role, can be fired from maritime patrol aircraft such as the P-3C Orion as well as from other Western-origin surface vessels and submarines.<sup>729</sup>

Pakistan has likely developed other nuclear-tipped systems as well: the Chinese C602 missile, called the Zarb, which is deployed aboard Pakistan's surface combatants and serves in its coastal defense batteries as well as is part of the Navy Strategic Force Command, is a particularly attractive candidate because its relatively large payload volume and its tactically useful range of 280 kilometers make it a useful area denial weapon when employed along

the Pakistani coastline.<sup>730</sup> For this mission—which is focused on potential naval threats from both the United States and India—Pakistan has also embarked on developing an anti-ship ballistic missile that could be either ship- or land-based; if the latter, it would be similar in principle, except perhaps for its range and its payload, to China’s own anti-ship ballistic missiles deployed along its eastern seaboard.<sup>731</sup> There are some reports suggesting Chinese assistance in the development of this close-range missile, but given that Pakistan lacks the wide area-integrated sensor network that makes China’s conventional anti-ship ballistic missiles so potent, Islamabad would probably substitute “a small nuclear weapon” in order to secure effective targeting of various offshore surface threats.<sup>732</sup>

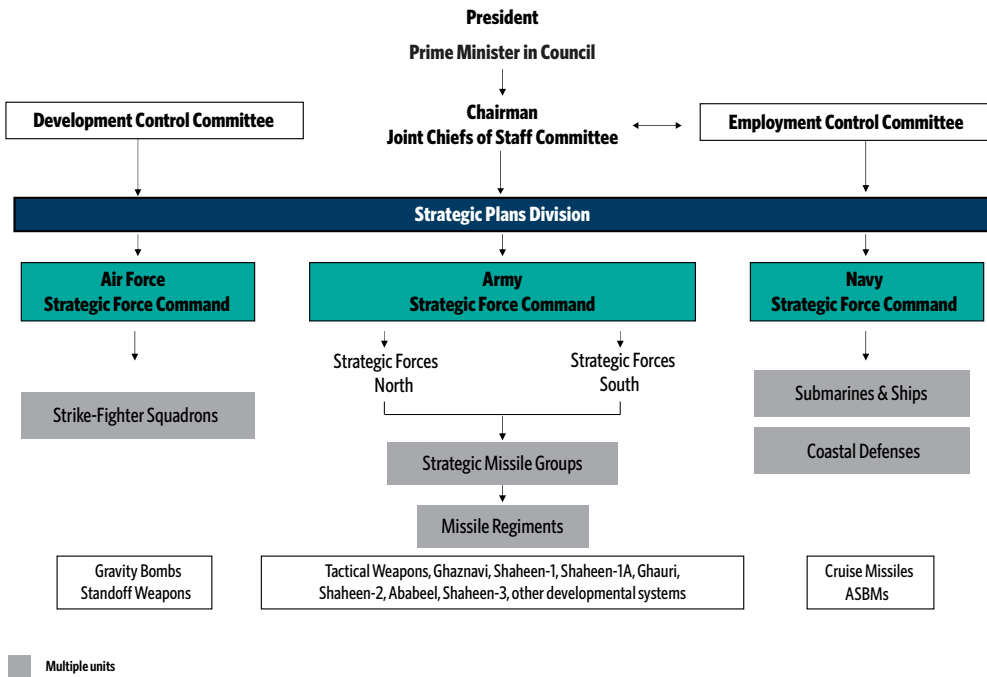
Given Pakistan’s success in developing compact nuclear warheads, it would not be surprising if its military technologists explore new naval weapons such as nuclear torpedoes and nuclear depth charges, just as the United States did during the Cold War.<sup>733</sup> Although small nuclear yields, say in the range of 1–3 kilotons, might have only modest impact in a land environment, they would more than suffice to inflict consequential devastation if they are detonated on or in proximity to naval vessels and submarines. Pakistan’s naval nuclear weapons currently are designed primarily as second-strike systems. In order of priority, they appear to focus on: protecting Pakistan’s own coastline against Indian and “extra-regional force” power projection operations; targeting an adversary’s major combatants in sea denial operations on the high seas; and, lastly, attacking Indian land targets relatively close to shore and, in the process, defeating New Delhi’s emerging missile defenses.

### **Command and Control, Operational Posture, and Force Employment**

While the internal activities of the key organizations involved in Pakistan’s strategic programs are hard to track, the broad organizational structure of Pakistan’s nuclear command system is well known. The National Command Authority (NCA), formalized in the aftermath of the 1998 nuclear tests, serves as the highest decisionmaking body for all matters pertaining to the nuclear arsenal. It is chaired by the prime minister and consists of two committees: the Employment Control Committee, responsible for nuclear use decisions, and the Development Control Committee, overseeing the nuclear acquisition process, with the Strategic Plans Division serving as the common secretariat for the NCA at large and the Strategic Plans Division’s director general serving concurrently as the secretary for both committees. Although the uniformed military is comprehensively represented in both bodies, there are civilian representatives as well: key ministers, such as those in charge of foreign affairs, defense, interior and finance, are present in the Employment Control Committee, and the heads of the major strategic industrial organizations have berths in the Development Control Committee.<sup>734</sup>

FIGURE 7

**PAKISTAN’S NUCLEAR FORCES AND COMMAND STRUCTURE**



Pakistan’s nuclear arsenal is thus administratively overseen and directed by the Strategic Plans Division headed by a three-star military officer. The Strategic Plans Division is a highly professional organization and consists of some seven directorates that include operations and plans; command, control, communications, computers, intelligence, surveillance, and reconnaissance; arms control; and security, among others.<sup>735</sup> The chief of army staff, the most powerful personage in the Pakistani military, selects the Strategic Plans Division’s director general, who thereafter reports to, and functions under the authority of, the chairman of the Joint Chiefs of Staff. The chairman exercises operational control over Pakistan’s nuclear arsenal through the three service-level commands and is ultimately accountable to the prime minister in council.

In theory, therefore, Pakistan possesses a unified civilian-military command structure with all nuclear acquisition, deployment, and use decisions made through a collective system that involves both elected officials and uniformed representatives equally. It is entirely possible that this corporate edifice works as designed in peacetime, at least formally, insofar as decisions pertaining to nuclear weapons development and procurement are reached by consensus. This fact, however, may obscure deeper imbalances in technical competence and political heft within the NCA—a problem that, though also prevalent elsewhere, has

particular connotations in Pakistan's "hybrid regime."<sup>736</sup> Whether civilian authorities, therefore, would have veto power over the military's preferences, especially on the critical issue of nuclear use in wartime, thus remains an open question. This problem is grounded fundamentally on the deep structure of power relations within the Pakistani state and it has led observers such as Michael Krepon to argue that, "while notional authority now resides in the office of the [Pakistani] prime minister, and while cabinet ministers on the NCA are involved in [nuclear] decisions, real authority lies with the chief of army staff, the chairman of the joint chiefs of staff, [the Director General, Strategic Plans Division], and few others, some of whom may not be involved in decisionmaking under extreme duress."<sup>737</sup> With a bit of luck, this matter will never be put to the test, but it will nonetheless persist because of the enduring praetorian dominance in Pakistani politics.

In any case, Pakistan's nuclear arsenal has another distinguishing characteristic. Although the Strategic Plans Division serves as the central node of the nation's nuclear force, Pakistan—unlike China and India—does not have a unified strategic command but rather maintains three service-level strategic force commands that oversee the nuclear delivery systems operated by each service. In peacetime, these service commands do not have any access to the nation's nuclear weapons. The control over, and the custody of, these weapons rests solely with the Strategic Plans Division as the executive agent of the NCA, with the weapons released to the service operators only when authorized by the Pakistani leadership in accordance with its multistep alerting system.

Of the three strategic commands, the Army Strategic Force Command, headed by a lieutenant general, is the largest and the most important. It controls all the ground-based delivery systems, including Pakistan's ballistic and cruise missiles and its tactical weapons. These capabilities are organized under two corps-equivalent formations, Strategic Forces North and Strategic Forces South, based at Sargodha and Petaro, respectively.<sup>738</sup> Each of these commands, in turn, controls a number of brigade-equivalent strategic missile groups, which are loosely modeled on the Pakistan Army's artillery brigades. If the organizational structure of the latter is any indication, a strategic missile group could have some three subordinate missile regiments with supporting capabilities such as signals, engineers, survey, and security elements among others. One seemingly authoritative briefing (of unknown provenance) on the Pakistan Army's order of battle and deployment in its western frontier regions indicates that each strategic missile group possesses eighteen missile launchers. This figure is analogous to the number of field artillery pieces in the Pakistan Army's standard artillery brigade, but it has not been corroborated elsewhere despite seeming reasonable.<sup>739</sup> Based on the news bulletins issued by the Pakistan Army after various missile tests, it also appears as if each strategic missile group deploys one particular kind of missile system, which would make sense from both an operational and a logistical perspective.<sup>740</sup> Early in the last decade, Pakistani military officers had indicated in private conversations that they would like to raise and equip somewhere between six and twelve strategic missile groups by 2025. Based on the steady enlargement and diversification of Pakistan's missile inventory, the army could

be well on its way to realizing these ambitions, but whether and how this changes the internal composition of the strategic missile groups is unclear.

The Air Force Strategic Command is next in order of importance. This command retains the oldest nuclear weapons in Pakistan's inventory as well as some of the newest air-delivered standoff weapons. The F-16 remains Pakistan's most reliable aircraft delivery platform with a useful operating radius of about 500 nautical miles in the strategic strike role.<sup>741</sup> Although the F-16 C/D Block 52 aircraft operated by 5 Squadron remains the PAF's most effective multirole variant, its superb air combat capabilities are likely to restrict it to a conventional mission, at least initially, likely leaving the Block 15 models of 9 and 11 Squadrons with nuclear responsibilities.<sup>742</sup> The Mirage III and V aircraft of 15, 25, and 27 Squadrons probably share the nuclear delivery mission, and, in time, will likely be joined by Pakistan's new JF-17.<sup>743</sup> Despite being secondary to the army's strategic forces, the Air Force Strategic Command takes its nuclear mission seriously, constantly rotating nuclear capable aircraft between air bases, practicing takeoffs and landings on highway strips, and testing the mating of nuclear weapons with combat aircraft at austere facilities in order to protect the effectiveness of the nuclear air arm in the face of the expected Indian attacks in wartime.<sup>744</sup>

The Navy Strategic Force Command controls Pakistan's naval nuclear delivery systems and most likely its coastal defense capabilities as well. Again, the nuclear warheads allocated to these vehicles are maintained under the centralized control of the Strategic Plans Division and are disbursed to the combat vessels (or shore weapons) when required according to the alert sequence. Like the PAF's nuclear weaponry, the navy's nuclear forces are viewed primarily as insurance—second-line capabilities that complement the principal land-based systems operated by the Army Strategic Force Command. Until the Pakistan Navy acquires submarine-launched nuclear ballistic missiles, its current capabilities will remain largely marginal as a deterrent.

Given the naval superiority that India is likely to enjoy in a conflict, the survivability of Pakistan's nuclear systems aboard any surface ships is questionable. If nuclear-armed versions of weapons such as the Harbah, the Harpoon, and the C602 are deployed on the Pakistan Navy's frigates and fast attack craft, they would be at high risk in any subcontinental war. Only the nuclear-tipped Babur submarine-launched cruise missile, the submarine- and air-launched nuclear Harpoons, and the nuclear-tipped coastal defense missiles are likely to remain relatively invulnerable. This suggests that Pakistan's real naval nuclear deterrent for the foreseeable future will consist mainly of the weapons deployed aboard sub-surface and air platforms (and secondarily on shore). Notwithstanding speculation to the contrary, Pakistan certainly has the technical capability "to shrink warheads enough for use with tactical or sea-launched weapons" and to deploy these aboard its surface vessels,<sup>745</sup> but the operational and strategic value of such systems is dubious in comparison to the hazards. Given Pakistan's conservatism regarding its nuclear posture, it is likely, therefore, that the Strategic Plans Division will eschew any temptations to deploy naval nuclear weapons on



vulnerable surface platforms or maintain them at higher levels of readiness in peacetime, even though the several nuclear cruise missiles now in service reflect both its investments in full-spectrum deterrence and the Pakistan Navy's desire to partake in the national nuclear deterrence mission.<sup>746</sup>

Although Pakistan is thus pushing the envelope in creating a large and diversified nuclear force along many dimensions, its operational posture has been strikingly cautious so far. Since the beginning of its nuclear program, Pakistan has maintained its nuclear warheads routinely in unassembled form—that is, with the cores separated from the rest of the weapon assembly, and with these two elements separated from their delivery systems as well.<sup>747</sup> The U.S. Department of Defense corroborated this description in 2001 and there have been no indications to the contrary since.<sup>748</sup> This posture was also alluded to by Musharraf, who metaphorically noted in 2003 that, “There is no button in our case. Missiles and warheads are not permitted together. There is a geographical separation between them.”<sup>749</sup> Subsequently, senior officials from the Strategic Plans Division confirmed that Pakistan's nuclear forces are not maintained routinely on “hair trigger alert,” but that the separation between components “is more linked to time rather than space.”<sup>750</sup> When senior Pakistani military officers have been queried about this formulation in private conversations during the last decade, they invariably acknowledge that even though the warhead components and the delivery systems were often stored together in dedicated repositories, the process of integrating them involved a lengthy sequence that prevented any instantaneous employment. Whatever the nuances, the clarifications confirmed that Pakistan's nuclear capabilities in peacetime are preserved in separated form even if the various elements are sequestered either within single facilities—a posture most relevant to land-based missile warheads and their delivery systems—or in close proximity to their delivery platforms—as is likely to be the case with aircraft-delivered and naval weapons.

To support this posture, Pakistan began to invest heavily in building a large and opaque network of underground storage sites to protect its strategic weaponry against both domestic threats and external attack. These facilities are invariably hardened, heavily guarded, and obscured by various deception and denial measures to prevent easy identification and targeting. These infrastructure investments, just like in India, began well before the 1998 tests but were accelerated after elevated fears over the possibility of the United States seizing Pakistan's nuclear weapons—first after the September 11, 2001, terrorist attacks and later after the Abbottabad raid on Osama bin Laden.<sup>751</sup> After A. Q. Khan's proliferation activities became public in 2003–2004, this effort acquired further impetus, leading the Strategic Plans Division to double down on enhancing the internal security of Pakistan's nuclear program while continuing its previous efforts at minimizing the vulnerability of Pakistan's nuclear weapons to potential external attacks.<sup>752</sup>

What is remarkable is that Pakistan's posture of maintaining unassembled nuclear weapons in peacetime has survived over the last two decades despite its perpetual fears of Indian aggression. In other words, the emphasis on positive control (requiring nuclear weapons to be readily

available for operations when necessary) has not overwhelmed the requirements of negative control (ensuring that nuclear weapons cannot be used except when authorized), even though Islamabad's concerns about India remain unabated. This speaks to the fundamental confidence that Pakistan has about the survivability of its deterrent against the worst forms of Indian attacks imaginable; this confidence, in turn, derives from the effectiveness of the Strategic Plans Division's preparations in both a technical and a procedural sense. Furthermore, it reflects the enduring conviction that all nuclear use contingencies vis-à-vis India (and any other power, for that matter) will be presaged by a period of strategic warning that will enable Pakistan to prudently increase its force readiness in accordance with strategic necessity.<sup>753</sup>

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Preserving the fine balance between maintaining disaggregated nuclear capabilities that are nonetheless responsive has been aided by both technical and procedural solutions. Fully cognizant of the imperatives of safety and security, one very senior Pakistani Air Force officer at the turn of the century indicated that Pakistan's device designs from the beginning incorporated something akin to insertable nuclear capsules, just as early U.S. nuclear weapons did as well.<sup>754</sup> Although Pakistan could not mimic the technical mechanisms employed in early U.S. nuclear weapons exactly, the virtue of the "insertable pit" solution is that it allows weapon cores to be preserved separately from the rest of the nuclear assembly while also permitting their easy integration when required in a crisis either at the storage site or even at a field location after dispersal.<sup>755</sup> The nuclear capsules in air-dropped U.S. weapons at the beginning of the nuclear era were, in fact, inserted into the high explosive shell of the weapon assembly by the bomber's crew en route to its target.<sup>756</sup> Nuclear weapons carried by tactical strike-fighters do not permit a similar solution and, hence, the pits in Pakistan's air-delivered weapons must be fully integrated prior to the aircraft's takeoff. A similar regime defines the integration activities pertaining to Pakistan's land- and sea-based missiles.

In any event, and whatever the differences characterizing Pakistan's weapons integration regime compared to that of the United States in the early Cold War, maintaining unassembled nuclear weapons in peacetime guards against accidents at the storage sites while also minimizing the dangers of seizure, since both elements—the cores and the weapon assembly—would have to be lost simultaneously for security to be compromised. Pakistan's procedural systems, like India's and China's, have consequently focused on creating the alerting system that would allow its military to systematically integrate the nuclear weapon and delivery systems components in their custody when required during a crisis.

The exact details of Pakistan's alerting sequence are not known but, like India's four-tier process, it involves a structured procedure whereby nuclear weapon components are assembled;

delivery systems are tested, relocated (if necessary), and prepared for mating with the warheads; weapons and delivery vehicles are integrated; and, finally, the completed systems are either readied for launch or dispersed to field sites or hides awaiting their orders to launch. Every step of the process can be undertaken only upon receipt of specific orders that are transmitted over a dedicated strategic communications network, which conveys the targeting data, the segmented twelve-digit alphanumeric arming code, and finally the launch code that authorizes the release of the weapon.<sup>757</sup> Multiple levels of authority are also involved in this process, from the Strategic Plans Division to the service Strategic Force Commands to the strategic missile group commanders (or their air force and naval equivalents) and their subordinates. The entire chain is subject to the strong scrutiny of a personnel reliability program and a stringent “two-man rule” is employed where all critical activities involving nuclear operations are concerned.<sup>758</sup> Depending on the delivery instrument involved—land-based missiles, aircraft, or naval platforms—the precise modalities of the integration and alerting process will vary, but the overall concept of steadily bringing routinely disaggregated capabilities to full integration over a period of time has survived thus far.

The length of time required to traverse the entire alert sequence from a starting start also varies depending on the delivery system involved. Aircraft-delivered weapons can be prepared most quickly—possibly a few hours—though they are the least preferred instruments for penetrating strike missions in the early days of a conflict. In comparison, land-based missile forces and naval nuclear forces would take longer to reach full readiness—many hours to a few days—but, since the entire force generation process is assumed to occur under conditions of strategic warning, it is likely that Pakistan will be able to ready many of even its slowest nuclear systems before the onset of any conflict. Depending on the amount of strategic warning available, the processes of integration could proceed and be

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completed even after the onset of a conventional conflict. And unless a high intensity, all-out conventional war is assumed, it is possible—even likely—that Pakistan, like India, would not integrate all of its strategic forces but merely a subset, keeping the rest in reserve as a force-in-being.

Islamabad have sensibly dismissed this contingency as unrealistic for the foreseeable future.<sup>759</sup> Notwithstanding some recent claims that India is contemplating “splendid first strikes” in the service of counterforce missions—an issue discussed at length in the following chapter—Pakistan’s strategic planners anticipate that their investments in hardening, deception, and force expansion and distribution, their tested routines for force generation,

The most stressing threat to the customarily disaggregated Pakistani nuclear force would be an extensive bolt-out-of-the-blue counterforce strike, but strategists in

and the quality of India's nuclear capabilities all combine to make any threats of a splendid first strike by New Delhi practically impossible.<sup>760</sup> Once Islamabad's nuclear forces have been generated and surged, the dangers of victimization to any imagined Indian counterforce strikes—conventional or nuclear—in fact recede even further. The real danger facing Pakistan's dispersed weapons, which would be fully integrated by that point, is actually accidents because its assembled weapons, just like India's, are unlikely to be “one point safe” in the face of the physical and thermal shocks that may arise during movement from their peacetime repositories to their wartime launch locations.<sup>761</sup>

The introduction of some kinds of new tactical nuclear weapons, both land- and sea-based, could stress Pakistan's traditional posture of maintaining its nuclear capabilities in separated form, but much depends on the specific device designs utilized in these systems. Pakistan still seeks to maintain its traditional solution in regard to most of its tactical weapons, and the benefits of having a recessed force can still be enjoyed if systems that cannot be maintained routinely in unassembled form are simply withheld from frontline deployment until absolutely necessary. At the moment, Pakistan appears to be pursuing both technical and procedural controls even in regard to its tactical nuclear weapons with an eye to ensuring at least their security in both peacetime and conflict.<sup>762</sup> The success of these efforts will be continually debated inside Pakistan and elsewhere, but there is little doubt that Islamabad is cognizant of the problems involved and, at least thus far, is pursuing relatively conservative solutions that are biased toward minimizing the dangers of unauthorized use. As such, there is no evidence supporting the claim that “whatever negative controls exist to ensure the security and safety of Pakistan's arsenal during peacetime, they are likely circumventable, *by design*, for deterrence purposes in a crisis or conflict situation with India” (emphasis added).<sup>763</sup>

Despite the expansion and diversification of its nuclear weapons inventory since the 1998 tests, Pakistan has, in fact, persisted with a centralized command system, preferring to devolve nuclear use authority as appropriate in war, rather than pre-delegating that authority to field commanders and dispersing ready nuclear weapons in peacetime. Many thoughtful Pakistani observers early on, including military officers who once served in the Strategic Plans Division, were fearful that the acquisition of tactical nuclear weapons might lead to the decentralization of nuclear command and control. In this vein, Naeem Salik had noted in 2012 that such capabilities “may force a rethink of existing centralized negative and assertive controls over nuclear weapons and may lead to a pre-delegation of command and control with its own attendant risks.”<sup>764</sup> Similarly, Feroz Hassan Khan had earlier warned even more portentously that:

should a trade-off [between positive and negative control] be required, [the] battle effectiveness of the nuclear force will trump centralized control. This does not mean that [a] nuclear use decision will be taken irrationally by the theater commander. But this transition of command-and-control in operational conditions is

an outcome of the fog of war and will require careful attention as the process of integration of nuclear and conventional forces goes apace.<sup>765</sup>

The evidence suggested by Pakistan's military exercises in recent years, however, corroborate earlier assurances offered by its nuclear strategists, such as Lieutenant General Khalid Kidwai, that "no delegation of authority concerning nuclear weapons is planned."<sup>766</sup> Although the temptation to do so is understandable, neither Pakistan's National Command Authority nor the Pakistani military leadership—even if it is assumed that the latter are the ultimate decisionmakers on nuclear use issues—has moved to pre-delegate authority for use decisions to subordinate echelons, such as the army's corps commanders who would oversee military operations in a conventional war.<sup>767</sup>

If anything, Pakistan has doubled down on centralized control even as it has acquired tactical nuclear weapons. Lieutenant General Khalid Kidwai has more recently noted that, "Pakistan has ensured seamless integration between nuclear strategy and conventional military strategy," but where nuclear weapons (to include tactical devices) are concerned, this "seamless integration" involves institutionalizing the procedures for releasing weapons only to the respective service-level strategic force commands—and *not* conventional formations—when required for possible use. Until that point, all of Pakistan's nuclear weapons, including its tactical systems, remain under the control of the Strategic Plans Division and protected by its own security force, which has now expanded to some 30,000 personnel. The current technical and procedural systems, therefore, do not permit anyone outside the services' strategic force command leadership and their direct subordinates to arm Pakistan's nuclear weapons. The extensive expansion and diversification of Pakistan's nuclear arsenal is intended to provide sufficient redundancy so as to allow the leadership enough alternative nuclear use options that mitigate the use-or-lose dilemmas that can be easily hypothesized in the context of an intense conventional war. Toward this end, Pakistan, despite some speculation to the contrary, has not *deliberately* weakened the technical safeguards preventing unauthorized nuclear use in order to allow field commanders to be able to fire nuclear weapons on their own initiative in the event of fractured communications or even localized military reverses.<sup>768</sup> In fact, except for some accident occurring in the chaos of war, no Pakistani conventional force component would ordinarily be able to lay its hands on any of the nation's nuclear weapons.

In support of such a command system, Pakistan has, and continues to, invest heavily in creating the physical, technical, and procedural infrastructure to ensure the protection of its leadership and their capacity to control nuclear forces even in the event of chaotic conventional operations. Toward that end, Islamabad has constructed "a National Command Center (NCC), which has a fully automated Strategic Command and Control Support System (SCCSS) that enables the decisionmakers at the NCC to have round the clock situational awareness of all strategic assets during peacetime and especially in times of crisis."<sup>769</sup>

This facility is complemented by other underground command centers connected to the hardened storage sites for Pakistan's weapons and the principal missile delivery systems, with the air and naval vectors relying on a combination of opacity and mobility for their survival. All the nodes in Pakistan's nuclear arsenal are now linked by a dedicated strategic communications system that, although interfacing with the nation's other leadership and conventional military communications networks, is distinct from them.<sup>770</sup> The strategic communications system, just like in India, is built on a buried fiber-optics backbone and supplemented by high-frequency radio, microwave radio relay, and satellite communications. The subsurface platforms of the naval arm, in addition, are connected by very low frequency communications, which as one analyst noted, "reinforce[s] the message that the country is investing in maintaining a credible and survivable nuclear deterrent."<sup>771</sup>

Islamabad has thus invested extensively in the physical infrastructure required to protect its nuclear systems and in the technical capabilities and procedural regimes required to ensure their effective generation, dispersal and use if required by strategic necessity. The extent of the investments sometimes gives rise to the impression that Pakistan is, in fact, preparing for nuclear warfighting—that is, resolving its tactical weaknesses at the conventional level through the application of nuclear fires. This perception is mistaken. Given Pakistan's geographic vulnerabilities, both its civilian and military leaders are sufficiently aware of the implications of widespread nuclear use for the nation's survival. However, because of their fears about India's superior capabilities—and, more to the point, its supposedly revanchist ambitions—they feel compelled to amass the largest nuclear capabilities possible and constantly threaten their use simply to signal their willingness to bear the high costs necessary in the event of Indian aggression. Even as they issue such threats, sometimes even provocatively,<sup>772</sup> Pakistan's overarching objective remains deterrence: preventing any conventional war that might put at risk its national survival and thereby provoke the very nuclear weapons use that could also eventually lead to its own physical destruction.

## **TAKING STOCK**

This survey of Pakistan's evolution since the 1998 tests highlights dramatic changes along with more limited, yet important, continuities. The clearest discontinuity has been manifested in Pakistan's nuclear doctrine, which has shifted from its original intention to build a minimum deterrent to a more expansive conception labeled full-spectrum deterrence. While the former notion conveyed the possession of a relatively small and possibly limited arsenal that would see use solely as a last resort and directed mainly as countervalue targets, the latter concept has justified a larger nuclear inventory consisting of a variety of weapons that range from tactical to strategic, which can potentially be used earlier in a conflict, in a more graduated way, and directed at a variety of targets ranging from military formations all the way to an adversary's cities. This transformation has been supported by an expansion in

Pakistan's fissile material production base, with new plutonium-producing reactors joining its traditional uranium enrichment program. The availability of plutonium has resulted in a transformation of Pakistan's device designs as well: it has allowed the fielding of new, more compact weapons that now arm the country's diverse substrategic systems, even as Pakistan has also proceeded to push for greater yields on its strategic systems through the development of boosted-fission and thermonuclear warheads.

The Pakistani nuclear arsenal today, accordingly, bears scant resemblance to the force that existed in 1998: the emerging dyad at the time has now mutated fully into an evolving triad that also incorporates a spectrum of tactical to strategic weapons. For all these changes, however, Pakistan's nuclear posture has remained remarkably conservative. Almost every system in the arsenal is still maintained in separated form, with integration occurring through a structured process depending on the level of alert, while the command system remains durably centralized, albeit dominated by the military despite the appearances of a hybrid civilian-military command system. Above all, the starkest element of continuity since 1998 remains Pakistan's emphasis on deterrence—that is, avoiding a conventional war that could threaten the survival of the nation. While Islamabad has moved away from a pure strategy of deterrence by punishment, it has not yet moved toward deterrence by denial either. Rather, it has incorporated symbolic elements of denial that are intended primarily to signal resolve and a willingness to escalate further in order to force war termination through external political intervention, at least in regard to conflicts involving India. Where other powers are concerned, principally the United States, Pakistan views the presence of a large number of diverse and survivable nuclear weapons as hopefully sufficient to prevent any aggressive actions.

## **NUCLEAR TRANSITIONS AND STRATEGIC STABILITY IN SOUTHERN ASIA**

The current patterns of nuclearization in Southern Asia confirm that although China, India, and Pakistan had at various points historically supported the idea of abolishing nuclear weapons, albeit with differing degrees of enthusiasm, that aspiration has now been consigned to the dust heap of history. At a formal level, all three states still claim that they would like to see the eventual abolition of nuclear weapons. But the character of competitive international politics has taken each of them further and further from that goal.

China's recent emergence as a superpower—facing the United States, the existing hegemon, in an open-ended competition for global influence—has made nuclear weapons modernization a critical element of its security calculus because these instruments, more than any other, provide Beijing with the ultimate guarantee that its strategic rivals will not be able to either issue existential threats or constrain its preferences on matters that affect its vital interests.<sup>773</sup> Although the United States remains the principal focus of China's nuclear transformation, these same capabilities also serve to deter Russia if Beijing's currently strong relationship with Moscow were to turn sour in the future. By the same token, Chinese nuclear weapons also serve as effective deterrents against its other regional rivals, including nuclear-armed states such as India and non-nuclear powers such as Japan, Vietnam, Australia, and the Philippines (in part because some of these countries host critical U.S. military bases that are relevant to potential U.S. military operations against China).<sup>774</sup>

India, for its part, also has reason to hold on to its nuclear weapons and expand its inventory further, mainly because it is confronted by two nuclear-armed rivals, China and Pakistan.



Of the three Southern Asian states, nuclear weapons arguably have the weakest utility for India because its robust conventional military forces offer it substantial protection vis-à-vis China and Pakistan. Consequently, India needs nuclear weapons only because its adversaries happen to possess them: they serve solely to deter nuclear threats and nuclear use, challenges that would disappear if its regional rivals did not possess nuclear weapons. Of course, New Delhi may still desire nuclear weapons for prestige, but in an era where nuclear weapons lack the salience they once had, this consideration would diminish in significance. In any event, the key point is that unlike China, which increasingly requires nuclear weapons because it is involved in an acute geopolitical competition with the United States, India has a less compelling need for nuclear weapons for security—requiring these capabilities only because its neighbors have acquired them for more pressing reasons and, in the process, have created new problems including the possibility of collusive threats against India.<sup>775</sup>

Of the three Southern Asian states, Pakistan perhaps represents the best exemplar of a country that desperately holds on to its nuclear weapons because they exemplify the indispensable guarantee of its security. Unlike China and India, which have large landmasses, huge populations, and substantial conventional military capabilities, Islamabad is convinced that its security, today and into the future, cannot be assured either by diplomacy or by conventional military power alone—an understandable inference derived from its painful defeat in the 1971 war with India. Consequently, Pakistan is embarked on a significant expansion and diversification of its nuclear arsenal and is unlikely today to ever give up its nuclear capabilities—even if universal nuclear disarmament otherwise beckoned—because the threats to national survival loom more heavily in Islamabad’s consciousness than they do in Beijing’s or New Delhi’s.<sup>776</sup>

As a result of these different, but intersecting, concerns, China, India, and Pakistan will for the foreseeable future pursue the steady buildup and diversification of their nuclear capabilities. This trend reflects their national judgments that the security threats, including those posed to each by the other(s), only seem to be increasing in intensity. Furthermore, although all three states recognize that the other major nuclear powers, especially the United States and Russia, have reduced the size of their own arsenals in recent years relative to their historic maxima, no Southern Asian state has yet concluded that these reductions obviate the need for an expansion of their own strategic deterrents. This conclusion is most clearly manifested in the case of China, whose choices then shape Indian decisions in some ways, with more complicating derivative effects on Pakistan in turn.<sup>777</sup> All told, nuclear weapons continue to be relevant to the security competition in both the Sino-Indian and the Indo-Pakistani dyads, although with distinctive attributes in each case. This chapter reviews these elements with an eye to understanding their impact on strategic stability—that is, assessing how different developments in the nuclear realm affect the prospects of war and peace as manifested in deterrence, crisis, and arms race stability.

## **NUCLEAR WEAPONS IN THE SINO-INDIAN SECURITY COMPETITION**

The Sino-Indian relationship is rivalrous across multiple dimensions. Even before the two states appeared in their modern incarnation—India as independent in 1947 and China as communist in 1949—their earliest struggles centered on status. India, thanks to its civilizational inheritance (which shaped the trajectory of many Asian nations, including China, through the spread of Buddhism), its extensive military involvement in Asia and beyond (because of the British Indian Army's operations under the Raj), and its precedent-setting decolonization (which signaled the demise of European imperialism), imagined that it would become the most influential power in Asia. China, for its part, scorned India as the subjugated ward of a colonial power and visualized its own reconstitution as a revolutionary state as offering the opportunity to resurrect its ancient centrality in East and Southeast Asia while serving as the fountainhead of revolution globally. The competition between these two ambitions quickly tainted Sino-Indian ties despite their early efforts to preserve amicability.<sup>778</sup>

Geopolitical and territorial problems further compounded these status rivalries. Mao's invasion of Tibet abolished the geopolitical buffer that New Delhi had hoped would survive to its north—another legacy of the Raj that would decay in time to India's disadvantage—and brought in trail acute disputes about territorial boundaries that ultimately led to the 1962 Sino-Indian war, which finally congealed the adversarial perceptions on both sides.<sup>779</sup> This antagonism quickly became enmeshed in the larger rivalries of the Cold War. India sought assistance first from the United States to cope with Chinese aggression at a time when Sino-U.S. relations were themselves hostile. When the latter improved in the early 1970s, India turned to the Soviet Union for assistance, a relationship that survived until the end of the Cold War, after which India reached out once again to the United States for support in managing the dangers posed by a rising China. Given China's greater capabilities relative to India, New Delhi's ties with other great powers came to be viewed by Beijing as more troublesome than India's independent actions toward China. Consequently, India's tacit alignments with the major states quickly become the third dimension of Sino-Indian competition, further exacerbating their other animosities.<sup>780</sup>

India moved quickly after its defeat in the 1962 war to limit China's capacity to endanger its security. Beyond the search for great power assistance, New Delhi invested heavily in modernizing its conventional military capabilities and developed in effect an entirely new land force, currently consisting of some twelve mountain divisions (and being expanded to include a mountain strike corps), to defend its Himalayan frontiers. Simultaneously, India modernized its airpower, improving both the quality of its combat aircraft and its air base infrastructure, to provide air defense and support its land forces in the event of any future conflict with China. In response to China's first nuclear test in 1964, India also initiated research aimed at investigating the development of nuclear weapons, an effort that finally

produced India's first nuclear test explosion a decade later but did not yield an operational device until the early 1990s.

These efforts underscored the intensity with which India perceived China as its most serious threat, even though the challenges involving Pakistan otherwise dominated its attention. The dangers posed by the latter, however, were judged to be more manageable because India's greater size and national resources provided it with a significant measure of protection, advantages that did not carry over to its rivalry with China. The high visibility surrounding India's balancing effort against China since 1962, consequently, gave rise to the widespread belief in the West that New Delhi is locked into a "one-sided rivalry" with Beijing because "China does not regard India as a serious rival."<sup>781</sup>

Nothing could be further from the truth. China admittedly faces bigger threats than India: the United States and Japan are the most prominent today, and Russia has been a major threat historically. China's strategic attention is thus dominated by the dangers emerging from its east, but the lower priority accorded to neutralizing India in the southwest "does not equate to neglect" by any means.<sup>782</sup> China, undoubtedly, has cultivated "a feigned indifference toward India, coupled with the consistent denial that New Delhi remains a potential rival."<sup>783</sup> This public posture, however, has been driven by the shrewd calculation that acknowledging India as an adversary would elevate it in importance undeservedly and thereby undermine China's efforts to position itself as the preeminent power in Asia.

Even as China has continually fostered the impression of ignoring India, its internal judgments have been quite different: as Gary Klintworth accurately summarized some three decades ago, "China perceives India to be an ambitious, overconfident yet militarily powerful neighbor with whom it may eventually have to have a day of reckoning."<sup>784</sup> Not surprisingly then, China's actions over the past sixty-odd years indicate that it has moved decisively—even if only subtly—to contain India in highly effective ways. Even more to the point, John Garver has argued, "China's moves to counter India over the last decades have been essentially successful, while Indian efforts to counter China have essentially failed."<sup>785</sup> These Chinese moves include bolstering Pakistan's power in order to "marginalise India in Asia and tie it down to the Indian sub-continent."<sup>786</sup> As part of this strategy, Beijing provided Islamabad with the "ultimate gift" of nuclear weapons<sup>787</sup>—a bequest that ensures New Delhi will always have to worry about its west even as it seeks to play a larger role in the wider Asian theater. Simultaneously, China developed preferential ties with the smaller states of Southern Asia itself, thus attempting to weaken India's hegemony within its own immediate neighborhood. Finally, over the last two decades, Beijing's conventional military weaknesses along its southwestern frontiers have been progressively corrected to slowly erode the advantages that New Delhi procured as a result of its post-1962 military modernization.

Because China has enjoyed a significant and growing edge in relative power over India since about 1990, it has been able "to do much with little"<sup>788</sup>—in other words, to constrain India

effectively without either inordinate exertions or seeming hell-bent on doing so.<sup>789</sup> That this approach has been successful is corroborated by the fact that many Western analysts claimed for the longest time that China was indifferent to India, clearly an odd contention for a country that has gone to great lengths to surreptitiously transfer nuclear weapons designs, technology, and materials to India's adversary Pakistan. Equally striking is that China began to target India with nuclear weapons soon after New Delhi conducted its first nuclear test in 1974. That this development materialized long before India had acquired a nuclear arsenal of its own refutes the notion that Beijing has nothing but patent disregard for India. The characteristics of the long-range missiles then in Beijing's inventory revealed its significant targeting of India, something academic observers of China's nuclear forces were able to slowly corroborate by the late 1990s.<sup>790</sup> This Chinese nuclear targeting of India has only expanded over time and will continue unabated as Beijing's nuclear inventory increases in size and diversity in the years ahead.

Until the Agni-II MRBM entered the Indian inventory around 2010, India remained highly vulnerable to Chinese nuclear weapons. New Delhi's air-delivered nuclear bombs still cannot reach the most important Chinese targets in the eastern half of the country. Consequently, India's development of long-range nuclear-tipped missiles since 1998 seeks to replace its previous abject vulnerability to China's nuclear forces with some semblance of mutual vulnerability—no matter how asymmetrical that might be.<sup>791</sup> In the years ahead, the Indian land-based missile deterrent force will incorporate larger number of Agni-IV and Agni-V IRBMs, with the latter likely to be based in secure locations in central and southern India. These investments could create weak arms race instability as India acquires the wherewithal to deter China, even as China directs most of its nuclear modernization primarily at the United States (while implicitly and automatically covering Russia as well). Beijing could respond by further increasing the number of nuclear weapons targeting India, in part because it will have the capacity to do so without compromising its other deterrence objectives. In any event, thanks to the expansion of China's nuclear capabilities driven by fears about the United States, India will come to subsist as a "lesser included case" of successful deterrence arising from Beijing's investments in neutralizing even bigger threats.

Just to be sure, however, China will also expand its strategic defense capabilities vis-à-vis India, but both states are likely to avoid a tightly interactive arms race with each other because China already possesses the capacity to inflict enormous damage on India while the latter is still trying to play catch-up.<sup>792</sup> India undoubtedly has to make critical decisions about its future force size, given the now increasingly visible Chinese nuclear expansion.<sup>793</sup> But the evidence thus far does not suggest any rush to expand the size of the Indian arsenal and this trend, too, is wholly consistent with the conviction of Indian policymakers that the nuclear balance of capabilities is unlikely to make the difference that theorists often suppose it does in a crisis.<sup>794</sup> Because both Chinese and Indian nuclear forces are primarily focused on countervalue targeting presently, the pressures on bilateral arms race stability are further dampened. And because Pakistan's nuclear forces targeting India also share a similar orien-

tation in the main, New Delhi has managed the challenges posed by the two asymmetrically capable nuclear rivals without heightened arms race instability.<sup>795</sup>

What offers hope in turn for deterrence stability—that is, preventing the use of nuclear weapons by one against the other—is the relatively low likelihood of nuclear crises between China and India. Despite the different kinds of nuclear expansion currently occurring in each country, neither state treats bolt-out-of-the-blue nuclear attacks as a realistic contingency that they must plan for vis-à-vis each other. Any nuclear crises, to the degree that these are plausible, would arise only in the context of a major conventional war along their disputed borders. The most dangerous contingency in this context would be a deliberate Indian effort to conquer Tibet or undermine Chinese control over the region. Such possibilities would threaten China's core interests—as Indian military leaders have long realized<sup>796</sup>—but there is no evidence that New Delhi has the intention either to pursue such goals or to acquire the capabilities toward these ends.

In all other circumstances, the incentive to employ nuclear weapons, either through threats or actual use, is extremely low for different reasons on each side. For starters, the disagreement over the boundaries implicates relatively marginal territories for China. For India, the stakes are higher, especially in the eastern sector—in Arunachal Pradesh—because the region is vast, it enjoys an active Indian administrative presence, and it hosts significant populations near the contested border. These conditions, however, do not obtain in the western sector—in Ladakh—and although India will continue to affirm its claims here all the way to the 1865–1897 Ardagh-Johnson Line, it has for all practical purposes reconciled itself to the loss of the territories that China has controlled in Aksai Chin since 1962. The remaining disputes consequently are over tiny pockets of territory in the western and central sectors of the border, which both sides claim, and which could provoke military confrontations of the kind that occurred in May 2020.

While it is highly unlikely that India will employ unprovoked military force to reclaim any Chinese-occupied territory, China could well attempt to seize Indian enclaves that it believes to be its own. Precisely to ward off this possibility, India has made vast military investments now for close to sixty years. As a RAND Corporation report concluded at the turn of the century:

it is often inadequately recognized that, as far as basic security is concerned, India is actually relatively well-off vis-à-vis China. The Himalayan mountain ranges that divide the two countries, for example, provide a natural defensive shield against any easy Chinese aggression, and these benefits of nature have only been reinforced by Indian artifice since the disastrous border war of 1962. Today, India's conventional forces enjoy a comfortable superiority over their Chinese counterparts in the Himalayan theater; the Indian Army has superior firepower, better-trained soldiers, carefully prepared defenses, and more reliable logistics. Similarly, the Indian Air

Force has better aircraft, superior pilots, and excellent infrastructure and would most likely gain tactical superiority over the battlefield within a matter of days if not hours in the event of renewed Sino-Indian hostilities. And, while the Indian Navy is not directly relevant to any Himalayan border conflict, the fact remains that it is superior to the Chinese Navy in technology, training, and war-fighting proficiency and would have little difficulty enforcing effective surface and subsurface barrier control should any Chinese naval units seek to break out into and operate within the Andaman Sea. Only in the realm of nuclear capabilities does China currently have an overwhelming, uncontested superiority over India.<sup>797</sup>

Although India's conventional military advantages have eroded since this analysis was published, the broad conclusion that India can effectively dissuade China at the operational level of war in the relevant theaters in and around Southern Asia arguably holds at least for now. For all the changes that have taken place in the land, air, and naval arenas in recent times—to include new Chinese investments in firepower, air defense, and precision missile strikes—India can still thwart Chinese aggression in the most likely scenarios imaginable. And if New Delhi successfully completes the military modernization program that the Indian Army and Air Force currently envisage, India will be able to hold off even major Chinese encroachments robustly during this decade and well into the next.<sup>798</sup> After the bilateral crises since May 2020, the Chinese civilian and military leaderships also cannot presume that India will be intimidated in ways that prevent it from confronting Beijing's aggression militarily.

These judgments have two important implications for nuclear stability. First, despite being the nominally weaker power, India does not need to use nuclear weapons to neutralize any Chinese conventional attacks along its frontiers. Second, despite being the nominally stronger power, China, for its part, is highly unlikely to either issue nuclear threats or actually employ nuclear weapons in order to secure control over what are essentially peripheral territories in the most plausible scenarios pertaining to deterrence breakdown.<sup>799</sup> On this count, the asymmetries of interests, capabilities, and resolve all favor India in principle: China is unlikely to seek to recover its claimed territories through the use of nuclear weapons where India has greater equities such as in its northeast; China is unlikely to use nuclear weapons to defeat India's conventional forces in situations where they enjoy operational advantage; and China is unlikely to threaten the use of, or to actually use, nuclear weapons to recover territories currently under Indian control in the face of New Delhi's determination to protect them.<sup>800</sup> Obviously, where these conclusions are concerned, contingencies involving the comprehensive struggle over Tibet are ruled out ex hypothesi. Furthermore, since unlimited-aims wars between China and India are incon-

***For all the changes that have taken place in the land, air, and naval arenas in recent times, India can still thwart Chinese aggression in the most likely scenarios imaginable.***

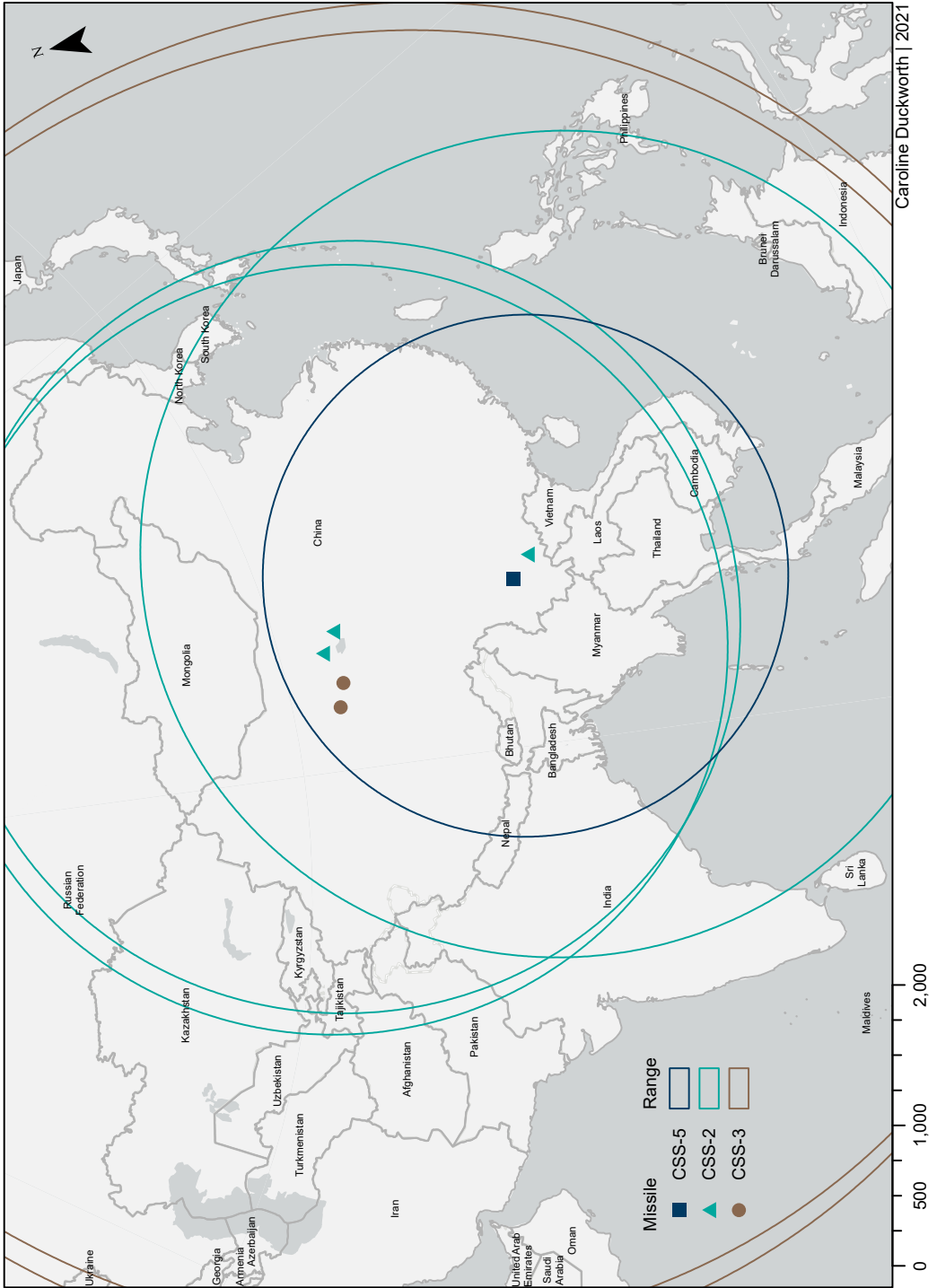
ceivable and no outcomes in any Sino-Indian limited-aims wars pose existential threats to national survival in either country, the temptation to seek nuclear solutions to conventional military problems is low to nonexistent where China and India are concerned. The no-first-use nuclear doctrines articulated by both states are, therefore, entirely consistent with the fundamental political-military realities that define their security competition.

Even if India were to find itself facing serious conventional reverses in a limited-aims Sino-Indian conflict, it would be better off developing non-nuclear operational solutions or alternative political strategies to neutralize any Chinese advantages. New Delhi understands this logic completely. Hence, it has rejected entirely Bharat Karnad's recommendation, for example, that India employ tactical nuclear weapons against China because it is not in New Delhi's interest to cross the nuclear firebreak first—no matter what the battlefield challenges may be—and thereby provide Beijing with the opportunity to unleash more lethal nuclear retaliation that could ultimately escalate to countervalue exchanges.<sup>801</sup> For some time to come, China's nuclear forces will remain optimized largely for attacks on soft targets. Beijing's larger and more reliable nuclear warheads, in comparison to India's, ensure that although any nuclear deterrence breakdown would be extremely costly for both sides, it would be inordinately more so for India.

At the time of the 1998 tests, and for the two decades preceding them, China deployed CSS-2 IRBMs with yields of close to 3 megatons, CSS-5 MRBMs with yields of somewhere around 500 kilotons, and even CSS-3 ICBMs with yields of close to 3 megatons targeted against India.<sup>802</sup> Neither the PLAAF nor the single Chinese SSBN likely had any nuclear responsibilities against India at the time. The Chinese missiles allocated to Indian targets were controlled primarily by 53 and 56 Bases, headquartered at Kunming in Yunnan Province and Xining in Qinghai Province, respectively, though it is possible that 52 Base headquartered at Huangshan (Tunxi) in Anhui Province and 55 Base headquartered at Huaihua in Hunan Province could have had secondary targeting responsibilities for India as well.<sup>803</sup> China's nuclear targeting of India around the time of the 1998 tests is illustrated in Map 1.

The modernization of the PLA Rocket Force and the reorganization that has occurred since the 2016 reforms are unlikely to have changed the basic responsibilities of the 53 and 56 Bases for targeting India. The base numbering system and their military unit cover designators, however, have changed as have their missile inventories. 53 Base, still headquartered at Kunming, is now 62 Base; 56 Base, now headquartered at Lanzhou, is 64 Base. The former consists of seven missile brigades, with at least four having a nuclear mission. The latter consists of at least seven missile brigades, with some six likely having nuclear responsibilities (Figure 2). Between these two bases, Indian targets are covered by a mix of nuclear CSS-5 MRBMs, CSS-18 IRBMs, and CSS-10 ICBMs. (Although the CSS-20 ICBM is also deployed by some brigades subordinate to 64 Base, these brigades historically were not known to be responsible for targeting India and, hence, may be discounted.) It is possible that some CSS-3 ICBMs, the remnants of China's early long-range strike capabilities, which

# CHINESE MISSILE TARGETING VIS-À-VIS INDIA, 2000





are now deployed solely at 66 Base (formerly 54 Base) headquartered at Luoyang in Henan Province, may have some residual targeting responsibilities for India, with the current 662 Brigade substituting for the older formations that previously deployed these missiles with 56 Base at Delingha or with 55 Base at Tongdao.<sup>804</sup> The coverage offered by China's current deployments of CSS-5 MRBMs, CSS-18 IRBMs, and CSS-10 ICBMs (Map 2) suggests that the CSS-3 ICBM may no longer be necessary for ranging India comprehensively as the newer weapons collectively are more than adequate substitutes including for the CSS-2 IRBMs that have now been retired. Any Chinese targeting of India through the allocation of its aircraft delivery systems and its new Jin-class SSBNs is thus entirely redundant.

All the Chinese missiles allocated against India, with the likely exception of the CSS-18 IRBM, are primarily intended for attacks on large, soft targets, consistent with Beijing's doctrinal emphasis on retaliatory strikes in the event of a nuclear attack on China. When employed in hypothetical attacks with thermonuclear warheads of three different but representative yields (150 kilotons, 500 kilotons, and 3 megatons) against the ten most-populous cities in India, the casualties that would be inflicted by such strikes—even assuming merely one Chinese weapon on one Indian target—are horrendous. These fatality figures cannot be matched by comparable Indian attacks on Chinese cities with the yields that Indian weapons are presumed to possess: the more-or-less reliable 12-kiloton fission warhead, the claimed 30-kiloton boosted-fission weapon, and the 200-kiloton thermonuclear device. Table 2 enumerates the fatalities that would be suffered by both sides if various Chinese and Indian warheads are employed on the ten most-populous cities in each country (as listed in Table 1).

TABLE 1

India	Population (2011 Census)	China	Population (2010 Census)
Mumbai	12,478,447	Shanghai	20,217,748
Delhi	11,007,835	Beijing	16,704,306
Bangalore	8,425,970	Guangzhou	10,641,408
Hyderabad	6,809,970	Shenzhen	10,358,381
Ahmedabad	5,570,585	Tianjin	9,583,277
Chennai	4,681,087	Chengdu	7,701,692
Kolkata	4,486,679	Wuhan	7,541,527
Surat	4,462,002	Dongguan	7,271,322
Pune	3,115,431	Foshan	6,771,895
Jaipur	3,073,350	Chongqing	6,263,790

Source: "Cities Having Population 1 Lakh and Above, Census 2011," Office of the Registrar General & Census Commissioner, October 27, 2011, [http://censusindia.gov.in/2011-prov-results/paper2/data\\_files/India2/Table\\_2\\_PR\\_Cities\\_1Lakh\\_and\\_Above.pdf](http://censusindia.gov.in/2011-prov-results/paper2/data_files/India2/Table_2_PR_Cities_1Lakh_and_Above.pdf); Thomas Brinkoff, "China: Provinces and Major Cities," City Population, November 14, 2020, <https://www.citypopulation.de/en/china/cities/>.

# CHINESE MISSILE COVERAGE VIEWED FROM INDIA, 2021

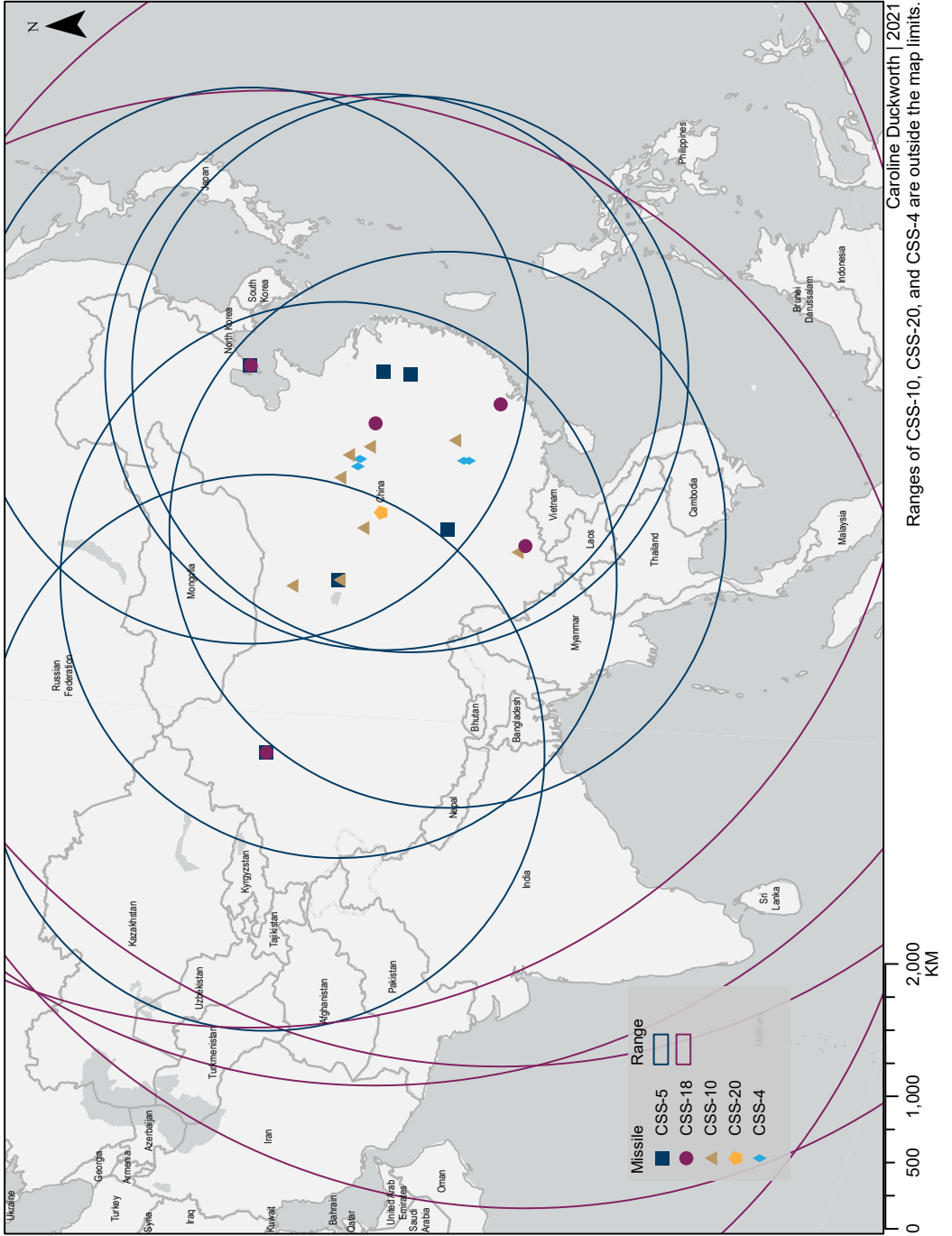


TABLE 2

**CHINESE STRIKE**

<b>Weapon Yield</b>	<b>Lethal Blast Area (km<sup>2</sup>)</b>	<b>Maximum Fatalities per Blast</b>	<b>Total Fatalities from a Ten-Weapon Strike</b>
150 kilotons	35.2	704,000	7.04 million
500 kilotons	78.5	1,570,000	15.7 million
3 megatons	259	5,180,000	45.7 million*

**INDIAN REPRISAL**

<b>Weapon Yield</b>	<b>Lethal Blast Area (km<sup>2</sup>)</b>	<b>Maximum Fatalities per Blast</b>	<b>Total Fatalities from a Ten-Weapon Strike</b>
12 kilotons	6.53	130,600	1.3 million
30 kilotons	12	240,000	2.4 million
200 kilotons	42.6	852,000	8.52 million

\*Note: The possible maximum fatalities from a 3-megaton blast exceeds the total population of five of the cities assumed to be targeted (Chennai, Kolkata, Surat, Pune, and Jaipur). In these cases, the total fatalities were calculated based on the total population of each city.

The illustrations above yield a series of important conclusions pertaining to deterrence stability in the Sino-Indian dyad. First, China has the capacity to inflict appalling pain on India by employing even a small number of nuclear missiles from its larger and growing inventory. If it is assumed that China will have some 250 long-range nuclear missiles in its arsenal soon, it could target India extensively with 10 percent or less of its strategic missile portfolio, leaving the remainder for holding other Chinese regional adversaries and the United States at risk. India cannot levy equivalent fatalities on China with a comparable number of weapons because its long-range missile inventory is still very small and its nuclear warhead yields are much smaller than China's in comparison.

As Table 3 indicates, the number of Indian weapons required to inflict equivalent fatalities on China, using just its five most-populous cities for comparison, is much, much higher. This constraint derives largely from the political failures of the BJP leadership and the dereliction of Indian nuclear scientists during the 1998 tests. By obscuring the failures of their thermonuclear device design, they ended up spurring the Vajpayee government's decision to end nuclear testing prematurely before the performance of India's highest-yield warhead—which even at its maximum delivers just about 20 percent of the explosive power of China's largest weapons—could be credibly demonstrated.<sup>805</sup> As a result of this current asymmetry in Chinese and Indian nuclear capabilities, New Delhi will be extraordinarily careful to

TABLE 3

**INDIAN EQUIVALENT REPRISAL**

Weapon Yield	Indian Weapons Necessary to Match a Ten-Weapon Chinese Strike Resulting In...		
	7.04 million fatalities	15.7 million fatalities	45.7 million fatalities
12 kilotons	54	120	350
30 kilotons	29	65	190
200 kilotons	8	18	54

Note: The number of fatalities for each ten-weapon Chinese strike are taken from the “Total Fatalities From a Ten-Weapon Strike” column of Table 2 based on fatalities calculations for varying yields of Chinese weapons. The number of Indian weapons necessary to match a given number of fatalities is calculated by dividing the total desired fatalities by the maximum fatalities per blast of a given Indian warhead yield.

avoid confrontations with China that could precipitate any nuclear use. Consequently, the prospect of *Indian* nuclear first use, even if only with tactical weapons, is entirely fanciful.

Second, India will seek to increase the levels of pain that can be equivalently inflicted on China through nuclear retaliation if that be required. The quickest path to this end would be New Delhi’s return to nuclear testing, which would provide it with the opportunity to validate its higher-yield device designs and convey more credible threats. But this would also be the most provocative course of action internationally and, hence, will be eschewed unless India is confronted by a supreme emergency or is provided with the opportunity because of resumed nuclear testing by other established nuclear powers. In the meanwhile, India is likely to settle for more conservative solutions to correcting the current asymmetries between itself and China: improving its thermonuclear designs through nuclear simulations and computational tools; possibly deploying multiple warheads aboard its missiles in order to economize on the number of airframes required while still enabling “cookie-cutter” targeting of important Chinese cities (although no current Indian missiles carry MRVs or MIRVs); or, more likely, simply increasing its number of nuclear-tipped missiles in order to permit multiple concurrent strikes on major Chinese cities with smaller-yield warheads in an effort to increase the casualties inflicted on China.

Third, although India’s limitations with respect to Chinese population targeting are pronounced, the critical question is whether the significantly lower fatalities that can be potentially inflicted by New Delhi essentially undermines nuclear deterrence stability in the Sino-Indian dyad. Pessimists have argued that India’s inability to inflict high losses on China undermines New Delhi’s capacity to deter Beijing in any serious confrontation because the latter will always have escalation dominance as long as the current nuclear balance persists.<sup>806</sup> After all, the illustrative losses that China could suffer as a result of Indian nuclear attacks, depicted in Table 2, do fall short of the immense suffering that has marked other painful moments in Chinese history.<sup>807</sup> By the canons of rational deterrence theory, there-

fore, India's capacity to ward off Chinese pressures is thus weak and arguably doomed to fail because New Delhi can at best inflict picayune punishment on China in contrast to China's ability to inflict massive retribution on India.

Whether this conclusion holds in reality as opposed to theory cannot be known because—in the absence of war—the requirements for successful deterrence will forever be a matter of debate. Indian policymakers, however, approach this issue from the perspective of politics in the real world rather than abstruse theorizing. Consequently, they believe that even India's small nuclear warheads would suffice to effectively deter China because the absolute losses suffered by Beijing would be intolerable today in the light of China's material achievements. The high value of these assets would only make China more risk-averse and lower its tolerance to accept damage given the relatively low stakes at issue in the most likely military scenarios predicated by Sino-Indian competition.<sup>808</sup> This conviction is only strengthened by Indian policymakers' belief that China cannot be certain India's high-yield weapons will not work as claimed and hence may in fact risk even greater damage than Beijing might assume if it operated on the presumption that all it had to fear are India's small nuclear warheads. In any event, the sheer uncertainty that accompanies any nuclear use—both in its immediate consequences and in its longer-term effects on larger geopolitics—are judged by New Delhi to be sufficiently persuasive in deterring any Chinese nuclear use against India even if the latter possesses only more modest nuclear capabilities. Consequently, the former Indian national security advisor Shivshankar Menon concluded, "India-China nuclear deterrence is stable and will likely remain so despite shifts leading to equilibrium at higher technological levels as both programs develop increasing sophistication."<sup>809</sup>

Since nuclear deterrence stability between China and India is thus relatively high for multiple virtuously interacting reasons—deriving more from the politics of the Sino-Indian competition than the technical characteristics of the two intersecting deterrents—nuclear crisis stability should also be reasonably robust almost automatically. If crisis stability pertains to the incentives for one state to use its nuclear weapons first because of fears that these assets could be neutralized by a preemptive attack unleashed by the other, then the Sino-Indian dyad is very much immune to these pressures if both sides have no incentives to employ their nuclear reserves to begin with. Even if in some remote hypothetical circumstances nuclear deterrence stability was perceived to be fragile, crisis instability would not inevitably ensue because China and India's nuclear weapons are survivable enough to preclude both precipitate nuclear use and damage-limiting nuclear attacks.

This is certainly true where Indian first strikes against China are concerned. Chinese nuclear forces are far more numerous, and Beijing has plenty of sufficiently opaque and hardened storage sites to make any Indian damage-limiting attacks inconceivable given its small-yield weapons and its fewer and relatively inaccurate delivery systems. Even though China's nuclear forces are superior to India's by multiple measures, New Delhi's nuclear reserves are arguably secure and hence it would not be confronted by the threat of speedy "use-it-or

lose-it” nuclear employment in current political circumstances. China’s high-yield nuclear weapons aboard its long-range missiles can readily hold at risk India’s nuclear production infrastructure, its air and naval bases that host nuclear delivery platforms in peacetime, and its identifiable aboveground command centers and strategic communications facilities. But the core of India’s retaliatory capacities—its land-based missile systems and its nuclear weapons—are still presumably immune to Chinese nuclear attacks if they are sequestered in underground facilities at unknown locations. The expectation that India will also deploy its SSBNs on deterrent patrols over time strengthens this conclusion.

The uncertainty about the location of its land-based nuclear weapons provides India with a high degree of protection in the first instance.<sup>810</sup> It must be expected, however, that China will seek to identify these facilities over time using a variety of space-based reconnaissance assets, traditional espionage, and possibly data exfiltration cyber attacks. Even if the locations of some facilities are discovered, however, China can never be certain that it has uncovered all of India’s secure storage sites, thus leaving it vulnerable to future retaliation from undiscovered facilities even if all the detected sites could be successfully attacked. A further constraint on such missions would be the number of Chinese nuclear weapons necessary for success, since a larger quantity might be necessary than is currently reserved for counter-value attacks on India. Although China could allocate many more nuclear weapons for such damage-limiting strikes—especially as its own nuclear arsenal continues to expand—there is no assurance that its attacks on buried Indian facilities would be always successful or, in other words, that it could completely immunize itself against even ragged Indian retaliation.

Underground targets in general are hard to interdict with air- and surface-burst nuclear weapons. Such strikes usually end up destroying the entrances to the storage sites, ventilation intakes, and external utility connections but not the functional substructure itself. For this reason, the United States developed earth-penetrating nuclear delivery systems to interdict the storage chambers where nuclear weapons may be sequestered by various adversaries. China, in contrast, is not known to possess any earth-penetrating nuclear weapons today.<sup>811</sup>

The roughly 500-kiloton warheads carried by the CSS-5 and CSS-10 could destroy India’s aboveground storage sites if identified, but China may require two or more warheads per bunker depending on its real hardness. The hardness of aboveground bunkers has been assigned a vulnerability number (VN) of 40P8 by one analysis.<sup>812</sup> This notation, based on the U.S. Defense Intelligence Agency’s Physical Vulnerability System, describes a target’s hardness in order to capture its susceptibility to damage: the number 40 represents the assessed hardness of the bunker, the letter P implies that the damage mechanism is overpressure, and the number 8 refers to yield dependency or the target’s sensitivity to the blast pressure and its duration.<sup>813</sup> Every target in principle has a unique VN based on its physical characteristics. Assigning the VN for specific targets is fundamentally an intelligence task because it requires information about the characteristics of the facility and, if necessary, its local environment or, if buried, its surrounding geology. Since the hardness of India’s aboveground

bunkers is unknown, however, the following analysis is intended mainly as a heuristic designed to illustrate the nature of the challenges facing China and India.

If it is assumed that all Indian aboveground bunkers are relatively hard—which is what the 40P8 notion implies—then a 150-kiloton Chinese warhead would have a weapon radius of 290 meters; a 500-kiloton warhead would have a weapon radius of 480 meters; and a 3-megaton warhead would have a weapon radius of 960 meters. In simple terms, the weapon radius is the distance from ground zero where, given a uniform distribution of like targets, a target inside has a roughly 50 percent probability of receiving at least the specified degree of damage—with the exact probability of damage depending on the sigma value which accounts for the shot-to-shot variations in nuclear effects and the random uncertainties characterizing a target’s hardness within a given category. Because some targets inside the weapon radius will escape damage while others outside it will not, successful nuclear targeting must account for the problems of response variability.

In the calculations that follow, the single-shot kill probability (SSKP) estimates take into account the uncertainties associated with both the nuclear weapon’s damage function—which depends on the type of target and its damage criteria (as represented by the VN number) as well as the weapon’s yield and its height of burst—and the delivery system’s accuracy as represented by its CEP, which is the radius of a circle within which half of the attacking weapons are expected to fall.

Table 4 summarizes the single-shot kill probability (SSKP) facing any given Indian storage bunker for three varying Chinese weapon yields if the CEP of the attacking Chinese missile is 700 meters—a generous assumption for long-range systems such as the CSS-5 and CSS-10, which could be used to target India.

TABLE 4  
**SINGLE-SHOT KILL PROBABILITY AGAINST AN INDIAN 40P8 TARGET WITH 700-METER-CEP CHINESE MISSILES**

<b>Weapon Yield</b>	<b>SSPK</b>
150 kilotons	11%
500 kilotons	27%
3 megatons	69%

The results summarized in Table 4 should be broadly reassuring for New Delhi. They suggest that multiple Chinese missiles would be required to destroy a single Indian aboveground nuclear weapons storage bunker if the attacking warheads have yields of 150–500 kilotons, the kind likely to be found on the CSS-5 and CSS-10s.<sup>814</sup> (The expenditure

ratio improves when China's warhead yields get into the megaton range. Only the Chinese CSS-3s and CSS-4s have megaton-range warheads today and these missiles, being few in number, are unlikely to be used for counterforce operations against India and hence can be ignored.) The generally unfavorable expenditure ratio facing China in all attacks utilizing CSS-5 and CSS-10 systems thus implies that even India's aboveground facilities are unlikely to be interdicted by such long-range missilery, assuming that the Indian bunkers are both genuinely hard 40P8 class targets and have all been detected.

TABLE 5  
**SINGLE-SHOT KILL PROBABILITY AGAINST AN INDIAN 40P8 TARGET WITH 50-METER-CEP CHINESE MISSILES**

Weapon Yield	SSPK
150 kilotons	100%
500 kilotons	100%
3 megatons	100%

This conclusion changes dramatically, however, if China employs more accurate missiles such as the CSS-18. The threat posed by Beijing to India's aboveground storage facilities is overwhelming when the CSS-18 is assigned an accuracy of some 50 meters (as illustrated in Table 5). At such accuracies, the variation in warhead yield is irrelevant, as each aboveground site falls well within the weapon radius of even a 150-kiloton warhead. In fact, even if the CSS-18 carried a much smaller warhead, say 12 kilotons, it would still enjoy a SSPK of 85 percent against a hard Indian overground 40P8-class bunker. Because the CSS-18 missile is atypically accurate for a Chinese nuclear-tipped ballistic missile, the issue of stability will be shaped largely by the number of identified Indian aboveground bunkers versus the number of Chinese nuclear CSS-18s available. Since neither piece of information is reliably obtainable, no firm conclusions can be drawn except to suggest that deterrence and crisis stability may yet obtain because China may either not have the number of accurate nuclear-tipped missiles relative to the number of Indian storage bunkers or it may choose not to allocate such missiles to destroying all of India's aboveground bunkers—assuming that they can all be detected and their nuclear role conclusively ascertained—when it is possible that New Delhi will still have additional undetected underground nuclear storage facilities.

Because India would prefer not to rely on China's reluctance on this count, its ongoing investments in assuring the physical survivability of its land-based deterrent are certain to be directed a fortiori in expanding its underground facilities *while preserving their opacity*. As subsequent examples suggest, the survivability of India's underground hides will depend variably



on depth *and* locational uncertainty, given various assumptions about the CEP of attacking Chinese missiles, the yield of their warheads, and the depth of burial of the Indian facilities.

TABLE 6

**SINGLE-SHOT KILL PROBABILITY AGAINST INDIAN 40P8 TARGETS AT VARYING DEPTHS WITH 700-METER-CEP CHINESE MISSILES**

Weapon Yield	Burial Depth of 25 Meters	Burial Depth of 100 Meters
	SSPK	SSPK
150 kilotons	9%	5%
500 kilotons	25%	18%
3 megatons	67%	61%

Once again, assuming that the Indian underground storage site is at least as hard as a 40P8 target, destroying any facility that is buried at a depth of 25 meters proves to be quite expensive if the attacking Chinese missile has a 700-meter accuracy. A CSS-5 or CSS-10 missile with such a 700-meter CEP and carrying a 150-kiloton warhead would have only a 9 percent chance of destroying its target and even a 500-kiloton detonation enjoys only 25 percent SSPK. An Indian underground site that is buried at a depth of 100 meters has even greater immunity as Table 6 indicates. A 150-kiloton warhead has only a 5 percent SSPK, and even a relatively large 500-kiloton warhead enjoys only a roughly proportionate—though still small—increase in lethality to yield.<sup>815</sup>

TABLE 7

**SINGLE-SHOT KILL PROBABILITY AGAINST INDIAN 40P8 TARGETS AT VARYING DEPTHS WITH 50-METER-CEP CHINESE MISSILES**

Weapon Yield	Burial Depth of 25 Meters	Burial Depth of 100 Meters
	SSPK	SSPK
150 kilotons	100%	99%
500 kilotons	100%	100%
3 megatons	100%	100%

Improving the accuracy of the delivery systems employed by China, however, changes the story completely. A Chinese CSS-18 with a 50-meter accuracy can destroy its Indian targets

irrespective of whether they are buried at a depth of 25 or 100 meters, and this outcome does *not* depend meaningfully on the yield of the attacking Chinese missile. This finding has important consequences for India insofar as it implies that the survivability of New Delhi's underground hides does not depend so much on their depth of burial—at least down to 100 meters (which is quite deep anyway)—but rather on denying China information about their location. In the face of the highly accurate nuclear missiles now present in the Chinese inventory, albeit in small numbers, India can best protect its underground storage sites principally by ensuring that China never discover where they actually are.

This will require concerted efforts to camouflage all activities, especially during the construction of these facilities when the possibility of detection is relatively high.

Assuming that detection during the construction phase has been eluded, extensive deception and denial investments to defeat Chinese intelligence collection activities will still be required. This entails not simply obscuring the physical character of the storage site and its supporting facilities—especially power, communications, and transportation—but also the conduct

of military operations conducted from and around the facility. If Table 7 indicates nothing else, it suggests that eluding detection remains the best way to avoid any Chinese damage-limiting attacks that could compromise the survivability of India's land-based missile deterrent. While denying China targeting information through opacity may impose some delays on India's capacity to retaliate in the aftermath of any attack, these lags would be worth the price if they had the effect of persuading Beijing that its first strikes would only postpone the Indian riposte but not conclusively eliminate it.

***In the face of the highly accurate nuclear missiles now present in the Chinese inventory, India can best protect its underground storage sites principally by ensuring that China never discover where they actually are.***

Admittedly, all the calculations above are impressionistic because the hardness of Indian storage sites as well as their location (including the burial depth of the underground facilities) are not known to outsiders. These calculations may also not be precise because information about the direct vulnerability of underground targets is unavailable. Consequently, the results above use the vulnerability of aboveground 40P8 targets as a proxy for underground targets, subtracting the target's depth from the weapon radius, as informed by the discussion found in the National Research Council's *Effects of Nuclear Earth-Penetrator and Other Weapons*.<sup>816</sup> It is, therefore, possible that other calculations—which incorporate better data about the vulnerability of specific Indian underground targets and better analytical techniques to measure the ground shock effects more accurately—might come to somewhat different conclusions. Even these, however, are unlikely to produce radically dissimilar results. Although the conclusions above are tentative, it is likely that the absence of accurate physical vulnerability data about various Indian storage sites more or less reflects the

situation that would confront any Chinese military planner. If the upshot, accordingly, is greater uncertainty about the effectiveness of any damage-limiting Chinese nuclear strikes on India's strategic reserves, the benefits for deterrence and crisis stability would only be further magnified.

In any case, given the risks, it should be expected that India will continue to invest in strengthening deterrence by preserving the locational opacity of its storage sites, hardening them through ever-deeper burial, and obscuring them through deception and denial measures—all intended to reduce any Chinese temptations to launch a splendid first strike in a serious crisis. Thus far, India's investments in protecting its nuclear assets have been driven mainly by the threat from Pakistan—which is much less significant—but it is certain that New Delhi will increasingly factor in China as it expands its storage infrastructure for prudential reasons, even though Beijing's incentives to use nuclear weapons against India are ordinarily low to begin with. India also has the option of pursuing other solutions: it could disperse at least some of its mobile missile systems at the onset of any crisis with China in order to mitigate the possible vulnerability of its storage sites. But the imperatives for early mobilization are also weaker where China is concerned because the Sino-Indian rivalry is not expected to become so acute as to warrant the employment of nuclear weapons—precisely the reason why deterrence stability is judged to be robust in the first place.

Consistent with this expectation, India did not alert its nuclear forces or flush its mobile missiles even during the most intense moments of the 2020 Sino-Indian border skirmish because it did not want to impose any nuclear overtones on a confrontation that might have provoked a more dangerous Chinese response. Far from attempting nuclear signaling, the flushing of the *Arihant* SSBN merely represented the Strategic Forces Command's standard operating procedure, which invariably entails dispersing the fleet from its home ports at the earliest opportunity during any crisis.<sup>817</sup> India, obviously, could have dispersed its land and air nuclear systems as the confrontation evolved, but it chose not to do so during this (still ongoing) standoff. As one Indian scholar noted, “The Ladakh crisis is widely perceived to have woken India up to the reality of an aggressive China that is no longer hesitant to showcase its strength. And yet, nuclear weapons have not fetched a mention.”<sup>818</sup> For the record, it is also worth noting that China, too, did not engage in any nuclear activities directed at India during this crisis—though, given both Beijing's nuclear doctrine and its advantages in relative power, such quiescence was only to be expected.<sup>819</sup>

In any event, New Delhi clearly understands that the long-term solution to mitigating its potential vulnerability to Chinese damage-limiting strikes—and thereby strengthening crisis stability even further—is to complete the acquisition of its nuclear ballistic missile submarine force. When this six-submarine flotilla is finally equipped with the 3,500-kilometer-ranged K-4 SLBM, and the even longer-ranged follow-on systems that are planned, India will have a relatively invulnerable second-strike capability deployed in safe bastions in the Bay of Bengal that can target China effortlessly. The significant weaknesses of Chinese

undersea anti-submarine warfare, especially in close proximity to India, makes the survivability of the Indian SSBN force reasonably assured.<sup>820</sup> A more significant challenge would be posed by China's ability to target India's shore-based infrastructure for communicating with its submarines, but developing air- and even surface ship-based alternatives to mitigate this threat remains a task for the future. The maturation of the Indian SSBN force in any case should completely extinguish any Chinese temptations for nuclear first strikes, even if these incentives are admittedly meager to begin with.

***Where nuclear arms race stability, deterrence stability, and crisis stability are concerned, the Sino-Indian dyad is highly stable.***

Where nuclear arms race stability, deterrence stability, and crisis stability are concerned, the Sino-Indian dyad is highly stable. This condition is likely to persist on current trends, as long as China's primary nuclear competition with the United States leaves India to benefit from the positive externalities. As long as China does not dramatically expand the number of its high-precision nuclear-tipped missiles and India is able to protect the opacity of its nuclear storage sites, New Delhi should be able to preserve the immunity of its nuclear reserves until the Indian SSBN flotilla becomes fully operational.

Over the longer term, one uncertainty that could complicate Sino-Indian nuclear stability more directly is the potential threat posed by the emergence of China's strategic defenses. Although supposedly initiated in response to India's emergence as a nuclear-weapons power, China's strategic defense investments currently clearly transcend its concerns about India. Although detailed information is hard to come by, China has already built (and is continuing to build) large phased-array radars at different locations across the mainland in order to secure warning of ballistic missile attacks from all around its periphery.<sup>821</sup> The radar installation at Korla is, in fact, intended to cover missile launches originating in India and perhaps across a wider east-west axis south of China.<sup>822</sup> These terrestrial systems are complemented by a variety of high-resolution space-based intelligence, surveillance, and reconnaissance sensors comprising electro-optical, synthetic aperture radar, and electronic intelligence satellites.<sup>823</sup> One analyst of international space programs, Gunter Krebs, has identified at least one Chinese satellite, the Huoyan-1, as an early warning platform with its published image clearly revealing the distinctive infrared sunshade that protects the signals passing through the corrector lens to the detector array aboard the satellite. This design, which is similar to the U.S. Defense Support Program spacecraft during the Cold War, suggests that the Huoyan-1 and its sister satellites are intended to detect ballistic missile launches through the use of either scanning or staring sensors that pick up the infrared energy emitted especially during a missile's boost phase of flight.<sup>824</sup>

For now, these capabilities appear intended mainly to characterize impending attacks to include providing China with information about the launch source, the numbers of incoming missiles in the attacking salvo, and their projected targets. Having advance warning on

these counts may marginally improve the survival of mobile missiles (if these are, indeed, the target of the strike) but generally would be more useful for mounting missile defense operations: space-based detection of offensive missile launches provides both the earliest warning of the impending threats as well as cueing information for terrestrial radars, which can then allocate their energy output to more intensively scan only those threat sectors from which the reentry vehicles are poised to emerge. Optimizing the search function in this way also enables the radar to focus its resources on more discriminate identification of the number of reentry vehicles and their accompanying penetrations aids, if any.<sup>825</sup> As China's missile defense capabilities mature, its strategic defense management systems would provide the targeting information required to launch the interceptors necessary to neutralize the attacking warheads carried by even the longest-range offensive missiles.<sup>826</sup>

If China builds a robust enough missile defense network over time, it could limit the retaliatory damage that India could inflict in response to any Chinese first strike. This scenario would replicate concerns that arose during the Cold War when it was feared that an ambitious attacker could launch a successful damage limiting attack and then use its defense capabilities to neuter the ragged retaliation that follows.<sup>827</sup> India will obviously seek to parry this eventuality by ensuring the survivability of its deterrent to begin with—with the sea-based component becoming even more significant in this context—but it could be expected to invest in assuring the penetrativity of its missile systems in different ways. This could take the form of increasing the size and diversity of the missile inventory itself, adopting different kinds of structured attacks to overwhelm the defenses, incorporating penetration aids into its offensive missile payloads, and deploying MRVs or hypersonic glide vehicles aboard its strategic missiles. All these solutions are likely to be explored by India and there are no political constraints on adopting them either.

The viability of India's nuclear deterrent vis-à-vis China can thus be maintained by investments that lie well within New Delhi's capabilities. But perhaps the most important consideration in this day and age is that nuclear weapons use cannot be treated cavalierly by any state—even the most powerful. That itself provides India the respite to preserve its deterrent effectiveness without extravagant investment. Because India sees its nuclear weapons as intended fundamentally to ensure that China will never have any reason to use (or to threaten to use) its nuclear weapons first—just as China views its nuclear weapons as serving the same purpose vis-à-vis India or other threats—the two rivals should be able to preserve strategic stability more easily so long as their current political circumstances do not alter in any radical way.

## **NUCLEAR WEAPONS IN INDO-PAKISTANI SECURITY COMPETITION**

Unlike the relatively high stability that marks nuclear competition in the Sino-Indian dyad, the nuclear rivalry between India and Pakistan, especially in its extended dimensions, is more fraught. The Sino-Indian contestation is fundamentally about power politics. Although manifesting itself in serious status and territorial disputes, it lacks the strongly emotive elements that are present in, for instance, China's rivalry with Japan. Except during episodes of heightened tension or conflict, the relative thinness of Sino-Indian ties has paradoxically enabled both states to manage their differences with a measure of equipoise that has been elusive where India and Pakistan are concerned.

The problems between New Delhi and Islamabad undoubtedly involve power-political disputes over ideology, territorial claims, and power imbalances as well. But unlike the Sino-Indian contestation, the rancor between India and Pakistan is also intensely emotive, thanks to their shared history of violent sunderance at the time of their founding as modern states.<sup>828</sup> The competition within the Indo-Pakistan dyad is thus akin to a “veritable civil war,”<sup>829</sup> almost a family feud, which gives it an affecting intensity that is absent in the Sino-Indian relationship. These passions are aggravated by Pakistan's grievances since many of its elites are deeply convinced that India has never reconciled itself to the partition of the erstwhile British Raj and, by implication, to their nation's very existence.<sup>830</sup> The partition that finally occurred with Indian acquiescence, however, did not make things any the less painful for India, which responded initially with a niggardly reluctance to fully transfer the material assets owed to the new state of Pakistan. The memory of these Indian actions—coupled with the early (and still ongoing) disputes over territory, especially the ownership of the Muslim-majority state of Jammu and Kashmir, which acceded to India instead of Pakistan—remains potent evidence for Pakistan's belief that India remains an abiding adversary. Pakistan's defeat in the 1971 war simply indurated this conviction, especially within the Pakistan Army, which had until that point viewed itself as equal, if not superior, to its Indian counterpart. The outcome of this war humiliated the Pakistan Army both as a fighting force and as the vaunted guardian of the state. By vivisectioning the country forever, it implanted within the army an enduring desire for vengeance against India that persists to this day.<sup>831</sup>

In contrast to Pakistan, which has nurtured grievances against India continuously since its founding, India sought to overcome its own initial trauma with Partition by focusing on the immense tasks of economic development and state- and nation-building at home in order to realize its ambitions of becoming a great power. Consequently, India instinctively preferred to ignore Pakistan—a testament partly to its own greater strength and to its very different aspirations—but Pakistan, with its myriad resentments, would not let itself be so easily ignored. Instead, driven by a fear of India and simultaneously a peculiar self-confidence about being able to keep it off-balance, Pakistan—more specifically, the Pakistan

Army—pursued a highly confrontational political-military strategy against its larger neighbor. Aided by impressive early economic growth, U.S. arms transfers, and expectations of Western alliance support, Pakistan set out to challenge India through a combination of conventional and subconventional wars on the assumption that seizing the initiative was critical to securing those claimed territories that represented the proof of its own national viability. Stephen P. Cohen aptly captured this psychology when he noted that “Pakistanis . . . like to think of their country as another Israel, with a tough, small, outnumbered, but ultimately triumphant, army that draws its strength from a shared religion and modern military technology.”<sup>832</sup> Pakistan’s emphasis on bold preemptive action paid off—until 1971, that is—as it was able to initiate conflicts that either yielded modest victories or played India’s military forces to a draw while relying on the great powers to restrict hostilities before India could muster the resources necessary to defeat Pakistan’s aggression conclusively.

That Pakistan, despite being the weaker state, could contemplate pursuing such a bold strategy for the longest time is a function of the “truncated asymmetry” that characterizes power relations within the Indo-Pakistani dyad.<sup>833</sup> Although both the Sino-Indian and the Indo-Pakistani pairs are characterized by pronounced inequalities—with China being far more powerful than India and India, in turn, being relatively more powerful than Pakistan—the differences in relative strength within each dyad are equally conspicuous. Pakistan is much stronger relative to India than India comparably is vis-à-vis China even today. Because India is much weaker than China, while still remaining a relatively satisfied power, New Delhi has never felt compelled to mount persistent challenges toward Beijing. Thanks to its power advantages, China has also been able to limit India’s threats to its interests rather cheaply, including by using Pakistan as an effective proxy. Unlike India, however, Pakistan is a deeply dissatisfied state that is also more powerful relative to its larger adversary; hence, has been able to defy India far more resolutely than India has ever dared with China.<sup>834</sup> Further complicating matters, India does not have any regional proxies that could be exploited to decisively undermine Pakistan. Although elites in Islamabad often believe that Afghanistan has served exactly this purpose for India in the past, the plain fact of the matter is that a friendly Kabul cannot constrain Islamabad on New Delhi’s behalf in the way that Islamabad

***The arrival of nuclear weapons to the Indian subcontinent only strengthened Pakistan’s capacity and elevated its determination to persist in its defiance of India.***

can comparably curtail New Delhi’s freedom of action at Beijing’s behest. For a variety of reasons that include deeper dissatisfaction, the character of the bilateral power differentials, and the presence of foreign (especially Chinese) support, Pakistan has been able to accost India more effectively than India has attempted to in reverse.

The arrival of nuclear weapons to the Indian subcontinent only strengthened Pakistan’s capacity and elevated its determination to persist in its defiance of India.<sup>835</sup> It is ironic that although New Delhi initiated its nuclear weapons development in response to fears precipi-

tated by China's—its larger adversary—first nuclear test, India's weaponization was finally consummated only by developments in Pakistan's—its smaller rival—nuclear program. This counterintuitive outcome was owed entirely to India's judgment that while China's nuclear weapons posed a latent danger to its security, this risk could be managed because the threats of coercion and violent conflict were relatively low and because few Chinese political aims would be advanced by the exploitative utilization of its nuclear capabilities. Pakistan's confrontation with India, on the other hand, was far more dangerous because Islamabad, proving to be more risk-acceptant than Beijing, had fewer compunctions about militarily provoking New Delhi despite the latter's superior strength. Pakistan's deep-rooted animosity toward India, even if sometimes for understandable reasons, then compelled India to hastily develop its own nuclear weapons in order to deter the often-reckless behavior of its smaller but brasher adversary.<sup>836</sup>

While the acquisition of nuclear weapons by both India and Pakistan since the 1980s should have served to dampen their mutual security competition—because these devices possess far greater utility for defensive rather than offensive purposes—that has unfortunately not been the case. The experience of the Cold War suggests that nuclear weapons generally tend to freeze territorial disputes because threatening to alter the status quo by force promises to be prohibitively costly in the face of nuclear deterrence. Pakistan's antagonism toward India, accordingly, should have abated as the induction of nuclear weapons on both sides should have not only reassured the weaker state but also limited its capacity to pursue territorial (and, more broadly, geopolitical) revisionism. This expectation, consistent with rational deterrence theory, was shared widely during the 1980s in both India and Pakistan, but the historical record since has confirmed that the demands of rationality can often be frustrated by the imperatives of strategic culture. As C. Christine Fair has insightfully explained, “because the [Pakistan] army defines defeat in terms of being unable to mount a challenge to India either territorially or politically, the army will prefer to take risks than to do nothing at all, which is [what it views as truly] synonymous with defeat.”<sup>837</sup> Given this attitude, it is not surprising that Pakistan's uniformed security managers have not perceived nuclear weapons in the subcontinent as decisively extinguishing the possibilities of conflict but rather as merely channeling them in new directions that yet provide hope for Islamabad to recover its claimed territories, weaken Indian power in the process, and thereby achieve Pakistan's long-standing dream of permanent security.<sup>838</sup>

Pakistan's nuclear weapons have made this strategy all too tenable. It contrasts dramatically with India's approach to nuclear deterrence—and the differences in the two countries' respective strategic circumstances and objectives lie at the root of the strategic instabilities that currently afflict the subcontinent.

Within the Indo-Pakistani dyad, India is obviously the stronger of the two powers—economically, militarily, and in terms of international standing. It is also the most status quo power in Southern Asia, and its primary strategic objectives are focused on ensuring rapid



economic growth and technological modernization, which New Delhi views as the ticket to achieving true great power capabilities internationally. For India, therefore, nuclear weapons serve important but very limited purposes: they are intended primarily to deter nuclear threats or attacks by its principal rivals, China and Pakistan, since all the other lesser contingencies can be handled adequately by India's quite capable conventional forces. The nuclear weapons that service this limited objective of deterrence also confer sufficient prestige, thereby satisfying India's demands for security and status simultaneously.

In contrast, Pakistan's requirements are more complex. In the first instance, Pakistan, too, views nuclear weapons as deterrents against nuclear threats or attacks emanating primarily from India. But this contingency is highly improbable, because there is no conceivable reason for India to launch an unprovoked nuclear attack on Pakistan. India's overall conventional superiority, however, unnerves Pakistan. As the Pakistani state continues to face domestic weaknesses, its fears on this count only increase. Pakistan's nuclear weapons then acquire an additional—arguably even principal—role: to deter Indian conventional military coercion and conventional military attacks.<sup>839</sup>

If these were the only missions that Pakistan's nuclear weapons serviced, nuclear stability in the Indian subcontinent would be fairly robust. After all, India has few incentives to attack Pakistan unprovoked by nuclear or conventional means, so Pakistan's nuclear weaponry should suffice to provide it with reassurance in case India were to behave maliciously. The primarily countervalue-capable nuclear forces on each side effectively checkmate the other, thus providing both states with confidence that neither can prosecute any disarming military strategies that would fundamentally undermine the other's security.

This *prima facie* safeguard, however, has been sabotaged—with corrosive effect—by Pakistan's efforts to use its nuclear reserves not merely for ensuring its own security but to actually force changes in the status quo to its advantage. Visualizing its nuclear weapons as providing it with strategic immunity, Pakistan has embarked on challenging India through subconventional warfare conducted by various proxy groups covertly supported by the Pakistani state.<sup>840</sup> This strategy of unleashing state-supported terrorism and insurgency against India in the hope of weakening its control over the contested territories (and enervating it more generally) operates on the assumption that New Delhi will be unable to retaliate through conventional military operations for fear of triggering an escalation sequence that eventually ends up producing a nuclear holocaust. Pakistan's nuclear weapons, accordingly, serve not merely to provide deterrence against Indian attacks, but more ambitiously to provide a license for “safe” subconventional wars against India.<sup>841</sup>

Should New Delhi, acting contrary to these expectations, attempt to punish Pakistan through the use of conventional military force, Islamabad's nuclear weapons only acquire additional utility for brandishing—that is, signaling aimed at compelling New Delhi to freeze its incipient military retaliation while simultaneously catalyzing great power intervention aimed at pressing India for restraint in order to avert the threats of initial nuclear

use as well as the horror of any subsequent unrestrained nuclear exchanges.<sup>842</sup> Although Pakistan's acquisition of nuclear weapons is, indeed, meant to free it from dependence on the great powers for its security, relying on external intervention to restrain India still remains a critical element of Pakistan's security strategy because such involvement holds the promise of suppressing Indian military action without Islamabad having to bear the potentially dreadful costs of actual nuclear weapons employment—which, however painful it may be for India, would be equally if not more costly for Pakistan.<sup>843</sup>

Inducing foreign intervention to suppress the threat of Indian military action operates on the assumption that any nuclear use between India and Pakistan would create awful negative externalities for the entire international community.<sup>844</sup> These burdens, accordingly, can be leveraged to prevent India from implementing its military threats in ways that could provoke either graduated or all-out Pakistani nuclear escalation—which would be disastrous all around. While the international interposing that inhibits India may not materialize in every subcontinental crisis as Islamabad might hope, the strategy of counting on it is not a priori irrational from Pakistan's point of view given the damage that potentially extensive nuclear weapons use would inflict on the international order and on the global ecosystem as well.<sup>845</sup> All the same, it highlights the problematic character of Islamabad's risk-taking: far from being discrete alternatives, Pakistan's politico-military strategy thus combines nuclear-shadowed subconventional conflicts, the threat of asymmetric escalation, and the ultimate pledge of assured retaliation to provoke catalytic interventions by the great powers to curb India, all in a mutually reinforcing and unbroken braid.<sup>846</sup> However understandable such an approach may be for a weaker power concerned about its security, it nonetheless embodies serious dangers that arise ultimately from Pakistan's inability to accept the territorial, power, and status realities that admittedly favor India.<sup>847</sup>

The fundamental danger to strategic stability in the subcontinent, accordingly, does not arise from the presence of Indian and Pakistani nuclear weapons per se, or even from their respective nuclear postures strictly speaking, but rather from the purposes to which Islamabad's nuclear capabilities are directed.<sup>848</sup> If Pakistan sought only to neutralize the perils of Indian nuclear and conventional threats or attacks, the political environment in the subcontinent would be far more placid. Pakistan's hazardous nuclear strategy, however, has opened Pandora's box: it has stimulated New Delhi to contemplate supporting Pakistan's own subnational challengers in retaliation for Islamabad's provocative behavior; even more importantly from the viewpoint of nuclear stability, it has induced India to develop conventional limited war options intended to swiftly punish Pakistan while remaining under its thresholds for nuclear weapons use.<sup>849</sup> Because implementing strategies of enervation—hurting the other through subconventional challenges supported from the outside—is harder for India than it is for Pakistan for various reasons (including geography, the extent of demographic homogeneity in each country, and the time required for success), New Delhi has focused more on exploring how bounded conventional military operations might be used to penalize (or restrain) Pakistan.<sup>850</sup>

Whether these take the form of large but shallow ground force operations as envisaged in India's Cold Start doctrine, or special operations behind Pakistan's borders, or discrete air or naval attacks on various Pakistani assets, the prospect of Indian retaliation has certainly caught Pakistan's attention. Islamabad has responded to these possibilities by both striving to maximize its force size and diversifying its nuclear weapons inventory to include everything from strategic to tactical nuclear weapons, a response that is shaped by at least four considerations. First, Islamabad views its nuclear capabilities as the ultimate compensation for its conventional inferiority which, although not as significant as is sometimes believed (an issue discussed subsequently), is nonetheless relevant. Second, the geographic disparities between India and Pakistan have compelled Islamabad to attempt to overcome its disadvantages in mutual vulnerability by building up a much larger nuclear force than it perhaps needs for purposes of simple deterrence. Because Pakistani nuclear strategists fear that India might exploit its superior post-conflict reconstitution capability to intimidate Pakistan in any tests of will, they appear intent on acquiring the expanded nuclear force necessary to inflict extensive damage on the bigger Indian homeland in an effort to support the goal of "victory denial."<sup>851</sup> Third, Pakistan requires a large and perhaps superior nuclear force relative to India if it is to enjoy the appropriate immunity to implement its policy of supporting subconventional wars within its adversary's territory. Because the ability to match the levels of violence embodied by any threatened Indian retaliation is desirable for the success of Pakistan's strategy of weakening India from within, it is not surprising that acquiring the wherewithal to support full-spectrum deterrence now dominates Islamabad's force planning. Fourth, and finally, Pakistan will continue to expand and improve its nuclear arsenal simply as a hedge against uncertainty: given the siege mentality that shrouds decisionmaking within Pakistan's garrison state, its military establishment will perpetually be tempted by the belief that more and different kinds of nuclear capabilities must be developed to counter every imaginable operational contingency, especially those arising from India.<sup>852</sup>

Although Pakistan's nuclear expansion is thus driven by various structural reasons, its military establishment has often encouraged various domestic voices to justify this development by reference to India's substantial conventional and nuclear capabilities. And many Indian interlocutors have only abetted this development in turn. For example, since the 1998 tests, several analysts and occasionally officials in the defense technology establishment have sometimes made extravagant claims about either India's nuclear capabilities, its missile defense technologies, or its conventional military forces. This hyperbole, which is invariably directed at domestic audiences, represents a species of "strategic solipsism" insofar as it disregards the impact on external constituencies.<sup>853</sup> Whether these assertions pertain to the purported yield of India's nuclear weapons or their relative sophistication more generally, or the quality of various Indian defense systems, or India's military prowess broadly speaking, they feed into the Pakistani fear of the overwhelming Indian threat and vindicate the necessity for a continued expansion of Islamabad's nuclear forces.

The author's conversations over the years with senior Pakistani military officials overseeing the nuclear program, however, suggest that they have an acutely realistic assessment of India's strengths and limitations, in both the nuclear and the conventional realms. Hence, it is hard to conclude that Pakistan's nuclear expansion is driven by simple misperception. Rather, the structural factors referred to previously appear to be more powerful motivations, though the bureaucratic interests of both Pakistan's Strategic Plans Division and the army itself often converge to exploit the exaggerated public impressions about India's military potency as cover to legitimize their own nuclear buildup.

India, for its part, appears to be marching to the beat of a different drummer. It has focused less on attempting to match Pakistan's nuclear capability either in numbers or in diversity. For example, it is building up its nuclear missile force quite slowly, while still staying away from developing any tactical nuclear weapons despite some recommendations to the contrary. Instead, New Delhi is investing heavily in ensuring the survivability of its modest nuclear force while extending its reach primarily to hold at risk more distant targets in China—a development that will eventually make Pakistan a “lesser included case” in its larger nuclear strategy. India continues to harbor a vast nuclear production capability, which derives substantially from its civilian nuclear program, but it seems content to refrain from any concerted expansion of its strategic forces given its judgment that relatively few nuclear weapons are required to deter Pakistan and China—although for different reasons in each case. To the degree that Indian nuclear weapons are increasing in numbers, this push appears to be driven more by the need to ensure that a sufficient residual force survives in the face of the enlarging Chinese and Pakistani nuclear arsenals rather than a desire to expand the Indian inventory for its own sake. Obviously, because the contours of the future global nuclear order are still unclear, New Delhi remains intent on preserving its capacity to expand its nuclear weapons capabilities if required, but it does not seem driven to build up the largest possible arsenal it could acquire—or even to match China and Pakistan's nuclear forces—right now.<sup>854</sup>

***Between the larger number of targets present in India and the perceived need to possess different kinds of nuclear weapons to deal with various operational challenges, Pakistan's nuclear inventory is expanding and diversifying faster than India's.***

The divergence in India and Pakistan's approach to nuclear modernization implies that, just as in the Sino-Indian dyad, there is still no real nuclear “arms race” within the subcontinent.<sup>855</sup> An arms race, at least in the classic sense, occurs when each side feels compelled to constantly react to an opponent's strategic acquisitions to preserve its security.<sup>856</sup> The persistent interactivity that usually marks arms races, at least in the popular imagination, is hard to find in the case of India and Pakistan since both seem driven, at least in the first instance, to match residual weapons to targets as defined by their overarching doctrines rather than matching weapons to weapons for their own sake. While this dynamic may oc-

asionally suggest weak arms race instability—what one scholar has aptly called “a languorous arms race”<sup>857</sup>—the more striking characteristic is Pakistan’s behavior: far more obsessed with India than India is in reverse, Pakistan’s nuclear expansion is driven by an intensity that is propelled by its own fears, obsessions, and ambitions. Between the larger number of targets present in India and the perceived need to possess different kinds of nuclear weapons to deal with various operational challenges, Pakistan’s nuclear inventory is expanding and diversifying faster than India’s. Here, the pervasive uncertainty that surrounds all rivalrous competitions is exacerbated by the complications of facing a more powerful adversary (including states beyond India); these, in turn, are intensified by bureaucratic pathologies, directed innovation, and state capture by the men on horseback. Altogether, these elements have combined to produce not “a vicious nuclear arms race” within the subcontinent as is often assumed,<sup>858</sup> but instead a determined one-legged nuclear dash that shows no signs of ending any time soon.<sup>859</sup>

The peculiarities that define arms race stability in the Indo-Pakistani dyad are also reflected in the problems of deterrence stability. As noted earlier, deterrence stability pertains to the incentives of one or both adversaries to use their nuclear weapons to deter nuclear or conventional threats. Neither India nor Pakistan imagine that they would be faced with nuclear attacks emerging from the other without provocation. These contingencies, which preoccupied U.S. and Soviet strategists during the early Cold War, have no parallel in the Indian subcontinent. For all their unresolved disputes, nuclear weapons in India and Pakistan are viewed fundamentally as instruments of deterrence: they serve by, their very presence, to prevent an adversary from issuing nuclear threats or launching nuclear attacks. Moreover, neither state believes that their nuclear weapons can be effectively eliminated by the other’s nuclear forces. This is partly because—on both sides—the weapon yields are small, the delivery systems are relatively inaccurate, and the locations of the strategic storage sites are obscure. Even if these constraints did not exist, however, the national leaderships in both countries do not believe that the risks of a successful nuclear war are worth their benefits and, hence, betray no interest in looking for opportunities to unleash so-called splendid first strikes of the sort that were widely feared during the Cold War. To that degree, the lessons of the nuclear revolution have been absorbed in both India and Pakistan.<sup>860</sup>

The challenges to nuclear deterrence stability in the Indian subcontinent, therefore, derive mainly from the threats of conventional war—even here, the incentives for nuclear first use are, once again, asymmetric. Because India has stronger conventional military forces, it can cope with all Pakistani conventional military threats without resorting to nuclear weapons in any way. Pakistan, on the other hand, is the weaker power and, hence, conceives of its nuclear capabilities as essential to deterring any significant Indian conventional military operations, including those materializing as retribution for Pakistan’s subconventional attacks on India. Consistent with this calculus, Pakistan has steadfastly refused to rule out the first use of nuclear weapons against India. As Islamabad’s arsenal steadily incorporates tactical nuclear weapons of different kinds, “the threat of early nuclear use on the battlefield” often

appears as a disconcerting possibility.<sup>861</sup> While the reason for why Pakistan might insinuate the *possibility* of early first use is understandable—it signals a willingness to bear the costs of escalation in self-defense in order to stop an Indian conventional offensive before it acquires momentum or produces success—it does raise the question of whether such a response is in fact necessary.

A cursory survey of the conventional military balance along the Indo-Pakistani border suggests that Pakistan has robust enough defenses to obviate the need for any early recourse to nuclear weapons, and conversations with Indian and Pakistani army officers over the years indicate that both sides have a remarkably accurate knowledge of the forces deployed across their common border. The Indian Army, undoubtedly, is much larger than its Pakistani counterpart, but a substantial portion of its forces—some twelve out of forty maneuver divisions—are allocated to defending the Sino-Indian border. Of the twenty-eight remaining maneuver divisions, as many as eight (and possibly more) could be requisitioned for operations against China in an emergency. In any event, the twenty-eight divisions nominally available for operations against Pakistan's twenty-four or so maneuver divisions cannot be committed promptly for such missions because many of them are dispersed during peacetime at cantonments located at great distances from the border.<sup>862</sup> If the strengths of the two countries are crudely compared by totaling the division-sized formations located within 200 kilometers of their boundary, it is likely that Pakistan's twenty divisions face only about twelve Indian divisions in proximity. Moreover, thanks to Pakistan's constricted geography, its forces have advance positions and logistics sites much closer to the border and in the past have been able to mobilize much faster than their Indian counterparts.<sup>863</sup> (Although these precise force ratios may be debated, they do capture the broad contours of the balance.)

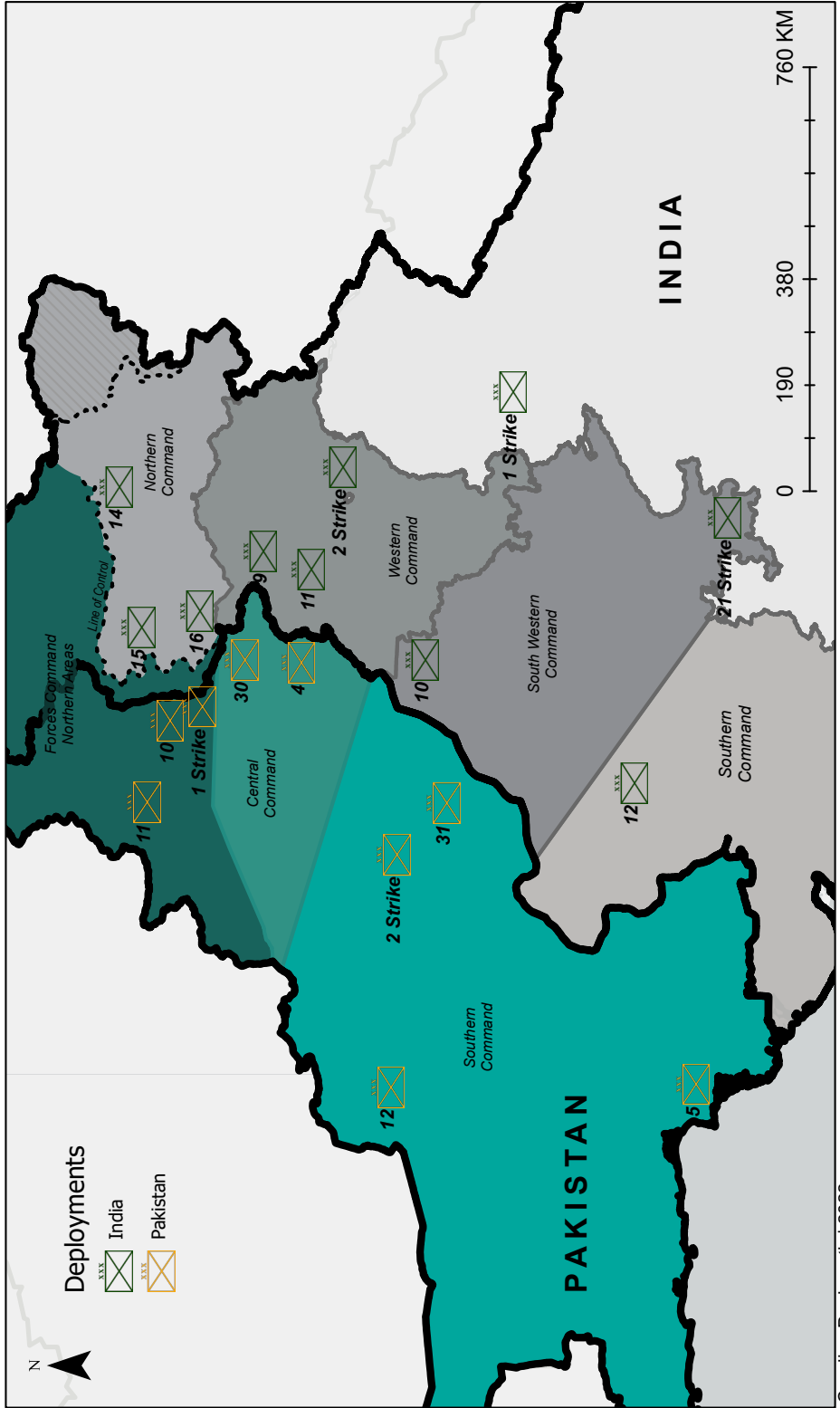
Force comparisons of maneuver divisions, however, can be quite misleading because many of these Indian and Pakistani formations are quite irregular, incorporating many more brigades than the standard tables of organization would suggest. The same is also true of brigade counts because many Indian and Pakistani brigades deviate from the standard three battalion/regiment structure; both sides, in any case, have numerous independent brigades that supplement the maneuver divisions. Yet comparisons centered on brigade strength offer a better approximation even if the information gleaned from interviews and public sources in both countries is often incomplete or imperfect.

The Indo-Pakistani border can be broadly divided into four sectors: Jammu and Kashmir; the heartlands of the Indian and Pakistani Punjab; the northern Thar desert in India and the southern Pakistani Punjab opposite it; and the southern Thar desert and the Rann of Kutch in India, which faces the entirety of Pakistan's Sindh province.

The western part of the state of Jammu and Kashmir, from the Siachen Glacier westward all the way to Akhnur, is the responsibility of the Indian Army's Northern Command, with its 15 and 16 Corps providing the bulk of the forces for its defense. The Pakistani territories

MAP 3

# INDIAN AND PAKISTANI FORCE DEPLOYMENTS, 2021



Caroline Duckworth | 2022

facing this border are defended by its Forces Command Northern Area supported by other Pakistan Army formations, from the 10 Corps, which is responsible for defending the districts from Muzaffarabad and Hattian Bala to Bhimber in Azad Jammu and Kashmir.

The area immediately south of Jammu and Kashmir, the heart of the Indian Punjab, is defended by the Indian Army's Western Command, whose area of responsibility covers all but the southernmost districts of the state. India's 9 and 11 Corps are the principal formations present for its defense, which is supported by some forward deployed components of its 2 Strike Corps as well. (India's 9 Corps is actually tasked for the defense of the Jammu-Pathankot axis, further north, in what is the Northern Command's nominal area of responsibility.) Pakistan's Central Command lies opposite the Indian Army's Western Command. Given that the Pakistani Punjab constitutes the core of the Pakistani state, an extremely large number of forces are allocated for its defense: Pakistan's 1 Strike Corps along with its 30 and 4 Corps are deployed very close to the border, and these formations in turn can be supplemented from forces drawn from Pakistan's 2 Strike Corps and its 31 Corps, which in peacetime are based actually in Pakistan's Southern Command.

The southernmost districts of the Indian Punjab and the northern Thar Desert in India, which lie within the boundaries of the state of Rajasthan, are the responsibility of the Indian Army's South Western Command. The Indian Army's 10 Corps, supported by its 1 Strike Corps based deep in the rear, face Pakistan's Southern Command, whose vast area of responsibility extends across the boundaries of both the Indian Army's South Western and Southern Commands. In operations against the former, Pakistan is likely to employ the bulk of its 2 Strike Corps and 31 Corps to protect the southern portion of the Pakistani Punjab.

The fourth and final sector, which extends from the southern Thar desert in Rajasthan all the way to the Rann of Kutch in India, is defended by India's Southern Command and its 12 Corps, supported by some forward deployed elements of its 21 Strike Corps. These elements face the Pakistan Army's Southern Command, whose area of responsibility includes the Sindh province. For defense, it relies primarily on 5 Corps supported by other elements drawn from 31 Corps in the north.

When the forces available to both sides within 200 kilometers of their border are compared by sector at the brigade level, the robustness of Pakistan's conventional deterrent becomes immediately apparent.<sup>864</sup> Only in the northernmost sector of Jammu and Kashmir does India enjoy a numerical superiority on a day-to-day basis. Here, India deploys probably one-and-a-half times more maneuver and combat support brigades than Pakistan, but this force advantage is driven entirely by geography. India has packed military forces within Jammu and Kashmir because hostile geography and tenuous lines of communication often prevent easy reinforcement from reaching the Northern Command's area of responsibility in times of conflict. However, the complex terrain along the Indo-Pakistani border in the state makes these Indian forces more useful for defense rather than offense. So, between



combating insurgencies, preventing further territorial losses, and preparing for military operations without possible reinforcement, India's numerical force advantages in Jammu and Kashmir cannot be exploited for undertaking rapid penetrations at operational depths in any short war (the only contingency that matters in a nuclear subcontinent). This, in turn, implies that despite its advantages, India would be hard pressed to threaten the state of Azad Jammu and Kashmir—let alone Pakistan—in ways that might provoke nuclear threats or use by Islamabad.

Outside of Jammu and Kashmir, India deploys fewer forces than Pakistan does within 200 kilometers of their common border on a routine basis. In the Punjab plains, where India's Western Command faces Pakistan's Central Command, the latter has close to twice the number of maneuver and support brigades deployed by India, and Pakistani forces can often reach full readiness and deploy faster to their wartime positions than their Indian counterparts. Whether this posture will survive India's Cold Start preparations over time remains to be seen, but Pakistan's huge force holdings in its Central Command testify to the fact

that the Punjab remains the most precious strategic real estate in Pakistan. Further south, Pakistan's Southern Command has almost one-fourth more brigades closer to the border than the Indian South Western Command. And in Pakistan's Sindh province, its Southern Command deploys over

***Outside of Jammu and Kashmir, India deploys fewer forces than Pakistan does within 200 kilometers of their common border on a routine basis.***

twice the total number of maneuver and support brigades within 200 kilometers of the international boundary in comparison to the forces maintained by India's Southern Command. Even if the forces deployed along Pakistan's western borders—11 and 12 Corps—are withheld from the calculation, the rough numerical balances favor the Pakistan Army in every sector save Jammu and Kashmir (where the disadvantage in any case has virtually no impact on Pakistan's survival).

These force ratios are admittedly approximations derived from the known locations of various Indian and Pakistani divisions and their attached assets. Although Indian and Pakistani interlocutors characterize these ratios somewhat differently, there are *no fundamental differences* in their assessments of the sectoral balances. Moreover, these balances have also remained remarkably stable over the last decade, thus suggesting the robustness of the Pakistani posture even in the face of fears about what one Indian chief of army staff described as the Indian Army's "proactive strategy."<sup>865</sup> Obviously, these static balances will eventually change in India's favor depending on the duration of a conflict and whether New Delhi is freed from the constraints of a two-front war, the two variables that will affect India's ability to shift forces from the rear and elsewhere toward its western border.<sup>866</sup> And given the nuclear shadow that lurks over every subcontinental confrontation, the role of the international community is just as important, with the most likely outcome being external pressures that force a pause before things got entirely out of control.

The important conclusion, therefore, is that Pakistan has sufficient conventional military capabilities deployed forward to assure its defense, thus making the necessity for nuclear use—and certainly, early nuclear employment—highly questionable in any short war contingency precipitated even by an Indian implementation of Cold Start. This reality also implies that Pakistan has little reason to pursue the ab initio dispersal of its tactical nuclear weapons, let alone pre-delegating nuclear use authority to its battlefield commanders. There is enough evidence to suggest that senior Pakistan Army leaders already appreciate Islamabad’s advantages: As Lieutenant General Khalid Kidwai openly admitted, “there is a healthy balance between the conventional forces on either side . . . notwithstanding the conventional asymmetries [between India and Pakistan] that we keep talking about.”<sup>867</sup> Similarly, Adil Sultan, formerly with Pakistan’s Strategic Plans Division, has also declared, “To reduce the possibility of early nuclear use, Pakistan maintains adequate conventional responses to counter India’s offensive military strategy of pro-active operations, and the relatively new strategy of surgical strikes.”<sup>868</sup>

Even if this were not the case, however—and Pakistan’s conventional defenses failed early in any war with India—Pakistan’s nuclear weapons, tactical or otherwise, would not suffice to defeat Indian military operations in the field. This is certainly true where land combat is concerned (in contrast to naval nuclear use where even discrete attacks can be tactically effective). Operational success in nuclear warfighting on land requires large numbers of nuclear weapons—potentially in the many hundreds—especially if hard targets, such as armored divisions in battlefield deployment, are sought to be attacked and defeated comprehensively.<sup>869</sup> Lacking a nuclear inventory of such size, even prospectively, any modest Pakistani nuclear use can only threaten the soft underbelly of the attacker’s logistics train or its forward stocking locations, but even such interdiction may be insufficient to prevent the offensive spearheads from achieving their tactical objectives.

To be sure, *any* threats of Pakistani nuclear use would have catalyzing political effects within the subcontinent and outside. They would certainly force a competition in risk-taking that either prevents (or freezes) Indian conventional military operations or incites New Delhi to dare Islamabad to use its nuclear weapons in the face of possibly massive Indian retaliation. Either way, international pressures for conflict termination are likely to be overwhelming. In any case, given India’s status quo disposition, it is highly unlikely that any Indian government will pursue substantial enough military operations that risk breaching Pakistan’s nuclear threshold, whatever that might be.<sup>870</sup> Instead, if recent history is any indication, New Delhi is likely to restrict its punitive actions to limited air, naval, or special forces activities that can be initiated and terminated quickly, with Indian land forces being held largely in reserve as insurance against any expansive Pakistani military riposte. Pakistan, similarly, is likely to withhold its principal army units mainly to deter any large-scale Indian use of force in retribution for Islamabad’s nuclear-shadowed subconventional warfare against New Delhi.

If such variations of “uglier stability” promise to characterize the Indo-Pakistani rivalry as their respective nuclear arsenals mature,<sup>871</sup> the value of Pakistan’s diverse nuclear weapons, especially at the tactical end, becomes questionable. After all, if the main utility of Pakistan’s nuclear weaponry is to signal its willingness to escalate in self-defense when confronted by major Indian conventional military operations—since defeating Indian forces through battlefield nuclear operations is beyond reach and deterring Indian nuclear bolt-out-of-the-blue attacks are irrelevant almost by definition—any Pakistani nuclear weapon would suffice for that purpose. As Pakistani military officers themselves have noted, because “nuclear weapons, irrespective of their size, are qualitatively different from conventional weapons,”<sup>872</sup> any threats of their use are always “strategic in nature”<sup>873</sup> and “would have strategic fallout,”<sup>874</sup> thus rendering the differences in their technical characteristics, yields, range, or even numbers largely irrelevant. This reality is an obvious consequence of the nuclear revolution—one that has been further strengthened by the nuclear taboo that has arisen over time.

Obviously, Pakistan’s current inventory suggests that its strategic planners believe that they must have many diverse and specialized nuclear devices to block every avenue “for serious military operations by the other side.”<sup>875</sup> If such capabilities help to provide Pakistan with reassurance, they might enhance deterrence stability as long as they can be preserved securely and their command and control remains robust even in a crisis. These are not trivial challenges for a country contemplating even symbolic battlefield use, but thus far Pakistan seems to have erred on the side of caution—which is all to the good. Thus, although the Pakistan Army has begun exploring how to integrate conventional and nuclear operations in the field, it has not as yet shown any signs of considering the early dispersal of its tactical systems or relinquishing centralized control over them.<sup>876</sup> This conservatism offers hope that these devices will remain primarily latent instruments of deterrence rather than tools for actual use, even if in the process it only ends up calling their very *raison d’être* into question. Reflecting on this conundrum, one Pakistani scholar sensibly concluded that the “large scale deployment of tactical nuclear weapons” should be eschewed because this “would be too costly and infeasible.” Rather, “it may be prudent for Pakistan to [merely] deploy a limited number of [these] weapons as signaling or warning to India and use the doctrinal ambiguity [about their use] to create doubt in the adversary’s mind” because there is no assurance that these capabilities at the end of the day promise better or more meaningful protection.<sup>877</sup> In fact, their widespread proliferation and any planning for their extensive use would only undermine the conventional defense that Pakistan is more than capable of mounting against most imaginable forms of Indian military action. The sorry consequence of such a choice would weaken Pakistan’s security while simultaneously exposing it to the perils of horrendous and possibly irreparable damage.

On balance, therefore, nuclear deterrence stability in the Indo-Pakistani dyad is afflicted by meaningful, even if not perpetually high, risks. These dangers do not arise from the presence of nuclear weapons themselves, or even their specific characteristics, or the postures in

which they are incarnated, but rather from the strategic uses they serve in the context of the ongoing security competition between the two states. Because Pakistan treats its nuclear capabilities as providing cover for its subconventional challenges to India, its nuclear weapons paradoxically

become disproportionately important to its defense against any threatened retaliation by New Delhi's nominally superior conventional forces. The ensuing competition for "escalation dominance"—driven at the Indian end by the desire to limit Pakistan's capacity to harm Indian interests through low intensity wars and at the Pakistani end by the objective of preventing India from inflicting retribution—has unfortunately taken Islamabad in the direction of developing tactical nuclear weapons that can ostensibly be employed in graduated fashion before seeking recourse to their strategic counterparts.<sup>878</sup> This development has, in principle, increased the prospect of nuclear weapons use in the Indian subcontinent, thus making issues of deterrence stability among the most problematic aspects of the rivalry between India and Pakistan.

Although these innovations are aimed at preventing war by buttressing deterrence, or at least forcing the early termination of conflict before deterrence breakdown eventuates in strategic nuclear exchanges, they do epitomize the problems of deterrence stability in the Indo-Pakistani context that are not present where the Sino-Indian rivalry is concerned.

Mercifully, however, the deterrence instability that is chronically present in the case of India and Pakistan has not translated thus far into acute challenges for crisis stability. As previous discussion indicated, whereas deterrence stability refers to the incentives that a state has to use nuclear weapons at all in the context of a conflict (either to avert conventional aggression or to avoid conventional defeat), crisis instability refers to the incentives that a state has to use its nuclear weapons *first* in order to avoid their loss to any enemy action that is intended to deliberately (or even inadvertently) target them.

The notion of crisis instability arose during the Cold War when the United States and the Soviet Union had many thousands of high-yield nuclear weapons that could be delivered by highly accurate delivery systems in circumstances when the locations of the adversary's strategic nuclear weapons were also well known. The problems of crisis instability were judged to afflict primarily land-based forces, both ICBMs and bomber fleets since the precise locations of the former's silos and the latter's airfields were well known (or at least could be readily discerned by various surveillance systems such as space-based imaging satellites). Under such circumstances, the "reciprocal fear of a surprise attack" became plausible in theory,<sup>879</sup> even though it was always doubtful whether policymakers in real life would ever execute such strategies including in a crisis. The fear of surprise attack, however, was not irrational in principle because both sides had large numbers of highly accurate nuclear systems that

***Nuclear deterrence stability in the Indo-Pakistani dyad is afflicted by meaningful, even if not perpetually high, risks.***

could be used to eliminate the other's land-based nuclear capabilities. Consequently, a bold aggressor could use its own weapons first in an attempt to eliminate the other's nuclear reserves and thereby spare itself the ravages of expansive retaliation.<sup>880</sup>

With both sides' nuclear forces thus susceptible to such first strikes, crisis instability inexorably ensued because the competitors would have strong incentives to use their weapons first in disarming attacks aimed at the other. The imperatives of avoiding crisis instability led to the development of the triad: distributing weapons across diverse delivery systems—land, air, and sea—to increase weapons survivability and thus reduce the incentives for any aggressor to launch any disarming first strikes to begin with. The problems of crisis instability also resulted in explorations about different missile launch regimes, such as launch on warning or launch under attack, whereby ballistic missiles could be launched on receipt of any indications that a first strike was either imminent or underway. These solutions were plausible, however, only because both superpowers during the Cold War had diverse, especially space-based, tactical early warning systems that enabled each to carefully monitor the locations and disposition of the other's land-based strategic systems.

These conditions do not comparably obtain in the case of India and Pakistan. The land-based systems are smaller in number and relatively inaccurate; the yields of the most reliable nuclear warheads in the respective inventories are small; the locations of the facilities where the warheads and missiles are stored are highly opaque; and the persistent detection systems that can provide tactical warning of nuclear operations by either side do not exist. Consequently, both sides presumably have some information about where the other's nuclear systems might be cloistered in peacetime, but neither can be confident that they have comprehensive knowledge about all the relevant storage sites. Even if they were to acquire this information by intelligence means, they do not have the requisite nuclear weapon systems either in numbers, device yields, or delivery system accuracy to enable them to interdict all (or even most) of their adversary's nuclear storage facilities so as to create the use-it-or-lose-it dilemmas that compel the victim to unleash its nuclear weapons first merely because it cannot risk riding out such attacks and going second.

This judgment remains the baseline condition in both India and Pakistan, which is confirmed by the peacetime posture of their respective nuclear forces as well as the little that is known about their patterns of alerting witnessed during crises and their nuclear employment exercises. More recently, however, two American scholars Christopher Clary and Vipin Narang have advanced the provocative claim that India, a country usually characterized as a reluctant nuclear power that envisages its nuclear arsenal as having utility primarily to deter Pakistani nuclear first use (and to retaliate against such first use if deterrence were to fail) might not just use its nuclear weapons first in a crisis but actually seek to unleash a comprehensive damage-limiting first strike against Pakistan's strategic nuclear forces if any nuclear use by the latter were to appear imminent.<sup>881</sup>

This claim is grounded in the first instance by India's strategic predicament, which, since the early 1990s, has sought to develop antidotes to Pakistan's nuclear-shadowed terrorism. The quest for such antidotes has pushed India to develop various conventional military retaliatory options, which, in turn, has propelled Pakistan to acquire diverse tactical nuclear weapons to prevent India from crossing the threshold from crisis to war. India's response to this Pakistani innovation has consisted of reiterating its doctrine of "massive retaliation," in effect threatening Pakistan with devastating punishment if it ever used its nuclear weapons on Indian forces, facilities, or cities first. Although the credibility of this threat has arguably weakened as Pakistan's nuclear capabilities have increased and improved—in much the same way that the early U.S. Cold War doctrine of "massive retaliation" progressively became less credible as Soviet nuclear forces grew in size and capability—New Delhi has judged that holding on to its retaliatory threat of massive punishment is still worthwhile because, among other things, it does not preclude proportional retaliation should that be necessary in practice.<sup>882</sup>

No Indian government official, however, has ever suggested that Indian nuclear first use—centered on comprehensive counterforce attacks on Pakistan's nuclear weapons—might be a sensible strategy for New Delhi even in the face of threatened Pakistani nuclear employment. The closest Indian policymakers have come to discussing this idea has been in the former Indian national security advisor Shivshankar Menon's book *Choices*, where he refers to the dilemma that New Delhi would face if it found itself in a situation where a nuclear adversary "had declared it would certainly use its weapons [against India], and if India were certain that [this] adversary's launch was imminent."<sup>883</sup> While noting that "India's present public nuclear doctrine is silent on this scenario," he nonetheless goes on to reiterate India's continuing commitment to its no-first-use policy because when all is said and done it still makes the most strategic sense for New Delhi in its prevailing strategic circumstances.<sup>884</sup>

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This contingency aired by Menon, coupled with the views of other retired Indian military officers who are skeptical about the benefits of their country's no-first-use declaration, however has provided the grist for Clary and Narang's claim that India may be shifting toward a nuclear strategy centered on the first use of nuclear weapons incorporating comprehensive damage-limiting counterforce attacks.

The fact that India is also enlarging its nuclear arsenal beyond what Clary and Narang believe is necessary for minimum deterrence serves as further justification for the assertion that these supposedly excessive capabilities are intended to service the first-strike counter-

force mission. This judgment is additionally reinforced by their argument that not only are the numbers of India's nuclear weapons increasing but the quality of its arsenal is undergoing transformative changes that make the counterforce mission plausible. In particular, they argue that India possesses the necessary surveillance capabilities to detect Pakistan's nuclear weapons and, furthermore, that India's nuclear delivery systems, primarily ballistic missiles, have developed the necessary accuracy to make a counterforce attack appear a realistic possibility to Indian policymakers. If all these claims are true—in terms of the analytical questions considered here—they imply that sharply heightened risks of crisis instability exist because in some scenarios pertaining to future Indian punitive military operations against Pakistan, New Delhi will have strong incentives to use its nuclear weapons first to eliminate the entire Pakistani nuclear arsenal (or most of it) before it can be used by Islamabad to threaten reprisals against Indian conventional military attacks.<sup>885</sup>

The evidence for Clary and Narang's core assertion—that India is shifting toward a first use nuclear counterforce strategy—however is thin on all three counts: the evidence drawn from the Indian debates, the size of the Indian arsenal, and the quality of India's counterforce capabilities.

First, although Clary and Narang offer a deeply Talmudic reading of the Indian controversies over New Delhi's no-first-use policy, their discussion insufficiently recognizes either the noisy character of this discourse (an inherent consequence of Indian democracy where a diversity of views, sometimes not well thought through, are freely aired), or the effort at advocacy that many of these discussions represent (including by retired Indian military officers who may have lost the internal debates on these issues), or the confused nuclear terminology that many Indian policymakers often employ (because satisfying the niceties of nuclear deterrence theory is not their primary concern). Even a thoughtful policymaker such as Shivshankar Menon has often used problematic language when writing about nuclear issues, but this is understandable because his work is not an academic treatise on deterrence but a policymaker's reflections on India's strategic challenges. The writings of many Indian military officers on nuclear strategy, including those who have served in India's nuclear establishment, are often even more muddled, again explained by the fact that, despite their past positions, they have neither been educated in the complexities of rational deterrence theory nor trained to express themselves with the linguistic or logical precision that is commonplace in academic analyses of deterrence. Consequently, the ruminations of Indian officials on nuclear strategy must be subjected to serious "source criticism" before they can be used to draw far reaching inferences about any changes in Indian nuclear strategy.

Not appreciating these limitations often results in foreign commentators treating many of the Indian writings they cite as if they were considered statements of strategy that were intended to satisfy the demands of precision as U.S. nuclear doctrinal and posture statements did during the Cold War. Even the United States, compared to other nuclear powers, was exceptional on this count. Very few Indian writings on military issues—whether conven-

tional or nuclear—ever meet the U.S. standard for conceptual exactitude, which was set from the very beginning by academic theorists who developed and articulated the concepts of nuclear deterrence from within the traditions of social science, mathematics, and game theory. The limitations of Indian writings on deterrence, including those cited by Clary and Narang, have been examined by Indian analysts such as Rajesh Rajagopal, Abhijnan Rej, and Dhruva Jaishankar.<sup>886</sup> Their analyses clearly highlight the imprecision that often marks many contemporary Indian writings on nuclear deterrence, which cannot therefore be treated as obviously indicative of the nation's real nuclear strategy. In some cases, Clary and Narang simply infer what they think their Indian sources must mean from what is often casual language (or even the tenses of their sentences), making the challenge of discerning India's nuclear strategy from the outside even more difficult. Furthermore, arguing that Indian officials "have refused to . . . deny interpretations of a shift in thinking"<sup>887</sup> about their nuclear strategy does not attest to the veracity of a changed strategy either: as one senior Indian official when queried by the author about this very question responded tartly, "the Government of India does not exist to satisfy the inquisitiveness of outsiders about its nuclear strategy," before chuckling that "uncertainty about what we may or may not do may be good for deterrence in any case."

Shivshankar Menon's analysis illustrates the challenges all too well. For example, in a discussion about why India had not chosen a nuclear doctrine centered on "calibrated or proportional responses" early in the post-1998 period, Menon notes that for many sensible reasons "the logical posture at first was counter-value targeting, or targeting the opponent's assets, rather than counter-force targeting, which concentrates on the enemy's military and command structures."<sup>888</sup> This sentence merely states that, early on India had few choices but to settle on countervalue targeting because of the character of its nuclear capabilities: "Nuclear-armed Prithvi missiles with their limited range of 350 kilometers were effective deterrents in our situation, since the only real targets for them are the cities of the Pakistani Punjab."<sup>889</sup> Menon's description of "counter-force targeting, which concentrates on the enemy's military and command structures," however does not corroborate the suspicion that India's nuclear targeting strategy has now shifted.<sup>890</sup> The classic conception of counterforce centered on interdicting an adversary's nuclear weapons, its delivery systems, its storage sites, and its associated command and control. It usually did not refer to attacking conventional military forces and their command structures either in garrison or in the field. India's nuclear capabilities even in and around 1998 could always have been used to attack Pakistan's conventional military forces but, because successfully penalizing the latter requires large numbers of nuclear weapons, it made sense for India to concentrate on targeting population centers as a means of inflicting unacceptable punishment.

Today, with the larger number of nuclear weapons present in the Indian arsenal, New Delhi can retaliate by interdicting a wider range of targets including industrial and infrastructure assets as well as conventional military forces in addition to population centers. Menon is, therefore, right to emphasize that "India's nuclear doctrine has far greater flexibility than



it gets credit for,”<sup>891</sup> but this does not imply that India only has a choice between “massive countervalue retaliation and preemptive counterforce options”<sup>892</sup>—as if these are the only alternatives. In fact, the range of Pakistani targets that are susceptible to punitive retaliation is large; hence, India can exact significant punishment on Pakistan without bringing upon itself the complication of attempting to target Islamabad’s nuclear forces either preemptively or after suffering any nuclear attack.

Moreover, there is little in Menon’s discussion suggesting that contemporary Indian nuclear targeting is now directed not only toward attacking Pakistan’s nuclear weapon systems but could do so preemptively and in ways that would be viewed as compatible with New Delhi’s no-first-use policy. In fact, on the one occasion that Menon actually mentions “a comprehensive first strike against Pakistan”—again the perfect example of misleading terminology—he does so solely in the context of *responding* to Pakistan’s first use of nuclear weapons, where he, in effect, restates the claim that India would be justified in massively retaliating with nuclear weapons the moment Islamabad crosses the nuclear threshold in any form.<sup>893</sup>

On the question of whether India should shift its no-first-use policy, his argument is actually unequivocal:

What are the alternatives to no first use? Announcing that India would strike first if it considered it necessary, as Pakistan and the United States do? Some say that our declaration is already meaningless as it is only a pious hope and does not cover other NWS [nuclear weapon states]. If it is meaningless, why the fuss? But that aside, a first-strike doctrine is surely destabilizing, and does not further the primary purpose of our weapons of deterring blackmail, threat, or use of nuclear weapons by an adversary against India. It is hard to see how it would.<sup>894</sup>

And when he subsequently raises the possibility that “circumstances are conceivable in which India might find it useful to strike first, for instance, against [a nuclear-weapon state] that had declared it would certainly use its weapons, and if India were certain that [the] adversary’s launch was imminent,” he only states laconically that “India’s present public nuclear doctrine is silent on this scenario”<sup>895</sup>—not that a preemptive nuclear strike *is* appropriate under such conditions. To infer such a response, as Clary and Narang do, not only raises significant hermeneutical questions about their interpretation—and the minutiae cannot be addressed in any further detail here—but more importantly provokes the question of whether their conclusion about the supposed Indian shift toward counterforce targeting is tenable given what is known about New Delhi’s nuclear and military capabilities more broadly.

This leads to their second argument—that the increasing size of the Indian nuclear force lends itself to a counterforce strategy vis-à-vis Pakistan. The evidence here is also far from persuasive. The Indian nuclear force is certainly growing, but it is *not* growing faster than that of Pakistan or China. The number of Indian nuclear weapons—meaning warheads

plus launchers—is smaller than their equivalent numbers in Pakistan, as most published assessments indicate.<sup>896</sup> Nonetheless, the slow growth of the Indian arsenal can be explained simply by New Delhi's desire to hedge against uncertainty: because India will want to match the numbers of *survivable* warheads to targets in both China and Pakistan, the size of the Indian nuclear inventory will continue to grow because its adversaries themselves have expanding nuclear forces that could be used to target India's nuclear reserves. Furthermore, because New Delhi can never be sure about the survivability of its own forces, given that their locational opacity could be breached in unanticipated ways, the incentives to build a larger nuclear arsenal to increase the fraction of the surviving force are relatively high. Finally, much of India's current—modest—nuclear expansion is driven by the investment in either long-range systems to target China or the sea-based weapons required to enhance survivability, and New Delhi's investments on both counts are not only far from complete but also entirely inappropriate for counterforce targeting.

In fact, what is striking about India's nuclear growth is not that its force size is increasing dramatically but how far below its weapons production possibility frontier it actually subsists. Most public sources may in fact overestimate the size of the Indian arsenal because New Delhi's approach consists not of accelerating the current output of nuclear weapons but rather preserving the potential to do so in case its strategic environment deteriorates in unexpected ways. Consequently, the modest expansion of the Indian nuclear arsenal that is currently occurring is driven by considerations that have nothing to do with its supposed counterforce ambitions. If the latter were, indeed, a driving force, India would have built up a much larger nuclear force in comparison to Pakistan because even the simplest calculations suggest that no preemptive nuclear strikes aimed at damage-limitation could be successfully prosecuted under conditions of either nuclear parity or, even worse, nuclear inferiority.

Finally, a close examination of India's nuclear capabilities also suggest that it cannot pursue the counterforce strategies that Clary and Narang attribute to it because it lacks the ability to detect Pakistan's nuclear forces, especially its mobile ballistic missiles, in real time. India's own nuclear ballistic missiles—the fastest attacking vectors in its arsenal and the only force component that could possibly execute large-scale counterforce attacks in a highly compressed timeframe—also do not have the accuracy necessary for this task. And India's high-yield nuclear weapons, which could, in some circumstances, compensate for the inaccuracy of its delivery systems, are still unreliable and would be ineffective if deployed without further testing. Most of all, however, India still lacks a command-and-control system designed to execute massive nuclear attacks—strikes that involve scores of simultaneous nuclear missile launches—of the kind that would be required for a splendid first strike directed at an adversary's nuclear forces.<sup>897</sup> Of equal pertinence is the fact that India shows no interest in developing such a command system because it seems satisfied that its current automated decision aids suffice for the retaliatory mission that its Strategic Forces Command plans for as the primary responsibility.

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capability to execute any meaningful first-strike counterforce strategies and, as such, is unlikely to be seduced by such alternatives.

If India were to contemplate damage-limiting nuclear first strikes on Pakistan in order to avert the dangers of any nuclear first use by Islamabad—whether through the employment of Pakistan’s tactical or its strategic nuclear forces—the best chance for success would be a bolt-out-of-the-blue attack, assuming that New Delhi knew the locations of all Pakistan’s nuclear storage sites to begin with. Such an attack offers the hope of destroying Pakistan’s entire land-based nuclear force (or most of it) when it is still concentrated in its peacetime locations. This scenario would be attractive because a surprise attack, if successful, on a relatively small number of Pakistani facilities, decisively eliminates Islamabad’s nuclear threat root and branch, and frees India from the fear of having to face Pakistan’s nuclear first use as a counter to New Delhi’s conventional military operations—the danger that India’s supposed shift toward a nuclear counterforce strategy is intended to mitigate.

Even this most favorable contingency—where all of Pakistan’s nuclear weapons are concentrated at their peacetime locations and the geo-coordinates of all these facilities are known to India—is currently riddled with serious challenges. For starters, Pakistan’s airfields may be the only targets that are susceptible to easy destruction with a relatively small number of Indian nuclear weapons. If it is assumed that India employs ballistic missiles with a circular error probable of about 100 meters to deliver a 12-kiloton fission warhead on critical Pakistani airfields, no more than two nuclear weapons targeted at the hangar areas would destroy most of the aircraft at a single airbase such as Sargodha with a relatively high probability (greater than or equal to 90 percent) of success.<sup>898</sup> If it is assumed that Pakistan has eight airfields where nuclear capable aircraft are either based or could operate out of, India would thus require about sixteen ballistic missile-delivered nuclear weapons to destroy Islamabad’s air-breathing nuclear delivery infrastructure. (In all the counterforce attack possibilities explored here, ballistic missile strikes are the only relevant forms of attack because aircraft and cruise missile delivery, being much slower and potentially susceptible to interception in comparison, would defeat the purpose of swiftly eliminating Pakistan’s nuclear reserves before they could be either dispersed or launched.)

Pakistan’s principal nuclear capabilities, however, no longer reside in its air-delivered weapons but in its ballistic missiles. Attacking the facilities containing these missiles and their warheads, however, will prove to be far more problematic, even assuming that their loca-

All the same, the discussion that follows illustrates the challenges that India would face in any first-strike nuclear counterforce campaign. By demonstrating the implausibility of success in even discrete operations through a series of vignettes, it corroborates the conclusion that India does not have the

tions are known with a high degree of accuracy. If it is assumed again that the CEP of most of India's strategic missiles is about 100 meters, India would need five 12-kiloton warheads to crush *each* aboveground Pakistani nuclear bunker with a ground shock vulnerability number of 40P8 on the expectation that it desires 90 percent probability of successful destruction. Two 30-kiloton warheads (the supposed yield of the Indian boosted-fission weapon) would be required to destroy each such bunker, though one 200-kiloton thermonuclear warhead would suffice to destroy each bunker with a single detonation.

The modest warhead yields and the relatively large inaccuracies of India's missiles combine to increase the number of nuclear weapons required to successfully interdict Pakistan's aboveground nuclear storage bunkers. If Indian missiles had greater accuracy—say, 30 meters—only one warhead of either 12 kilotons, 30 kilotons, or 200 kilotons would suffice to destroy each bunker at a 90 percent probability of destruction. If Indian war planners demand higher degrees of confidence in their interdiction operations—say, a 95 percent probability of success—the number of Indian weapons necessary to destroy Pakistan's aboveground nuclear bunkers increases even further if the attacking Indian missiles have a CEP of 100 meters or larger. Because success is more sensitive to accuracy rather than yield, only a missile with a 30-meter CEP or better can destroy one bunker with a single nuclear weapon.

Given current Indian missile accuracies, destroying Pakistan's aboveground nuclear storage bunkers can quickly absorb a significant number of India's most reliable nuclear weapons. Even this burden pales into insignificance, however, when Indian attacks on Islamabad's underground storage facilities are considered. Like most emerging nuclear powers, Pakistan has invested heavily in hard and buried storage sites. These facilities can be divided into two broad categories: facilities built by "cut and cover" methods of construction and located at depths that do not exceed 20 meters (which could be designated shallow underground facilities), and facilities that require specialized tunneling for their construction, possess redundant ventilation, power and communications systems, are located at between depths of 20 to 100 meters (which are considered deep underground facilities). These deep underground facilities can exist under flat plains or under hills and mountains, with their entrance and internal layouts varying considerably depending on the topography. Facilities built at depths greater than 100 meters are also common worldwide and these present difficult targets for attack even with nuclear weapons. The United States has developed specific earth penetrating nuclear warheads for such missions, but neither China, nor India, nor Pakistan are known to have such capabilities today.<sup>899</sup> If the information pertaining to Pakistan's Kirana Hills nuclear weapons storage site is any indication, Islamabad's deeply buried nuclear storage sites are large—ranging anywhere from a few square kilometers to a few tens of square kilometers in size—and subsist at depths greater than 100 meters.<sup>900</sup>

If a 40P8-class Pakistani underground storage site located at a depth of 25 meters is attacked by a 12-kiloton warhead carried by an Indian ballistic missile with a CEP of 100 meters, the single shot probability of kill would be only about 24 percent (when measured against

a desired 90 percent probability of success), thus requiring 9 Indian nuclear weapons to destroy each buried site. Only if the CEP of Indian missiles is reduced to 30 meters—no Indian ballistic missile is currently capable of such accuracy—does the number required drop to one missile attack per storage site if a 90 percent probability of success is desired. If Pakistan's storage sites are located at depths of 100 meters—and the Kirana Hills facility, for example, suggests even greater depths from the summit even if its entrance tunnels are entirely horizontal—the requirements for a successful Indian nuclear attack increase dramatically. With a CEP of both 30 and 100 meters, no Indian missile can successfully destroy such targets if they are armed with 12-kiloton warheads. With 30-kiloton warheads and a CEP of 30 meters, India would need 3 nuclear weapons for destroying each target at a 90 percent probability level, but with a CEP of 100 meters (the rough standard for most Indian long-range missiles), India would need to commit 22 nuclear missiles to destroy each Pakistani underground storage site.

This calculation by itself should provide pause. It suggests that even if India's most reliable nuclear weapons—the 12-kiloton devices—are utilized for attacks on underground targets using highly accurate ballistic missiles of 30-meter CEP—delivery systems that do not yet exist—the expenditure ratio of weapons-to-targets is not always favorable: one weapon would be needed to successfully destroy each shallow underground site, but deep underground sites would be completely impervious to destruction. For Indian leaders possessing a small nuclear arsenal and facing an uncertain number of underground Pakistani targets at varying depths, the benefits of expending their nuclear reserves on this mission, *vice* some alternative deterrent strategy, cannot make such damage-limiting counterforce strikes particularly attractive.

Even these crude calculations, however, assume that the Pakistani underground facilities to be interdicted are solely *point* targets. Destroying the entirety of the overground topology that rests above the storage sites is beyond the reach of India's current nuclear weaponry. The best that India can do in present circumstances is to attempt targeting each of the adits leading to the underground storage caverns, but the number of aim points quickly becomes very large—assuming all can be identified to begin with—and could easily exceed the number of missile-borne nuclear weapons in the Indian arsenal. For example, one Indian analyst has identified ten entry portals at Pakistan's Kirana Hills facility.<sup>901</sup> The actual number of adits could be much larger and depending on their number and the distances between them, multiple 12-kiloton nuclear weapons might be required to suppress this facility. Even if all these weapons were successfully employed, it is worth remembering that the Kirana Hills site is only one among many other facilities that Pakistan has presumably constructed. Interdicting all these targets would quickly absorb a large number of Indian nuclear weapons from what is still a relatively modest arsenal.

The key conclusion of relevance, therefore, to the claim that Indian counterforce attacks are now plausible is that even in the best scenario imaginable—a bolt-out-of-the-blue Indian

nuclear attack on an unprepared and undispersed Pakistani nuclear force—the number of Indian nuclear weapons required for success in such operations is potentially large. This outcome is driven partly by the fact that the effective radius of India’s 12-kiloton weapons against hard storage sites is relatively small (because of both their small yields and, more importantly, the inaccuracy of their delivery systems), and equally significantly because the craggy terrain that envelopes the portals of many underground sites could further limit their destructive effects. As a result, attempting to successfully attack all of Pakistan’s underground storage sites—many of which are not point targets—will not only exceed the number of strategic missiles currently in the Indian arsenal but also the numbers that might be reasonably anticipated to exist a decade or so from now.

This conclusion can be easily illustrated. With 12-kiloton-yield warheads and using 100-meter-CEP missiles, India would need ninety weapons merely to interdict ten 25-meter deep Pakistani nuclear weapon storage sites at a desired 90 percent probability of kill; using the same parameters, 450 weapons would be needed to interdict fifty Pakistani targets.<sup>902</sup> The ratios might look more appealing if the Indian missiles’ CEP is reduced to 30 meters. Now a single warhead, irrespective of yield, can destroy a single target buried at a depth of 25 meters. But this economy is misleading because if the Pakistani storage sites are enclave and not point targets, then the 1:1 ratio of warheads to targets actually refers to the number of “designated ground zeros” or aim points, many of which may be required to suppress a single Pakistani nuclear storage facility. If Pakistani nuclear weapon storage sites located at a depth of 100 meters have to be attacked, the numbers required become even larger and hence are not worthy of consideration. The bottom line, therefore, is simple: any Indian attempts to destroy all of Pakistan’s underground storage sites will require a large number of nuclear weapons that will certainly exceed the number of missile delivery systems likely to exist in the Indian arsenal during this decade. This issue is particularly relevant because although India will continue to expand its overall nuclear inventory, most of its weapons will not be optimized for damage limiting counterforce attacks.

Even the best-case scenario for Indian nuclear counterforce strikes—a surprise attack on an un-generated Pakistani nuclear deterrent—can, therefore, be eliminated from consideration because of the burdens imposed on India’s still modest nuclear forces.<sup>903</sup> And this conclusion does not consider other factors that any attacker must take into account: that the reliability of India’s nuclear weapons and its delivery systems in practice might fall short of their nominal values,<sup>904</sup> and the likelihood that any single attacking missile may have a larger CEP than the abstract estimate for its class as a whole. Both these factors would end up making the nuclear force requirements for a successful Indian first strike even larger than they already are. Moreover, the possibility that India may not have successfully identified all of Pakistan’s covert nuclear weapons storage sites, which are continuing to increase in number, should induce sufficient caution in any Indian policymakers contemplating preemptive counterforce strikes because the consequences of coping with any surviving Pakistani weapons, especially those aimed at Indian cities in retaliation, would be devastating. Given this

prospect, expending the bulk, if not the entirety, of the Indian land-based missile force on a preemptive attack on Pakistani nuclear forces makes little sense if it does not more or less eliminate Islamabad's deterrent, even while it would leave India vulnerable to subsequent nuclear threats from China, its much larger and more demanding adversary.

When scenarios other than a bolt-out-of-the-blue strike are more closely examined, the chances of a successful Indian damage limiting nuclear strike are just as, if not more, bleak. Current Pakistani strategic planning calls for a rapid alerting and dispersal of its nuclear forces at the onset of any serious crisis. This does not require the entirety of the Pakistan's land-based force to be flushed in one go, although that possibility has also been planned for if necessary. What is more likely—precisely because Pakistan is confident that India cannot conduct a successful disarming nuclear attack—is the quick dispersal of its nuclear capable aircraft to various alternative airfields to ride out any possible Indian nuclear strikes. There are over a hundred functional airfields in Pakistan and hundreds of hardened shelters, so reserving a small number of nuclear delivery aircraft, if necessary, to survive early Indian nuclear attacks is entirely within Islamabad's capacity.

More important, however, are the dispersal routines involving Pakistan's land-based ballistic missiles. Notwithstanding many claims to the contrary,<sup>905</sup> India does not have the technical capacity to continuously track the movement of Pakistan's mobile missiles or even to identify their dispersed hides where the transporter-erector-launchers would bivouac prior to departing to their launch points. Once flushed from their peacetime storage sites, the detection and continuous tracking of Pakistan's mobile missile force cannot be undertaken by India's space systems because the small number of surveillance platforms on orbit also have limited revisit rates.<sup>906</sup> And while India could exploit Western commercial high-resolution satellite networks to mitigate the limitations of its own space platforms when executing counterforce strikes, Indian nuclear planners would be diffident to do so because access to such systems could be interrupted if foreign governments, choosing to exercise force majeure, prevent their companies from providing such space surveillance services during an intense subcontinental war. No prudent decisionmakers would, therefore, execute a nuclear war plan that relies on surveillance and targeting information as well as bomb damage assessment deriving from platforms over which they have no control.

The detection and tracking of Pakistan's mobile missiles also cannot be undertaken by India's current fleet of unmanned aerial vehicles, which possess mainly electro-optical and electronic intelligence sensors. While these sensors can detect and identify individual transporter-erector-launchers in principle—especially if cued by other sources—India's unmanned aerial platforms presently are not wide area surveillance systems and hence would be unable to surveil the entirety of the dispersed Pakistani nuclear force.<sup>907</sup> They would, moreover, have to operate deep inside Pakistani airspace to conduct their reconnaissance missions, thus making their survival problematic. The Pakistan Air Force routinely prosecutes counter-UAV missions against India, and it must be expected that in wartime both

Islamabad's air and ground-based air defenses will target Indian unmanned aerial platforms as part of their defense of Pakistani airspace.<sup>908</sup>

Finally, India's small fleet of airborne warning and control systems (AWACS) are also constrained in different ways: they are optimized for detecting primarily airborne and maritime surface targets rather than relatively slow-moving ground vehicles operating in a complex terrain characterized by a high degree of surface clutter. For example, the radar aboard the most capable Indian AWACS, the Israeli-developed Phalcon, operates in the low gigahertz range, which is highly effective for detecting aircraft but not for locating ground vehicles or for characterizing and tracking them to support targeted attacks, which would require airborne radars that operate in the higher end of the X-band frequency.<sup>909</sup>

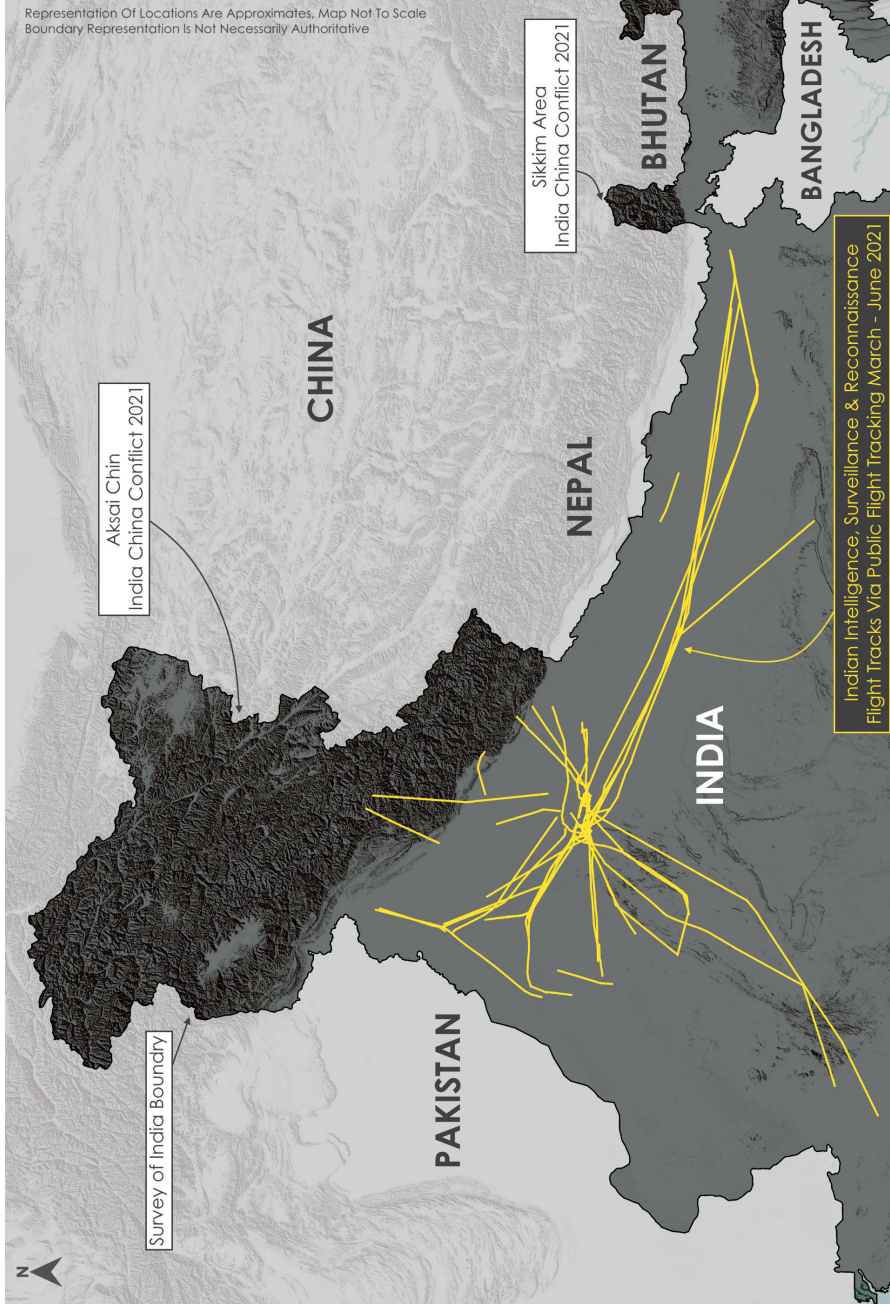
India will acquire such capabilities when it finally purchases intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) aircraft of the kind that have been under discussion for many years.<sup>910</sup> This airborne platform carries a side-looking phased array antenna that combines a ground moving target indicator (GMTI) to track mobile land vehicles in real time and a synthetic aperture radar (SAR) to image the targets. Both operating modes are necessary to detect and track mobile missile transporter-erector-launchers: The GMTI mode enables the radar to track the missile transporter while it moves (but loses the track if the vehicle pauses while the radar beam shifts focus). While the GMTI can thus track vehicular movement depending on the radar's revisit rate relative to the target, its resolution is insufficient to identify specific vehicles such as mobile missile transporter-erector-launchers. The SAR mode, however, creates high resolution images that can be used to identify specific targets.<sup>911</sup> The ISTAR radar system thus fuses the data collected by the GMTI and SAR modes operating alternatively, along with other electro-optical infrared data as well as signal and electronics intelligence, to enable it to track moving targets, such as mobile ballistic missiles once they are dispersed from their peacetime storage sites.<sup>912</sup>

Acquiring the ISTAR system, however, does not imply that India will be able to detect and track all of Pakistan's mobile ballistic missiles at will. For starters, the number of platforms that India may acquire—three to five aircraft are currently contemplated—may not suffice for round the clock coverage. Furthermore, its side-looking radar system, which is unlikely to exceed 250 kilometers in slant range at the aircraft's optimal radar operating altitude of 30,000–40,000 feet implies that it will be able to survey only a narrow 200-kilometer zone coterminous with the Indo-Pakistani border because its operating orbit is likely to lie at least 50 kilometers inside Indian air space to enhance the aircraft's survivability.<sup>913</sup> Data relating to the flight tracks of Indian intelligence, surveillance, and reconnaissance aircraft from March to June 2021 suggest that these platforms operate much deeper inside Indian airspace even in peacetime, which is not at all surprising given the retrograde constraints that would apply in the face of Pakistani fighters such as the F-16 C/D armed with the ~50 nautical mile-ranged AIM-120C5 missile (Map 4).<sup>914</sup> The surveillance zone inside Pakistani territory would, accordingly, be even smaller than the 200-kilometer swath referred to earlier.



MAP 4

# FLIGHT TRACKS OF INDIAN INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE AIRCRAFT, MARCH-JUNE 2021



Source: Damien Symon (@detresfa\_), The Intel Lab.

The inability to deploy the ISTAR platform in penetrating missions in Pakistani airspace—as the U.S. Air Force, for example, was able to employ its equivalent Joint Surveillance Target Attack Radar System aircraft in Iraq because of the air superiority it enjoyed during both Gulf Wars—implies that mobile missiles deploying from most of Pakistan’s nuclear weapons storage sites cannot be easily tracked by India’s ISTAR fleet or its various UAVs. The detection of some Pakistani nuclear missile transporter-erector-launchers operating close to the border is possible but locating and tracking the entirety (or most) of the dispersed force to support a preemptive nuclear counterforce attack is implausible.

Even if this were not the case, however, the principal challenge that India faces in targeting Pakistani mobile missiles through nuclear counterforce strikes is the absence of an information fusion and command-and-control system designed to interdict large numbers of time critical mobile targets simultaneously. India has not developed such a system for its nuclear operations—as the United States did during the Cold War and maintains to this day—precisely because its nuclear deterrent has not been designed for the conduct of preemptive nuclear counterforce attacks. Curiously, Clary and Narang argue that “pursuing . . . graduated [nuclear retaliatory] options would place enormous pressure on India’s command and control system.”<sup>915</sup> If the command-and-control requirements for Indian nuclear retaliation in the aftermath of a Pakistani nuclear attack are burdensome—precisely the scenario that India has in fact developed substantial technical and procedural capabilities for—the command-and-control burdens to manage a preemptive nuclear strike on even a few dozen fixed targets are enormous. If these strikes must be conducted, as would be more likely, on what could be over a hundred dispersed Pakistani ballistic missiles (and counting), the command-and-control problems could quickly become unmanageable.

All such attacks would require unleashing scores of Indian nuclear missiles from widely dispersed locations to arrive simultaneously (or almost simultaneously) on their equally extensively scattered targets. A sequential arrival of the attacking missiles would be futile because that would alert Pakistan to the Indian first strike and would precipitate the launch of many or all of Islamabad’s surviving weapons. Given the difficult challenges of acquiring accurate targeting information about Pakistan’s dispersed missile force and managing the largescale structured attack necessary to neutralize Islamabad’s deterrent, it is hard to understand why New Delhi would contemplate preemptive counterforce attacks on the entire Pakistani nuclear arsenal if the challenges of managing nuclear retaliation—a much simpler task when focused on countermilitary and countervalue targets—is already deemed to be oppressive.

Even if the problems of command and control are excluded from the analysis, any Indian preemptive counterforce attacks on dispersed Pakistani nuclear missiles would face serious challenges—as the following illustrative calculation indicates. Since mobile missile launchers are soft targets that are more vulnerable to dynamic pressure—that is, the drag from wind effects (designated Q)—rather than overpressure, which is usually used to describe

the vulnerability of hard targets, the imputed hardness of such systems is much less than that characterizing aboveground bunkers for example. In the U.S. Defense Intelligence Agency's vulnerability number system,<sup>916</sup> the vulnerability of mobile missile launchers is 11Q9, which is sufficient to overturn the launcher and crush the missile.<sup>917</sup> These values are highly reliable because the hardness of all missile systems is comparable unlike those of aboveground or underground bunkers whose hardness depends on their design, materials, construction techniques, and passive protection.

With 11Q9 targets, a 12-kiloton warhead's weapon radius is 1,000 meters, a 30-kiloton warhead's is 1,600 meters, and a 200-kiloton warhead's is 3,800 meters.<sup>918</sup> For heuristic purposes, the attacking Indian missile is assumed to have a zero CEP, and it is assumed that India has detected the location of the storage site from whence the Pakistani missile launcher would emerge. Two different launcher speeds are assumed: 30 kilometers per hour (that is, the launcher moves 1 kilometer every two minutes) and 60 kilometers per hour (or 1 kilometer every minute). Again, for the sake of simplicity, it is assumed that the launcher is moving along a straight road and has the option of moving in two directions away from its fixed facility. For a Q-type target, the attacking weapon must detonate within 0.6 times the weapons radius away from the missile launcher to achieve a destruction probability of 91 percent.<sup>919</sup>

On these assumptions, if India attacked a mobile Pakistani missile launcher moving at a speed of 30 kilometers per hour with a missile-delivered 12-kiloton warhead, the weapon would have to reach the target within 1.2 minutes from the time that the launcher started moving. If the Pakistani mobile missile moved at a speed of 60 kilometers per hour, India would have only 0.6 minutes to effectively interdict the Pakistani system. If the size of the Indian warhead is increased to 30 kilotons, the time required for successful attacks on Pakistani missiles moving at 30 and 60 kilometers per hour would be 1.9 minutes and 1.0 minutes, respectively. For a 200-kiloton weapon, the claimed yield of India's thermonuclear warheads, the attack time required to successfully interdict Pakistani missiles moving at 30 and 60 kilometers per hour would be 4.6 minutes and 2.3 minutes, respectively. If the launcher had the option of moving in only one direction from its fixed facility, then all these reaction times double.

In other words, successfully destroying a Pakistani mobile missile with a 12-kiloton warhead would require an Indian missile to reach its target within 0.6 to 2.4 minutes of the Pakistani launcher leaving its storage site. Given three assumptions—that the Agni-I SRBM, with its 700-kilometer maximum range, is the most responsive Indian offensive system available, that all the Agni-I missiles are ready and prepared for launch as soon as the Pakistani missile transporter-erector-launchers are detected leaving their storage sites, and—astonishingly—that the time required to both fix and track the Pakistan transporter-erector-launcher after detection and complete updating the target coordinates into the attacking Agni-I missile is zero—the Agni-I's flight time to target at any range up to its maximum always exceeds

the time window required for successful interdiction by an extraordinary margin. Even if the Agni-I is armed with a 200-kiloton thermonuclear warhead, its flight time to target invariably exceeds the maximum time window required to destroy the Pakistani system. The use of India's longer-ranged systems, such as the Agni-IP, Agni-2, and Agni-3, in such counterforce attacks—irrespective of their accuracy or yield—does not resolve the problem of constrained time windows either.

These calculations are admittedly crude, but they clearly suggest that interdicting Pakistan's mobile ballistic missiles while dispersing from their storage sites will not be easy for India—despite the artificially favorable assumptions that have been used to favor the hypothetical Indian attack. A more realistic vignette focused on attacking Pakistan's missile transporters that may be detected when shuttling around after dispersal only confirms the point that the number of Indian nuclear weapons that would be required for this task are extremely and, almost certainly, unacceptably large.

Assume that a Pakistani missile launcher is detected in the field (by any means) at  $t_0$ . It is reasonable to assume that at least five minutes are required to fix the target, establish a track, confirm the identity of the target, and select and commit the Agni-I missiles to barrage the detected area. Since it takes about nine minutes for the Agni-I to fly to its maximum range, it will require about fourteen minutes to reach the designated target. Again, the Agni-I is assumed to have a zero (or near zero) CEP, and the detected Pakistani missile launcher is operating off-road at a speed of 30 kilometers per hour. From the time of detection to actual interdiction, the Pakistani missile could have traveled in any direction (at least notionally) for up to seven kilometers, thus placing it anywhere inside a circle with a seven-kilometer radius.

The number of attacking missiles required to cover a seven-kilometer radius circle varies depending on the yield of the Agni-I's warhead: this figure is determined by calculating how many circles pertaining to a given weapon's radius can be fitted within a larger seven-kilometer circle of uncertainty. The three yields of relevance to the Agni-I, as before, are 12 kilotons, 30 kilotons, and 200 kilotons, with 0.6 of each weapon's radius—where the probability of kill is 91 percent from a single weapon—treated as defining the lethal area. Because a mobile missile launcher is a Q-type target, there is a substantial probability that it will be destroyed even if it is located outside the lethal perimeter of any *single* attacking missile if the entire circle of uncertainty is blanketed by the requisite number of missiles required to achieve a kill probability of 0.9 or greater.

The results of such a calculation are sobering. If the Agni-I is assumed to possess a single 12-kiloton warhead, its effective kill radius is 600 meters and 103 missile-delivered nuclear weapons would be required to cover the mobile missile's circle of uncertainty of some 154 square kilometers. If the Agni-I is assumed to carry a single 30-kiloton warhead, its effective kill radius increases to 960 meters and fewer weapons—thirty-nine warheads—are now

required to cover the Pakistani mobile missile's circle of uncertainty. If the Agni-I's yield is increased to 200 kilotons, the claimed yield of India's thermonuclear weapons, its effective kill radius increases dramatically to 2.28 kilometers and only seven weapons are now required to cover the mobile missile's circle of uncertainty.

While the number of Indian weapons required to successfully interdict Pakistan's dispersing mobile missiles thus reduces significantly as the yields of its weapons increase, this can be hardly any consolation to Indian military planners because the weapons exchange ratios are still highly unfavorable to India at a time when the Indian nuclear inventory is still smaller than, or at best on par with, Pakistan's nuclear arsenal.

The bottom line suggested by this extended discussion is that only Indian counterforce attacks against Pakistan's airfields stand a reasonable chance of success. Similar attacks, when levied against aboveground or underground storage sites or against mobile ballistic missiles, could be extremely costly in terms of the weapons expended while still not being assured of any high probabilities of success. If, notwithstanding anything that has been said so far, a major Indian counterforce strike might, in fact, manage to eliminate say some 90 percent of Pakistan's land-based missiles, that option arguably could prove to be attractive to New Delhi in a crisis because the residual Pakistani nuclear force would be small enough to be parried by India's emerging missile defenses.

Clary and Narang do advance exactly this argument, but it is fallacious on three counts. First, the foregoing explorations suggest that the levels of success required to make an Indian counterforce strategy plausible currently lie beyond India's reach because it does not have the number of nuclear weapons and delivery systems, relative to Pakistan's own growing arsenal, for the task. When the complications produced by the small yields of India's nuclear weapons, the limitations of its surveillance capabilities, the constraints imposed by its command-and-control system, and the larger issues of systems reliability are all factored in, the limitations of any hypothesized Indian counterforce strike become virtually self-evident. Any improvements to India's strategic capabilities since the turn of the century fail to alter the fundamental implausibility of a counterforce strike, as Indian strategic planners readily recognize.

Second, India's missile defense systems, which are nowhere near being operational—despite the Indian Defense Research and Development Organization's oft-cited claims—would even at maturity serve only as point (or, at best, as enclave) defenses for a handful of locations at most.<sup>920</sup> Despite their eventual integration into India's air defense system, their effectiveness against attacking missiles is uncertain. In any case, these systems will defend only a small number of critical sites, which implies that vast portions of the Indian landmass will continue to remain vulnerable to Pakistani retaliation undertaken by its surviving land-based ballistic missiles, not to mention its increasing numbers of land-based cruise missiles as well as its sea-based systems.

Third, the enormous casualties that would be inflicted on India even by Pakistan's residual nuclear attacks fundamentally call into question the logic of prosecuting even those "successful" counterforce strikes that might be imagined. Clary and Narang correctly note that India has lost "more than 30,000 civilians and security force personnel to terrorist or militant violence in the last thirty years."<sup>921</sup> The possibility of Indian counterforce strikes arise only in the context of New Delhi's effort to cope with the threats of Pakistani nuclear use in response to India's conventional punishment against Islamabad for supporting terrorist acts. But the absurdity of the trade-offs involved here is manifestly apparent: even if ten Pakistani land-based nuclear missiles survive India's counterforce strike, the devastation suffered by the Indian population outside its missile defenses would be enormous. If the average population density in the core areas of major Indian cities is around 20,000 people per square kilometer, then a single ~12-kiloton Pakistani weapon would kill about 130,000 people and injure another 240,000 more. If this is the price to be paid for an attack on one Indian city—let alone ten—Indian policymakers would be better off accepting the annual 1,000 casualties from terrorism than risking the loss of 130 times more deaths alone from a nuclear attack.

***Successive Indian prime ministers, from Atal Bihari Vajpayee down to Narendra Modi, have shied away from even major conventional land force operations that could trigger a Pakistani nuclear response.***

Successive Indian prime ministers, from Atal Bihari Vajpayee down to Narendra Modi, have internalized this calculus, however disconcerting, and therefore have shied away from even major conventional land force operations that could trigger a Pakistani nuclear response—let alone contemplating preemptive nuclear counterforce strikes as is now claimed. Because India (like Pakistan) has been a late nuclearizer, its security managers have fully absorbed the lessons of the nuclear revolution. They approach issues pertaining to nuclear weaponry as political animals rather than as academic theorists and, consequently, epitomize the conservatism that McGeorge Bundy described when he wrote:

There is an enormous gulf between what political leaders really think about nuclear weapons and what is assumed in complex calculations of relative "advantage" in simulated strategic warfare. Think-tank analysts can set levels of "acceptable" damage well up in the tens of millions of lives. They can assume that the loss of dozens of great cities is somehow a real choice for sane men. They are in an unreal world. In the real world of real political leaders—whether here or in the Soviet Union—a decision that would bring even one hydrogen bomb on one city of one's own country would be recognized in advance as a catastrophic blunder; ten bombs on ten cities would be a disaster beyond history; and a hundred bombs on a hundred cities are unthinkable.<sup>922</sup>

This judgment, while emphatically true, does not address Menon's dilemma: How would India react if it were faced with the knowledge that Pakistan was readying nuclear weapons for launch on India? This conundrum is hardly new and Indian policymakers since Vajpayee's term in office have had to grapple with it—most acutely both during the 1999 Kargil conflict and during the 2001–2002 India-Pakistan crisis. In all imagined contingencies during that time, their conclusions were the same: there is no rational reason for India to attack preemptively even if Pakistan appears to be on the cusp of using nuclear weapons first. The great doyen of Indian strategic thinking, K. Subrahmanyam (and subsequently one of Menon's predecessors, Brajesh Mishra), summarized these arguments in the following way, which are worth quoting at length from an earlier work:

First . . . any information about imminent nuclear attack, if such is available at all, is likely to be more ambiguous and incomplete than transparent and conclusive given the nature of the strategic capabilities, force architectures, and deployment postures maintained on all sides. Thanks to this fact, incomplete information ought to warrant reticent responses rather than hasty overreaction, especially given the high costs of mistaken action in the nuclear realm. Second . . . even if credible information about an imminent attack is available, it is still prudent for India *not* to respond preemptively because preemption would only ensure that an attack, which was only probable up to that point, actually became inescapable. Because the difference between probable and inescapable attack embodies enormous consequences for both Indian and regional security . . . prudence and moral sensibility would demand responses that decelerate the pace of escalation, not speed it up—as preparations for preemptive responses ineluctably do. Third and finally . . . the very challenge that such contingencies pose places special obligations on India and its no-first-use pledge: It requires New Delhi to ensure that its strategic assets are survivable enough that even if its adversaries are tempted to unleash first strikes, *India* will never feel compelled to use its nuclear weapons first merely because the vulnerability of its strategic reserves produces enormous differences between the expected costs of striking first and those of striking last.<sup>923</sup>

Nothing has changed in the Indian and Pakistan arsenals between 1998 and the present day to fundamentally vitiate these judgments reached early by Indian policymakers. They still remain the most sensible response (other than conventional counterforce) to Menon's dilemma as well as to other domestic critics of India's no-first-use policy. Because Pakistan evinces no interest in counterforce strikes against Indian nuclear forces nor has the capacity to execute such attacks even if it so desired, Indian *nuclear* preemptive counterforce attacks against Pakistan's static nuclear storage sites or Pakistan's mobile nuclear weapon systems that may be episodically detected are irrational if they cannot eliminate close to the entire Pakistani nuclear reserve and thereby immunize India against the subsequent retaliation that would become inevitable. In any conventional conflict, it is possible that Pakistan's mobile nuclear systems may be occasionally attacked successfully by India's conventional

forces, but such instances are a far cry from preemptive nuclear counterforce operations prosecuted by New Delhi.

In any case, neither preemptive Indian conventional nor preemptive Indian nuclear attacks on Pakistan's nuclear arsenal would comprehensively destroy it, thus making *such a campaign futile to begin with*. This is exactly the conclusion that Clary and Narang fail to draw even when they admit that "the prospects for [Indian] counterforce success even against Pakistan's current force are questionable."<sup>924</sup> If so, why would Indian policymakers be supposedly flirting with any nuclear damage-limitation strategies to begin with? Consequently, in the absence of more persuasive evidence—such as a buildup of India's nuclear weapons inventory relative to Pakistan; an increase in the number of highly accurate Indian missiles; the acquisition of an intelligence, surveillance, and reconnaissance network that permits real-time targeting; the development of a command-and-control system designed to execute large and structured attacks; or nuclear force exercises that involve rapid alerting, integration, and salvo launches of multiple missiles simultaneously—the insinuation that India is veering toward preemptive nuclear counterforce operations against Pakistan must be dismissed conclusively.<sup>925</sup> As Shyam Saran, reflecting the convictions of India's policymakers, summed it up succinctly, nuclear weapons "are not weapons of war in any meaningful sense. These are weapons of mass destruction—and the keyword here is "mass." Their use would render *any* credible war aim irrelevant" (emphasis added).<sup>926</sup>

Given this judgment, it is equally important to recognize that in any contingency where Pakistan uses its nuclear weapons first, India has targeting options beyond strikes on Pakistani cities when it comes time to retaliate—if New Delhi desires to prosecute strategies other than massive retaliation. India can—and likely will—pursue countermilitary targeting or countervalue targeting outside of population attacks if it seeks to respond proportionately to Pakistani nuclear use that is not directed at India's own cities to begin with. None of these options will obviously be advertised a priori, but such retaliation does not require alacrity for its effectiveness, and, consequently, the need for striking Islamabad's nuclear weapons even in retaliation is not at all compelling partly because of the difficulties involved in executing such attacks and partly because such counterforce attacks may not be punitive enough depending on the targets that Pakistan has struck first. India's nuclear posture has already evolved toward alerting a small subset of its strategic systems at the onset of any crisis—just as Pakistan does as well—in order to both signal resolve to bolster deterrence and to be able to retaliate rapidly against a range of soft targets as part of a strategy of punishment, not denial.

All this confirms the conclusion offered at the beginning of this discussion—that nuclear crisis stability in the Indo-Pakistani dyad is actually quite high despite conventional deterrence stability potentially being threatened by the possibilities of limited war arising from Pakistan's continuing nuclear-shadowed campaign of terrorism against India.<sup>927</sup> Even here, however, things are more hopeful than often feared because even the most muscular Indian



leaders, conscious of the risks of nuclear war, have chosen not to exercise force in ways that could lead to easy nuclear escalation.<sup>928</sup> To that degree, Pakistan's nuclear planners have it exactly right: whatever the illogic of their tactical nuclear weapons or the expansion and diversification of their larger nuclear arsenal might be, they have succeeded in cementing deterrence at both the conventional and the nuclear levels vis-à-vis India as a result of a policy that threatens nuclear "first-use-but-last resort."<sup>929</sup> Indian leaders, in turn, may deny that they are deterred by Pakistan's nuclear threats but that is largely rhetorical posturing that is intended to avoid giving Islamabad the impression that it can needle New Delhi with impunity. The Indian military will obviously prepare for major conventional conflict even amid the threats of Pakistani nuclear use but outside of responding to Pakistan's most egregious acts of nuclear-shadowed terrorism with limited force, Indian leaders have little interest in provoking or undermining Pakistan (or prosecuting any significant conventional attacks against Pakistan) for their own reasons.

Consequently, Islamabad's security would be enhanced far more deeply if it were to consciously come to terms with the current geopolitical realities in the subcontinent. This implies accepting the territorial status quo with India, desisting from the futile pursuit of equality with its larger neighbor, and abandoning the religious idioms of rivalry that have proven so corrosive within Southern Asia (with the last pathology, unfortunately, now afflicting India as well). A strategic shift of such magnitude in Islamabad and, more importantly, Rawalpindi would lead both to avoid baiting New Delhi through subconventional conflict—an outcome that would contribute mightily toward mitigating the stresses that otherwise find manifestation in the nuclear realm between both countries.

# CONCLUSION

## POTENTIAL DANGERS AHEAD

This survey of the nuclear weapons programs in China, India, and Pakistan describes the significant transitions underway in the character of their respective arsenals. These changes, however, do not automatically portend increased instability in each dyad. The Sino-Indian nuclear relationship, for example, has remained remarkably subdued where arms race, deterrence, and crisis stability are concerned. This comforting outcome is produced by the fact that the political problems between the two nations do not intensely implicate nuclear weapons. That China's nuclear modernization is driven by concerns about the United States rather than India also helps in this context, though the growing sophistication of Chinese nuclear forces ends up putting India at a further disadvantage.

Whether this matters to policymakers (as opposed to analysts) is less clear: to the degree that state managers are influenced by the reality that both sides possess "absolute" weapons, the differences in the relative quality of these capabilities or the precise nuclear balances between the two countries matter less. In any case, Chinese nuclear superiority over India is so pronounced that, for the foreseeable future, New Delhi will focus mainly on increasing its capacity to hold Chinese countervalue targets at risk in order to limit any future nuclear threats issuing from Beijing—which are judged to be remote in any case.

Although the Indo-Pakistani nuclear rivalry dominates public attention more than its Sino-Indian counterpart, here too the dangers of nuclear instability may be less acute than many widely voiced fears suggest. The fundamental challenge in this dyad is less the competing

nuclear weapons themselves and more the circumstances under which they become relevant. Both India and Pakistan are continuing to develop their nuclear arsenals primarily to deter threats that might be posed by the other (and in the case of India, deterring China simultaneously). Left to their own devices, the Indian and Pakistani nuclear programs will continue to emphasize survivability through a combination of increasing inventory size and diversification. But the two nations' aims are subtly different: Pakistan seeks to use its nuclear weapons to prevent all forms of conventional war, whereas India seeks to use its nuclear weapons primarily to prevent nuclear use or nuclear threats directed against itself.

This asymmetry of objectives would not matter were it not for Pakistan's attempt to use its nuclear weapons as cover to challenge India through terrorism and other forms of sub-conventional war. Pursuing such a strategy of nuclear coercion has opened the door to Indian threats of conventional military retaliation, which, in turn, precipitate the dangers of Pakistan's tactical nuclear weapons use and further escalation therefrom. The hazards of deterrence instability thus persist in the case of India and Pakistan as a chronic condition. That it has not mutated into acute crises more often is largely due to the fact that India had been rather cautious about responding with force against Pakistan for many reasons, including the dangers of nuclear escalation. Even a supposedly muscular government of the sort represented by Narendra Modi has not been indifferent to these risks. As a result, the problems of crisis instability too have been muted—a particular danger that has been mitigated largely because the nuclear arsenals on both sides have been designed primarily for punitive retaliation rather than damage limitation.

When all is said and done, however, the most important factor for maintaining strategic stability in the Sino-Indian and Indo-Pakistani dyads is that all three nations still view their nuclear weapons primarily as political instruments rather than as devices for true warfighting. This is most clearly the case where India is concerned. It also holds for China, though this could shift depending on how its current force expansion turns out. Although it may seem counterfactual, even Pakistan ultimately values its nuclear weapons more for their political than their operational effectiveness. Even its tactical nuclear weapons, which are advertised as usable instruments and were developed explicitly for that purpose, find their greatest value not in neutralizing operational threats on the battlefield but as tripwires that signal a willingness to escalate to higher levels of violence and thereby hopefully provoke international intervention on Pakistan's behalf when facing intense Indian conventional military operations. Both outcomes are, in any case, intended to exploit the political consequences of nuclear use to produce speedy war termination rather than really attempting to alter the operational outcomes to produce battlefield success.

The perception of nuclear weapons as essentially political instruments in all three Southern Asian states thus produces a measure of strategic stability that is more robust than their expanding arsenals would suggest. The nuclear asymmetries in the region, accordingly, are manifested in both external and internal dimensions. Externally, the nuclear postures of

China, India, and Pakistan remain sharply differentiated from the postures of the world's strongest nuclear-weapon states, namely, the United States and Russia. The latter still maintain very large nuclear arsenals that are fundamentally configured for executing those prompt counterforce operations associated with damage-limiting nuclear strategies. The continued U.S. emphasis on nuclear deterrence by denial is understandable in the light of Washington's security obligations to its numerous allies. But as a result, and also because of its own Cold War inheritance, Russia has also persisted with a force structure that is intended to prosecute nuclear warfighting, sometimes in even more ambitious guises at the theater and tactical levels than the United States. All the same, the current asymmetry in nuclear doctrine and force posture between the United States and Russia on the one hand and between the three Southern Asian states on the other hand is both significant and conspicuous.

The internal asymmetries in capabilities and posture within the Southern Asian nuclear triangle have been the subject of close examination in this monograph. But the key insights are worth reiterating in this conclusion. Where the increases in force size are concerned, China has moved much faster than India to build up its nuclear capabilities in recent years. On this count, it is matched only by Pakistan, which has also moved with alacrity to expand its arsenal in comparison to the force levels obtained around 1998. India, too, has undoubtedly enlarged its nuclear forces since that time, but the growth here has been remarkably slow and the actual numbers of weapons deployed much smaller than public estimates imply. The same conclusion holds with respect to the qualitative transformation of the arsenal itself. Again, China leads the Southern Asian trio in the diversity of nuclear weapons possessed and in terms of their yields and quality. Pakistan follows next, with India further behind. China also leads where the transformation of the nuclear posture is concerned: now moving toward maintaining a small, rotating portion of its force on heightened alert, Beijing could shift eventually toward preserving a much larger proportion of its capabilities primed for prompt operations. Neither Pakistan nor India have followed suit in regard to their land-based forces, though the advent of continuous Indian (and Chinese) SSBN deterrent patrols will change that outcome in years to come. Even here, though, China is likely to realize this transition much faster than India.

The bottom line, therefore, is that within the Southern Asian triangle, China remains the dominant nuclear power: this is not surprising, given its ambitions to challenge the United States as the global hegemon. But the pursuit of this aim has widened its nuclear superiority over India in consequential ways, even if New Delhi has not yet felt compelled to mitigate this challenge, again for sensible reasons of its own. On many counts, Pakistan

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remains the second-most-capable nuclear power in Southern Asia, whether measured by the number or the diversity of its nuclear weapons. Yet this advantage is less politically significant than it seems because India, its principal antagonist, is unlikely to prosecute any military operations that make Islamabad's nuclear reserves relevant

for purposes of defense. This fact, however, is itself an overdetermined tribute to the success of Pakistani deterrence. The plodding expansion of India's nuclear capabilities then suit New Delhi's status quo disposition just fine, and its third-place status in the regional nuclear sweepstakes does not seem to alarm its decisionmakers unduly because of their conviction that India's modest nuclear reserves today suffice to protect their interests in all plausible threat scenarios involving China and Pakistan.

For all the stability deriving from these conclusions, however, there are uncertainties that could become significant in the years ahead and should be watched carefully by U.S. policymakers. The real dangers of strategic instability would arise if the present expansion of the nuclear inventories in China, India, and Pakistan went beyond numerical growth into specific aspects of qualitative change. Three innovations would be especially destabilizing in this regard.

The first danger arises from the development of defense-driven damage-limiting capabilities and the associated strategies that go with them over time. Specifically, the missile defense programs in China and India merit observation, with a particular emphasis on Beijing's efforts. Pakistan has displayed no interest in developing missile defenses and India seems satisfied with thin enclave defenses at this point. Neither approach fundamentally threatens strategic stability. China, however, appears to be pursuing a more significant missile defense program: if this effort were to produce a "thick" nationwide defense umbrella or even substantial enclave defenses, the impact on the advanced nuclear powers—including the United States, Russia, and even the United Kingdom and France—would be minimal. But, when married to China's offensive weapons, it would possibly weaken India's retaliatory capabilities and could spur New Delhi into pursuing a larger offensive nuclear and missile program than is currently underway in order to correct the imbalance.

The second danger arises from the development of offense-driven hard-target counterforce kill capability, together with the requisite damage-limitation strategy that exploits such potential, over time, in one or more of the Southern Asian states. Neither China nor India nor Pakistan possess such capabilities today, although China comes closest because it has some highly accurate ballistic missiles and, of course, high-yield warheads. China's principal strategic nuclear delivery systems, however, are still relatively inaccurate: this includes its more modern ICBMs, such as the CSS-10 and the CSS-20. Whether China's follow-on

ICBMs or later flights of its current ICBMs end up being extremely accurate and in what numbers remains to be seen. Any consequential shift on both counts would bring the possibility of damage-limiting counterforce strikes within reach, with significant impact on both distant rivals like the United States and nearer competitors such as India. The standard set by the nuclear version of the CSS-18 is already unsettling. If other evolving Chinese theater systems, such as the CSS-22 and the CH-AS-X-13 ALBM, come to possess a combination of variable- or lower-yield warheads and high accuracies, they could—again depending on their numbers—pose special threats to India insofar as they could support counterforce strikes against India’s nuclear reserves in a crisis.

India could address such developments by increasing its own ballistic missile accuracies, but it would almost certainly respond to any increased Chinese counterforce capability by investing more resolutely in its submarine-based nuclear force with an eye to enhancing the survivability of its own national deterrent. Notwithstanding speculation on this issue, India currently does not possess counterforce capabilities against Pakistan, and Islamabad, for its part, has shown little interest in pursuing counterforce capabilities against India. On balance, therefore, any counterforce competition within Southern Asia will be driven primarily by China. Beijing will likely push the envelope in developing some hard-target counterforce weapons over time. These capabilities will be stimulated mainly by its desire to target specific U.S. systems and strategic facilities along China’s periphery and eventually on the U.S. homeland; to be able to mount symmetrical responses in case of U.S. limited nuclear attacks on Chinese military or strategic targets; and to support any discrete nuclear first-use strategies should Beijing feel compelled to adopt extreme measures in any intense conventional conflict with the United States. Such an evolution, however, would also affect India in ways that could trigger conscious counter-responses by New Delhi.

The third danger arises from the possibility that one or more of the Southern Asian states might over time acquire the technical capability to procure asymmetric intelligence transparency vis-à-vis its rivals—a development that in tandem with the other two dangers could produce significant crisis instability of the sort that does not exist today. As previous discussion elaborated, the fact that China, India, and Pakistan all maintain relative opaque nuclear forces is actually conducive to strategic stability in the region. The significant uncertainty about the location of the others’ nuclear reserves mitigates the temptation to attempt any efforts at interdicting them, even in an acute crisis. But various developments in surveillance technology, data aggregation and analysis, and cyber intrusion and exfiltration could enable one or more of the rivals to pierce the prevailing veil of opacity and learn the locations of their adversary’s nuclear reserves. Any asymmetric advantage in locating the others’ nuclear forces increases the prospect of instability—especially if one country, such as China, also enjoys nuclear superiority in terms of the number of weapons and the accuracy of the delivery systems. The most destabilizing aspect of asymmetric intelligence transparency is that the compromise of locational uncertainty may not be detected by the victim in good enough time to develop countermeasures. Obviously, the uncertainty about whether any

counterforce attacks based on the intelligence procured would enjoy comprehensive success would still persist as a break on any temptations to launch splendid first strikes in a crisis, but the possibility of any regional state breaching opacity is something that the United States should be closely attentive to.

If Pakistan were to achieve such a breakthrough vis-à-vis India, or if India were to achieve such clarity vis-à-vis Pakistan or China, the outcome is unlikely to be destabilizing as long as India and Pakistan persist with small inventories of relatively inaccurate nuclear systems. Any Chinese advantages in intelligence transparency vis-à-vis India, however, would have grave consequences because, in time, Beijing is likely to possess sufficient numbers of either large or accurate nuclear weapons to target the entirety of India's nuclear storage sites and the military bases that support nuclear operations. The United States, accordingly, should be concerned about this prospect; Washington should warn New Delhi if it becomes aware that China is realizing such an advantage. India's growing importance in the evolving U.S. strategy toward China demands such intelligence cooperation.

Even as Washington mulls these possibilities, the United States ought to recognize other dilemmas—both its own and India's.

The key dilemma facing the United States because of the nuclear transitions in Southern Asia, and especially China's dramatic nuclear expansion, will be the constraints imposed upon Washington's long-standing desire for further nuclear reductions with Russia. Pakistan's new desire to be able to hold at least some U.S. targets at risk with nuclear weapons adds an additional complication, though Islamabad's nuclear forces are likely to remain sufficiently modest that they can be treated as a "lesser included case" of China's nuclear expansion. If Beijing's nuclear forces, however, are poised to rival the number of deployed U.S. strategic warheads over this decade and the next, it is highly unlikely that either Washington or

Moscow will be able to negotiate further reductions in their strategic arsenals without China's participation in such future efforts. Assuming it persists, the growing Russo-Chinese strategic alignment on display in the lead-up to the 2022 war in Ukraine will only make the imperatives of metering future U.S. strategic nuclear forces to those possessed by both these competitors more pressing, especially if Washington's current nuclear strategy of deterrence by denial remains firmly ensconced.

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Given the uncertainties of international politics, even if the United States were to seek strategic arms reductions in the face of growing Chinese nuclear capabilities, it is unlikely that Russia would be enthused about such diminutions since nuclear weapons alone today

remain markers of its great power pretensions. In any event, U.S. allies are also unlikely to be enthusiastic about any future arms control efforts that portend a weakening of U.S. nuclear advantages because they rely on the benefits of Washington's functional nuclear superiority for their own security. Even friendly bystanders like India, although quick to support all nuclear reductions that purportedly lead up to eventual nuclear disarmament, are astute enough to recognize that U.S. nuclear dominance serves their strategic interests at a time when China remains a major threat to New Delhi and Russia's future trajectory seems entirely uncertain.

For its part, India faces two significant and unique dilemmas as well. As this report highlighted, India's biggest nuclear deficiency vis-à-vis China (and Pakistan) is the absence of reliable high-yield weapons in its inventory. Although Indian policymakers have underplayed this limitation, in part because of a genuine belief that fission warheads are adequate substitutes for thermonuclear weapons, this deficit mattered little when Sino-Indian ties and U.S.-China relations were each relatively stable. At a time when both dyadic partnerships are in deep trouble, however—especially the former—there may come a point when New Delhi feels the need to deploy robust and validated thermonuclear warheads to strengthen deterrence against a more powerful adversary while still maintaining a relatively small nuclear arsenal.

Unfortunately for India, the inadequacies that mark its thermonuclear weapons stockpile cannot be confidently remedied without a return to hot testing. New Delhi undoubtedly has several friends—such as Russia, France, the United Kingdom, and Israel—who have the capacity to aid its weapons designers in perfecting their thermonuclear devices. But it is unclear whether any one of them would be willing to provide such assistance, which, in all cases save Israel, would also require them to violate their NPT obligations. In a different era, the United States provided exactly such help to France when, faced with the growing Soviet threat, U.S. president Richard Nixon's administration made the bold decision to aid Paris in surmounting its difficulties with developing a staged thermonuclear weapon. The highly secret discussions between U.S. and French nuclear designers took the form of a "Gong Show," where the former, permitted by presidential authorization only to provide "negative guidance,"<sup>930</sup> clued the latter with a clanging chime whenever their technical errors surfaced in the conversations. The resulting cooperation helped France to develop an effective trigger for its fusion weapons, among other nuclear capabilities. Although this partnership with a legitimate nuclear-weapon state, as defined by the NPT, did not fall afoul of international obligations, it "almost certainly . . . violated U.S. law."<sup>931</sup> But it was entirely justified because such cooperation represented an audacious U.S. pursuit of its own supreme national interests, which required supporting the French *force de frappe* in the face of the growing Soviet threat.

At a time when U.S. competition with China finds India in an analogous position to that of France during the Cold War, Washington's choices could help India to develop a power-



***At a time when U.S. competition with China finds India in an analogous position to that of France during the Cold War, Washington's choices could help India to develop a powerful nuclear deterrent that durably protects its ability to balance Chinese power in ways that ultimately benefit the United States in Asia and globally.***

of other U.S. nonproliferation objectives and its extant international obligations at a time when the U.S.-China rivalry may not seem as intense as U.S.-Soviet competition once was and, hence, would not precipitate the hard decisions previously made by Nixon (and, in a different way later, by George W. Bush through his civil nuclear cooperation agreement with India).

Yet the United States can aid the Indian effort to develop a capable nuclear deterrent, and this assistance would be manifested most clearly when India decides that it is necessary to return to hot testing. As argued previously, New Delhi is unlikely to field-test its nuclear weapons until it either faces a supreme emergency or other established nuclear-weapon states, especially its adversaries, test their nuclear devices first. Whatever the provocation, any Indian return to overt nuclear testing could provoke U.S. sanctions and almost inevitably either the suspension or the termination of the U.S.-Indian civil nuclear cooperation agreement. It would also lead to an interruption of India's collaboration with other partners in the Nuclear Suppliers Group. These outcomes are certain because the Bush administration, despite trying valiantly, was not able to persuade the U.S. Congress to give India a clean waiver from the relevant provisions of the U.S. Atomic Energy Act (especially Section 129), which would have treated India as a de jure nuclear-weapon state by releasing the U.S. president from the obligation to terminate nuclear cooperation in the event of nuclear testing by New Delhi.

As a consequence of this constraint, any Indian return to nuclear testing would provoke a termination of the bilateral 2008 civil nuclear cooperation agreement. Although a nuclear test by New Delhi is by no means imminent, it is important for the United States to recognize that such an event could occur eventually, and that the administration of the day will have to exercise its waiver authorities in partnership with the U.S. Congress to avoid penalizing India for its renewed nuclear testing. India's decision to resume nuclear testing, if and when it occurs, will be necessary to both perfect its fusion weapon designs and to credibly

ful nuclear deterrent that durably protects its ability to balance Chinese power in ways that ultimately benefit the United States in Asia and globally. In an ideal world, the United States would be able to directly assist India—as it once did France—in developing its own advanced weapons, especially its thermonuclear devices in regard to their effectiveness, reliability, and safety. Even though U.S. President Joe Biden's administration is seeking ways to deepen strategic cooperation with India versus China, nuclear design assistance will prove to be a bridge too far because it would run afoul

communicate that it possesses the requisite capability to deter Beijing in the context of what may be deeply intensifying Sino-Indian (and possibly U.S.-China) strategic rivalries. An Indian ability to balance China in this way is fundamentally in America's interest. Because India can independently improve its delivery systems and their effectiveness without any external constraints, protecting its freedom to test its advanced nuclear weapons when circumstances demand it constitutes the best U.S. contribution toward enhancing geopolitical stability in the wider Asian region at a time when Chinese assertiveness will be increasingly harder to deter in the face of the ongoing improvements of its own strategic capabilities.

The second dilemma facing India pertains to how it might increase the survivability of its nuclear deterrent in the face of the growing Chinese threat. Unlike the problems associated with possibly resumed Indian nuclear testing, which fundamentally implicate U.S. law, the challenges at the U.S. end with aiding India to develop a more resilient nuclear force only implicate U.S. policy—but are complex all the same. As the analysis in this report highlights, the rapidly expanding Chinese nuclear force could bequeath Beijing with a large number of highly accurate ballistic missiles that could in time hold at risk almost every Indian nuclear storage site if China succeeds in piercing the veil of opacity that currently protects these facilities. In the past, Chinese simply did not possess either the appropriate number of missiles or the accuracies required to execute such damage-limiting attacks. Both these constraining conditions now promise to become relics of the past—with only continued opacity and the inferred Chinese disinterest in using nuclear weapons against India intervening to prevent a potential breakdown in crisis stability, yet with significant uncertainties as to their permanence.

Since New Delhi cannot count on both conditions persisting in perpetuity, the Indian answer to this threat cannot consist of building either more or deeper terrestrial storage facilities because such solutions will only place it at the wrong end of the cost-effectiveness equation. Rather, enhancing the survivability of the Indian deterrent will require a combination of stealth and mobility in the form of an effective nuclear ballistic missile submarine force. Unfortunately, New Delhi thus far has not been able to develop a powerful yet compact naval nuclear reactor, and it is unclear whether India possesses the diverse other technologies required to produce a truly quiet submersible either. As a matter of policy, the United States does not assist other countries in this regard—and for good reason. The U.S. Navy is the world's preeminent force in underseas warfare and, hence, has eschewed sharing its technological capabilities for fear of diminishing its own advantages. The recent agreement between Australia, the United Kingdom, and the United States (AUKUS) to help Canberra acquire nuclear attack submarines remains the most conspicuous exception to the standing policy and was controversial precisely because it was such a startling deviation.

The very logic that drove the Biden administration's decision on AUKUS, however—aiding a close friend to advance Washington's aim of balancing China—arguably carries over in the case of India, even though New Delhi is not a treaty ally. Because India shares strong

common interests with the United States in constraining the Chinese quest for hegemony in Asia, and because the survivability of India's nuclear deterrent is a critical backstop to that effort, Washington ought to consider ways to advance this latter objective. Fortunately, it does not require the United States to necessarily offer direct assistance, as it did in the case of Australia. Instead, through a deliberate policy shift analogous to that of Bush's nuclear agreement with India but at much lower political cost, it could encourage another U.S. ally—France—to offer India such collaboration with explicit American support.

The resulting agreement between India, France, and the United States (INFRUS) would not only go some distance in placating Paris for the shabby manner in which Washington helped to abort the previous Franco-Australian agreement for submarine construction, but it would also help India to avail of the superb French naval nuclear propulsion technology to build up its own sea-based deterrent (as well as its nuclear attack submarine force). What Washington would do most of all in such a hypothetical INFRUS compact is to endorse and midwife an Indo-French arrangement. Such an agreement, of course, could be concluded independently between Paris and New Delhi, but it is rather unlikely that France would pursue such a deal in the face of either U.S. reluctance or opposition. Consequently, the most sensible approach to aid India in building an effective naval nuclear reactor would be to develop a trilateral mechanism that first discusses the nature of Indian requirements and, thereafter, develops a plan of action that the United States could endorse even if it does not itself contribute any particular nuclear technology. The threats that will be posed by China's growing nuclear capabilities to India's strategic reserves are likely to be significant enough in the coming years to warrant the exploration of such ambitious solutions—if the common U.S., French, and Indian goal of preventing Beijing's hegemony in Asia and globally is to be realized.

Even as Washington considers these issues, however, the analysis in this report confirms that the continuing expansion and modernization of the nuclear deterrents in Southern Asia will be an enduring fact of life for a long time to come. The recent—and blatant—Russian effort to engage in nuclear coercion during the Ukraine war could provide an example for an ever more ambitious China to exploit in the context of a future crisis with either Taiwan or India. Given these possibilities, the United States ought to begin thinking now about how nuclear weapons ought to be utilized to prevent any unfavorable outcomes to its interests. And where India is concerned, this will require entertaining some innovative policy options that enable New Delhi to blunt Beijing's nuclear superiority in ways that advance both its own national security and American geopolitical aims.

## NOTES

- 1 For an overview of the India-Pakistan conflict, see Sumit Ganguly, *Conflict Unending: India-Pakistan Tensions Since 1947* (New York: Columbia University Press, 2001).
- 2 The connections between Pakistan's search for security, vengeance, nuclear weapons, and terrorism are summarized in Ashley J. Tellis, *Stability in South Asia*, Documented Briefing, DB-185 (Santa Monica: RAND Corporation, 1997), 34–62; and in Ashley J. Tellis, *Are India-Pakistan Peace Talks Worth a Damn?* (Washington, DC: Carnegie Endowment for International Peace, 2017), 25–42. The history of Pakistan's pursuit of nuclear weapons is detailed in Hassan Abbas, *Pakistan's Nuclear Bomb: A Story of Defiance, Deterrence and Deviance* (London: Hurst and Company, 2018); Feroz Khan, *Eating Grass: The Making of the Pakistani Bomb* (Stanford: Stanford University Press, 2012); and Naeem Salik, *The Genesis of South Asian Nuclear Deterrence: Pakistan's Perspective* (Oxford: Oxford University Press, 2009).
- 3 The antecedents of this program and its evolution are splendidly documented in George Perkovich, *India's Nuclear Bomb: The Impact on Global Proliferation* (Berkeley: University of California Press, 1999).
- 4 For a superb summary, see Rudolf G. Wagner, "China and India Pre-1939," in *Routledge Handbook of China-India Relations*, eds. Kanti Bajpai, Selina Ho, and Manjari Chatterjee Miller (London: Routledge, 2020), 35–62; and Tansen Sen, *India, China and the World* (New Delhi: Oxford University Press, 2018), which describes the wider non-strategic interactions.
- 5 An excellent summary overview can be found in Peter John Brobst, *The Future of the Great Game* (Akron, OH: The University of Akron Press, 2005), 15–76.
- 6 The best overviews of British India's interactions with Tibet remain Alastair Lamb, *British India and Tibet, 1766–1910* (London: Routledge and Kegan Paul, 1986); and Alastair Lamb, *Tibet, China, and India, 1914–1950: A History of Imperial Diplomacy* (Hertingfordbury: Roxford Books, 1989).
- 7 Steven A. Hoffman, *India and the China Crisis* (Berkeley: University of California Press, 1990); and John W. Garver, "China's Decision for War With India in 1962," in *New Directions in the Study of China's Foreign Policy*, eds. Alastair Iain Johnston and Robert S. Ross (Stanford: Stanford University Press, 2006), 86–130.
- 8 John Wilson Lewis and Xue Litai, *China Builds the Bomb* (Stanford, CA: Stanford University Press, 1988), 47–48. For the Chinese government's justification for its nuclear weapons program, issued on the occasion of its first nuclear test in 1964, see "Statement of the Government of the People's Republic of China," Wilson Center Digital Archive, October 16, 1964, <http://large.stanford.edu/courses/2018/ph241/shan1/docs/prc-16oct64.pdf>.
- 9 Perkovich, *India's Nuclear Bomb*, 86–105; and A. G. Noorani, "India's Quest for a Nuclear Guarantee," *Asian Survey* 7, no. 7 (1967): 490–502.
- 10 The best history of this tortured evolution remains Perkovich, *India's Nuclear Bomb*, 106–443.
- 11 Hans M. Kristensen, "Prepared Statement of Hans M. Kristensen, Director, Nuclear Information Project, Federation of American Scientists Before the U.S.-China Economic and Security Review Commission Hearing on China's Nuclear Forces," U.S.-China Economic and Security Review Commission, June 10, 2021, [https://www.uscc.gov/sites/default/files/2021-06/Hans\\_Kristensen\\_Testimony.pdf](https://www.uscc.gov/sites/default/files/2021-06/Hans_Kristensen_Testimony.pdf), 1–2.

- 12 “Treaty on the Non-Proliferation of Nuclear Weapons,” opened for signature July 1, 1968, *Treaty Series: Treaties and International Agreements Registered or Filed and Recorded With the Secretariat of the United Nations* 729, no. 10485 (1974): 174.
- 13 Perkovich, *India’s Nuclear Bomb*, 125–189.
- 14 Bharat Karnad, *Nuclear Weapons and Indian Security* (New Delhi: Macmillan India, 2002), 281–445.
- 15 Stephen P. Cohen, *The Idea of Pakistan* (Washington, DC: Brookings Institution Press, 2004), 80.
- 16 Khan, *Eating Grass*, 95–190.
- 17 Haans J. Freddy, “China, India & Pakistan Strategic Triangle – the Pakistan Factor in Sino-Indian Relations,” *Global Affairs* 6, nos. 4–5 (2020): 559–575.
- 18 Ashley J. Tellis, “South Asia,” in *Strategic Asia 2001–02: Power and Purpose*, eds. Richard J. Ellings and Aaron L. Friedberg (Seattle, WA: National Bureau of Asian Research, 2001), 223–268; and Paul J. Smith, “The Tilting Triangle: Geopolitics of the China–India–Pakistan Relationship,” *Comparative Strategy* 32, no. 4 (2013): 313–330.
- 19 These multiple interactions are usefully explored in Jeff M. Smith, “The China-India-US Triangle: A View From Washington,” Andrew Small, “India and the China-Pakistan Relationship: De-hyphenation and Re-hyphenation,” and Vidya Nadkarni, “Russia: A Balancer in India-China Relations;” in *Routledge Handbook of China-India Relations*, eds. Bajpai, Ho, and Miller, 365–379, 410–419, 380–395.
- 20 Hans M. Kristensen and Robert S. Norris, “Global Nuclear Weapons Inventories, 1945–2013,” *Bulletin of the Atomic Scientists* 69, no. 5 (2013): 76. A modest exception to this trend has been the United Kingdom, which after its recent Integrated Review decided to increase its nuclear stockpile ceiling to 260 warheads in comparison to its previous cap of 225 warheads. The reasons associated with this decision are usefully surveyed in Heather Williams, “U.K. Nuclear Weapons: Beyond the Numbers,” *War on the Rocks*, April 6, 2021, <https://warontherocks.com/2021/04/u-k-nuclear-weapons-beyond-the-numbers/>.
- 21 Ashley J. Tellis, *India’s Emerging Nuclear Posture: Between Recessed Deterrent and Ready Arsenal* (Santa Monica: RAND Corporation, 2000): 251.
- 22 Robert Einhorn and W. P. S. Sidhu, “The Strategic Chain: Linking Pakistan, India, China, and the United States,” Brookings Institution, March 2, 2017, [https://www.brookings.edu/wp-content/uploads/2017/03/acnpi\\_201703\\_strategic\\_chain.pdf](https://www.brookings.edu/wp-content/uploads/2017/03/acnpi_201703_strategic_chain.pdf); and Sharad Joshi, “Nuclear Proliferation and South Asia: Recent Trends,” Nuclear Threat Initiative, August 1, 2007, <https://www.nti.org/analysis/articles/nuclear-proliferation-south-asia/>.
- 23 Bill Gertz, “New Chinese Missiles Target All of East Asia,” *Washington Times*, June 10, 1997; and Bates Gill and James Mulvenon, “The Chinese Strategic Rocket Forces: Transition to Credible Deterrence,” in *China and Weapons of Mass Destruction: Implications for the United States, Conference Report* (Washington, DC: National Intelligence Council, 1999).
- 24 Ashley J. Tellis, “The Changing Political-Military Environment: South Asia,” in *The United States and Asia: Toward a New U.S. Strategy and Force Posture* (Santa Monica: RAND Corporation, 2001), 204–205; and Ashley J. Tellis, “China and India in Asia,” in *The India-China Relationship: What the United States Needs to Know*, eds. Francine R. Frankel and Harry Harding (New York: Columbia University Press, 2004), 141.
- 25 “US Embassy Cables: US Expresses Fears Over Pakistan Nuclear Weapon Programme,” *Guardian*, December 5, 2008, <https://www.theguardian.com/world/us-embassy-cables-documents/181529>.
- 26 The drivers of Pakistan’s expanding nuclear program beyond its fears of India are explored in Pervez Hoodbhoy and Zia Mian, “Nuclear Fears, Hopes and Realities in Pakistan,” *International Affairs* 90, no. 5 (2014): 1,125–1,142.
- 27 Daniel S. Geller, “Nuclear Weapons and the Indo-Pakistani Conflict: Global Implications of a Regional Power Cycle,” *International Political Science Review* 24, no. 1 (January 2003): 137.
- 28 *Ibid.*, 147.
- 29 For details, see “China’s Nuclear Tests: Dates, Yields, Types, Methods, and Comments,” Center for Nonproliferation Studies, [https://archive.ph/20131205083146/http://cns.miis.edu/archive/country\\_china/coxrep/testlist.htm#selection-57.0-57.67](https://archive.ph/20131205083146/http://cns.miis.edu/archive/country_china/coxrep/testlist.htm#selection-57.0-57.67).
- 30 Mao Zedong, “On Protracted War,” *Selected Military Writings of Mao Tse-tung* (Beijing: Foreign Languages Press, 1963), 217–218, cited in Shu Guang Zhang, “Between ‘Paper’ and ‘Real Tigers’: Mao’s

- View of Nuclear Weapons,” in *Cold War Statesmen Confront the Bomb: Nuclear Diplomacy Since 1945*, eds. John Lewis Gaddis, Philip Gordon, Ernest May, and Jonathan Rosenberg (New York: Oxford University Press, 1999), 194–215, which highlights the importance of traditional Chinese strategic thought on Mao’s early approach to nuclear weapons.
- 31 For insightful analyses that examine how Marxism struggled to come to terms with nuclear weapons, see Karel Kára, “On the Marxist Theory of War and Peace,” *Journal of Peace Research* 5, no. 1 (1968): 1–27; and Campbell Craig, “When the Whip Comes Down: Marxism, the Soviet Experience, and the Nuclear Revolution,” *European Journal of International Security* 2, no. 2 (2017): 223–239.
  - 32 Renny Babiarz, “The People’s Nuclear Weapon: Strategic Culture and the Development of China’s Nuclear Weapons Program,” *Comparative Strategy* 34, no. 5 (2015): 422–446.
  - 33 For an excellent survey of how Mao’s attitudes to nuclear weapons changed over time, see Zhang, “Between ‘Paper’ and ‘Real Tigers,’” 194–215.
  - 34 For more on how the Chinese nuclear weapons program was intended to respond to these challenges, see Alice Langley Hsieh, *Communist China’s Strategy in the Nuclear Age* (Englewood Cliffs: Prentice-Hall, 1963).
  - 35 The definitive history of this effort remains Lewis and Xue, *China Builds the Bomb*.
  - 36 For details, see 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 (2010): 48–87; and Wu Riqiang, “Certainty of Uncertainty: Nuclear Strategy With Chinese Characteristics,” *Journal of Strategic Studies* 36, no. 4 (2013): 579–614. China also produced an SSBN that never saw an operational patrol.
  - 37 Robert Jervis, *The Meaning of the Nuclear Revolution: Statecraft and the Prospect of Armageddon* (Ithaca: Cornell University Press, 1989).
  - 38 Mao Zedong, *Mao Zedong waijiao wenxuan* [Mao Zedong’s selected works on diplomacy] (Beijing: Shijie zhishi chubanshe, 1994), 540, cited in Fravel and Medeiros, “China’s Search for Assured Retaliation,” 63.
  - 39 Mao Zedong, “The Second Speech at the Second Session of the Eighth Party Congress, 5–23 May 1958,” cited in Lewis and Xue, *China Builds the Bomb*, 69.
  - 40 This characterization of a nuclear weapon’s capabilities is found in an early Chinese Communist Party study published in 1950 and the quote is drawn from Zhang, “Between ‘Paper’ and ‘Real Tigers,’” 198.
  - 41 Zhang, “Between ‘Paper’ and ‘Real Tigers,’” 205.
  - 42 Yin Xiong and Huang Xuemei, *Shijie yuanzidan fengyunlu* [The stormy record of the atomic bomb in the world] (Beijing: Xinhua chubanshe, 1999), 258, cited in Fravel and Medeiros, “China’s Search for Assured Retaliation,” 58.
  - 43 Zhang, “Between ‘Paper’ and ‘Real Tigers,’” 213.
  - 44 Mao Zedong, *Mao Zedong wenji* [Mao Zedong’s collected works], Vol. 8 (Beijing: Xinhua chubanshe, 1999), 407, cited in Fravel and Medeiros, “China’s Search for Assured Retaliation,” 63.
  - 45 Mao Zedong, *Mao Zedong xuanji* [Mao Zedong’s selected works], Vol. 4 (Beijing: Renmin chubanshe, 1964), 1133–1134, cited in Fravel and Medeiros, “China’s Search for Assured Retaliation,” 59.
  - 46 Mao Zedong, “The Second Speech at the Second Session of the Eighth Party Congress, 5–23 May 1958,” cited in Lewis and Xue, *China Builds the Bomb*, 69.
  - 47 Mao Zedong’s speech at a meeting of the Politburo of the CCP Central Committee held at Wuchang, December 1, 1958, quoted in Zhang, “Between ‘Paper’ and ‘Real’ Tigers,” 210.
  - 48 Ministry of Foreign Affairs of the People’s Republic of China and CCCPC Party Literature Research Office, eds., *Selected Works of Mao Zedong on Diplomacy* (Beijing: CCCPC Party Literature Publishing House, 1994), 476, cited in Liu Chong, “The Relationship Between Nuclear Weapons and Conventional Military Conflicts,” in *Understanding Chinese Nuclear Thinking*, eds. Li Bin and Tong Zhao (Washington, DC: Carnegie Endowment for International Peace, 2016), 153.
  - 49 *Mao Zedong yu Zongguo yuanzineng shiye* [Mao Zedong and China’s nuclear energy industry] (Beijing: Yuanzineng chubanshe, 1993), 13, cited in Fravel and Medeiros, “China’s Search for Assured Retaliation,” 59.
  - 50 Liu, “The Relationship Between Nuclear Weapons and Conventional Military Conflicts,” 155.

- 51 Mao Zedong, *Mao Zedong junshi wenji* [Mao Zedong's selected works on military affairs], Vol. 6 (Beijing: Junshi kexue chubanshe, 1993), 359, cited in Fravel and Medeiros, "China's Search for Assured Retaliation," 60.
- 52 Ibid., 61.
- 53 Ibid., 58.
- 54 Zhang, "Between 'Paper' and 'Real Tigers,'" 211.
- 55 Sun Xiangli, "An Analysis of the Nature and Characteristics of China's Nuclear Strategy," *World Economics and Politics*, no. 9 (2006): 227 (author's translation). See the reference to Dao on the same page, suggesting that Mao absorbed enough of the traditional Chinese preoccupation with right although it sat uncomfortably with his record of overseeing the deaths of millions of Chinese at home.
- 56 Zedong, *Mao Zedong junshi wenji*, 374. For a further discussion of prestige in Chinese calculations, see Susan Turner Haynes, "The Power of Prestige: Explaining China's Nuclear Weapons Decisions," *Asian Security* 16, no. 2 (2020): 35–52.
- 57 Mingquan Zhu, "The Evolution of China's Nuclear Nonproliferation Policy," *Nonproliferation Review* 4, no. 2 (1997): 41.
- 58 Ibid.
- 59 Sun, "An Analysis of the Nature and Characteristics of China's Nuclear Strategy," 28.
- 60 Jeffrey Lewis, *The Minimum Means of Reprisal: China's Search for Security in the Nuclear Age* (Cambridge: MIT Press, 2007).
- 61 For more on this issue, see Lyle J. Goldstein, "Do Nascent WMD Arsenal Deter? The Sino-Soviet Crisis of 1969," *Political Science Quarterly* 118, no. 1 (2003): 53–80.
- 62 These arguments in different forms appear in Zhang, "Between 'Paper' and 'Real Tigers,'" 194–215; Wu, "Certainty of Uncertainty"; Babiarz, "The People's Nuclear Weapon: Strategic Culture and the Development of China's Nuclear Weapons Program"; Chen Yi et al., "A Preliminary Evaluation of the War Situation," *CCP Party History Materials* 42 (1992): 70–75, quoted in Chen Jian and David L. Wilson, "All Under the Heaven Is Great Chaos: Beijing, the Sino-Soviet Border Clashes, and the Turn Toward Sino-American Rapprochement, 1968–69," *Cold War International History Project Bulletin* 11 (1996): 166–168; Lewis, *Minimum Means of Reprisal*; Sun, "An Analysis of the Nature and Characteristics of China's Nuclear Strategy"; Sun Xiangli, "The Development of Nuclear Weapons in China," in *Understanding Chinese Nuclear Thinking*, 79–101; and Fravel and Medeiros, "China's Search for Assured Retaliation," 48–87.
- 63 Fravel and Medeiros, "China's Search for Assured Retaliation," 48–87.
- 64 For an excellent Chinese summation of these contrasts, especially as exemplified in Chinese and American approaches to nuclear deterrence, see Yao Yunzhu, "Chinese Nuclear Policy and the Future of Minimum Deterrence," in *Perspectives on Sino-American Strategic Nuclear Issues*, ed. Christopher P. Twomey (New York: Palgrave Macmillan, 2008), 111–124.
- 65 For an illuminating discussion of how the United States ended upon this course, see Frank J. Gavin, *Nuclear Weapons and American Grand Strategy* (Washington, DC: Brookings Institution Press, 2020).
- 66 John G. Hines, Ellis M. Mishulovich, and John F. Shull, *Soviet Intentions, 1965–1985, Vol. 1: An Analytical Comparison of U.S.-Soviet Assessments During the Cold War*, and Vol. 2: *Soviet Post-Cold War Testimonial Evidence* (McLean: BDM Federal, 1995). The judgments in these two volumes are usefully supplemented and qualified by Beatrice Heuser, "Warsaw Pact Military Doctrine in the 1970s and 1980s: Findings in the East German Archives," *Comparative Strategy* 12, no. 4 (1993): 437–457; and Beatrice Heuser, "Victory in a Nuclear War? A Comparison of NATO and WTO War Aims and Strategies," *Contemporary European History* 7 (1998): 311–327.
- 67 Mancur Olson, Jr. and Richard Zeckhauser, "An Economic Theory of Alliances," *Review of Economics and Statistics* 48, no. 3 (1966): 266–279; Todd Sandler and Jon Cauley, "On the Economic Theory of Alliances," *Journal of Conflict Resolution* 19, no. 2 (1975): 330–348; Todd Sandler, "Impurity of Defense: An Application to the Economics of Alliances," *Kyklos* 30, no. 3 (1977): 443–460; and Todd Sandler and Keith Hartley, "Economics of Alliances: The Lessons for Collective Action," *Journal of Economic Literature* 39 (2001): 869–896.

- 68 For an insightful theoretical exploration of the problem of tripolar stability, see R. Harrison Wagner, “Bargaining, War, and Alliances,” *Conflict Management and Peace Science* 21, no. 3 (Fall 2004): 215–231.
- 69 Zhang, “Between ‘Paper’ and ‘Real Tigers,’” 194–215; Michael S. Gerson, *The Sino-Soviet Border Conflict: Deterrence, Escalation, and the Threat of Nuclear War in 1969* (Arlington: Center for Naval Analyses, 2010), 39–52; and Avery Goldstein, “Discounting the Free Ride: Alliances and Security in the Postwar World,” *International Organization* 49, no. 1 (1995): 39–71.
- 70 T.V. Paul, *The Tradition of Non-Use of Nuclear Weapons* (Stanford: Stanford University Press, 2009).
- 71 Nicola Horsburgh, “Change and Innovation in Chinese Nuclear Weapons Strategy,” *China Information* 26, no. 2 (2012): 188.
- 72 Li Hua, “Draft Speaking Notes on Facts and Thinking of Chinese Disarmament” (paper presented at Revitalizing Nuclear Disarmament: The 50th Anniversary of the Pugwash Conferences, Pugwash, Nova Scotia, July 5–7, 2007), 4.
- 73 Ibid.
- 74 For a clear Chinese analysis that elaborates this argument, see Pan Zhenqiang, “China’s No First Use of Nuclear Weapons,” in *Understanding Chinese Nuclear Thinking*, 51–77.
- 75 Wu, “Certainty of Uncertainty.”
- 76 It is in fact highly likely that China had long anticipated systemic rivalry with the United States even before the Cold War ended, but the demise of the Soviet Union and the perception of a towering United States, especially during the unipolar interregnum, only solidified Beijing’s expectations that it would have to contend with Washington as its principal rival in the emerging international system. For more of this issue, see Michael Pillsbury, *The Hundred Year Marathon: China’s Secret Strategy to Replace America as the Global Superpower* (New York: St. Martin’s Griffin, 2015); and Rush Doshi, *The Long Game: China’s Grand Strategy to Displace American Order* (New York: Oxford University Press, 2021).
- 77 Xu Weidi, “China’s Security Environment and the Role of Nuclear Weapons,” in *Understanding Chinese Nuclear Thinking*, 34–36; Wu Riqiang, “China’s Anxiety About US Missile Defence: A Solution,” *Survival* 55, no. 5 (2013): 29–52; and James M. Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike* (Washington, DC: Carnegie Endowment for International Peace, 2013), 121–125.
- 78 Elizabeth Economy, *The Third Revolution: Xi Jinping and the New Chinese State* (Oxford: Oxford University Press, 2018).
- 79 For an excellent survey of this transformation, see Phillip C. Saunders, Arthur S. Ding, Andrew Scobell, Andrew N.D. Yang, and Joel Wuthnow, eds., *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms* (Washington, DC: National Defense University Press, 2019).
- 80 *Military and Security Developments Involving the People’s Republic of China 2020* (Arlington: Office of the Secretary of Defense, 2020), 55–56.
- 81 Mark B. Schneider, “The Massive Expansion of China’s Strategic Nuclear Capability,” RealClearDefense, July 20, 2021, [https://www.realcleardefense.com/articles/2021/07/20/the\\_massive\\_expansion\\_of\\_chinas\\_strategic\\_nuclear\\_capability\\_786245.html](https://www.realcleardefense.com/articles/2021/07/20/the_massive_expansion_of_chinas_strategic_nuclear_capability_786245.html).
- 82 The impact of the 2018 U.S. NPR is discussed in Michael S. Chase, “Chinese Views on the 2018 Nuclear Posture Review, and Their Implications,” *China Brief* 18, no. 4 (2018): 11–14; and Raymond Wang, “Making Sense of Chinese Reactions to the US 2018 Nuclear Posture Review,” *The Diplomat*, February 27, 2018, <https://thediplomat.com/2018/02/making-sense-of-chinese-reactions-to-the-us-2018-nuclear-posture-review/>.
- 83 See Wayne P. Hughes, Jr. and Robert P. Girrier, *Fleet Tactics and Naval Operations*, 3rd ed. (Annapolis: Naval Institute Press, 2018), 20–23.
- 84 Soviet Faculty of the General Staff Academy, *Dictionary of Basic Military Terms: A Soviet View* (Washington, DC: United States Government Publishing Office, 1976), 37.
- 85 Horsburgh, “Change and Innovation in Chinese Nuclear Weapons Strategy,” 188.
- 86 This issue is discussed at length in Li Bin, “Differences Between Chinese and U.S. Nuclear Thinking and Their Origins,” in *Understanding Chinese Nuclear Thinking*, 3–18.
- 87 Sun, “An Analysis of the Nature and Characteristics of China’s Nuclear Strategy,” 28.



- 88 Lu Yin, "Reflections on Strategic Stability," in *Understanding Chinese Nuclear Thinking*, 132–134.
- 89 Robert S. Norris and Hans M. Kristensen, "Global Nuclear Weapons Inventories, 1945–2010," *Bulletin of the Atomic Scientists* 66, no. 4 (2010): 81.
- 90 Defense Intelligence Agency, "Defense Estimative Brief: Nuclear Weapons Systems in China," Defense Intelligence Agency, April 24, 1984, <https://web.archive.org/web/20051209040155/http://www.gwu.edu/~nsarchiv/news/19990527/01-01.htm>.
- 91 U.S. National Security Council, "Report to Congress on Status of China, India and Pakistan Nuclear and Ballistic Missile Programs," Federation of American Scientists, August 4, 2000, <https://web.archive.org/web/20100520002118/http://www.fas.org/irp/threat/930728-wmd.htm>.
- 92 Examples of the exaggerated assessments are usefully collected in Hans M. Kristensen, Robert S. Norris, and Matthew G. McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Washington, DC: Federation of American Scientists, 2006), 35–126.
- 93 Norris and Kristensen, "Global Nuclear Weapons Inventories, 1945–2010," 81.
- 94 H. B. Hollins, Averill L. Powers, and Mark Sommer, *The Conquest of War: Alternative Strategies for Global Security* (Boulder, CO: Westview Press, 1989), 54–55.
- 95 Robert S. Norris, Andrew S. Burrows, and Richard W. Fieldhouse, *Nuclear Weapons Databook, Volume 5: British, French and Chinese Nuclear Weapons* (Boulder: Westview Press, 1994), 358–397, 420–422.
- 96 "Design Characteristics of China's Ballistic and Cruise Missile Inventory," Nuclear Threat Initiative, November 2014, [https://media.nti.org/pdfs/design\\_characteristics\\_of\\_chinas\\_ballistic\\_cruise\\_missiles\\_3.pdf](https://media.nti.org/pdfs/design_characteristics_of_chinas_ballistic_cruise_missiles_3.pdf).
- 97 For most of the twentieth century, the Chinese air force took for granted that it would be unable to execute serious offensive missions, including in the delivery of nuclear weapons. See Michael S. Chase and Cristina L. Garafola, "China's Search for a 'Strategic Air Force,'" *Journal of Strategic Studies* 39, no. 1 (2016): 4–28; for an analysis of the nuclear delivery capabilities of the PLAAF in particular, see page 24.
- 98 Wu, "Certainty of Uncertainty"; and Tong Zhao, "Changes in and the Evolution of China's Nuclear Thinking" in *Understanding Chinese Nuclear Thinking*, 267–272.
- 99 Ibid.
- 100 Gerald Segal, "Nuclear Forces," in *Chinese Defence Policy*, eds. Gerald Segal and William T. Tow (London: Macmillan Press, 1984), 98–113.
- 101 Bates Gill and Evan S. Medeiros, "China," in *Governing the Bomb: Civilian Control and Democratic Accountability of Nuclear Weapons*, eds. Hans Born, Bates Gill, and Heiner Hänggi (Oxford: Oxford University Press, 2010), 128–151.
- 102 Gill and Medeiros, "China." See also Gerald Segal, "China's Nuclear Posture for the 1980s," *Survival* 23, no. 1 (1981): 11–18.
- 103 See the discussion from a U.S. perspective in Kristensen, Norris, and McKinzie, "Chinese Nuclear Forces and U.S. Nuclear War Planning," 127–172.
- 104 Zhongyang junwei bangongting, ed., *Deng Xiaoping guanyu xin shiqi jundui jianshe lunshu xuanbian* [Selection of Deng Xiaoping's expositions on army building in the new period] (Beijing: Bayi chubanshe, 1993), 44–45, cited in Fravel and Medeiros, "China's Search for Assured Retaliation," 63.
- 105 Banning N. Garrett and Bonnie S. Glaser, *War and Peace: The Views From Moscow and Beijing* (Berkeley: University of California, 1984), 129.
- 106 Shou Xiaosong et. al, *The Science of Military Strategy* (Beijing: Military Academic Works, Academy of Military Science, 2013), 172–173; and Eric Heginbotham et al., *China's Evolving Nuclear Deterrent: Major Drivers and Issues for the United States* (Santa Monica: RAND Corporation, 2017), 16–17.
- 107 Hollins, Powers, and Sommer, *The Conquest of War*, 54–55.
- 108 Xiaosong et. al, *The Science of Military Strategy*, 172–173.
- 109 This concept was first articulated by Devin T. Hagerty, "Nuclear Deterrence in South Asia: The 1990 Indo-Pakistani Crisis," *International Security* 20, no. 3 (1995): 79–114. See also Avery Goldstein, *Deterrence and Security in the 21st Century: China, Britain, France, and the Enduring Legacy of the Nuclear Revolution* (Stanford: Stanford University Press, 2000), 111–138.
- 110 Herman Kahn, *On Thermonuclear War* (Princeton: Princeton University Press, 1961), 36–37.

- 111 See for example, Baohui Zhang, “The Taiwan Strait and the Future of China’s No-First-Use Nuclear Policy,” *Comparative Strategy* 27, no. 2 (2008): 164–182; and Xu, “China’s Security Environment and the Role of Nuclear Weapons,” 32–33.
- 112 Yu Jixun, ed., *The Science of Second Artillery Campaigns* (Beijing: People’s Liberation Army Press, 2004), 294.
- 113 For details, see Horsburgh, “Change and Innovation in Chinese Nuclear Weapons Strategy,” 185–204.
- 114 Alastair Iain Johnston, “Prospects for Chinese Nuclear Force Modernization: Limited Deterrence Versus Multilateral Arms Control,” *China Quarterly* 146 (1996): 552–558.
- 115 For this most recent reiteration, see State Council Information Office of the People’s Republic of China, *China’s National Defense in the New Era* (Beijing: Foreign Languages Press Co. Ltd., 2019), [http://www.xinhuanet.com/english/2019-07/24/c\\_138253389.htm](http://www.xinhuanet.com/english/2019-07/24/c_138253389.htm), 9.
- 116 Rong Yu and Peng Guangqian, “Nuclear No-First Use Revisited,” *China Security* 5, no. 1 (2009): 78–87.
- 117 Xu, “China’s Security Environment and the Role of Nuclear Weapons,” 33–35, 38; Pan, “China’s No First Use of Nuclear Weapons,” 70–71; Evan S. Medeiros, “Evolving Nuclear Doctrine,” in *China’s Nuclear Future*, eds. Paul J. Bolt and Albert S. Willner (Boulder: Lynne Rienner Publishers, 2006), 60–61; and Christopher P. Twomey, “China’s Nuclear Doctrine and Deterrence Concept,” in *China’s Strategic Arsenal*, eds. James M. Smith and Paul J. Bolt (Washington, DC: Georgetown University Press, 2021), 45–62.
- 118 See for example Twomey, “China’s Nuclear Doctrine and Deterrence Concept,” 51–53; and Heginbotham et al., *China’s Evolving Nuclear Deterrent*, 129–133.
- 119 Fiona S. Cunningham and M. Taylor Fravel, “Dangerous Confidence? Chinese Views on Nuclear Escalation,” *International Security* 44, no. 2 (2019): 61–109.
- 120 Sun, “The Development of Nuclear Weapons in China,” 79–101.
- 121 For more on the context of these investments, see Pan, “China’s No First Use of Nuclear Weapons,” 51–77.
- 122 Bates Gill and Adam Ni, “The People’s Liberation Army Rocket Force: Reshaping China’s Approach to Strategic Deterrence,” *Australian Journal of International Affairs* 73, no. 2 (2019): 160–180.
- 123 Heginbotham et al., *China’s Evolving Nuclear Deterrent*, 19. Caitlin Talmadge, “The US-China Nuclear Relationship: Why Competition Is Likely to Intensify,” Brookings Institution, September 2019, [https://www.brookings.edu/wp-content/uploads/2019/09/FP\\_20190930\\_china\\_nuclear\\_weapons\\_talmadge-2.pdf](https://www.brookings.edu/wp-content/uploads/2019/09/FP_20190930_china_nuclear_weapons_talmadge-2.pdf).
- 124 Christopher P. Twomey, “Testimony Before the U.S.–China Economic and Security Review Commission Hearing on ‘China’s Nuclear Forces,’” U.S.–China Economic and Security Review Commission, June 10, 2021, [https://www.uscc.gov/sites/default/files/2021-06/Christopher\\_Twomey\\_Testimony.pdf](https://www.uscc.gov/sites/default/files/2021-06/Christopher_Twomey_Testimony.pdf). In contrast, David Logan has argued that the collocation of conventional and nuclear missiles is owed to bureaucratic dynamics rather than a deliberate strategy. See David C. Logan, “Are They Reading Schelling in Beijing? The Dimensions, Drivers, and Risks of Nuclear-Conventional Entanglement in China,” *Journal of Strategic Studies*, (2020): 1–51, <https://doi.org/10.1080/01402390.2020.1844671>.
- 125 Sun, “The Development of Nuclear Weapons in China,” 82–83.
- 126 Xu, “China’s Security Environment and the Role of Nuclear Weapons,” 29.
- 127 “National Defense Policy,” in *China’s National Defense in 2006* (Beijing: Information Office of the State Council, 2006), [http://en.people.cn/whitepaper/defense2006/defense2006\(2\).html](http://en.people.cn/whitepaper/defense2006/defense2006(2).html).
- 128 See, for example, Sun, “The Development of Nuclear Weapons in China,” 82–84; and Xu, “China’s Security Environment and the Role of Nuclear Weapons,” 35–36.
- 129 Sun, “The Development of Nuclear Weapons in China,” 83.
- 130 Hans M. Kristensen and Matt Korda, “Chinese Nuclear Forces, 2021,” *Bulletin of the Atomic Scientists* 77, no. 6 (2021): 350. The U.S. Department of Defense’s *2021 Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China*, which was published after a major reevaluation of the Chinese nuclear weapons program by the U.S. intelligence community, does not explicitly mention the force size offered by Kristensen and Korda in their 2021 publication. Instead, it declares that the “DoD estimated [in the 2020 report] that the PRC had a nuclear warhead stockpile in the low-200s and projected it to at least double over the next decade. Since then, Beijing has accelerated

its nuclear expansion, which may enable the PRC to have up to 700 deliverable nuclear warheads by 2027 and likely intends to have at least 1,000 warheads by 2030.” *Military and Security Developments Involving the People’s Republic of China 2021* (Arlington: Office of the Secretary of Defense, 2021), 92. As such, the 350 warheads currently attributed to China by Kristensen and Korda can be treated as plausible despite the uncertainties involved in such assessments.

- 131 *Military and Security Developments Involving the People’s Republic of China 2020*, ix.
- 132 Hans M. Kristensen, “DIA Estimates for Chinese Nuclear Warheads,” Federation of American Scientists, May 31, 2019, <https://fas.org/blogs/security/2019/05/chinese-nuclear-stockpile/>; and Mark B. Schneider, “The Chinese Nuclear Threat,” RealClearDefense, October 24, 2020, [https://www.realcleardefense.com/articles/2020/10/24/the\\_chinese\\_nuclear\\_threat\\_581838.html](https://www.realcleardefense.com/articles/2020/10/24/the_chinese_nuclear_threat_581838.html).
- 133 Robert P. Ashley, Jr. and Rebecca Heinrichs, “The Arms Control Landscape ft. DIA Lt. Gen. Robert P. Ashley, Jr.,” Hudson Institute, 5, May 29, 2019, <https://s3.amazonaws.com/media.hudson.org/Hudson%20Transcript%20-%20The%20Arms%20Control%20Landscape.pdf>.
- 134 Kristensen and Korda, “Chinese Nuclear Forces, 2020,” 444.
- 135 *Military and Security Developments Involving the People’s Republic of China 2021*, 92.
- 136 Charles A. Richard, “Statement of Charles A. Richard, Commander, United States Strategic Command, Before the Senate Armed Services Committee,” Senate Armed Services Committee, April 20, 2021, <https://www.armed-services.senate.gov/imo/media/doc/Richard04.20.2021.pdf>, 6.
- 137 Charles A. Richard, “Forging 21st-Century Strategic Deterrence,” *Proceedings* 147, no. 2 (February 2021): <https://www.usni.org/magazines/proceedings/2021/february/forging-21st-century-strategic-deterrence>.
- 138 Kristensen, “Prepared Statement,” 1–2.
- 139 For an analysis emphasizing the role of the United States over that of Xi Jinping in the expansion of the Chinese arsenal, see Tong Zhao, “What’s Driving China’s Nuclear Buildup?,” Carnegie Endowment for International Peace, August 5, 2021, <https://carnegieendowment.org/2021/08/05/what-s-driving-china-s-nuclear-buildup-pub-85106>.
- 140 Even if the United States and Russia reduced their nuclear stockpiles at the same rate as they had during the negotiations leading up to the New START treaty, their arsenals would still be several times as large as that of China. As Steven Pifer points out, “New START’s limits do not cover 60–65 percent of the active nuclear stockpiles of the two countries [the United States and Russia]. Reserve (or non-deployed) strategic nuclear warheads, and non-strategic nuclear warheads—whether deployed or non-deployed—are unconstrained.” See Steven Pifer, “Nuclear Arms Control in the 2020s,” Brookings Institution, April 8, 2021, <https://www.brookings.edu/blog/order-from-chaos/2021/04/08/nuclear-arms-control-in-the-2020s/>.
- 141 Hans M. Kristensen and Matt Korda, “Status of World Nuclear Forces,” Federation of American Scientists, May 2021, <https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/>.
- 142 Li, “Differences Between Chinese and U.S. Nuclear Thinking and Their Origins,” 11; Sun, “The Development of Nuclear Weapons in China,” 96; and Wu Riqiang, “How China Practices and Thinks About Nuclear Transparency,” in *Understanding Chinese Nuclear Thinking*, 228.
- 143 “Non-nuclear strategic weapons” could refer to a vast panoply of systems, from lasers to non-nuclear missile defenses to chemical biological weapons to strategic-range PGMs. Michael J. Mazarr, *START and the Future of Deterrence* (London: Palgrave Macmillan, 1991), 183–207.
- 144 “National Defense Policy.”
- 145 “China Vows ‘Extreme Restraint’ in Development of Nukes,” Nuclear Threat Initiative, May 4, 2010, <https://www.nti.org/gsn/article/china-vows-extreme-restraint-in-development-of-nukes/>.
- 146 *China’s National Defense in 2008* (Beijing: Information Office of the State Council, 2008).
- 147 Fravel and Medeiros, “China’s Search for Assured Retaliation,” 48–87; and Fiona S. Cunningham and M. Taylor Fravel, “Assuring Assured Retaliation: China’s Nuclear Posture and U.S.-China Strategic Stability,” *International Security* 40, no. 2 (2015): 7–50.
- 148 *Military and Security Developments Involving the People’s Republic of China 2021*, 92.
- 149 Kristensen and Korda, “Chinese Nuclear Forces, 2020.”
- 150 Wu, “Certainty of Uncertainty”; and Bin, “Differences Between Chinese and U.S. Nuclear Thinking and Their Origins.”

- 151 Good examples of analyses that stressed China's previous nuclear vulnerability are Keir A. Lieber and Daryl G. Press, "The End of MAD? The Nuclear Dimensions of U.S. Primacy," *International Security* 30, no. 4 (2006): 7–44; and Eric Heginbotham et al., *The U.S.-China Military Scorecard: Forces, Geography, and the Evolving Balance of Power, 1996–2017* (Santa Monica: RAND Corporation, 2015), 285–319. See also Austin Long and Brendan Rittenhouse Green, "Stalking the Secure Second Strike: Intelligence, Counterforce, and Nuclear Strategy," *Journal of Strategic Studies* 38, nos. 1–2 (2015): 38–73; Keir A. Lieber and Daryl G. Press, "The New Era of Counterforce: Technological Change and the Future of Nuclear Deterrence," *International Security* 41, no. 4 (2017): 9–49; and, with qualifications, Wu Riqiang, "Living With Uncertainty: Modeling China's Nuclear Survivability," *International Security* 44, no. 4 (2020): 84–118.
- 152 See Donald Rumsfeld, "Prepared Statement," *Hearings Before the Committee on Foreign Relations: Treaty on Strategic Offensive Reduction: The Moscow Treaty*, 107th Cong., 2d sess., 2002, S. Hrg. 107–622.
- 153 Mark A. Stokes, "China's Nuclear Warhead Storage and Handling System," Project 2049 Institute, March 12, 2010, [https://project2049.net/wp-content/uploads/2018/05/chinas\\_nuclear\\_warhead\\_storage\\_and\\_handling\\_system.pdf](https://project2049.net/wp-content/uploads/2018/05/chinas_nuclear_warhead_storage_and_handling_system.pdf), 5–9; and Larry M. Wortzel, *China's Nuclear Forces: Operations, Training, Doctrine, Command, Control and Campaign Planning* (Carlisle: Strategic Studies Institute, 2007), 19–26.
- 154 A relatively authoritative Chinese military official, Sr. Col. Yang Chengjun, recently retired from the PLARF, for example, publicly stated that the PLARF can now conduct nuclear retaliation within minutes of receiving appropriate orders. See "Nuclear Strategist Yang Chengjun: It's Not Appropriate to Speculate on Nuclear-Related Issues on the Internet," Phoenix Military, May 12, 2020, <https://ishare.ifeng.com/c/s/7wRF4ea00Qk>. This claim, however, is still conditional on the circumstances prevailing in China in the aftermath of a nuclear attack. I am grateful to Tong Zhao for pointing me to this reference.
- 155 *Military and Security Developments Involving the People's Republic of China 2020*, 88.
- 156 *Ibid.*
- 157 See the discussion in Tellis, *India's Emerging Nuclear Posture*, 368–369.
- 158 *Military and Security Developments Involving the People's Republic of China 2021* (Arlington: Office of the Secretary of Defense, 2021), 93.
- 159 For the broader context that describes Xi Jinping's growing control of the Chinese military, see Timothy R. Heath, "The Consolidation of Political Power in China Under Xi Jinping Implications for the PLA and Domestic Security Forces," RAND Corporation, February 7, 2019, <https://www.rand.org/pubs/testimonies/CT503.html>.
- 160 Yu, *Science of Second Artillery Campaigns*, 297.
- 161 *Ibid.*, 304.
- 162 *Ibid.*
- 163 *Ibid.*, 254.
- 164 Bi Xinglin, ed., *Campaign Theory Study Guide* (Beijing: National Defense University Press, 2002), 384–385.
- 165 Yu, *Science of Second Artillery Campaigns*, 308.
- 166 *Ibid.*, 273.
- 167 Cunningham and Fravel, "Dangerous Confidence?," 61–109.
- 168 Yu, *Science of Second Artillery Campaigns*, 306–309.
- 169 Timothy Thomas, *The Chinese Way of War: How Has It Changed?* (McLean: MITRE Corporation, 2020), 19.
- 170 Military Strategy Research Department, PLA Academy of Military Science, *The Science of Military Strategy* 3rd ed., (Beijing: Military Science Press, 2013), 89.
- 171 *Ibid.*, 124.
- 172 The idea of successfully fighting and winning a nuclear war reached its apotheosis during the Cold War. See for example, Colin S. Gray, "Nuclear Strategy: The Case for a Theory of Victory," *International Security* 4, no. 1 (Summer 1979): 54–87; and Colin S. Gray and Keith Payne, "Victory Is Possible," *Foreign Policy* 39 (Summer 1980): 14–27. The residues of the notion of fighting to win a nuclear war are still present in current U.S. and Russian strategic nuclear war plans.

- 173 He Qionghua, "Nuclear Deterrence," in *China Strategic Missile Force Encyclopedia* (Beijing: China Encyclopedia Publishing House, 2012), 41, cited in Burgess Laird, "War Control: Chinese Writings on the Control of Escalation in Crisis and Conflict," Center for a New American Security, March 30, 2017, <https://s3.us-east-1.amazonaws.com/files.cnas.org/documents/CNASReport-ChineseDescalation-Final.pdf>, 20.
- 174 Fravel and Madeiros, "China's Search for Assured Retaliation," 58–66; and Cunningham and Fravel, "Dangerous Confidence," 61–109.
- 175 The expansion of civilian nuclear energy, which received modest emphasis during the 1990s, took off in earnest in the mid-2000s when China, concerned about its energy vulnerability and environmental deterioration, launched a major program of constructing power reactors with technology acquired from France, Canada, Russia and the United States. Today, China operates 45 nuclear power reactors, has another 12 under construction, and even more about to start construction, making the Chinese nuclear power program the fastest growing in the world. China and the IAEA formally signed a voluntary offer safeguards agreement in September 1988 which permits the IAEA to inspect the Qinshan Nuclear Power Plant, the Tsinghua University HTGR, and the Hanzhong uranium enrichment plant. No other nuclear fuel cycle facilities in China are safeguarded.
- 176 Hui Zhang, *China's Uranium Enrichment Capacity: Rapid Expansion to Meet Commercial Needs* (Cambridge: Belfer Center for Science and International Affairs, 2015), 13–16.
- 177 *Ibid.*, 28.
- 178 *Ibid.*, 29; and Thomas B. Cochran and Henry D. Sokolski, "How Many Nuclear Warheads China Might Acquire by 2030," in *China's Civil Nuclear Sector: Plowshares to Swords?*, ed. Henry D. Sokolski (Arlington: Nonproliferation Policy Educational Center, 2021), 22.
- 179 Catherine Dill, "The Jinkouhe Gaseous Diffusion Plant Is Hot!," *Arms Control Wonk*, September 23, 2015, <https://www.armscontrolwonk.com/archive/605445/the-jinkouhe-gaseous-diffusion-plant-is-hot/>.
- 180 Hui Zhang, "China's HEU and Plutonium Production and Stocks," *Science & Global Security* 19 (2011): 68–89.
- 181 Robert E. Kelley, "Starve Nuclear Weapons to Death With a Tritium Freeze," Stockholm International Peace Research Institute, August 28, 2020, <https://www.sipri.org/commentary/topical-backgroundunder/2020/starve-nuclear-weapons-death-tritium-freeze>; and Hans Kristensen, "No, China Does Not Have 3,000 Nuclear Weapons," Federation of American Scientists, December 3, 2011, <https://fas.org/blogs/security/2011/12/chinanukes/>.
- 182 Ann MacLachlan and Mark Hibbs, "China Stops Production of Military Fuel: All SWU Capacity Now for Civil Use," *Nuclear Fuel*, November 13, 1989.
- 183 "Countries: China," International Panel on Fissile Materials, August 13, 2021, <http://fissilematerials.org/countries/china.html>. In addition to this stockpile of HEU and WGPU, China also has a modest stockpile of some 25 kilograms of reactor-grade plutonium. Further, it appears to have about 1,800 kilograms of lightly enriched uranium primarily for fueling its nuclear submarines. The massive expansion of civilian nuclear energy in China will provide Beijing with much larger quantities of reactor-grade plutonium in the future, all of which can be used in the manufacture of nuclear weapons if China so chooses without any technical or legal constrictions. Given the access China already has to weapons-grade material, however, there is no reason for China to utilize reactor-grade plutonium in its nuclear weapons in the first instance.
- 184 Samuel Glasstone and Philip J. Dolan, *The Effects of Nuclear Weapons*, 3rd ed. (Washington, DC: Departments of Defense and Energy, 1977), 22.
- 185 Hui Zhang, "Why China Stopped Making Fissile Material for Nukes," *Bulletin of the Atomic Scientists*, March 15, 2018, <https://thebulletin.org/2018/03/why-china-stopped-making-fissile-material-for-nukes/>.
- 186 For a useful effort at such an assessment, see Hui Zhang, "China's HEU and Plutonium Production and Stocks," *Science & Global Security*, 19:1 (2011): 68–89.
- 187 Hui Zhang, "China's Uranium Enrichment and Plutonium Recycling 2020–2040: Current Practices and Projected Capacities," in *China's Civil Nuclear Sector: Plowshares to Swords?*, ed. Sokolski, 25–53.
- 188 Cochran and Sokolski, "How Many Nuclear Warheads China Might Acquire by 2030," 6–24.
- 189 Federation of American Scientists, "Status of World Nuclear Forces," February 2022, <https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/>.

- 190 See David C. Logan, "Hard Constraints on a Chinese Nuclear Breakout," *Nonproliferation Review* 24, no. 1–2 (2017): 13–30.
- 191 Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions* (Washington, DC: National Defense University Press, 2014), 74–75.
- 192 Jeffrey Lewis, *Paper Tigers: China's Nuclear Posture* (London: International Institute for Strategic Studies, 2014), 43–75; Richard L. Garwin, "Why China Won't Build U.S. Warheads," *Arms Control Today* 29, no. 3 (1999): 28–29; and Robert S. Norris, "French and Chinese Nuclear Weapon Testing," *Security Dialogue* 27, no. 1 (1996): 39–54.
- 193 Harold M. Agnew, "Looking for Spies in Nuclear Kitchen," *Wall Street Journal*, May 17, 1999.
- 194 Lewis, *Paper Tigers*, 43–75.
- 195 Lewis, *The Minimum Means of Reprisal*, 93.
- 196 John W. Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," *International Security* 17 (1992): 30.
- 197 Robert S. Norris, "French and Chinese Nuclear Weapon Testing," *Security Dialogue* 27, no. 1 (1996): 50.
- 198 James Mahaffey, *Atomic Adventures* (New York: Pegasus Books, 2017), 165–189.
- 199 Gregory Kulacki, "China's Nuclear Arsenal: Status and Evolution," Union of Concerned Scientists, October 13, 2011, <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.337.5855&rep=rep1&type=pdf>.
- 200 For an excellent discussion of these issues, see Jonathan Medalia, "Chinese Nuclear Testing and Warhead Development," Congressional Research Service, November 14, 1997, [https://www.everycrsreport.com/files/19971114\\_97-1022\\_192bb0f10895f24ad60d9a4eea7328e049d7aa2c.pdf](https://www.everycrsreport.com/files/19971114_97-1022_192bb0f10895f24ad60d9a4eea7328e049d7aa2c.pdf).
- 201 Norris, "French and Chinese Nuclear Weapon Testing," 50.
- 202 Peter Vincent Pry, "China: EMP Threat: The People's Republic of China Military Doctrine, Plans, and Capabilities for Electromagnetic Pulse (EMP) Attack," EMP Task Force on National and Homeland Security, June 10, 2020, <https://apps.dtic.mil/sti/pdfs/AD1102202.pdf>; and Julia Masterson and Shannon Bugos, "Pentagon Warns of Chinese Nuclear Development," Arms Control Association, October 2020, <https://www.armscontrol.org/act/2020-10/news/pentagon-warns-chinese-nuclear-development>.
- 203 Lewis, *Paper Tigers*, 62–64, 68.
- 204 The Nuclear Weapon Archive, "China's Nuclear Weapons: Present Capabilities," Nuclear Weapon Archive, May 1, 2001, <https://nuclearweaponarchive.org/China/ChinaArsenal.html>.
- 205 For references to the possibility of Chinese low-yield nuclear testing, see *Adherence to and Compliance With Arms Control, Nonproliferation, and Disarmament Agreements and Commitments* (Washington, DC: Department of State, 2020), 49–50; and Robert P. Ashley, Jr., "Russian and Chinese Nuclear Modernization Trends: Remarks at the Hudson Institute," Defense Intelligence Agency, May 29, 2019, <https://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/1859890/russian-and-chinese-nuclear-modernization-trends/>.
- 206 Rod Lyon, "Is China in Breach of Its Nuclear-Testing Commitments?," *The Strategist, Australian Strategic Policy Institute*, May 14, 2020, <https://www.aspistrategist.org.au/is-china-in-breach-of-its-nuclear-testing-commitments/>.
- 207 "Design Characteristics of China's Ballistic and Cruise Missile Inventory."
- 208 *Military and Security Developments Involving the People's Republic of China 2021*, 93.
- 209 Richard, "Statement," 6.
- 210 Cao Zhi and Zhang Xuanjie, "Xi Jinping: Building a Powerful Information-based Strategic Missile Force," *Xinhuanet*, December 5, 2012, <http://cpc.people.com.cn/n/2012/1205/c64094-19804598.html>.
- 211 Kristensen and Korda, "Chinese Nuclear Forces, 2021," 320.
- 212 *Ibid.*, 320.
- 213 *Ibid.*
- 214 Missile Defense Project, "DF-31 (Dong Feng-31 / CSS-10)," Missile Threat, Center for Strategic and International Studies, October 8, 2019, <https://missilethreat.csis.org/missile/df-31/>; and Missile Defense Project, "DF-41 (Dong Feng-41 / CSS-X-20)," Missile Threat, Center for Strategic and International Studies, October 8, 2019, <https://missilethreat.csis.org/missile/df-41/>.

- 215 Hans M. Kristensen and Robert S. Norris, “Chinese Nuclear Forces, 2018,” *Bulletin of the Atomic Scientists*, 74:4 (2018): 290.
- 216 Paul Bernstein and Dain Hancock, “China’s Hypersonic Weapons,” *Georgetown Journal of International Affairs*, January 27, 2021, <https://gjia.georgetown.edu/2021/01/27/chinas-hypersonic-weapons/>.
- 217 Joby Warrick, “China Is Building More Than 100 New Missile Silos in Its Western Desert, Analysts Say,” *Washington Post*, June 30, 2021, [https://www.washingtonpost.com/national-security/china-nuclear-missile-silos/2021/06/30/0fa8debc-d9c2-11eb-bb9e-70fda8c37057\\_story.html](https://www.washingtonpost.com/national-security/china-nuclear-missile-silos/2021/06/30/0fa8debc-d9c2-11eb-bb9e-70fda8c37057_story.html).
- 218 Rodrick Lee, “PLA Likely Begins Construction of an Intercontinental Ballistic Missile Silo Site Near Hanggin Banner,” *China Aerospace Studies Institute*, August 12, 2021, <https://www.airuniversity.af.edu/CASI/Display/Article/2729781/pla-likely-begins-construction-of-an-intercontinental-ballistic-missile-silo-si/>; and Ma Xiu and Peter W. Singer, “China’s New Missile Fields Are Just Part of the PLA Rocket Force’s Growth,” *DefenseOne*, August 11, 2021, <https://www.defenseone.com/ideas/2021/08/chinas-new-missile-fields-are-just-part-pla-rocket-forces-growth/184442/>.
- 219 *Military and Security Developments Involving the People’s Republic of China 2021*, 94.
- 220 James M. Acton, “Don’t Panic About China’s New Nuclear Capabilities,” *Washington Post*, July 27, 2021, <https://www.washingtonpost.com/politics/2021/06/30/dont-panic-about-chinas-new-nuclear-capabilities/>.
- 221 For Chinese posturing on Australia, see Zhang Hui, “China Urged to Increase Sea-Based Nuclear Deterrent Amid US Intensified Strategic Threat,” *Global Times*, May 28, 2021, <https://www.globaltimes.cn/page/202105/1224773.shtml>.
- 222 Missile Defense Project, “DF-21 (CSS-5),” *Center for Strategic and International Studies*, July 31, 2021, <https://missilethreat.csis.org/missile/df-21/>.
- 223 *Military and Security Developments Involving the People’s Republic of China 2021*, 61.
- 224 *Military and Security Developments Involving the People’s Republic of China 2020*, 88.
- 225 Austin Long, “Myths or Moving Targets? Continuity and Change in China’s Nuclear Forces,” *War on the Rocks*, December 4, 2020, <https://warontherocks.com/2020/12/myths-or-moving-targets-continuity-and-change-in-chinas-nuclear-forces/>.
- 226 Michael S. Chase, Jeffrey Engstrom, Tai Ming Cheung, Kristen A. Gunness, Scott Warren Harold, Susan Puska, and Samuel K. Berkowitz, *China’s Incomplete Military Transformation: Assessing the Weaknesses of the People’s Liberation Army (PLA)* (Santa Monica: RAND Corporation, 2015), 104; and Roger Cliff, John Fei, Elizabeth Hague, Eric Heginbotham, and John Stillion, *Shaking the Heavens and Splitting the Earth* (Santa Monica: RAND Corporation, 2011), 50.
- 227 David C. Logan, “Testimony Before the U.S.-China Economic and Security Review Commission Hearing on ‘China’s Nuclear Forces,’” U.S.-China Economic and Security Review Commission, June 10, 2021, [https://www.uscc.gov/sites/default/files/2021-06/David\\_Logan\\_Testimony.pdf](https://www.uscc.gov/sites/default/files/2021-06/David_Logan_Testimony.pdf), 9.
- 228 China can already mount standoff attacks with cruise missiles that would stress many missile defenses and given the high penetrativity of China’s land-based ballistic missiles even against major adversaries, the utility and the effectiveness of pursuing alternative systems, such as the ALBM today and possibly nuclear cruise missiles in the future, for retaliatory purposes is unclear. It must be noted, however, that there is no evidence currently that China seeks to deploy nuclear-tipped cruise missiles, although it has the capacity to develop such systems if it wants to. See Gormley, Erickson, and Yuan, *A Low-Visibility Force Multiplier*, 74–75.
- 229 Justin Bronk, *Russian and Chinese Combat Air Trends: Current Capabilities and Future Threat Outlook* (London: Royal United Services Institute, 2020), 47.
- 230 Long and Green, “Stalking the Secure Second Strike,” and Tom Stefanick, *Strategic Antisubmarine Warfare and Naval Strategy* (Lexington: Lexington Books, 1987).
- 231 Heginbotham et al., *China’s Evolving Nuclear Deterrent*, 42, 107–108.
- 232 Matthew Harris, “Rig for Sea: Countering the Deployment of Chinese Ballistic Missile Submarines,” *Comparative Strategy* 35, no. 5 (2016): 348–350.
- 233 For more on this issue, see Tong Zhao, *Tides of Change: China’s Nuclear Ballistic Missile Submarines and Strategic Stability* (Washington, DC: Carnegie Endowment for International Peace, 2018), 25–33; see also Wu Riqiang, “Survivability of China’s Sea-Based Nuclear Forces,” *Science & Global Security* 19, no. 2 (2011): 91–120.

- 234 *Military and Security Developments Involving the People's Republic of China 2020*, 55.
- 235 The most recent data can be found in Hans M. Kristensen and Matt Korda, "Chinese Nuclear Weapons, 2021," *Bulletin of the Atomic Scientists*, November 15, 2021, <https://www.tandfonline.com/doi/full/10.1080/00963402.2021>; and Ma Xiu, "PLA Rocket Force Organization – Executive Summary," China Aerospace Studies Institute, November 29, 2021, <https://www.airuniversity.af.edu/CASI/Display/Article/2849664/pla-rocket-force-organization-executive-summary/>.
- 236 These figures consider the DF-31, DF-31A, DF-31AG, and JL-2 as composing the current Chinese inventory of modern intercontinental-ranged missiles and the DF-26 and DF-21 as modern theater-range missiles. All figures from Kristensen and Korda, "Chinese Nuclear Forces, 2021," 320.
- 237 John Costello and Joe McReynolds, "China's Strategic Support Force," in *Chairman Xi Remakes the PLA*, 437–515.
- 238 Edmund J. Burke and Arthur Chan, "Coming to a (New) Theater Near You: Command, Control, and Forces," in *Chairman Xi Remakes the PLA*, 227–255; and David C. Logan, "Making Sense of China's Missile Forces," in *Chairman Xi Remakes the PLA*, 393–435.
- 239 Bates Gill, "Organization of China's Strategic Forces," in *China's Strategic Arsenal*, 159–194.
- 240 Bruce G. Blair, "Russian Nuclear Policy and the Status of Detargeting," Brookings, March 17, 1997, <https://www.brookings.edu/testimonies/russian-nuclear-policy-and-the-status-of-detargeting/>.
- 241 *Ibid.*
- 242 *Military and Security Developments Involving the People's Republic of China 2021*, 61.
- 243 For an assessment in 1997, see Gill and Mulvenon, "The Chinese Strategic Rocket Forces," 39.
- 244 Kristensen and Korda, "Chinese Nuclear Forces, 2021," 325.
- 245 Gill and Ni, "The People's Liberation Army Rocket Force," 166–167; Caitlin Talmadge, "Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War With the United States," *International Security* 41, no. 4 (2017): 50–92; and Tong Zhao and Li Bin, "The Underappreciated Risks of Entanglement: A Chinese Perspective," in *Entanglement: Russian and Chinese Perspectives on Non-Nuclear Weapons and Nuclear Risks*, ed. James M. Acton (Washington, DC: Carnegie Endowment for International Peace), 47–75.
- 246 Richard Woolgar-James, "China's Nuclear Submarines: The End of 'No First Use?'," *Bulletin of the Atomic Scientists*, November 19, 2015, <https://thebulletin.org/2015/11/chinas-nuclear-submarines-the-end-of-no-first-use/>; and Hans M. Kristensen & Robert S. Norris, "Worldwide Deployments of Nuclear Weapons, 2017," *Bulletin of the Atomic Scientists* 73, no. 5 (2017): 289–297.
- 247 Steven Grogan, "China, Nuclear Security and Terrorism: Implications for the United States," *Orbis* 53, no. 4 (2009): 685–704.
- 248 *Military and Security Developments Involving the People's Republic of China 2020*, 88.
- 249 Stokes, "China's Nuclear Warhead Storage and Handling System," 3–9.
- 250 *Ibid.*
- 251 Phillip Karber, *Strategic Implications of China's Underground Great Wall* (Washington, DC: Georgetown University Asian Arms Control Project, 2011).
- 252 Stokes, "China's Nuclear Warhead and Handling System," 8; and Wortzel, *China's Nuclear Forces*, 19–26.
- 253 Cunningham and Fravel, "Assuring Assured Retaliation," 44–45.
- 254 Wortzel, *China's Nuclear Forces*, 16.
- 255 Damen Cook, "China's Most Important South China Sea Military Base," *The Diplomat*, March 9, 2017, <https://thediplomat.com/2017/03/chinas-most-important-south-china-sea-military-base/>.
- 256 Stokes, "China's Nuclear Warhead Storage and Handling System," 8.
- 257 *Military and Security Developments Involving the People's Republic of China 2020*, 85.
- 258 *Ibid.*, 88.
- 259 Gregory Kulacki, "China's Military Calls for Putting Its Nuclear Forces on Alert," Union of Concerned Scientists, February 2016, <https://www.ucsusa.org/sites/default/files/attach/2016/02/China-Hair-Trigger-full-report.pdf>.



- 260 Fiona S. Cunningham, “Nuclear Command, Control, and Communications Systems of the People’s Republic of China,” Nautilus Institute, July 18, 2019, 7, <https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-systems-of-the-peoples-republic-of-china/>.
- 261 Cunningham and Fravel, “Assuring Assured Retaliation,” 44–45; and Cunningham, “Nuclear Command, Control, and Communications Systems of the People’s Republic of China,” 3–7.
- 262 For an excellent survey of the different possibilities involved, see David C. Logan, “China’s Future SSBN Command and Control Structure,” Institute for National Strategic Studies, November 28, 2016, <https://ndupress.ndu.edu/Portals/68/Documents/stratforum/SF-299.pdf?ver=2016-11-28-093723-680>.
- 263 Elsa B. Kania, “China’s Strategic Situational Awareness Capabilities,” Center for Strategic and International Studies, July 29, 2019, <https://res.cloudinary.com/csasideaslab/image/upload/v1564246946/on-the-radar/China%20strategic%20SA.pdf>.
- 264 Hans M. Kristensen, “China’s Strategic Systems and Programs,” in *China’s Strategic Arsenal*, 93–124.
- 265 Shou et. al, *The Science of Military Strategy*, 175; and Cunningham and Fravel, “Assuring Assured Retaliation,” 30–31.
- 266 *Military and Security Developments Involving the People’s Republic of China 2020*, 88.
- 267 Phillip C. Saunders, “Testimony Before the U.S.-China Economic and Security Review Commission Hearing on China’s Nuclear Forces,” U.S.-China Economic and Security Review Commission, June 10, 2021, [https://www.uscc.gov/sites/default/files/2021-06/Phillip\\_Saunders\\_Testimony.pdf](https://www.uscc.gov/sites/default/files/2021-06/Phillip_Saunders_Testimony.pdf), 10.
- 268 The evidence on this count is actually quite striking: China has often been a target of nuclear blackmail but never the perpetrator historically. For a quick survey, see “Incidents of Nuclear Blackmail,” American Friends Service Committee, April 9, 2012, <https://www.afsc.org/document/incidents-nuclear-blackmail>. How the current Russian war in Ukraine changes Chinese attitudes on this issue remains to be seen.
- 269 Defense Industry Daily, “Boeing Will Deliver a New Nuclear Failsafe | The Battlefield Needs Some Management | Spain’s S-80 Still Having a Siesta,” July 27, 2018, <https://www.defenseindustrydaily.com/boeing-will-deliver-a-new-nuclear-failsafe-the-battlefield-needs-some-management-spains-s-80-still-having-a-siesta-040357/>.
- 270 Bruce W. MacDonald and Charles D. Ferguson, *Understanding the Dragon Shield: Likelihood and Implications of Chinese Strategic Ballistic Missile Defense* (Washington, DC: Federation of American Scientists, 2015).
- 271 *Military and Security Developments Involving the People’s Republic of China 2020*, 74–75.
- 272 Ibid.
- 273 Robert Jervis is typically credited with originating the concept of an “offense-dominant” or “defense-dominant” security environment in Robert Jervis, “Cooperation Under the Security Dilemma,” *World Politics* 30, no. 2 (1978): 167–214. This concept has since spawned a sizeable body of literature.
- 274 MacDonald and Ferguson, *Understanding the Dragon Shield*.
- 275 Homi J. Bhabha, “Note on the Organisation of Atomic Research in India (April 26, 1948),” *Nuclear India* 43, no. 5–6 (2008): 3.
- 276 Homi J. Bhabha and N. B. Prasad, “A Study of the Contribution of Atomic Energy to a Power Programme in India,” in *Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy* (Geneva: United Nations, 1958), 89–101.
- 277 S. Banerjee, R.K. Sinha, and S. Kailas, “Thorium Utilization for Sustainable Supply of Nuclear Energy,” *Journal of Physics: Conference Series* 312 (2011).
- 278 Perkovich, *India’s Nuclear Bomb*, 282–292; and K. Subrahmanyam, “Indian Nuclear Policy – 1964-98 (A Personal Recollection),” *Strategic Analysis* 42, no. 3 (2018): 305.
- 279 For a good review of these issues connected with India’s second stage fast breeder reactor program, see R.D. Kale, “India’s Fast Reactor Programme – A Review and Critical Assessment,” *Progress in Nuclear Energy* 122 (April 2020): 19–42.
- 280 Nuclear Energy Agency, “Perspectives on the Use of Thorium in the Nuclear Fuel Cycle,” Organization for Economic Cooperation and Development, August 15, 2015, [https://www.oecd-neo.org/jcms/pl\\_14932/perspectives-on-the-use-of-thorium-in-the-nuclear-fuel-cycle-extended-summary](https://www.oecd-neo.org/jcms/pl_14932/perspectives-on-the-use-of-thorium-in-the-nuclear-fuel-cycle-extended-summary), 17.
- 281 Perkovich, *India’s Nuclear Bomb*, 17.

- 282 A comprehensive overview of foreign involvement in India's development of its nuclear capabilities is given in Perkovich, *India's Nuclear Bomb*, especially 1–145, 190–292. See also, Roberta Wohlstetter, “The Buddha Smiles: U.S. Peaceful Aid and the Indian Bomb,” in *Nuclear Heuristics: Selected Writings of Albert and Roberta Wohlstetter* (Carlisle: Strategic Studies Institute, 2009), 339–356.
- 283 Itty Abraham, *The Making of the Indian Atomic Bomb: Science, Secrecy and the Postcolonial State* (New York: Zed Books, 1998), 49.
- 284 Perkovich, *India's Nuclear Bomb*, 60–85. See also, *Engineering With Nuclear Explosives: Proceedings of the Third Plowshare Symposium* (Washington, DC: U.S. Atomic Energy Commission, 1964).
- 285 For a discussion about the differences between a “nuclear explosion” and a “nuclear weapon test explosion,” see Tellis, *India's Emerging Nuclear Posture*, 195–200.
- 286 In *From Surprise to Reckoning: The Kargil Review Committee Report*, a document substantially authored by K. Subrahmanyam, it was revealed officially for the first time that India did in fact weaponize its nuclear capabilities sometime between 1992 and 1994. See *From Surprise to Reckoning: The Kargil Review Committee Report* (New Delhi: Sage Publications, 2000), 205.
- 287 For an account of the international backlash and the larger nonproliferation response following the Pokhran-I test, see Perkovich, *India's Nuclear Bomb*, 161–225; and Ian Smart, “Janus: The Nuclear God,” *The World Today* 34, no. 4 (1978): 118–127.
- 288 For an overview of U.S. and international export controls during this period, see Office of Technology Assessment, *Export Controls and Nonproliferation Policy* (Washington, DC: U.S. Government Printing Office, 1994). The impact of secrecy of the evolution of the Indian nuclear weapons program has been illuminatingly assessed in Gaurav Kampani, *India's Nuclear Proliferation Policy: The Impact of Secrecy on Decision Making, 1980–2010* (New York: Routledge, 2021).
- 289 Kalman A. Robertson and John Carlson, “The Three Overlapping Streams of India's Nuclear Program,” Belfer Center for Science and International Affairs, April 1, 2016, <https://www.belfercenter.org/sites/default/files/legacy/files/thethreesoverlappingstreamsofindiasnuclearpowerprograms.pdf>, 18–19. Whether the Indian enrichment facilities identified in Robertson and Carlson's paper are involved in the Indian weapons program is discussed later in this report.
- 290 For a full discussion, see Tellis, *India's Emerging Nuclear Posture*, 280–296.
- 291 Glenn H. Snyder, *Deterrence and Defense* (Princeton: Princeton University Press, 1961).
- 292 For a clear statement of the convictions that persist to this day, see “India Not to Engage in a N-Arms Race: Jaswant,” *The Hindu*, November 29, 1999; and Shivshankar Menon, *Choices: Inside the Making of India's Foreign Policy* (Washington, DC: Brookings Institution Press, 2016), 105–123.
- 293 Menon, *Choices*, 105–123.
- 294 See the discussion in the Preamble to “Draft Report of National Security Advisory Board on Indian Nuclear Doctrine,” Ministry of External Affairs of the Government of India, August 17, 1999, <https://mea.gov.in/in-focus-article.htm?18916/Draft+Report+of+National+Security+Advisory+Board+on+Indian+Nuclear+Doctrine>; and Tellis, *India's Emerging Nuclear Doctrine*, 281.
- 295 Peter Feaver, “Command and Control in Emerging Nuclear Nations,” *International Security* 17, no. 3 (1993): 160–187.
- 296 “Draft Report of National Security Advisory Board on Indian Nuclear Doctrine”; and “The Cabinet Committee on Security Reviews [O]perationalization of India's Nuclear Doctrine,” Ministry of External Affairs of the Government of India, January 4, 2003, [https://mea.gov.in/press-releases.htm?dtl/20131/The\\_Cabinet\\_Committee\\_on\\_Security\\_Reviews\\_operationalization\\_of\\_Indias\\_Nuclear\\_Doctrine+Report+of+National+Security+Advisory+Board+on+Indian+Nuclear+Doctrine](https://mea.gov.in/press-releases.htm?dtl/20131/The_Cabinet_Committee_on_Security_Reviews_operationalization_of_Indias_Nuclear_Doctrine+Report+of+National+Security+Advisory+Board+on+Indian+Nuclear+Doctrine).
- 297 Raja Ramanna, “Security, Deterrence, and the Future,” *Journal of the United Services Institution of India* 122, no. 509 (1992): 282–292.
- 298 For a full discussion of Indian calculations around the size of its nuclear arsenal, see Tellis, *India's Emerging Nuclear Posture*, 374–401.
- 299 See Tellis, *India's Emerging Nuclear Posture*, 20–89.
- 300 This lower bound was given by K. Subrahmanyam, longtime head of the government-funded Institute for Defense Studies and Analyses (IDSA); see K. Subrahmanyam, “Articulating Our Nuclear Policy,” *Economic Times*, June 15, 1994. The upper bound was given by defense analyst Bharat Karnad; see

- Bharat Karnad, “A Thermonuclear Deterrent,” in *India’s Nuclear Deterrent*, ed. Amitabh Mattoo (New Delhi: Har-Anand Publications, 1999), 128. In an earlier 1998 paper, however, as Naeem Salik points out, “Karnad ha[d] openly called upon the Indian government to establish a force based on 400 thermonuclear warheads with diversified delivery systems.” Naeem Ahmad Salik, “Pakistan’s Ballistic Missile Development Programme—Security Imperatives, Rationale and Objectives,” *Strategic Studies* 21, no. 1 (Spring 2001): 37.
- 301 An excellent analysis that illuminates this Indian policy judgment can be found in Rajesh Basrur, “Deterrence, Second Strike and Credibility: Revisiting India’s Nuclear Strategy Debate,” Institute of Peace and Conflict Studies, July 1, 2014, [http://www.ipcs.org/issue\\_select.php?recNo=572](http://www.ipcs.org/issue_select.php?recNo=572).
- 302 For the contrast with U.S. attitudes during the Cold War, see Tellis, *India’s Emerging Nuclear Posture*, 271–280.
- 303 A larger analysis of the global trends that make this expectation sensible can be found in T. V. Paul, “The Paradox of Power: Nuclear Weapons in a Changed World,” *Alternatives* 20, no. 4 (1995): 479–500.
- 304 “Draft Report of National Security Advisory Board on Indian Nuclear Doctrine.”
- 305 “The Cabinet Committee on Security Reviews [O]perationalization of India’s Nuclear Doctrine.”
- 306 Ibid.
- 307 See Toby Dalton, “Much Ado About India’s No-first-use Nuke Policy,” Carnegie Endowment for International Peace, September 26, 2019, <https://carnegieendowment.org/2019/09/26/much-ado-about-india-s-no-first-use-nuke-policy-pub-79952>.
- 308 The next three paragraphs are drawn from contemporaneous notes of official conversations between the author and NSA Brajesh Mishra and senior Indian officials in the Prime Minister’s Office in January 2003 and subsequently and which were reported in telegrams from the U.S. Embassy in New Delhi at the time.
- 309 Scott D. Sagan and Jane Vaynman, “Reviewing the Nuclear Posture Review,” *Nonproliferation Review* 18, no. 1 (2011): 248–249.
- 310 Author’s private notes of contemporaneous official conversations with NSA Mishra and senior Indian officials in the Prime Minister’s Office in January 2003 and subsequently.
- 311 Menon, *Choices*, 110.
- 312 Rajesh Rajagopalan, “The Strategic Logic of the No First Use Nuclear Doctrine,” Observer Research Foundation, August 30, 2019, <https://www.orfonline.org/expert-speak/strategic-logic-no-first-use-nuclear-doctrine-54911/>.
- 313 “Draft Report of National Security Advisory Board on Indian Nuclear Doctrine.”
- 314 “The Cabinet Committee on Security Reviews [O]perationalization of India’s Nuclear Doctrine.”
- 315 Ashley J. Tellis, “The Changing Political-Military Environment: South Asia,” in *The United States and Asia: Toward a New U.S. Strategy and Force Posture* (Santa Monica: RAND Corporation, 2001), 203–240; Francisco Aguilar et al., *An Introduction to Pakistan’s Military* (Cambridge: Belfer Center for Science and International Affairs, 2011), 8–11; and Frank O’Donnell and Alex Bollfrass, *The Strategic Postures of China and India: A Visual Guide* (Cambridge: Belfer Center for Science and International Affairs, 2020).
- 316 Ashley J. Tellis, C. Christine Fair, and Jamison Jo Medby, *Limited Conflicts Under the Nuclear Umbrella* (Santa Monica: RAND Corporation, 2001), 16–17.
- 317 Lora Saalman, “India’s No-First-Use Dilemma: Strategic Consistency or Ambiguity Towards China and Pakistan,” Stockholm International Peace Research Institute, December 2, 2020, <https://www.sipri.org/commentary/blog/2020/indias-no-first-use-dilemma-strategic-consistency-or-ambiguity-towards-china-and-pakistan>. For a perceptive Indian analysis—albeit in the guise of political fiction—of the conditions under which Chinese nuclear use against India might occur, see General K. Sundarji, *Blind Men of Hindoostan* (New Delhi: UBS Publishers’ Distributors Ltd., 1993), 141–157.
- 318 Shyam Saran, “Is India’s Nuclear Deterrent Credible?” (speech, New Delhi, IN, April 24, 2013), Research and Information System for Developing Countries, [https://ris.org.in/images/RIS\\_images/pdf/Final%20Is%20India’s%20Nuclear%20Deterrent%20Credible-%20rev1%202%202.pdf](https://ris.org.in/images/RIS_images/pdf/Final%20Is%20India’s%20Nuclear%20Deterrent%20Credible-%20rev1%202%202.pdf).
- 319 The details of a “force-in-being” approach are discussed in detail in Tellis, *India’s Emerging Nuclear Posture*, 251–724.

- 320 Harsh V. Pant, "India's Nuclear Doctrine and Command Structure: Implications for Civil-Military Relations in India," *Armed Forces & Society* 33, no. 2 (2007): 238–264.
- 321 For a description of the development and technical specifications of the Agni family of missiles, see Missile Defense Project, "Missiles of India," Center for Strategic and International Studies, June 14, 2018, <https://missilethreat.csis.org/country/india/>.
- 322 See Missile Defense Project, "Dhanush," Center for Strategic and International Studies, August 11, 2016, <https://missilethreat.csis.org/missile/dhanush/>.
- 323 David Albright, "India's and Pakistan's Fissile Material and Nuclear Weapons Inventories, end of 1999," Institute for Science and International Security, October 11, 2000, <https://isis-online.org/publications/southasia/stocks1000.html>.
- 324 Tellis, *India's Emerging Nuclear Posture*, 371–372, 402–428; other useful details are found in Bharat Karnad, *India's Nuclear Policy* (Westport: Praeger Security International, 2008), 63–106.
- 325 Sushant Singh, "20 Years After Kargil War: How India Readied Nuclear Weapons in IAF's Mirage," *Indian Express*, July 21, 2019, <https://indianexpress.com/article/india/india-pakistan-kargil-war-air-force-mirage-fighter-jets-5839794/>; and Kampani, *India's Nuclear Proliferation Policy*, ff. 115.
- 326 For a full discussion, see Tellis, *India's Emerging Nuclear Posture*, 321–340.
- 327 See, for example, "India Not to Engage in a N-Arms Race: Jaswant"; and M. S. Subirthana, "Deterrence, Assured Retaliation Capability—An Analysis on India's Second-Strike Policy," *International Journal of Multidisciplinary Research and Publications* 3, no. 3 (2020): 53–57.
- 328 "Draft Report of National Security Advisory Board on Indian Nuclear Doctrine."
- 329 For an analytically illuminating discussion about the capabilities of small nuclear forces in relation to deterrence, see Rajesh Rajagopalan, "Nuclear Strategy and Small Nuclear Forces: The Conceptual Components," *Strategic Analysis* 23, no. 7 (1999): 1,117–1,131.
- 330 The varied demands of such targeting strategies in the U.S-Soviet context are discussed in David Alan Rosenberg, "U.S. Nuclear War Planning, 1945–160," Desmond Ball, "The Development of the SIOP, 1960–1983," and William T. Lee, "Soviet Nuclear Targeting Strategy," in *Strategic Nuclear Targeting*, eds. Desmond Ball and Jeffery Richelson (Ithaca: Cornell University Press, 1986), 35–56, 57–83, and 84–108.
- 331 Dean A. Wilkening, "Nuclear Warfare," in *Stress of War, Conflict and Disaster*, ed. George Fink (Amsterdam: Elsevier, 2010), 314–328.
- 332 See by way of example Vipin Narang, "Five Myths About India's Nuclear Posture," *Washington Quarterly* 36, no. 3 (2013): 143–157; Christopher Clary and Vipin Narang, "India's Counterforce Temptations: Strategic Dilemmas, Doctrine, and Capabilities," *International Security* 43, no. 3 (2019): 7–52; Sidharth Kaushal, James Byrne, Joe Byrne and Gary Somerville, "India's Nuclear Doctrine: The Agni-P and the Stability-Instability Paradox," Royal United Services Institute for Defence and Security Studies, July 8, 2021, <https://rusi.org/explore-our-research/publications/commentary/indias-nuclear-doctrine-agni-p-and-stability-instability-paradox>; Ankit Panda, "Nuclear South Asia and Coming to Terms With 'No First-Use' With Indian Characteristics," *The Diplomat*, March 28, 2017, <https://thediplomat.com/2017/03/nuclear-south-asia-and-coming-to-terms-with-no-first-use-with-indian-characteristics/>; and Kumar Sundaram and M. V. Ramana, "India and the Policy of No First Use of Nuclear Weapons," *Journal for Peace and Nuclear Disarmament* 1, no. 1 (2018): 152–168.
- 333 This conclusion is emphatically affirmed in Menon, *Choices*, 105–123.
- 334 Brahma Chellaney, "Why India's Powerful Anti-Deterrent Lobby Supports Nuclear Deal With the U.S.," *Asian Age*, January 5, 2008, <http://chellaney.net/2008/01/05/why-indias-powerful-anti-deterrent-lobby-supports-nuclear-deal-with-the-u-s/>.
- 335 Rajesh Rajagopalan, "India's Nuclear Doctrine Debate," Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/india-s-nuclear-doctrine-debate-pub-63950>.
- 336 For examples of the attempts made by Indian scholars to correct some hermeneutical confusion on India's nuclear doctrine, see Rajesh Rajagopalan, "India's Nuclear Doctrine Debate," and Abhijnan Rej, "India Is Not Changing Its Policy on No First Use of Nuclear Weapons," *War on the Rocks*, March 29, 2017, <https://warontherocks.com/2017/03/india-is-not-changing-its-policy-on-no-first-use-of-nuclear-weapons/>.
- 337 Yogesh Joshi and Frank O'Donnell, *India and Nuclear Asia: Forces, Doctrine, and Dangers* (Washington, DC: Georgetown University Press, 2019), 14–15.

- 338 A similar judgment applies *a fortiori* to the claims advanced by Christopher Clary and Vipin Narang, who aver that “India’s investment in a diverse array of capabilities . . . would be useful for damage-limiting first strikes, but which otherwise make little sense for an assured retaliation or a minimum deterrence posture.” See Clary and Narang, “India’s Counterforce Temptations: Strategic Dilemmas, Doctrine, and Capabilities,” 24.
- 339 B. S. Nagal, “Perception and Reality: An In-Depth Analysis of India’s Credible Minimum Deterrent,” *Force*, October 2014, <https://forceindia.net/guest-column/guest-column-b-s-nagal/perception-and-reality/>.
- 340 “India Dismisses US Demand on Minimum Nuclear Deterrence,” *Hindustan Times*, January 6, 1999.
- 341 Norris and Kristensen, “Global Nuclear Weapons Inventories, 1945–2010,” 82.
- 342 For good overviews, see Lawrence Freedman, “British Nuclear Targeting” and David S. Yost, “French Nuclear Targeting,” in *Strategic Nuclear Targeting*, eds. Ball and Richardson, 109–126 and 127–156.
- 343 Press Trust of India, “Pakistan Trying to Bleed India to Death Through a Thousand Cuts: Official,” *Economic Times*, October 11, 2011, <https://economictimes.indiatimes.com/news/politics-and-nation/pakistan-trying-to-bleed-india-through-a-thousand-cuts-official/articleshow/10313870.cms?from=mdr>.
- 344 P.R. Chari, “India’s Nuclear Doctrine: Stirrings of Change,” Carnegie Endowment for International Peace, June 4, 2014, <https://carnegieendowment.org/2014/06/04/india-s-nuclear-doctrine-stirrings-of-change-pub-55789>.
- 345 “BJP Manifesto for 2014 Lok Sabha Elections,” *News18*, April 7, 2014, <https://www.news18.com/news/politics/full-text-bjp-manifesto-for-2014-lok-sabha-elections-679304.html>.
- 346 “Why Bind Ourselves to ‘No First Use Policy’: Parrikar on India’s Nuclear Policy,” *The Wire*, November 10, 2016, <https://thewire.in/politics/why-bind-ourselves-to-no-first-use-policy-parrikar-on-indias-nuclear-policy>.
- 347 “No First Use Nuclear Policy May Change in Future, Says Rajnath Singh on India’s Defence Strategy,” *India Today*, August 16, 2019, <https://www.indiatoday.in/india/story/india-no-first-use-nuclear-policy-may-change-rajnath-singh-1581403-2019-08-16>.
- 348 For example, in the case of Defense Minister Manohar Parrikar’s comments in 2016: see Sushant Singh, “Manohar Parrikar Questions India’s No-First-Use Nuclear Policy, Adds ‘My Thinking,’” *Indian Express*, November 11, 2016, <https://indianexpress.com/article/india/india-news-india/manohar-parrikar-questions-no-first-use-nuclear-policy-adds-my-thinking-4369062/>.
- 349 Pankaj Sharma, “Statement by Ambassador (Dr.) Pankaj Sharma, Permanent Representative of India to the Conference on Disarmament, Geneva During the General Debate of the First Committee of the United Nations General Assembly on October 14, 2020,” Permanent Mission of India to the Conference on Disarmament, October 14, 2020, <http://meaindia.nic.in/cdgeneva/?11648?000>.
- 350 “Why Bind Ourselves to ‘No First Use Policy’: Parrikar on India’s Nuclear Policy.”
- 351 See, by way of example, Anil A. Athale, “Why India Needs Nuclear Weapons,” Rediff, September 25, 2009, <https://news.rediff.com/column/2009/sep/25/why-india-needs-nuclear-weapons.htm>; B.S. Nagal, “Nuclear No First Use Policy: A Time for Appraisal,” *Force*, December 2014, <http://forceindia.net/guest-column/guest-column-b-s-nagal/nuclear-no-first-use-policy/>; and Anil Kumar, “Jettison the No-First-Use Nuke Policy,” Rediff, November 27, 2007, <https://www.rediff.com/news/2007/nov/27mp.htm>.
- 352 Glenn Snyder, “The Balance of Power and the Balance of Terror,” in *The Balance of Power*, ed. Paul Seabury (San Francisco: Chandler, 1965), 185–201.
- 353 Menon, *Choices*, 117.
- 354 Chari, “India’s Nuclear Doctrine.”
- 355 Paul, “The Paradox of Power,” 484.
- 356 Ibid. See also, Todd S. Sechser and Matthew Fuhrmann, “Crisis Bargaining and Nuclear Blackmail,” *International Organization* 67, no. 1 (2013): 173–195.
- 357 Athale, “Why India Needs Nuclear Weapons.”
- 358 Ibid.
- 359 Menon, *Choices*, 110.

- 360 Clary and Narang, "India's Counterforce Temptations," 17–20; Vipin Narang, "Plenary: Beyond the Nuclear Threshold: Causes and Consequences of First Use," Carnegie Endowment for International Peace, March 20, 2017, <https://fbfy83yid9jldqsev3zq0w8n-wpengine.netdna-ssl.com/wp-content/uploads/2013/08/Vipin-Narang-Remarks-Carnegie-Nukefest-2017.pdf>; and Frank O'Donnell and Debalina Ghoshal, "Managing Indian Deterrence: Pressures on Credible Minimum Deterrence and Nuclear Policy Options," *Nonproliferation Review* 25, no. 5–6 (2019): 419–436.
- 361 See for example, Ankit Panda, "From 'No First Use' to 'No, First Use?'" *The Diplomat*, August 18, 2019, <https://thediplomat.com/2019/08/from-no-first-use-to-no-first-use/>; and Matthew R. Costlow, *A Net Assessment of "No First Use" and "Sole Purpose" Nuclear Policies* (Fairfax: National Institute for Public Policy, 2021).
- 362 Manpreet Sethi, "Perceptions of India's Nuclear Capability Buildup," *The Diplomat*, April 2, 2019, <https://thediplomat.com/2019/04/perceptions-of-indias-nuclear-capability-buildup-ghost-hunting-and-a-reality-check/>.
- 363 K. Subrahmanyam, "Nuclear Tests: What Next?," *IIC Quarterly* 25, no. 2-3 (1998): 57.
- 364 Tellis, *India's Emerging Nuclear Posture*, 311.
- 365 Tellis, *India's Emerging Nuclear Posture*, 312.
- 366 Prakash Menon, "India's Nuclear Journey Post Kargil," *Journal of Defence Studies* 13, no. 3 (2019): 139–153.
- 367 Siddharth Varadarajan, "Menon: The Policy of No First Use of Nuclear Weapons Has Served India's Purpose," *The Wire*, December 12, 2016, <https://thewire.in/diplomacy/menon-india-nuclear-weapons-nfu-nsa>.
- 368 Khalid Kidwai and Peter Lavoy, "A Conversation With Gen. Khalid Kidwai," Carnegie Endowment for International Peace, March 23, 2015, <https://carnegieendowment.org/files/03-230315carnegieKIDWAI.pdf>, 4–5, 8–9. See also, Sannia Abudallah, "Pakistan's Full-Spectrum Deterrence: Trends and Trajectories," *South Asian Voices*, December 13, 2018, <https://southasianvoices.org/pakistan-full-spectrum-deterrence-trends-trajectories/>.
- 369 J. E. Stromseth, *The Origins of Flexible Response: NATO's Debate Over Strategy in the 1960s* (London: Palgrave Macmillan, 1988). For a useful corrective, see also John S. Duffield, "The Evolution of NATO's Strategy of Conventional Response: A Reinterpretation," *Security Studies* 1, no. 1 (1991): 132–156.
- 370 Rajagopalan, "India's Nuclear Doctrine Debate."
- 371 Kidwai and Lavoy, "A Conversation With General Khalid Kidwai."
- 372 G. Balachandran and Kapil Patil, "Revisiting India's Nuclear Doctrine," Manohar Parrikar Institute for Defence Studies and Analyses, March 27, 2017, [https://www.idsa.in/idsacomments/revisiting-india-nuclear-doctrine\\_gbala-kpatil\\_270317](https://www.idsa.in/idsacomments/revisiting-india-nuclear-doctrine_gbala-kpatil_270317).
- 373 Saran, "Is India's Nuclear Deterrent Credible?"
- 374 Verghese Koithara, *Managing India's Nuclear Forces* (Washington, DC: Brookings Institution Press, 2012), 244–245; Raja Menon, "Boxed In by Pakistan," *Indian Express*, September 6, 2014, <http://indianexpress.com/article/opinion/columns/boxed-in-by-pakistan/>; and Bharat Karnad, "India's Nuclear Amateurism," *New Indian Express*, June 28, 2013, <https://www.newindianexpress.com/opinions/2013/jun/28/Indias-nuclear-amateurism-491261.html>.
- 375 Menon, *Choices*, 110–112.
- 376 *Nuclear Weapons and Foreign Policy*, 93rd Cong. (1974) (responses of James R. Schlesinger, secretary of defense, to questions submitted by Senator William S. Symington, Thursday, April 4, 1974), <https://babel.hathitrust.org/cgi/pt?id=mdp.39015078615740&view=lup&seq=1>, 160.
- 377 Ajai Shukla, "After a Pakistani TNW Strike, India Can Go for Pakistan's Nuclear Arsenal: Former NSA Shivshankar Menon," *Business Standard*, March 18, 2017, <http://ajaiashukla.blogspot.com/2017/03/after-pakistani-tnw-strike-india-will.html>.
- 378 *Ibid.*
- 379 Menon, *Choices*, 110–111.
- 380 Clary and Narang, "India's Counterforce Temptations," 10–11.

- 381 Remarks by Professor Vipin Narang, Department of Political Science, Massachusetts Institute of Technology, “Plenary: Beyond the Nuclear Threshold: Causes and Consequences of First Use,” Carnegie International Nuclear Policy Conference Washington, DC, March 20, 2017, <https://southasianvoices.org/sav-dc-nukefest2017-potential-indian-nuclear-first-use/>.
- 382 Dhruva Jaishankar, “Decoding India’s Nuclear Status,” *The Wire*, April 3, 2017, <https://thewire.in/diplomacy/decoding-india-nuclear-status>.
- 383 Tellis, *India’s Emerging Nuclear Posture*, 339–340.
- 384 *Ibid.*, 338, with a detailed discussion on 333–341.
- 385 Gaurav Rajen and Michael Vannoni, “Fissile Materials Control in South Asia: Regional Analyses and Potential Confidence Building Measures,” Sandia National Laboratories, February 2006, [https://www.sandia.gov/cooperative-monitoring-center/\\_assets/documents/FMCinSouthAsiaFINAL.pdf](https://www.sandia.gov/cooperative-monitoring-center/_assets/documents/FMCinSouthAsiaFINAL.pdf), 12–13; and Rekha Chakravarthi, Yogesh Joshi, and R. Rajaraman, “India and the Impending FMCT: Interview With Prof. R. Rajaraman,” IPCS Nuclear Security Project, June 1, 2009, [https://www.jstor.org/stable/resrep09282?seq=1#metadata\\_info\\_tab\\_contents](https://www.jstor.org/stable/resrep09282?seq=1#metadata_info_tab_contents).
- 386 Admittedly, this conclusion hinges on the assumption that India would not accelerate the production of weapons-grade fissile materials in anticipation of the conclusion of a Fissile Material Cutoff Treaty.
- 387 M.V. Ramana, “More Missiles Than Megawatts,” *IEEE Spectrum*, July 1, 2007, <https://spectrum.ieee.org/more-missiles-than-megawatts>.
- 388 “Nuclear Power in India,” <https://world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx>.
- 389 Several facilities have been submitted for safeguards that are not yet operational. “Agreement Between the Government of India and the International Atomic Energy Agency for the Application of Safeguards to Civilian Nuclear Facilities,” International Atomic Energy Agency, January 10, 2020, <https://www.iaea.org/sites/default/files/publications/documents/infcircs/2009/infcirc754a10.pdf>.
- 390 Manu Tayal, “PFBR Likely to Commission by Oct 2020; Add 500 MW Electrical Power to Grid,” *Energetica*, September 23, 2020, <https://www.energetica-india.net/news/pfbr-likely-to-commission-by-oct-2022-add-500-mw-electrical-power-to-grid>.
- 391 Alexander Glaser and M.V. Ramana, “Weapon-Grade Plutonium Production Potential in the Indian Prototype Fast Breeder Reactor,” *Science and Global Security* 15 (2007): 85–105.
- 392 Even critics of India’s safeguards agreements, such as John Carlson, “India’s Nuclear Safeguards: Not Fit for Purpose,” Belfer Center for Science and International Affairs, January 2018, <https://www.belfercenter.org/sites/default/files/files/publication/India%E2%80%99s%20Nuclear%20Safeguards%20-%20Not%20Fit%20for%20Purpose.pdf>, do not claim that India’s eight unsafeguarded reactors are used for producing weapons-grade materials, only that they could do so because of their “strategic” appellation. See also, Robertson and Carlson, *The Three Overlapping Streams of India’s Nuclear Program*. India’s use of the terminology “strategic,” however, which was discussed at length between the U.S. and Indian governments during the negotiations over India’s separation plan, did not refer to weapons-related activities.
- 393 Karnad, *India’s Nuclear Policy*, 92–93.
- 394 Ashley J. Tellis, *Atoms for War? U.S.-Indian Civilian Nuclear Cooperation and India’s Nuclear Arsenal* (Washington, DC: Carnegie Endowment for International Peace, 2006), 17–37.
- 395 See the discussion in David Albright and Serena Kelleher-Verantini, *India’s Stocks of Civil and Military Plutonium and Highly Enriched Uranium, End 2014* (Washington, DC: Institute for Science and International Security, 2015); and in Gregory S. Jones, *Reactor-Grade Plutonium and Nuclear Weapons: Exploding the Myths* (Arlington: Nonproliferation Policy Education Center, 2018), 101–121.
- 396 R. Ramachandran, “Pokhran II: The Scientific Dimensions,” in *India’s Nuclear Deterrent*, ed. Mattoo, 34–61.
- 397 *Ibid.*, 36.
- 398 See for example, Zia Mian and M. V. Ramana, “Wrong Ends, Means, and Needs: Behind the U.S. Nuclear Deal With India,” *Arms Control Today* 36, no. 1 (2006): 11–17.
- 399 “India,” International Panel on Fissile Materials, August 31, 2021, <https://fissilematerials.org/countries/india.html>.

- 400 This upper bound is given in David Albright and Serena Kelleher-Verantini, *India's Stocks of Civil and Military Plutonium and Highly Enriched Uranium, End 2014* (Washington, DC: Institute for Science and International Security, 2015).
- 401 See, for example, *Global Fissile Material Report 2015: Nuclear Weapon and Fissile Material Stockpiles and Production* (Princeton: International Panel on Fissile Materials, 2015), 41–44.
- 402 David Albright and Serena Kelleher-Verantini, “India’s Stocks of Civil and Military Plutonium and Highly Enriched Uranium, End 2014,” Institute for Science and International Security, November 2, 2015, [https://isis-online.org/uploads/isis-reports/documents/India\\_Fissile\\_Material\\_Stock\\_November2\\_2015-Final.pdf](https://isis-online.org/uploads/isis-reports/documents/India_Fissile_Material_Stock_November2_2015-Final.pdf), 3–4.
- 403 *Ibid.*, 2.
- 404 “India,” International Panel on Fissile Materials.
- 405 J. Carson Mark (with an Appendix by Frank von Hippel and Edward Lyman), “Explosive Properties of Reactor-Grade Plutonium,” *Science and Global Security*, 17 (2009): 170–185. See also, Jones, *Reactor-Grade Plutonium and Nuclear Weapons: Exploding the Myths*, 8–100, for an excellent overview of the viability of reactor-grade plutonium for making nuclear weapons.
- 406 André Gsponer and Jean-Pierre Hurni, “ITER: The International Thermonuclear Experimental Reactor and the Nuclear Weapons Proliferation Implications of Thermonuclear-Fusion Energy Systems,” Independent Scientific Research Institute, February 2, 2008, 15.
- 407 Perkovich, *India's Nuclear Bomb*, 427–428.
- 408 Jones, *Reactor-Grade Plutonium and Nuclear Weapons*, 61.
- 409 Amory B. Lovins, “Nuclear Weapons and Power-reactor Plutonium,” *Nature* 283 (1980): 820–821.
- 410 Jones, *Reactor-Grade Plutonium and Nuclear Weapons*, 63.
- 411 *Ibid.*, 58–71.
- 412 Tellis, *Atoms for War? U.S.-Indian Civilian Nuclear Cooperation and India's Nuclear Arsenal*, 17–37.
- 413 David Albright and Susan Basu, “India’s Gas Centrifuge Enrichment Program: Growing Capacity for Military Purposes,” Institute for Science and International Security, December 1, 2006, <https://isis-online.org/uploads/isis-reports/documents/indiaenrichment.pdf>, 3–5.
- 414 M.V. Ramana, “An Estimate of India’s Uranium Enrichment Capacity,” *Science & Global Security* 12, no. 1–2 (2004): 115–124.
- 415 David Albright and Serena Kelleher-Verantini, “India’s New Uranium Enrichment Plant in Karnataka,” Institute of Science and International Security, July 1, 2014, <https://isis-online.org/isis-reports/detail/indias-new-uranium-enrichment-plant-in-karnataka/>.
- 416 Tellis, *India's Emerging Nuclear Posture*, 478–481, 487–490.
- 417 “India,” International Panel on Fissile Materials.
- 418 Adrian Levy, “Experts Worry That India Is Creating New Fuel for an Arsenal of H-Bombs,” Center for Public Integrity, December 21, 2015, <https://publicintegrity.org/national-security/experts-worry-that-india-is-creating-new-fuel-for-an-arsenal-of-h-bombs/>; and Mansoor Ahmed, “Reactors, Reprocessing & Centrifuges: India’s Enduring Embrace of Fissile Material,” South Asian Voices, June 26, 2014, <https://southasianvoices.org/reactors-reprocessing-centrifuges-indias-enduring-embrace-of-fissile-material/>.
- 419 Perkovich, *India's Nuclear Bomb*, 186, describes India’s traditional constraints with respect to, for example, polonium production. But the bigger challenge is likely to be tritium production: like so much else, India has the potential capacity to produce large quantities of tritium, but whether it has actually done so either through lithium enrichment or detritiation of heavy water is unclear.
- 420 “New Reactor Being Planned in Trombay,” *The Hindu*, April 28, 1999.
- 421 Saurav Jha, “India’s Research Fleet,” Nuclear Engineering International, December 12, 2017, <https://www.neimagazine.com/features/featureindias-research-fleet-6000630/>.
- 422 See Perkovich, *India's Nuclear Bomb*, 181–183; and Tellis, *India's Emerging Nuclear Posture*, 195–199.
- 423 Raj Chengappa, *Weapons of Peace: The Secret Story of India's Quest to Be a Nuclear Power* (New Delhi: HarperCollins Publishers, 2000), 207–208.
- 424 Brian Barker et al., “Monitoring Nuclear Tests,” *Science* 282 (September 25, 1998): 1968.



- 425 The yield of the Hiroshima weapon is now calculated at 15 kilotons and the Nagasaki weapon produced a yield of 21 kilotons. For details, see John Malik, "The Yields of the Hiroshima and Nagasaki Nuclear Explosions," Los Alamos National Laboratory, September 1985, <http://large.stanford.edu/courses/2018/ph241/cheng2/docs/malik.pdf>.
- 426 Karnad, *India's Nuclear Policy*, 56; and Kampani, *India's Nuclear Proliferation Policy*, 126.
- 427 Karnad, *India's Nuclear Policy*, 68.
- 428 R. Ramachandran, "Pokhran II: The Scientific Dimensions," 46.
- 429 Richard L. Garwin, "Maintaining Nuclear Weapons Safe and Reliable Under a CTBT," Paper presented at "The Comprehensive Test Ban Treaty and US National Security Interests," AAAS Annual Meeting, San Francisco, CA, February 16, 2001, <https://rlg.fas.org/010216-aaas.htm>.
- 430 Gregory S. Jones, "The Role of Boosting in Nuclear Weapon Programs," July 25, 2017, <http://nebula.wsimg.com/ccbc92a7e380925d944880521d489ea5?AccessKeyId=40C80D0B51471CD86975&disposition=0&alloworigin=1>, 4.
- 431 Karnad, *India's Nuclear Policy*, 65.
- 432 For a discussion of the early academic skepticism of the test's success, see Tellis, *India's Emerging Nuclear Posture*, 508–519. These initial assessments were later confirmed by K. Santhanam, a senior scientist in the Pokhran-II project and former chief advisor to the DRDO; see K. Santhanam and Ashok Parthasarathi, "Pokhran-II Thermonuclear Test, a Failure," *The Hindu*, September 17, 2009, <https://www.thehindu.com/opinion/op-ed/Pokhran-II-thermonuclear-test-a-failure/article13736892.ece>.
- 433 See Tellis, *India's Emerging Nuclear Posture*, 508–518.
- 434 Karnad, *India's Nuclear Policy*, 73; and "India Can Produce N-Bomb of 200 Kiloton: Chidambaram," *Times of India*, May 23, 1998.
- 435 See, for example, Arun Prakash, "Strategic Policy Making and the Indian System," *Maritime Affairs* 5, no. 2 (2009): 22–31, who offers a curious formulation: "In the midst of the current brouhaha, we need to retain clarity on one issue; given that deuterium tritium boosted-fission weapons can generate yields of 200–500 kilotons, the credibility of India's nuclear deterrent is not in the slightest doubt." The issue, of course, is not whether DT-boosted fission weapons can yield 200–500 kilotons, but whether *India's* boosted fission weapons can produce such yields since they did not demonstrate such in 1998. For a more breath-takingly optimistic assessment of India's capabilities, see Karnad, *India's Nuclear Policy*, 35–107; and Sanjay Badri-Maharaj, *Indian Nuclear Strategy: Confronting the Potential Threat From Both China and Pakistan* (New York: Routledge, 2019), 31–98.
- 436 For useful details, see Kampani, *India's Nuclear Proliferation Policy*, 112–143.
- 437 Badri-Maharaj, *Indian Nuclear Strategy: Confronting the Potential Threat From Both China and Pakistan*, 59–62.
- 438 P. K. Iyengar et al., "On Thermonuclear Weapon Capability and Its Implications for Credible Minimum Deterrence," *Mainstream* 48, no. 1 (2009): <http://www.mainstreamweekly.net/article1865.html>.
- 439 See the justification in K. Subrahmanyam and V.S. Arunachalam, "Deterrence and Explosive Yield," *The Hindu*, September 2009, <http://www.thehindu.com/opinion/op-ed/article22870>.
- 440 Air Commodore Rippon Gupta, "Tactical Nuclear Weapons: Myths and Realities," *Journal of the United Service Institution of India* 148, no. 614, (October-December 2018), <https://usiofindia.org/publication/usi-journal/tactical-nuclear-weapons-myths-and-realities/>.
- 441 Koithara, *Managing India's Nuclear Forces*, 126.
- 442 *Ibid.*
- 443 Zia Mian, "Commanding and Controlling Nuclear Weapons," in *Confronting the Bomb: Pakistani and Indian Scientists Speak Out*, ed. P. Hoodbhoy (Karachi: Oxford University Press, 2012), 226.
- 444 *Ibid.*, 231.
- 445 *Ibid.*, 227.
- 446 Steven F. Rice and Randall L. Simpson, "The Unusual Stability of TATB: A Review of the Scientific Literature," Lawrence Livermore National Laboratory, UCRL-LR-103683, July 4, 1990, 1, <https://www.osti.gov/servlets/purl/6426268>.

- 447 For a reflection on this subject, see Michael Krepon, “Safe Nuclear Weapons,” *Arms Control Wonk*, April 29, 2015, <https://www.armscontrolwonk.com/archive/404598/safe-nuclear-weapons/>. See also Koithara, *Managing India’s Nuclear Forces*, 122–128.
- 448 As Gaurav Kampani notes, although the developers of India’s nuclear weapons have begun to train the operators, the Strategic Forces Command (and presumably the Indian armed forces), about how to handle nuclear weapons safely, these institutions have “no independent academic-scientific training to challenge [their] sources of technical information and knowledge,” especially when India’s nuclear weapons are not yet “one point safe” and will not be without further hot testing. See Kampani, *India’s Nuclear Proliferation Policy*, 132. On the importance of a deep design base and the accumulated experience on weapons design in ensuring device safety, see Jason M. Weaver, “One in a Million, Given the Accident: Assuring Nuclear Weapon Safety,” Sandia National Laboratory, August 25, 2015, <https://www.osti.gov/servlets/purl/1426902>.
- 449 Karnad, *India’s Nuclear Policy*, 80.
- 450 Subrahmanyam and Arunachalam, “Deterrence and Explosive Yield.”
- 451 For a discussion of the advantages of the Indian Air Force in a possible conflict with Pakistan, see Ashley J. Tellis, *Troubles, They Come in Battalions* (Washington, DC: Carnegie Endowment for International Peace, 2016), 9–15.
- 452 Pravin Sawhney, “Bombed,” *Force*, February 2004, 8.
- 453 Gurmeet Kanwal, “India’s Nuclear Force Structure 2025,” Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/india-s-nuclear-force-structure-2025-pub-63988>.
- 454 “DRDO Successfully Tests ‘Glide Bombs’ in Pokhran,” *Times of India*, August 20, 2016, <https://timesofindia.indiatimes.com/city/jodhpur/DRDO-successfully-tests-glide-bombs-in-Pokhran/articleshow/53780015.cms?from=mdr>.
- 455 “DRDO Tests 1000 Kg Class Indigenous Guided Glide Bomb,” Press Information Bureau, December 19, 2014, <https://pib.gov.in/newsite/PrintRelease.aspx?relid=113801>.
- 456 Hans M. Kristensen and Matt Korda, “Indian Nuclear Forces, 2020,” *Bulletin of the Atomic Scientists* 76, no. 4 (2020): 218–219.
- 457 Joshi and O’Donnell, *India and Nuclear Asia: Forces, Doctrines, and Dangers*, 20; and O’Donnell and Bollfrass, *The Strategic Postures of China and India*, 5.
- 458 Kristensen and Korda, “Indian Nuclear Forces, 2020,” 218.
- 459 Manoj Joshi, “India’s Nuclear Arsenal Failed by ‘Unreliable’ Missiles,” *India Today*, September 4, 2012, <https://www.indiatoday.in/india/story/india-indian-nuclear-forces-bulletin-of-atomic-scientists-agni-115109-2012-09-04>.
- 460 Ajai Shukla, “New-age Agni to Boost Pak-focused Nuclear Deterrent,” *Business Standard*, December 17, 2016, [https://www.business-standard.com/article/economy-policy/new-age-agni-to-boost-pak-focused-nuclear-deterrent-116121601111\\_1.html](https://www.business-standard.com/article/economy-policy/new-age-agni-to-boost-pak-focused-nuclear-deterrent-116121601111_1.html).
- 461 Snehash Alex Philip, “Agni Prime Is the New Missile in India’s Nuclear Arsenal. This Is Why It’s Special,” *The Print*, June 30, 2021, <https://theprint.in/defence/agni-prime-is-the-new-missile-in-indias-nuclear-arsenal-this-is-why-its-special/687271/>.
- 462 Kaushal, Byrne, Byrne, and Somerville, “India’s Nuclear Doctrine: The Agni-P and the Stability–Instability Paradox.”
- 463 Kristensen and Korda, “Indian Nuclear Forces, 2020,” 220.
- 464 *Ibid.*, 218.
- 465 Krishn Kaushik and Sushant Kulkarni, “Explained: Agni (ICBM) vs China’s Hypersonic Missile,” *Indian Express*, October 28, 2021.
- 466 Vikas Sv, “Why India May Not Test Agni 6 Even if DRDO Is Ready With Technology?,” *OneIndia*, July 10, 2019, <https://www.oneindia.com/india/why-india-may-not-test-agni-6-even-if-drdo-is-ready-with-technology-2805212.html>.
- 467 V. K. Saxena, “Agni I to VI – Not Just a Number Game,” *Journal of the United Service Institution of India* 148, no. 613 (2018).

- 468 Hemant Kumar Rout, "India to Conduct First User Trial of Agni-V Missile," *New Indian Express*, September 13, 2021, <https://www.newindianexpress.com/states/odisha/2021/sep/13/india-to-conduct-first-user-trial-of-agni-v-missile-2357942.html>.
- 469 Saxena, "Agni I to VI – Not Just a Number Game."
- 470 For more, see Halvor A. Udem, "A Random Variable Approach to Nuclear Targeting and Survivability," *Military Operations Research* 5, no. 2 (2000): 19–36; and for a graphic illustration, see Office of Technology Assessment, *The Effects of Nuclear War* (Washington, DC: U.S. Government Printing Office), 44.
- 471 Clary and Narang, "India's Counterforce Temptations", 7–52; and Zachary Keck, "India's Agni-V ICBM to Carry Multiple Nuclear Warheads," *The Diplomat*, May 31, 2013, <https://thediplomat.com/2013/05/indias-agni-v-icbm-to-carry-multiple-nuclear-warheads/>.
- 472 "Agni-V Vital: Tessa Thomas," *The Hindu*, October 02, 2013.
- 473 Arjun Subramanian.P, "Longer Reach and Enabling More Options: AGNI V," Center for Air Power Studies, April 30, 2012, [capsindia.org.managewebsiteportal.com/files/documents/ISSUE-BRIEF\\_49\\_LONGER-REACH-AND-ENABLING-MORE-OPERATIONS\\_30-April-2012.pdf](https://www.capsindia.org.managewebsiteportal.com/files/documents/ISSUE-BRIEF_49_LONGER-REACH-AND-ENABLING-MORE-OPERATIONS_30-April-2012.pdf), 2.
- 474 The only possible exception to this conclusion where Indian ballistic missiles are concerned is the Agni-IP, but even its attributed CEP of 10 meters is more likely an expansive ambition rather than a demonstrated capability. In contrast, India's cruise missiles are likely to be relatively accurate but, at least as of now, neither the Brahmos nor the Nirbhay are nuclear armed and the latter at any rate cannot conduct prompt counterforce operations.
- 475 Ajit Kumar Dubey, "Indian Army Might Get Pinaka Rockets to Counter Pakistan's Mini-nuclear Weapons," *India Today*, September 26, 2017; "Indian Army Test Launches Prahaar Short-range Ballistic Missile," *Army Technology*, September 21, 2018, <https://www.army-technology.com/news/india-test-launches-prahaar-missile/>; Franz-Stefan Gady, "India Test Fires Nuclear-Capable Nirbhay Cruise Missile," *The Diplomat*, April 15, 2019, <https://thediplomat.com/2019/04/india-test-fires-nuclear-capable-nirbhay-cruise-missile/>; "BrahMos Fired From Sukhoi," *Times Now News*, October 30, 2020, <https://www.timesnownews.com/india/article/more-power-to-iaf-as-nuclear-capable-brahmos-is-successfully-test-fired-from-sukhoi-30-mki-off-bay-of-bengal/675205>; Debabrata Mohanty and Rahul Singh, "India Successfully Tests Nuclear-capable Shourya Missile," *Hindustan Times*, October 3, 2020, <https://www.hindustantimes.com/india-news/india-successfully-tests-nuclear-capable-shourya-missile/story-fkYlozVJ5oq1MWO26GOWNN.html>; and "DRDO Successfully Carries Maiden Flight Test of 'Pralay'," *The Pioneer*, December 23, 2021, <https://www.dailypioneer.com/2021/india/drdo-successfully-carries-maiden-flight-test-of---pralay---.html>.
- 476 Karnad, *India's Nuclear Policy*, 82; and Franz-Stefan Gady, "India to Test 800-km Range BrahMos Supersonic Cruise Missile in 2018," *The Diplomat*, January 24, 2018, <https://thediplomat.com/2018/01/india-to-test-800-km-range-brahmos-supersonic-cruise-missile-in-2018/>.
- 477 For example, the "Draft Report of National Security Advisory Board on Indian Nuclear Doctrine" states that India will develop "a triad of aircraft, mobile land-based missiles and sea-based assets" so that the "survivability of the forces will be enhanced by a combination of multiple redundant systems, mobility, dispersion and deception," providing the "assured capability... to retaliate effectively even in a case of significant degradation by hostile strikes."
- 478 Rahul Roy-Chaudhary, "India and Pakistan: Nuclear-Related Programs and Aspirations at Sea," in *South Asia's Nuclear Security Dilemma: India, Pakistan, and China*, ed. Lowell Dittmer (New York: Routledge, 2015), 85.
- 479 Iskander Rehman, *Murky Waters: Naval Nuclear Dynamics in the Indian Ocean* (Washington, DC: Carnegie Endowment for International Peace, 2015); and Hans M. Kristensen and Robert S. Norris, "Indian Nuclear Forces, 2017," *Bulletin of the Atomic Scientists* 73, no. 4 (2017): 205–209.
- 480 The meandering history of this program is illuminatingly detailed in Yogesh Joshi, "Samudra: India's Convoluted Path to Undersea Nuclear Weapons," *Nonproliferation Review* 26, no. 5–6 (2019): 481–497.
- 481 Kristensen and Korda, "Indian Nuclear Forces, 2020," 218–219.
- 482 "India Continues to Develop New K-5 Submarine-launched Ballistic Missile SLBM," Navy Recognition, February 1, 2020, <https://www.navyrecognition.com/index.php/naval-news/naval-news-archive/2020/akista/8002-india-continues-to-develop-new-k-5-submarine-launched-ballistic-missile-slbm.html>.

- 483 Sandeep Unnithan, “A Peek Into India’s Top Secret and Costliest Defence Project, Nuclear Submarines,” *India Today*, December 18, 2017, <https://www.indiatoday.in/magazine/the-big-story/story/20171218-india-ballistic-missile-submarine-k-6-submarine-launched-drdo-1102085-2017-12-10>; and Rajat Pandit, “Arihant’s N-capable Missile ‘Ready to Roll,’” *Times of India*, January 25, 2020, <https://timesofindia.indiatimes.com/india/india-successfully-test-fires-k-4-submarine-launched-missile/articleshow/73589861.cms>.
- 484 See, for example, Andrew C. Winner and Ryan W. French, “Rip Currents: The Dangers of Nuclear-armed Submarine Proliferation,” *Bulletin of the Atomic Scientists* 72, no. 4 (2016): 222–227; Diana Wueger, “India’s Nuclear-Armed Submarines: Deterrence or Danger?,” *Washington Quarterly* 39, no. 3 (2016): 77–90; and Tom Hundley, “India and Pakistan Are Quietly Making Nuclear War More Likely,” *Vox*, April 4, 2018, <https://www.vox.com/2018/4/2/17096566/pakistan-india-nuclear-war-submarine-enemies>.
- 485 For details, see Rehman, *Murky Waters*, 14–15.
- 486 While China’s ASW capabilities have been rapidly improving in recent years, they remain limited. See, for example, Eric Heginbotham et al., *The U.S.-China Military Scorecard: Forces, Geography, and the Evolving Balance of Power, 1996–2017* (Santa Monica: RAND Corporation, 2015), 208–214, 224; Ronald O’Rourke, *China’s Naval Modernization: Implications for U.S. Navy Capabilities – Background and Issues for Congress* (Washington, DC: Congressional Research Service, 2018), 4; and William S. Murray, “Underwater TELs and China’s Antisubmarine Warfare: Evolving Strength and a Calculated Weakness,” in *China’s Near Seas Combat Capabilities*, eds. Peter Dutton, Andrew S. Erickson, and Ryan Martinson (Newport: U.S. Naval War College, 2014), 17–30.
- 487 For a description of Russia’s role in the development of the Arihant program, see Kerry R. Bolton, “Indo-Russian Defence Cooperation and *INS Arihant*: Some Geopolitical Implications,” *World Affairs* 17, no. 1 (2013): 52–61. For an account of Russia’s unreliable track record of nuclear submarine safety, see Cristina Chuen, Michael Jasinski, and Bret Lortie, “Russia’s Blue Water Blues,” *Bulletin of the Atomic Scientists* 57, no. 1 (2001): 65–69.
- 488 G. Balachandran, “What Is the Relevance of a Triad?,” *The Hindu*, September 10, 1999.
- 489 For further elaboration, see Tellis, *India’s Emerging Nuclear Posture*, 309–310.
- 490 For an overview of India’s interests in missile defense, see Balraj Nagal, “India and Ballistic Missile Defense: Furthering a Defensive Deterrent,” Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/india-and-ballistic-missile-defense-furthering-defensive-deterrent-pub-63966>; and Ashok Sharma, *India’s Missile Defence Programme: Threat Perceptions and Technological Evolution* (New Delhi: Centre for Land Warfare Studies, 2009).
- 491 See the discussion in Rajeswari Pillai Rajagopalan, “Strategic Implications of India’s Ballistic Missile Defense,” Federation of American Scientists, May 8, 2017, <https://uploads.fas.org/media/Strategic-Implications-of-India%E2%80%99s-Ballistic-Missile-Defense.pdf>.
- 492 Balraj Nagal, “India and Ballistic Missile Defense.”
- 493 Perkovich, *India’s Nuclear Bomb*, 422–424.
- 494 For an overview of the expansion of India’s nuclear infrastructure under Prime Minister Singh, see Vipin Narang, *Nuclear Strategy in the Modern Era: Regional Powers and International Conflict* (Princeton: Princeton University Press, 2014), 100–110; and Kampani, *India’s Nuclear Proliferation Policy*, 112–143.
- 495 Arun Prakash, “India’s Nuclear Deterrent: The More Things Change...” S. Rajaratnam School of International Studies, March 2014, [https://www.rsis.edu.sg/wp-content/uploads/2014/07/PR140301\\_India\\_Nuclear\\_Deterrent.pdf](https://www.rsis.edu.sg/wp-content/uploads/2014/07/PR140301_India_Nuclear_Deterrent.pdf), 4.
- 496 Karnad, *India’s Nuclear Policy*, 101–103; and Kampani, *India’s Nuclear Proliferation Policy*, 121–131.
- 497 Saran, “Is India’s Nuclear Deterrent Credible?”
- 498 Tellis, *India’s Emerging Nuclear Posture*, 595–609.
- 499 Ibid.; and Lauren J. Borja and M.V. Ramana, “Command and Control of India’s Nuclear Arsenal,” *Journal for Peace and Nuclear Disarmament*, 3:1 (2020): 1–20.
- 500 Karnad, *India’s Nuclear Policy*, 97; and Kampani, *India’s Nuclear Proliferation Policy*, 129.
- 501 Karnad, *India’s Nuclear Policy*, 101–103. See also, Borja and Ramana, “Command and Control of India’s Nuclear Arsenal,” 1–20.

- 502 See Tellis, *India's Emerging Nuclear Posture*, 609–635.
- 503 Saran, “Is India’s Nuclear Deterrent Credible?,” 11; and Kampani, *India’s Nuclear Proliferation Policy*, 112–143.
- 504 Kampani, *India’s Nuclear Proliferation Policy*, 129.
- 505 For a good overview of the role of the SFC, though with caveats about some specifics, see Kampani, *India’s Nuclear Proliferation Policy*, 112–143.
- 506 As Yogesh Joshi notes, “There exists a strict division of labor between the navy and the SFC: maintenance and day-to-day operations of India’s SSBN fleet are the navy’s job; operational deployment falls exclusively under the SFC’s purview. Unlike the air vector of India’s nuclear-delivery systems, SSBNs will have no dual tasking and will remain solely under the operational command of the SFC.” Joshi, “*Samudra*,” 495. Presumably, a similar arrangement obtains where control of the ship-based nuclear deterrent is concerned as well.
- 507 For examples pertaining to the three services, see “Chief Staff Officer (Air Vector Strategy) Appointments at Strategic Forces Command,” Bharat Rakshak, <http://www.bharat-rakshak.com/IAF/Database/Units/list.php?qunit=SFC&qapppt=CSO+%28Air+Vector+Strat%29>; “Maj Gen Gamlin Takes Charge as SFC Chief Staff Officer,” *Dawnlit Post*, August 28, 2017, <https://thedawnlitpost.com/2017/08/maj-gen-gamlin-takes-charge-as-sfc-chief-staff-officer/>; and “Biodata: Rear Admiral SY Shrikhande, AVSM, IN (Retd),” <http://indianmaritimefoundation.org/mrc/Biodata/shrikhande.docx>.
- 508 Tellis, *India's Emerging Nuclear Posture*, 91; and “India’s Nuclear Weapons Program: Smiling Buddha: 1974,” Nuclear Weapons Archive, November 8, 2001, <http://nuclearweaponarchive.org/India/IndiaSmiling.html>.
- 509 Hans M. Kristensen and Robert S. Norris, “Worldwide Deployments of Nuclear Weapons, 2017,” *Bulletin of the Atomic Scientists* 73, no. 5 (2017): 289–297.
- 510 Karnad, *India’s Nuclear Policy*, 102–103.
- 511 Tellis, *India's Emerging Nuclear Posture*, 417.
- 512 Koithara, *Managing India’s Nuclear Forces*, 142–149; Karnad, *India’s Nuclear Policy*, 102–103; and Kampani, *India’s Nuclear Proliferation Policy*, 129–130.
- 513 Kampani, *India’s Nuclear Proliferation Policy*, 130.
- 514 *Ibid.*, 112–143.
- 515 Koithara, *Managing India’s Nuclear Forces*, 147–149, however, infers that the need for assembled weapons derives from the fact that India deploys sealed pit warheads. But sealed pit warhead designs are not necessarily incompatible with low assembly states, thus suggesting that the imperatives for maintaining assembled warheads, whatever their number, is driven by the need to support speedy retaliation rather than because of their technical features.
- 516 Kampani, *India’s Nuclear Proliferation Policy*, 112–143.
- 517 Narang, *Nuclear Strategy in the Modern Era*, 100–109.
- 518 Kampani, *India’s Nuclear Proliferation Policy*, 130.
- 519 Shiv Aroor, “New Chief of India’s Military Research Complex Reveals Brave New Mandate,” *India Today*, July 3, 2013, <https://www.indiatoday.in/india/story/indias-nuclear-counterstrike-response-time-to-be-in-minutes-drdo-chief-169019-2013-07-03>.
- 520 Narang, “Five Myths About India’s Nuclear Posture,” 148.
- 521 Bharat Karnad, “Why Concerns About an India-Pakistan Nuclear War Are Highly Exaggerated,” *Hindustan Times*, March 31, 2017, <https://www.hindustantimes.com/analysis/concerns-about-an-india-pakistan-nuclear-war-are-highly-exaggerated/story-rnKGeo3qZ0oCpMhR1edRqL.html>.
- 522 Ajey Lele and Parveen Bhardwaj, *India’s Nuclear Triad: A Net Assessment* (New Delhi: Institute for Defence Studies and Analyses, 2013), 24–28.
- 523 In this vein, a former DRDO director, Dr. Avinash Chander—in a display of bravado aimed at domestic audiences—has claimed that “In the second strike capability, the most important thing is how fast we can react. We are working on canisterised systems that can launch from anywhere at anytime. . . . We are making much more agile, fast-reacting, stable missiles so response can be within minutes.” Aroor, “New Chief of India’s Military Research Complex Reveals Brave New Mandate.”

- 524 Kampani, *India's Nuclear Proliferation Policy*, 131.
- 525 Joshi, "Samudra," 495.
- 526 Joshi, "Samudra," 494; and Kampani, *India's Nuclear Proliferation Policy*, 130.
- 527 Kaushik and Kulkarni, "Explained: Agni (ICBM) vs China's Hypersonic Missile."
- 528 Clary and Narang, "India's Counterforce Temptations," 37–38.
- 529 Tellis, *India's Emerging Nuclear Posture*, 672–724.
- 530 Joshi, "Samudra," 494.
- 531 Tellis, *India's Emerging Nuclear Posture*, 410.
- 532 Narang, *Nuclear Strategy in the Modern Era*, 107–108.
- 533 Tellis, *India's Emerging Nuclear Posture*, 463–466.
- 534 Saran, "Is India's Nuclear Deterrent Credible?," 17–18.
- 535 *Ibid.*, 19–20.
- 536 Gaurav Kampani, "India's Evolving Civil-Military Institutions in an Operational Nuclear Context," June 30, 2016, <https://carnegieendowment.org/2016/06/30/india-s-evolvingcivil-%20military-institutions-in-operational-nuclear-context-pub-63910>.
- 537 The PES/PAL system is flagged in Prakash, "India's Nuclear Deterrent," 4; and in Koithara, *Managing India's Nuclear Forces*, 100–105.
- 538 Saran, "Is India's Nuclear Deterrent Credible?," 21.
- 539 Kampani, *India's Nuclear Proliferation Policy*, 113, does not disagree with this conclusion but his linguistic formulation is confusing.
- 540 Press Trust of India, "India Accidentally Fired Missile Into Pakistan, Govt Orders Probe," *Economic Times*, March 11, 2022, <https://economictimes.indiatimes.com/news/defence/india-says-it-accidentally-fired-missile-into-pakistan/articleshow/90154909.cms>.
- 541 For gripping overviews of the pain of Partition, see Dominique Lapierre and Larry Collins, *Freedom at Midnight*, 7th ed. (New Delhi: Vikas Publishing House, 2011); Yasmin Khan, *The Great Partition: The Making of India and Pakistan*, 2nd ed. (New Haven: Yale University Press, 2008); and Barney White-Spunner, *Partition* (London: Simon & Schuster, 2017). A very useful academic overview of the enormous literature on Partition is Ian Talbot and Gurharpal Singh, *The Partition of India* (Cambridge: Cambridge University Press, 2009).
- 542 For excellent analysis of the historical and structural factors that shaped the making of Pakistan, see Ian Talbot, *Pakistan: A Modern History* (London: Hurst, 2009) and Ayesha Jalal, *The Struggle for Pakistan* (Cambridge: Harvard University Press, 2014).
- 543 Ayesha Jalal, *The Sole Spokesman: Jinnah, the Muslim League and the Demand for Pakistan* (Cambridge, UK: Cambridge University Press, 1994), 121.
- 544 C. Christine Fair, *Fighting to the End: The Pakistan Army's Way of War* (Oxford: Oxford University Press, 2014), 139–141.
- 545 For a detailed, albeit controversial, reading of the dispute pertaining to Jammu and Kashmir, see Alastair Lamb, *Kashmir: A Disputed Legacy 1846–1990* (Oxford: Oxford University Press, 1992); the Afghan-Pakistan dispute over the Durand Line is summarized in Bijan Omrani, "The Durand Line: History and Problems of the Afghan-Pakistan Border," *Asian Affairs* 40, no. 2 (2009): 177–195; and in Elisa Giunchi, "The Origins of the Dispute Over the Durand Line," *Internationales Asienforum* 44, nos. 1–2 (2013): 25–46. A detailed examination of the Durand Line dispute at the time of Partition can be found in Elizabeth Leake, *The Defiant Border: The Afghan-Pakistan Borderlands in the Era of Decolonization, 1936–1965* (Cambridge: Cambridge University Press, 2017).
- 546 Vali Nasr, "The Negotiable State: Borders and Power-Struggles in Pakistan," in *Right-sizing the State: The Politics of Moving Borders*, eds. Brendan O'Leary, Ian S. Lustick, and Thomas Callaghy (Oxford: Oxford University Press, 2001), 168–200.
- 547 For more on this theme and its complexities, see Stephen Philip Cohen, *The Idea of Pakistan* (Washington, DC: Brookings Institution Press, 2004).
- 548 T. V. Paul, *The Warrior State: Pakistan in the Contemporary World* (Oxford: Oxford University Press, 2014), 69–126.

- 549 For useful discussions about the role of the Army in Pakistan's security consciousness, see Paul, *The Warrior State: Pakistan in the Contemporary World*, 69–93; and the extensive and illuminating discussion in Aqil Shah, *The Army and Democracy* (Cambridge: Harvard University Press, 2014). The ethnic representation of the Pakistan Army and the changes therein are discussed in Ayesha Siddiqi, "Pakistan Military—Ethnic Balance in the Armed Forces and Problems of Federalism," Manekshaw Paper 39, Centre for Land Warfare Studies, 2013; and C. Christine Fair and Shuja Nawaz, "The Changing Pakistan Army Officer Corps," *The Journal of Strategic Studies* 34, no. 1 (2011): 63–94.
- 550 For more on this issue, see Ashley J. Tellis, *Are India-Pakistan Peace Talks Worth a Damn?* (Washington, DC: Carnegie Endowment for International Peace, 2017), 25–42.
- 551 The term is Bernard Brodie's and appears in the title of his pathbreaking volume, Bernard Brodie, ed., *The Absolute Weapon: Atomic Power and World Order* (New York: Harcourt, Brace and Company, 1946).
- 552 Stephen Philip Cohen, *The Pakistan Army* (Berkeley: University of California Press, 1984), 152–161; and Feroz Hassan Khan, "Pakistan as a Nuclear State," in *Pakistan—Beyond the Crisis State*, ed. Maleeha Lodhi (Karachi: Oxford University Press, 2011), 267–282.
- 553 Bhumitra Chakma, "Road to Chagai: Pakistan's Nuclear Programme, Its Sources and Motivations," *Modern Asian Studies* 36, no. 4 (2002): 871–912.
- 554 Bhumitra Chakma, *Pakistan's Nuclear Weapons* (London: Routledge, 2008): 10–17, 46.
- 555 Dwight D. Eisenhower, "Address by Mr. Dwight D. Eisenhower, President of the United States of America, to the 470th Plenary Meeting of the United Nations General Assembly, Tuesday, 8 December 1953," International Atomic Energy Agency, <https://www.iaea.org/about/history/atoms-for-peace-speech>.
- 556 Chakma, "Road to Chagai," 875–877.
- 557 Abdul Sattar, *Pakistan's Foreign Policy 1947–2005: A Concise History* (Oxford: Oxford University Press, 2007), 46–52, 57–60.
- 558 Khan, *Eating Grass*, 53–58, 129–134.
- 559 Chakma, "Road to Chagai," 878–879. See also, Samina Ahmed, "Pakistan's Nuclear Program: Turning Points and Nuclear Choices," *International Security* 23, no. 4 (Spring 1999): 178–204.
- 560 Ahmed, "Pakistan's Nuclear Program: Turning Points and Nuclear Choices," 181–183.
- 561 Khushwant Singh, "Pakistan, India and The Bomb," *New York Times*, July 1, 1979.
- 562 Khan, *Eating Grass*, 68–71.
- 563 Ibid., 129–134, 198–200.
- 564 For useful and colorful details, see William Langewiesche, "The Wrath of Khan," *The Atlantic*, November 2005, <https://www.theatlantic.com/magazine/archive/2005/11/the-wrath-of-khan/304333/>.
- 565 Khan, *Eating Grass*, 120–121.
- 566 Ahmed, "Pakistan's Nuclear Weapons Program: Turning Points and Nuclear Choices," 185–192; Ghulam Mujaddid, "The Next Decade of Nuclear Unlearning: Command and Control and Management of Pakistan's Nuclear Weapons," in *Nuclear Learning in South Asia: The Next Decade*, eds. Feroz Hassan Khan, Ryan Jacobs, and Emily Burke (Monterey: Naval Postgraduate School, 2014), 102–110.
- 567 Khan, *Eating Grass*, 188.
- 568 U.S. Congress, *Congressional Record*, 104th Cong., 1st sess., vol. 141, no. 107 (1995): S9230.
- 569 P.R. Chari, "Nuclear Signaling in South Asia: Revisiting A. Q. Khan's 1987 Threat," Carnegie Endowment for International Peace, November 14, 2013, <https://carnegieendowment.org/2013/11/14/nuclear-signaling-in-south-asia-revisiting-a-q-khan-s-1987-threat-pub-53328>.
- 570 The history of this effort is detailed in Khan, *Eating Grass*, 196–198, who insists, however, that this project was largely indigenous. For a critique of Khan's historiography, see C. Christine Fair, "Feroz Hassan Khan, Eating Grass: The Making of the Pakistani Bomb," *Journal of Strategic Studies* 36, no. 4 (2013): 624–630; and Khan's response can be found in Feroz Hassan Khan, "Response to C. Christine Fair," *Journal of Strategic Studies* 36, no. 4 (2013): 630–634.
- 571 Robert S. Greenberger and Matt Forney, "China-Pakistan Missile Pact Shows a Calculated Strategy," *Wall Street Journal*, December 15, 1998, <https://www.wsj.com/articles/SB913672324547291500>; and Joby Warrick and Peter Slevin, "Libyan Arms Designs Traced Back to China," *Washington Post*, February 15, 2004, <http://www1.udel.edu/globalagenda/2004/student/readings/libya-chinaconnection.html>. For

- more detailed overviews, see T.V. Paul, "Chinese-Pakistani Nuclear/Missile Ties and Balance of Power Politics," *Nonproliferation Review* 10, no. 2 (2003): 21–29; and Paul K. Kerr and Mary Beth Nikitin, "Pakistan's Nuclear Weapons," Congressional Research Service, February 12, 2016, <https://sgp.fas.org/crs/nuke/RL34248.pdf>.
- 572 David Horowitz, "Israelis Dismiss Claims of Plans to Blow Up Pakistani Nuclear Sites," *Irish Times*, June 3, 1998, <https://www.irishtimes.com/news/israelis-dismiss-claims-of-plans-to-blow-up-pakistani-nuclear-sites-1.159410>.
- 573 David Albright, *Peddling Peril: How the Secret Nuclear Trade Arms America's Enemies* (New York: Free Press, 2010), 46–50.
- 574 Khan, *Eating Grass*, 321–337, 374–375; and Peter Lavoy, "Islamabad's Nuclear Posture: Its Premises and Implementation," in *Pakistan's Nuclear Future: Worries Beyond War*, ed. Henry D. Sokolski (Carlisle: Strategic Studies Institute, 2008), 149–153.
- 575 Lavoy, "Islamabad's Nuclear Posture," 146–147.
- 576 *Ibid.*, 155–156.
- 577 Meenakshi Sood, "Pakistan's (Non-Nuclear) Plan to Counter 'Cold Start,'" *The Diplomat*, March 25, 2017, <https://thediplomat.com/2017/03/pakistans-non-nuclear-plan-to-counter-cold-start/>.
- 578 Steve Coll, *Ghost Wars: The Secret History of the CIA, Afghanistan, and Bin Laden, From the Soviet Invasion to September 10, 2001* (London: Penguin Press, 2004); and Carlotta Gall, *The Wrong Enemy: America in Afghanistan, 2001–2014* (Boston: Mariner Books, 2014).
- 579 Seth G. Jones and C. Christine Fair, *Counterinsurgency in Pakistan* (Santa Monica: RAND Corporation, 2010), 85–141.
- 580 Between 2008 and 2011, there were at least six significant skirmishes before the incident at Salala in November 2011 where twenty-eight Pakistani soldiers, including two officers were killed as a result of a U.S. attack on a Pakistani border post. For an overview of this incident in the context of wider U.S.-Pakistan skirmishes along the Afghan border, see Ahmad Rashid Malik, "The Salala Incident," *Strategic Studies* 32/33, nos. 4/1 (Winter 2012 and Spring 2013): 45–60.
- 581 The evolution of Pakistan's threat assessment regarding the United States in the context of its other dangers has been illuminatingly documented in John H. Gill, "Through the Khaki Lens: Pakistan Army Views of the US as Presented in Military Journals 2002–2016," July 31, 2016, unpublished manuscript. I am deeply grateful to Colonel Gill for sharing this paper.
- 582 Brigadier Shaukat Iqbal, "Present and Future Conflict Environment in Pakistan: Challenges for Pakistan Army and the Way Forward," *Green Book 2008: Future Conflict Environment* (Rawalpindi: Pakistan Army, 2008), 43–50.
- 583 Najam Rafique, "Rethinking Pakistan–U.S. Relations," *Strategic Studies* 31, no. 3 (2011): 126.
- 584 Jane Perlez, "Pakistani Army, Shaken by Raid, Faces New Scrutiny," *New York Times*, May 4, 2011, <https://www.nytimes.com/2011/05/05/world/asia/05pakistan.html>; and Toby Dalton and George Perkovich, "Beware Decline in Pakistani Relations," *Politico*, May 15, 2011, <https://www.politico.com/story/2011/05/beware-decline-in-pakistani-relations-055014>.
- 585 Cohen, *The Idea of Pakistan*, 39–130.
- 586 See the remarks of Lieutenant General (Retd) Khalid Kidwai, Advisor, National Command Authority, and former Director-General, Strategic Plans Division, Pakistan, at the Seventh IISS-Centre for International Strategic Studies (CISS) (Pakistan) workshop on "South Asian Strategic Stability: Deterrence, Nuclear Weapons and Arms Control," London, February 6, 2020, <https://www.iiss.org/events/2020/02/7th-iiss-and-ciss-south-asian-strategic-stability-workshop>.
- 587 Peter R. Lavoy, "Pakistan's Nuclear Doctrine," in *Prospects for Peace in South Asia*, eds. Rafiq Dossani and Henry S. Rowen (Stanford: Stanford University Press, 2005), 281.
- 588 Pervaiz Iqbal Cheema, "Anatomizing Pakistan's Motivations for Nuclear Weapons," *Pakistan Horizon* 64, no. 2 (2011): 5–19.
- 589 Rizwan Zeb, "Pakistan: A Reluctant Nuclear State, 20 Years After?," *Asia Dialogue*, June 28, 2018, <https://theasiadialogue.com/2018/06/28/pakistan-a-reluctant-nuclear-state/>; and Naeem Salik, "The Evolution of Pakistan's Nuclear Doctrine," in *Nuclear Learning in South Asia: The Next Decade*, eds. Khan, Jacobs, and Burke, 71–84.



- 590 Nawaz Sharif, "Remarks of the Prime Minister of Pakistan, Nawaz Sharif, on Nuclear Policies and the CTBT at the National Defense College" (speech, Islamabad, PK, May 20, 1999), cited in Rodney W. Jones, *Minimum Nuclear Deterrence Postures in South Asia: An Overview* (Reston: Policy Architects International, 2001), 27.
- 591 Lavoy, "Islamabad's Nuclear Posture," 137.
- 592 Abdul Sattar, "Pakistan's Nuclear Strategy: Inaugural Address," *Strategic Issues* (March 2000): 3.
- 593 Ibid.
- 594 David Albright, "The Shots Heard 'Round the World," *Bulletin of the Atomic Scientists* 54, no. 4 (1998): 25.
- 595 Bhumitra Chakma, "Pakistan: Whither Minimum Deterrence?," S. Rajaratnam School of International Studies, December 2013, [https://www.rsis.edu.sg/wp-content/uploads/2014/07/PB131201\\_Pakistan\\_Whither\\_Minimum\\_Deterrence.pdf](https://www.rsis.edu.sg/wp-content/uploads/2014/07/PB131201_Pakistan_Whither_Minimum_Deterrence.pdf), f. 2.
- 596 Naeem Salik, "Minimum Deterrence and India Pakistan Nuclear Dialogue: Case Study on Pakistan," Landau Network-Centro Volta South Asia Security Project, Working Paper 1/2006, March 2006, 15.
- 597 Mahmud Ali Durrani, *Pakistan's Strategic Thinking and the Role of Nuclear Weapons* (Albuquerque: Sandia National Laboratories, 2004), 12.
- 598 Sharif, "Remarks of the Prime Minister of Pakistan, Nawaz Sharif, on Nuclear Policies and the CTBT at the National Defense College."
- 599 See the discussion in Zulfqar Khan, "India-Pakistan Nuclear Rivalry: Perceptions, Misperceptions, and Mutual Deterrence," Islamabad Policy Research Institute, IPRI PAPER 9, January 2005; and Hassan Masood, "Pakistan's Search for Security Through Reliable Balance of Power and Nuclear Weapons," *Journal of Political Studies* 25, no. 1 (2018): 1–16.
- 600 Durrani, *Pakistan's Strategic Thinking and the Role of Nuclear Weapons*, 11–12.
- 601 Cf., Vernie Liebl, "India and Pakistan: Competing Nuclear Strategies and Doctrines," *Comparative Strategy* 28, no. 2 (2009): 154–163. For a more accurate reading, see Michael Quinlan, "How Robust Is India-Pakistan Deterrence?," *Survival* 43, no. 4 (2000): 149–150.
- 602 Although Bhutto did not employ this precise term, the idea was certainly popularized by him and its justification is clearly articulated in Zulfikar Ali Bhutto, *If I Am Assassinated*, Reproduced in PDF Format by Sani Hussain Panhwar, 148, <https://bhutto.org/wp-content/uploads/2020/12/If-I-am-Assassinated-Zulfikar-Ali-Bhutto.pdf>.
- 603 Samina Yasmeen, "Is Pakistan's Nuclear Bomb an Islamic Bomb?," *Asian Studies Review* 25, no. 2 (2001): 201–215.
- 604 Khan's proliferation activities, driven at different times by state encouragement and by personal pecuniary interests—sometimes complementarily, sometimes oppositionally—are usefully surveyed in Gordon Corera, *Shopping for Bombs: Nuclear Proliferation, Global Insecurity, and the Rise and Fall of the A. Q. Khan* (Oxford: Oxford University Press, 2006).
- 605 See Christopher Clary and Mara Karlin, "The Pak-Saudi Nuke, and How to Stop It," *American Interest* 7, no. 6 June 2012): [www.the-american-interest.com/2012/06/10/the-pak-saudi-nuke-and-how-to-stop-it/](http://www.the-american-interest.com/2012/06/10/the-pak-saudi-nuke-and-how-to-stop-it/); "Pakistan Rules Out Sharing Nukes with Saudis, Anyone Else," Associated Press, June 5, 2015, <https://www.dawn.com/news/1186344>; and Dan Drollette, Jr., "View From the Inside: Prince Turki al-Faisal on Saudi Arabia, Nuclear Energy and Weapons, and Middle East Politics," *Bulletin of the Atomic Scientists* 72, no. 1 (2016): 16–24.
- 606 Elaine Sciolino, "The World: Buzz Words; Who's Afraid of the Islamic Bomb?," *New York Times*, June 7, 1998, <https://www.nytimes.com/1998/06/07/weekinreview/the-world-buzz-words-who-s-afraid-of-the-islamic-bomb.html>.
- 607 "Text of Prime Minister Nawaz Sharif's Speech at the UN: September 23, 1998," *Strategic Studies* 19/20 (1998): 135.
- 608 Zafar Nawaz Jaspal, "Evolution of Pakistan's Nuclear Programme: Debates in Decision-Making," *Regional Studies* 30, no. 2 (2012): 4.
- 609 Lavoy, "Islamabad's Nuclear Posture," 131.

- 610 Paolo Cotta-Ramusino and Maurizio Martellini, "Nuclear Safety, Nuclear Stability, and Nuclear Strategy in Pakistan: A Concise Report of a Visit by Landau Network Centro Volto," Pugwash Conferences on Science and World Affairs, January 14, 2002, <https://pugwash.org/2002/01/14/report-on-nuclear-safety-nuclear-stability-and-nuclear-strategy-in-pakistan/>.
- 611 Lavoy, "Pakistan's Nuclear Doctrine," 283.
- 612 Durrani, *Pakistan's Strategic Thinking and the Role of Nuclear Weapons*, 32.
- 613 Hans M. Kristensen and Matt Korda, "Pakistani Nuclear Weapons, 2021," *Bulletin of the Atomic Scientists* 77, no. 5 (2021): 266. Dr. Samar Mubarakmand more improbably, however, claimed a capacity to produce yields of some 15–18 kilotons. See Khalid Qayyum, "Shaheen Missile Awaits Go-ahead for Test Fire," *The Nation*, June 1, 1998, cited in 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, 2010), 6.
- 614 Kamal Matinuddin, *Nuclearization of South Asia* (Karachi: Oxford University Press Pakistan, 2002), 242.
- 615 Chakma, "Pakistan: Whither Minimum Deterrence?," f. 2.
- 616 Durrani, *Pakistan's Strategic Thinking and the Role of Nuclear Weapons*, 26.
- 617 See the sensible discussion in Zulfqar Khan, "The Changing Dynamics of India-Pakistan Deterrence," *Pakistan Horizon*, 66, no. 4 (October 2013), 1–19.
- 618 Feroz Hasan Khan, "Pakistan's Nuclear Future," in *South Asia in 2020: Future Strategic Balances and Alliances*, ed. Michael R. Chambers (Carlisle: U.S. Army War College, 2002), 153–189.
- 619 On the tensions and ambiguities involved, see Sadia Tasleem, "Pakistan's Nuclear Use Doctrine," Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/pakistan-s-nuclear-use-doctrine-pub-63913>.
- 620 "No PR-94/2011-ISPR," Inter Services Public Relations, April 19, 2011, <https://www.ispr.gov.pk/press-release-detail.php?id=1721>.
- 621 Naeem Salik, "Pakistan's Nuclear Force Structure in 2025," Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/pakistan-s-nuclear-force-structure-in-2025-pub-63912>.
- 622 Zafar Nawaz Jaspal, "Full Spectrum Deterrence: Capability and Credibility," *Pakistan Politico*, June 7, 2018, <https://pakistanpolitico.com/full-spectrum-deterrence-capability-and-credibility/>.
- 623 All quotes in this paragraph are drawn from "Rare Light Shone on Full Spectrum Deterrence," *Dawn*, December 7, 2017, <https://www.dawn.com/news/1375079/rare-light-shone-on-full-spectrum-deterrence-policy>.
- 624 For a comprehensive discussion of NATO's original flexible response strategy, see J. Michael Legge, *Theater Nuclear Weapons and the NATO Strategy of Flexible Response* (Santa Monica: RAND Corporation, 1983). The Pakistani effort at emulation is discussed in Sadia Tasleem and Toby Dalton, "Nuclear Emulation: Pakistan's Nuclear Trajectory," *Washington Quarterly* 41, no. 4 (2018): 135–155; and Shashank Joshi, "Pakistan's Tactical Nuclear Nightmare: Déjà Vu?," *Washington Quarterly* 36, no. 3 (2013): 159–172.
- 625 Wilkening, "Nuclear Warfare," 314–328.
- 626 Adil Sultan, "Pakistan's Emerging Nuclear Posture: Impact of Drivers and Technology on Nuclear Doctrine," *Strategic Studies* 31, no. 4 (2012): 147–167.
- 627 David J. Karl, "Pakistan's Evolving Nuclear Weapon Posture," *Nonproliferation Review* 21, nos. 3–4 (2014): 317–336; and Mansoor Ahmed, "India's Nuclear Exceptionalism," Discussion Paper (Cambridge, MA: Project on Managing the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School, May 2017).
- 628 "Rare Light Shone on Full Spectrum Deterrence."
- 629 Sannia Abdullah, "Pakistan's Evolving Doctrine and Emerging Force Posture: Conceptual Nuances and Implied Ramifications," *Pakistan Horizon* 71, no. 1/2 (2018): 80.
- 630 As Lieutenant General (ret'd.) Khalid Kidwai has argued, "in order to deter the unfolding of [offensive] operations under the [Indian Cold Start] doctrine, Pakistan opted to develop a variety of short

- range, low-yield nuclear weapons, also dubbed tactical nuclear weapons.” See Kidwai and Lavoy, “A Conversation With Gen. Khalid Kidwai,” 4, and the more extended discussion on this topic on p. 8.
- 631 Bhumitra Chakma, “Pakistan’s Nuclear Doctrine and Command and Control System: Dilemmas of Small Nuclear Forces in the Second Atomic Age,” *Security Challenges* 2, no. 2 (2006): 116.
- 632 Sultan, “Pakistan’s Emerging Nuclear Posture Impact of Drivers and Technology on Nuclear Doctrine,” 147.
- 633 P.R. Kumaraswamy, “Israel and Pakistan: Public Rhetoric versus Political Pragmatism,” *Israel Affairs* 12, no. 1 (2006): 123–135.
- 634 Ibid., 128–131.
- 635 Sohail H. Hashmi, “Islamic Ethics and Weapons of Mass Destruction,” in *Ethics and Weapons of Mass Destruction: Religious and Secular Perspectives*, eds. Sohail H. Hashmi and Steven P. Lee (Cambridge: Cambridge University Press, 2004), 340–341.
- 636 For a good example of how Pakistani officials sometimes betray Freudian slips on this score, see Russell Goldman, “Reading Fake News, Pakistani Minister Directs Nuclear Threat at Israel,” *New York Times*, December 24, 2016, <https://www.nytimes.com/2016/12/24/world/asia/pakistan-israel-khawaja-asif-fake-news-nuclear.html>. Pakistani fears about the Israeli-Indian relationship are usefully summarized in Muqtadar Khan, “Are Pressures From the U.S., India, and Israel Too Much for Pakistan’s Nuclear Weapons Program to Withstand?,” Institute for Policy Studies, September 23, 2003, [https://ips-dc.org/are\\_pressures\\_from\\_the\\_us\\_india\\_and\\_israel\\_too\\_much\\_for\\_pakistans\\_nuclear\\_weapons\\_program\\_to\\_withstand/](https://ips-dc.org/are_pressures_from_the_us_india_and_israel_too_much_for_pakistans_nuclear_weapons_program_to_withstand/); and in Ahmed Ayaz, “Indo-Israeli Bonhomie,” *Defence Journal* 20, no. 12 (2017): 23–24.
- 637 Azriel Bermant, “Pakistan Is the Only Muslim Nuclear State – So Why Is Israel’s Hysteria Reserved for Iran?,” *Haaretz*, May 20, 2015; and Shimon Arad, “How Israel and Pakistan Can Avoid a Nuclear Showdown,” *National Interest*, February 19, 2018, <https://nationalinterest.org/feature/how-israel-pakistan-can-avoid-nuclear-showdown-24554>.
- 638 Munir Akram, “The Nuclear Dimension,” *Dawn*, October 1, 2017, <https://www.dawn.com/news/1361115>. For an example of the kind of news that accentuates Pakistan’s fears of U.S. threats, see Jeffrey Goldberg and Marc Ambinder, “The Pentagon’s Secret Plans to Secure Pakistan’s Nuclear Arsenal,” *National Journal*, November 9, 2011, [https://gtitraining.org/news\\_110911.htm](https://gtitraining.org/news_110911.htm).
- 639 Sannia Abdullah, “Pakistan’s Full-Spectrum Deterrence: Trends and Trajectories,” *South Asian Voices*, December 13, 2018, <https://southasianvoices.org/pakistan-full-spectrum-deterrence-trends-trajectories/>.
- 640 “China Helping Pak With ICBM: U.S. Congressman,” *The Hindu*, April 29, 2016, <https://www.thehindu.com/news/international/china-helping-pak-with-icbm-us-congressman/article8535575.ece>; and “Pakistan, US Yet to Remove Differences Over N-arsenal,” *Dawn*, March 2, 2016, <https://www.dawn.com/news/1243057>.
- 641 Feroz Hassan Khan, “Pakistan’s Perspective on the Global Elimination of Nuclear Weapons,” in *National Perspectives on Nuclear Disarmament*, eds. Barry M. Blechman and Alexander K. Bollfras (Washington, DC: Stimson Center, 2010), 218.
- 642 Sood, “Pakistan’s (Non-Nuclear) Plan to Counter ‘Cold Start.’”
- 643 This local force balance has been in place since the 1990s, as illustrated in Ashley J. Tellis, *Stability in South Asia* (Santa Monica: RAND Corporation, 1997), 19–29. The discussion in next chapter confirms that despite India’s “Cold Start” doctrine, the force ratios along the India-Pakistan border favor the latter on C-day.
- 644 I am deeply grateful to Naeem Salik for bringing this point to my attention. See also, Major Muhammad Zeeshan Ali, “Strategic Delusions – The Cold Start Doctrine: Proactive Strategy,” School of Advanced Military Studies, United States Army Command and General Staff College, Fort Leavenworth, Kansas, 2016, <https://apps.dtic.mil/sti/pdfs/AD1021787.pdf>, 44.
- 645 Ali Ahmed, “India and Pakistan: Azm-e-Nau as a Response to the Cold Start,” Institute for Peace and Conflict Studies, July 28, 2013, [http://www.ipcs.org/comm\\_select.php?articleNo=4056](http://www.ipcs.org/comm_select.php?articleNo=4056).
- 646 Sannia Abdullah, “Cold Start in Strategic Calculus,” *IPRI Journal* 12, no. 1 (Winter 2012): 1–27; and Zafar Khan, “The Arrival of Tactical Nuclear Weapons in South Asia: Deterrent Stability or Instability?,” *Comparative Strategy* 32, no. 5 (2013): 402–417.

- 647 For one exploration of this issue, see Nishank Motwani, “Be Prepared for an India-Pakistan Limited War,” *The Diplomat*, October 5, 2018, <https://thediplomat.com/2018/10/be-prepared-for-an-india-pakistan-limited-war/>.
- 648 Timothy Hoyt, “Pakistan’s Nuclear Posture: Thinking About the Unthinkable?,” *Strategy in the Second Nuclear Age*, eds. Toshi Yoshihara and James R. Holmes (Washington, DC: Georgetown University Press, 2012), 181–200.
- 649 Sannia Abdullah, “The Quest for Escalation Dominance: Pakistan’s Response of Full Spectrum Deterrence,” Sandia National Laboratories, December 1, 2016, <https://www.osti.gov/servlets/purl/1413403>.
- 650 Lavoy, “Islamabad’s Nuclear Posture,” 133–134.
- 651 Michael Fitzsimmons, “The False Allure of Escalation Dominance,” War on The Rocks, November 16, 2017, <https://warontherocks.com/2017/11/false-allure-escalation-dominance/>.
- 652 The logic underlying this strategy goes back to the Cold War and was first articulated with clarity in Thomas Schelling, *The Strategy of Conflict* (Cambridge: Harvard University Press, 1980), 187–203; and Thomas Schelling, *Arms and Influence* (New Haven: Yale University Press, 2008), 92–125.
- 653 Christopher Clary, “The Future of Pakistan’s ‘Nuclear Weapons Program,’” in Ashley J. Tellis, Abraham M. Denmark, and Travis Tanner, eds., *Asia in the Second Nuclear Age* (Seattle and Washington, DC: National Bureau of Asian Research, 2013), 153.
- 654 Sultan, “Pakistan’s Emerging Nuclear Posture: Impact of Drivers and Technology on Nuclear Doctrine,” 147–167.
- 655 The fact that Pakistan’s tactical nuclear weapons are not intended as genuine functional antidotes to operational threats on the battlefield is often missed even in otherwise excellent analyses on the subject. See, for example, 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 Jaganath Sankaran, “Pakistan’s Battlefield Nuclear Policy: A Risky Solution to an Exaggerated Threat,” *International Security* 39, no. 3 (2015): 118–151.
- 656 For an argument that posits rapid war termination to also be *India’s* next best outcome in the event of Pakistani nuclear use, see Ali Ahmed, “Limiting a Subcontinental Nuclear War,” *SP’s Land Forces*, <https://www.spslandforces.com/story/?id=317&h=Limiting-a-Subcontinental-Nuclear-War>.
- 657 The potential physical costs of Pakistan’s tactical nuclear weapons use on its own soil are strikingly demonstrated in Sankaran, “Pakistan’s Battlefield Nuclear Policy: A Risky Solution to an Exaggerated Threat,” 118–151, based only on an assessment of using the Nasr battlefield rocket system. If other Pakistani tactical weapons, such as nuclear artillery shells and atomic demolition munitions, are factored in, the burdens on Pakistan would only be further magnified.
- 658 That this concern may not be unfounded is insightfully explored in Ahmed, “Limiting a Subcontinental Nuclear War,” 4.
- 659 For a discussion of how these factors shaped Indian attitudes to Pakistan around the time of the 1998 tests, see Tellis, *India’s Emerging Nuclear Posture*, 51–55.
- 660 Michael Krepon, “Pakistan’s Nuclear Strategy and Deterrence Stability,” in *Deterrence Stability and Escalation Control in South Asia*, eds. Michael Krepon and Julia Thompson (Washington, DC: Stimson Center, 2013), 53.
- 661 Sadia Tasleem, “Pakistan’s Nuclear Use Doctrine,” Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/pakistan-s-nuclear-use-doctrine-pub-63913>.
- 662 Schelling, *The Strategy of Conflict*, 187–203.
- 663 Abdullah, “The Quest for Escalation Dominance: Pakistan’s Response of Full Spectrum Deterrence,” 5.
- 664 On catalytic nuclear strategies, see Vipin Narang, “What Does It Take to Deter? Regional Power Nuclear Postures and International Conflict,” *Journal of Conflict Resolution* 57, no. 3 (2012): 478–508. In Vipin Narang, “Posturing for Peace? Pakistan’s Nuclear Postures and South Asian Stability,” *International Security* 34, no. 3 (2009): 38–78, Narang argues that Pakistan abandoned its strategy for catalyzing international intervention after 1991, but both the logic of Pakistan’s predicament and its behavior in recent crises with India, especially during the Pulwama-Balakot crisis in 2019, suggest that relying on external intervention remains an integral element of Pakistan’s broader strategy and would be especially critical in any nuclear standoff.

- 665 On the threats posed by successful nuclear use in South Asia to the nuclear taboo, see Tellis, *Stability in South Asia*, 2–3; and Nina Tannenwald, “How Strong Is the Nuclear Taboo Today?,” *Washington Quarterly* 41, no. 3 (2018): 89–109. For an example of high negative externalities, see Owen B. Toon, Charles G. Bardeen, Alan Robock, Lili Xia, Hans Kristensen, Matthew McKinzie, R. J. Peterson, Cheryl S. Harrison, Nicole S. Lovenduski, and Richard P. Turco, “Rapidly Expanding Nuclear Arsenals in Pakistan and India Portend Regional and Global Catastrophe,” *Science Advances* 5, no. 10 (2019).
- 666 These levels are assessed at a uniform price point of less than U.S. \$260 per kilo of uranium. See Organisation for Economic Co-operation and Development, *Uranium 2020: Resources, Production and Demand* (Paris: Organization for Economic Cooperation and Development, 2020), 19.
- 667 Nuclear Energy Agency, *World Uranium Geology and Resource Potential: International Uranium Resources Evaluation Project* (San Francisco: Miller-Freeman Publications, 1980), cited in Zia Mian, A.H. Nayyar, and R. Rajaraman, “Exploring Uranium Resource Constraints on Fissile Material Production in Pakistan,” *Science and Global Security* 17, no. 2–3 (2009): 77–108.
- 668 “Nuclear Power in Pakistan,” World Nuclear Association, December 2020, <https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/pakistan.aspx>.
- 669 Organisation for Economic Co-operation and Development, *Uranium 2020*, 56.
- 670 Hans M. Kristensen and Robert S. Norris, “Pakistan’s Nuclear Forces, 2011,” *Bulletin of the Atomic Scientists* 67, no. 4 (2011): 91.
- 671 Toby Dalton and Michael Krepon, *A Normal Nuclear Pakistan* (Washington, DC: Carnegie Endowment for International Peace, 2015), 21.
- 672 PowerTechnology, “Karachi Nuclear Power Plant (KANUPP) Expansion,” PowerTechnology, <https://www.power-technology.com/projects/karachi-nuclear-power-plant-expansion>.
- 673 Tamara Patton, “Combining Satellite Imagery and 3D Drawing Tools for Nonproliferation Analysis: A Case Study of Pakistan’s Khushab Plutonium Production Reactors,” *Science & Global Security* 20 (2012): 117–140; and David Albright, Sarah Burkhard, Claire Chopin, and Frank Pabian, “New Thermal Power Estimates of the Khushab Nuclear Reactors,” Institute for Science and International Security, May 23, 2018, [https://isis-online.org/uploads/isis-reports/documents/Khushab\\_Reactor\\_Power\\_\\_23May2018\\_Final.pdf](https://isis-online.org/uploads/isis-reports/documents/Khushab_Reactor_Power__23May2018_Final.pdf).
- 674 Maria Sultan, Zafar Nawaz Jaspal, Mohmmad Riaz, Jamshed Hashmi, Jawad Hashmi, and Asra Hassan, *Governing Uranium in Pakistan* (Copenhagen: Danish Institute for International Studies, 2015).
- 675 The 2020 report estimates a cumulative production of 1,664 tons at the end of 2019. Reports since 2010 have estimated a rate of 45 tons of uranium production a year, estimating that this rate continues into 2019; if this rate persists, Pakistan’s cumulative production will stand at 1,709 tons at the end of 2020. See Organisation for Economic Co-operation and Development, *Uranium 2020*, 56.
- 676 “Pakistan’s Oldest Nuclear Reactor KANUPP-1 Closed,” World Nuclear Industry Status Report, October 22, 2021, <https://www.worldnuclearreport.org/Pakistan-s-Oldest-Nuclear-Reactor-KANUPP-1.html>.
- 677 “Countries: Pakistan,” International Panel on Fissile Materials, August 31, 2021, <http://fissilematerials.org/countries/pakistan.html>.
- 678 One early scholarly effort at addressing this issue suggested a variety of scenarios, but only one in which Pakistan’s natural uranium stockpile lasts until roughly 2024. This timeline, based on different calculations from those employed here, would allow Pakistan to produce about 80 kilograms of HEU annually using feedstock from the past stockpile, while leaving its ongoing annual production of some 45 tons to fuel the Khushab reactors for operations at close to the levels assumed earlier. See Mian, Nayyar, and Rajaraman, “Exploring Uranium Resource Constraints on Fissile Material Production in Pakistan,” 77–108.
- 679 While the IPFM does not explicitly publish annual production rates, they can be tentatively extrapolated from the IPFM’s publications over time. Over the last decade, the IPFM has released five mean estimates (with constant uncertainty of 400 kg in either direction): 3,000 kg HEU in end-2012, 3,100 kg in end-2014, 3,400 kg in end-2016, 3,700 kg at the beginning of 2019, and 3,900 kg at the beginning of 2020. In recent years, this would imply annual production rates of 150 kg HEU between end-2016 and end-2018 (equivalent to the beginning of 2019), rising to a production rate of an astonishing 200 kg between end-2018 and end-2019 (equivalent to the beginning of 2020). However, it is not clear from

the IPFM website what accounts for this change in rate, nor is it clear whether the new estimate indeed reflects a new estimate of *annual* change or instead a retroactive change to the base estimates of HEU, pre-2019. In any case, as the IPFM acknowledges, “Uncertainty about Pakistan’s uranium resources [and its enrichment capacity] limit the reliability of the estimate”; this means that inferred annual production figures should be treated with caution, particularly in the case of dramatic shifts such as the jump in production rate pre- and post-2018. For the subsequent analysis, an annual production rate of 130 kg HEU has been chosen as an average of estimates between end-2012 and end-2019/beginning 2020. Conclusions are substantively the same with lower annual production rates, e.g., 100 kg. More aggressive estimates of Pakistan’s HEU production, including the maximum estimate of 200 kg annually, would only exacerbate the deficiency of natural uranium described in this section.

- 680 This is extrapolated from IPFM’s estimates of Pakistan’s total cumulative production of WGPu at the beginning of 2019 and at the beginning of 2020 as 370 kg and 410 kg, respectively. Note that as discussed in the previous footnote, inferred changes in annual output should be treated with caution. International Panel on Fissile Materials, “Countries: Pakistan,” Internet Archive, December 19, 2020, <http://web.archive.org/web/20201219074250/http://fissilematerials.org/countries/pakistan.html>; and International Panel on Fissile Materials, “Countries: Pakistan,” Internet Archive, October 14, 2020, <http://web.archive.org/web/20211014230034/http://fissilematerials.org/countries/pakistan.html>.
- 681 Given these possibilities, and running against the conventional wisdom, one serious Indian assessment examining this issue has concluded that, based on natural uranium constraints, Pakistan’s nuclear weapons stockpile is actually smaller than advertised. See Lalitha Sundaresan and Kaveri Ashok, “Uranium Constraints in Pakistan: How Many Nuclear Weapons Does Pakistan Have?,” *Current Science* 115, no. 6 (2018): 1,042–1,048. The available evidence, however, does not support Sundaresan and Ashok’s conclusion.
- 682 Dalton and Krepon, *A Normal Nuclear Pakistan*, 21.
- 683 U.S. Energy Information Administration, *2019 Uranium Marketing Annual Report* (Washington, DC: U.S. Department of Energy, 2020), 1.
- 684 Mian, Nayyar, and Rajaraman, “Exploring Uranium Resource Constraints on Fissile Material Production in Pakistan,” 89–90.
- 685 David Albright, Sarah Burkhard, and Frank Pabian, “Pakistan’s Growing Uranium Enrichment Program,” Institute for Science and International Security, May 30, 2018, [https://isis-online.org/uploads/isis-reports/documents/Kahuta\\_Update\\_30May2018\\_Final\\_with\\_time-lapse.pdf](https://isis-online.org/uploads/isis-reports/documents/Kahuta_Update_30May2018_Final_with_time-lapse.pdf).
- 686 Khan, *Eating Grass*, 200; Hans M. Kristensen and Matt Korda, “Nuclear Notebook: How Many Nuclear Weapons Does Pakistan Have in 2021?,” *Bulletin of the Atomic Scientists*, September 7, 2021, <https://thebulletin.org/premium/2021-09/nuclear-notebook-how-many-nuclear-weapons-does-pakistan-have-in-2021/>; and Milton R. Benjamin, “Pakistan Building Secret Nuclear Plant,” *Washington Post*, September 23, 1980, cited in Zia Mian and A.H. Nayyar, “An Initial Analysis of 85Kr Production and Dispersion From Reprocessing in India and Pakistan,” *Science and Global Security* 10 (2002): 161.
- 687 This conclusion would not change even if Pakistan were to secure a comprehensive civilian nuclear cooperation similar to India’s in the future. Such an agreement—of which the current Sino-Pakistani nuclear cooperation agreement that led up to the construction of the Chashma Nuclear Power Complex is an example—would provide Pakistan only with safeguarded natural uranium that could not be used for weapons. If Pakistan is to sustain a much larger weapons program, therefore, it would require more natural uranium either from increased domestic extraction or from covert purchases abroad because its attributed current production, which supports its unsafeguarded weapons-production reactors at Khushab, its uranium enrichment facilities, and its minor research activities, would not underwrite a dramatically expanded strategic program. Hence, it is not surprising, as one study concluded, that “as a result of Pakistan’s consistent deficit of uranium, the PAEC [Pakistan Atomic Energy Commission] has launched expensive uranium exploration drilling projects in the Kirthar mountain range, the Kohat plateau, and the Potwar plateau.” See Melissa Hanham, Grace Liu, Joseph Rodgers, Ben McIntosh, Margaret Rowland, Mackenzie Best, Scott Milne and Octave Lepinard, “Monitoring Uranium Mining and Milling in India and Pakistan Through Remote Sensing Imagery,” James Martin Center for Nonproliferation Studies, CNS Occasional Paper, Number 41, November 2018, 9–10.
- 688 International Panel on Fissile Materials, “Countries: Pakistan,” August 31, 2021, <https://fissilematerials.org/countries/pakistan.html>.

- 689 Kristensen and Korda, "Pakistani Nuclear Weapons, 2021," 265–278.
- 690 Author's private conversations. This judgment also runs counter to the Indian estimate found in Sundaresan and Ashok, "Uranium Constraints in Pakistan: How Many Nuclear Weapons Does Pakistan Have?," 1047, which judged that Pakistan could at best have had a total of between 112 and 156 nuclear weapons in 2018.
- 691 Khan, *Eating Grass*, 234–251; and Albright, *Peddling Peril*, 47.
- 692 Khan, *Eating Grass*, 174–190.
- 693 Terry C. Wallace, "The May 1998 India and Pakistan Nuclear Tests," *Seismological Research Letters* 69, no. 5 (1998): 386–393.
- 694 Gregory S. Jones, "Do India and Pakistan Possess Boosted Nuclear Weapons? Tritium Supply Considerations," *Proliferation Matters*, July 31, 2019, <https://nebula.wsimg.com/b2c3c9b49ad062fdf2c7a52be054c98c?AccessKeyId=40C80D0B51471CD86975&disposition=0&alloworigin=1>.
- 695 David Albright and Paul Brannan, "Pakistan Expanding Plutonium Separation Facility Near Rawalpindi," Institute for Science and International Security, May 19, 2009, [https://isis-online.org/uploads/isis-reports/documents/PakistanExpandingNewLabs\\_19May2009.pdf](https://isis-online.org/uploads/isis-reports/documents/PakistanExpandingNewLabs_19May2009.pdf); and David Albright, Paul Brannan, and Robert Kelley, "Pakistan Expanding Dera Ghazi Khan Nuclear Site: Time for U.S. to Call for Limits," ISIS Imagery Brief, Institute for Science and International Security, May 19, 2009, <http://www.isis-online.org/publications/southasia/PakistanExpandingCPC.pdf>.
- 696 Clary, "The Future of Pakistan's Nuclear Weapons Program," 135–137; and Mansoor Ahmed, "Trends in Technological Maturation and Strategic Modernization: The Next Decade," in *Nuclear Learning in South Asia: The Next Decade*, eds. Khan, Jacobs, and Burke, 58–70.
- 697 Allusions to such testing can be found in Rob Matsick, "Shaking the Rust Off the Comprehensive Nuclear-Test-Ban Treaty Ratification Process," 418; and in National Academy of Sciences, *Technical Issues Related to the Comprehensive Nuclear Test Ban Treaty* (Washington, DC: National Academies Press, 2002), 74.
- 698 Kristensen and Korda, "Pakistani Nuclear Weapons, 2021," 269.
- 699 Estimates for the M-11/Ghaznavi and Shaheen-1 are also constant for all years for which Kristensen and Norris have data, although these authors' estimates begin only in 2015.
- 700 Kidwai and Lavoy, "A Conversation With Gen. Khalid Kidwai," 12.
- 701 Rajaram Nagappa, *An Assessment of Ballistic Missile Production Capacity in Pakistan* (Bangalore: National Institute of Advanced Studies, 2007).
- 702 Alex Roland, "Was the Nuclear Arms Race Deterministic?," *Technology and Culture* 51, no. 2 (April 2010): 448.
- 703 Bruno Tertrais, "Pakistan's Nuclear and WMD Programmes: Status, Evolution and Risks," EU Non-Proliferation Consortium, Non-Proliferation Papers, Number 19, July 2012, 2.
- 704 The entirety of Pakistan's strategic complex is well described in Project Alpha, *Pakistan's Strategic Nuclear and Missile Industries*, Centre for Science and Security Studies, King's College, London, 2016.
- 705 Mujaddid, "The Next Decade of Nuclear Unlearning," 103–104, 106.
- 706 The most recent edition of the Federation of American Scientists' Nuclear Notebook is more ambivalent, attributing a nuclear role only to Pakistan's Mirages: "In light of uncertainties regarding Pakistan's nuclear-capable aircraft, the PAF's F-16s and JF-17s are not identified in this Nuclear Notebook as having a dedicated nuclear weapon delivery system." See Kristensen and Korda, "Pakistani Nuclear Weapons, 2021," 271. There is, however, no reason to believe that Pakistan has removed its F-16 strike-fighters from their nuclear responsibilities.
- 707 Bilal Khan, "Will Pakistan Focus on Force Multipliers (Part-1)," *Quwa*, July 6, 2016, <https://quwa.org/2016/07/06/will-pakistan-focus-force-multipliers/>; Bilal Khan, "Pakistan's Force Multipliers (Part 2): Precision-Guided Bombs," *Quwa*, July 8, 2016, <https://quwa.org/2016/07/08/pakistans-force-multipliers-part-2-precision-guided-bombs/>; and Bilal Khan, "Pakistan's Force Multipliers (Part 3): Cruise Missiles & Sub-Munitions," *Quwa*, July 6, 2016, <https://quwa.org/2016/07/09/pakistans-force-multipliers-part-3-cruise-missiles-sub-munitions/>.
- 708 Bilal Khan, "The Rationale Behind Pakistan's Nuclear Program," *Quwa*, October 25, 2015, <https://quwa.org/2015/10/25/the-rationale-behind-pakistans-tactical-nuclear-program/>.

- 709 Kidwai and Lavoy, “A Conversation With Gen. Khalid Kidwai,” 4–5.
- 710 The limitations of this strategy, which propelled a later shift to theater nuclear weapons, is discussed in Ashley J. Tellis, “NATO and Theater Nuclear Force Modernization: Looking Backward, Looking Forward,” *Journal of East and West Studies* 15, no. 2 (1986): 101–126.
- 711 “Complete List of All U.S. Nuclear Weapons,” Nuclear Weapon Archive, June 12, 2020, <https://nuclearweaponarchive.org/Usa/Weapons/Allbombs.html>.
- 712 Asad Haroon, “Pakistan Test-fires Hatf-IX,” *Dispatch News Desk*, September 26, 2014, <https://dnd.com.pk/pakistan-conducted-successful-test-fire-short-range-surface-surface-missile-hatf-ix-nasr>.
- 713 Rajaram Nagappa, Arun Vishwanathan, and Aditi Malhotra, *HATF-IX/NASR – Pakistan’s Tactical Nuclear Weapon: Implications for Indo-Pak Deterrence* (Bangalore: National Institute of Advanced Studies), 20–24; and Khan, *Eating Grass*, 388.
- 714 Kristensen and Korda, “Pakistani Nuclear Weapons, 2021,” 271.
- 715 Mansoor Ahmed, “Pakistan’s Tactical Nuclear Weapons and Their Impact on Stability,” Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/pakistan-s-tactical-nuclear-weapons-and-their-impact-on-stability-pub-63911>.
- 716 Sikander Shaheen, “Upgraded Hatf IV test-fired,” *The Nation*, April 26, 2012, <https://nation.com.pk/26-Apr-2012/upgraded-hatf-iv-test-fired>.
- 717 This counterintuitive fact derives from Pakistan’s use—just like India’s—of hydroxyl-terminated polybutadiene (HTPB) with ammonium perchlorate (AP) and aluminum (AL) powder as its solid missile propellant. HTPB/AP/AL propellants, which must be stored at low temperatures to protect the structural integrity of the missile, take significant amounts of time to be gradually brought to the ambient environmental temperature for combat operations. This characteristic of HTPB/AP/AL propellants drove the Indian shift to canisterization for its larger ballistic missiles.
- 718 Khan, *Eating Grass*, 240–244.
- 719 Missile Defense Project, “Hatf 6 ‘Shaheen 2,’” Center for Strategic and International Studies, June 15, 2018, <https://missilethreat.csis.org/missile/hatf-6/>.
- 720 Missile Defense Project, “Ababeel,” Center for Strategic and International Studies, June 15, 2018, <https://missilethreat.csis.org/missile/ababeel/>. Somewhat implausibly, the Ababeel is sometimes cited as being able to carry more than three warheads but irrespective of the number carried, the intent is clearly to defeat India’s emerging ballistic missile defense systems. See “Ensured Nuclear Strike: Indian Ballistic Missile Defense and Pakistani Countermeasures,” August 27, 2020, <https://pakstrategic.com/2020/08/27/ensured-nuclear-strike-indian-ballistic-missile-defense-and-pakistani-countermeasures/>; and Feroz H. Khan and Mansoor Ahmed, “Pakistan, MIRVs, and Counterforce Targeting,” in *The Lure and Pitfalls of MIRVs: From the First to the Second Nuclear Age*, eds. Michael Krepon, Travis Wheeler and Shane Mason (Washington, DC: Stimson Center, 2016), 149–175. For a skeptical Indian assessment of the Ababeel’s capabilities, see Rajaram Nagappa, “Does Pakistan’s Ababeel Medium Range Ballistic Missile Really Have MIRV Capability?,” *Delhi Defence Review*, February 3, 2017, <https://delhidefencereview.com/2017/02/03/does-pakistans-ababeel-medium-range-ballistic-missile-really-have-mirv-capability/>.
- 721 Kidwai and Lavoy, “A Conversation With Gen. Khalid Kidwai,” 10.
- 722 Missile Defense Project, “Hatf 7 ‘Babur,’” Center for Strategic and International Studies, June 15, 2018, <https://missilethreat.csis.org/missile/hatf-7/>.
- 723 “Arms Control and Proliferation Profile: Pakistan,” Arms Control Association, July 2018, <https://www.armscontrol.org/factsheets/pakistanprofile>.
- 724 H.I. Sutton, “Pakistan’s New Type-039B AIP Submarines: Image Shows Shipyard Expansion,” *Naval News*, October 6, 2020, <https://www.navalnews.com/naval-news/2020/10/pakistans-new-chinese-aip-submarines-image-shows-karachi-site/>.
- 725 Kidwai and Lavoy, “A Conversation With Gen. Khalid Kidwai,” 16.
- 726 Andrew Detsch, “Pakistan’s Oversized Submarine Ambitions,” *The Diplomat*, October 9, 2013, <https://thediplomat.com/2013/10/pakistans-oversized-submarine-ambitions/>.
- 727 Sufian Ullah, “Strategic Calculations Behind Pakistan’s Pursuit of Sea-Based Nuclear Deterrence,” *South Asian Voices*, June 11, 2020, <https://southasianvoices.org/strategic-calculations-behind-pakistans-pursuit-of-sea-based-nuclear-deterrence/>.



- 728 Ankit Panda, "Pakistan Conducts Second Test of Babur-3 Nuclear-Capable Submarine-Launched Cruise Missile," *The Diplomat*, April 1, 2016, <https://thediplomat.com/2018/04/pakistan-conducts-second-test-of-babur-3-nuclear-capable-submarine-launched-cruise-missile/>.
- 729 Eric Schmitt and David E. Sanger, "U.S. Says Pakistan Made Changes to Missiles Sold for Defense," *New York Times*, August 29, 2009, <https://www.nytimes.com/2009/08/30/world/asia/30missile.html>. See also, Ayesha Siddiqa-Agha, "South Asia: Nuclear Navies?," *Bulletin of Atomic Scientists* 56, no. 5 (September/October 2000): 12–14.
- 730 "Pakistan Navy Launches Land-based Anti-ship Missile," *Hilal*, March 2018, <https://www.hilal.gov.pk/eng-article/pakistan-navy-launches-land-based-anti-ship-missile/NjM=.html>.
- 731 Usman Ansari, "Outgoing Pakistan Navy Chief Reveals Details of Modernization Programs," *Defense News*, October 14, 2020, <https://www.defensenews.com/naval/2020/10/14/outgoing-pakistan-navy-chief-reveals-details-of-modernization-programs/>; "M-20B Anti-ship Ballistic Missiles for Pakistan?," *Vayu Aerospace & Defence Review*, January 1, 2019, 147; and "Pakistan's A2/Ad Efforts: P282 Anti-Ship Ballistic Missile," *Quwa*, November 1, 2020, <https://quwa.org/2020/11/01/pakistans-a2-ad-efforts-p282-anti-ship-ballistic-missile-2/>.
- 732 Ajai Shukla, "China's New 'Aircraft Carrier Killer' Missile Could Add Teeth to Pakistan Navy," *Business Standard*, December 28, 2018, [https://www.business-standard.com/article/defence/china-s-new-aircraft-carrier-killer-missile-could-add-teeth-to-pak-navy-118122701075\\_1.html](https://www.business-standard.com/article/defence/china-s-new-aircraft-carrier-killer-missile-could-add-teeth-to-pak-navy-118122701075_1.html).
- 733 A useful assessment of the Pakistani motivations for such capabilities can be found in Siddiqa-Agha, "South Asia: Nuclear Navies?," 12–14; and Iskander Rehman, "Nuclear Weapons and Pakistan's Naval Strategy," *The Interpreter*, August 22, 2014, <https://www.lowyinstitute.org/the-interpreter/nuclear-weapons-and-pakistans-naval-strategy>. See also the pertinent comments in David O. Smith, "The US Experience With Tactical Nuclear Weapons: Lessons for South Asia," Stimson Center, March 4, 2013, 2–3, <http://www.jstor.org/stable/resrep10878>. For an Indian discussion of these capabilities, see Roshan Khanijo, "Pakistan's Sea-based Nuclear Deterrence: Implications for India," *Journal of the United Service Institution of India* 147, no. 607 (2017).
- 734 Lavoy, "Islamabad's Nuclear Posture," 149–153.
- 735 Ibid.
- 736 For more on this issue, see Katharine Adeney, "How to Understand Pakistan's Hybrid Regime: The Importance of a Multidimensional Continuum," *Democratization* 24, no. 1 (2017): 119–137; and Shah, *The Army and Democracy* for how the Pakistan Army continues to control the nation's politics even after formal democratization.
- 737 Krepon, "Pakistan's Nuclear Strategy and Deterrence Stability," 56. See also, Ghulam Mujaddid, "The Next Decade of Nuclear Unlearning," 102–107.
- 738 "Pakistan Army," Pak Defense, November 16, 2018, <https://www.pakdefense.com/blog/pakistan-army/pakistan-army/>; and Ian Macdonald, "Pakistan's Army Strategic Forces," CRW Flags, December 10, 2010, <https://www.crwflags.com/forw/flags/pk%5Easf.html>.
- 739 "Pakistan Army: Its ORBAT and Deployment in NWFP and FATA," <https://www.slideserve.com/alika-porter/pakistan-army-its-orbat-and-deployment-in-nwfp-and-fata>, 13.
- 740 See for example, Inter-Services Public Relations, No. PR-83/2008-ISPR, February 13, 2008, <https://ispr.gov.pk/press-release-detail.php?id=446>. See also, Zia Mian and M. V. Ramana, "Going MAD: Ten Years of the Bomb in South Asia," *Economic and Political Weekly* 43, nos. 26-27 (2008): 201–208.
- 741 "F-16 Fighting Falcon," U.S. Air Force, September 23, 2015, <https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104505/f-16-fighting-falcon/>.
- 742 Kristensen and Korda, "Pakistani Nuclear Weapons, 2021," 271.
- 743 Kristensen and Korda conjecture that the 7 and 8 Squadrons may have a nuclear mission as well. Kristensen and Korda, "Pakistani Nuclear Weapons, 2021," 270.
- 744 For an example of some of these activities, see "F-16s Landing on Highways, Airspace Restriction: All You Need to Know About Pakistan's Largest Military Exercise," *India Today*, September 23, 2016, <https://www.indiatoday.in/world/story/f-16-fighter-jets-pakistan-largest-military-exercise-high-mark-342802-2016-09-23>.

- 745 Tim Craig and Karen DeYoung, “Pakistan Is Eyeing Sea-based and Short-range Nuclear Weapons, Analysts Say,” *Washington Post*, September 21, 2014.
- 746 The challenges involved here are usefully explored in Christopher Clary and Ankit Panda, “Safer at Sea? Pakistan’s Sea-Based Deterrent and Nuclear Weapons Security,” *Washington Quarterly* 40, no. 3 (2017): 149–168.
- 747 “Pakistan Nuclear Weapons,” Federation of American Scientists, December 11, 2002, <https://nuke.fas.org/guide/pakistan/nuke/>.
- 748 Office of the Secretary of Defense, *Proliferation: Threat and Response*, January 2001 (Washington, DC: Department of Defense, 2001), 27.
- 749 “Musharraf Rules Out Accidental N-war With India,” *Times of India*, January 10, 2003, <https://timesofindia.indiatimes.com/world/pakistan/Musharraf-rules-out-accidental-N-war-with-India/articleshow/33957533.cms>.
- 750 Maurizio Martellini, *Security and Safety Issues About the Nuclear Complex: Pakistan’s Standpoints* (Landau Network-Centro Volta; Como, 2008), cited in Tertrais, “Pakistan’s Nuclear and WMD Programmes: Status, Evolution and Risks,” 5.
- 751 Goldberg and Ambinder, “The Pentagon’s Secret Plans to Secure Pakistan’s Nuclear Arsenal.”
- 752 For details, see Feroz Hassan Khan, “Nuclear Security in Pakistan: Separating Myth From Reality,” Arms Control Association, July 2009, <https://www.armscontrol.org/act/2009-07/features/nuclear-security-pakistan-separating-myth-reality>.
- 753 Conversations with Pakistani military officers suggest that they entirely appreciate the risks of “warning failure,” as described in Gregory S. Jones, “From Testing to Deploying Nuclear Forces: The Hard Choices Facing India and Pakistan,” IP-192, RAND, Santa Monica, 2000, 9, and have developed plans that limit such dangers partly by increasing the number of weapons in the stockpile and partly through the opacity surrounding their secure nuclear storage sites. In any event, the risks associated with warning failure are judged to be lesser in comparison to the dangers of deploying standing nuclear forces, a judgment that is reflected in the Indian posture as well.
- 754 How insertable capsules were employed in early U.S. nuclear designs are described clearly in Michael H. Maggelet, “North Korea’s Inevitable Nuclear Threat Is Here,” *American Consequences* 3 (2017): 37–43.
- 755 For more on such designs, see Chuck Hansen, ed., *The Swords of Armageddon*, Vol. 8 (Sunnyvale: Chukelea Publications, 1995), 11–36.
- 756 Maggelet, “North Korea’s Inevitable Nuclear Threat Is Here,” 38.
- 757 Ahmed, “Pakistan’s Tactical Nuclear Weapons and Their Impact on Stability.”
- 758 Naeem Salik and Kenneth N. Luongo, “Challenges for Pakistan’s Nuclear Security,” *Arms Control Today* 43, no. 2 (2013): 14–19; and in illuminating detail in Christopher Clary, “Thinking About Pakistan’s Nuclear Security in Peacetime, Crisis and War,” IDSA Occasional Paper Number 12, Institute for Defence Studies and Analyses, New Delhi, 2010.
- 759 Apparently taking his cue from some Western speculation, one Pakistani military officer has recently claimed that India’s “recent technological and force posture developments indicate that New Delhi is mulling over announcing a pre-emptive nuclear doctrine that relies on counterforce targeting.” See Colonel Imran Hassan, “Strategic Instabilities in South Asia and Pakistan’s Nuclear Policy,” International Institute of Strategic Studies, Thursday, May 28, 2020, <https://www.iiss.org/events/2020/05/strategic-instabilities-south-asia-pakistan-nuclear-policy>. Not only is Hassan’s central assertion baseless, but it also remains the exception rather than the rule.
- 760 This confidence has been memorialized most authoritatively in the remarks of Lieutenant General Kidwai, at the Seventh IISS–Centre for International Strategic Studies (CISS) (Pakistan) workshop on “South Asian Strategic Stability: Deterrence, Nuclear Weapons and Arms Control,” London, February 6, 2020.
- 761 David Albright, “Securing Pakistan’s Nuclear Weapons Complex,” Paper commissioned and sponsored by the Stanley Foundation for the 42nd Strategy for Peace Conference, Strategies for Regional Security (South Asia Working Group), October 25–27, 2001, Airlie Conference Center, Warrenton, Virginia, <https://www.isis-online.org/publications/terrorism/stanleypaper.html>.
- 762 Ahmed, “Pakistan’s Tactical Nuclear Weapons and Their Impact on Stability.”

- 763 Narang, "Posturing for Peace? Pakistan's Nuclear Postures and South Asian Stability," 70.
- 764 Naeem Salik, "Tactical Nuclear Weapons and Deterrence Stability," U.S. Naval Postgraduate School, 2012, 3.
- 765 Feroz Hassan Khan, "Nuclear Command and Control in South Asia during Peace, Crisis, and War," *Contemporary South Asia* 14 (June 2005): 169.
- 766 Cotta-Ramusino and Martellini, "Nuclear safety, nuclear stability and nuclear strategy in Pakistan," 4.
- 767 Sébastien Miraglia, "Deadly or Impotent? Nuclear Command and Control in Pakistan," *Journal of Strategic Studies* 36, no. 6 (2013): 841–866.
- 768 For an example, see Narang, "Posturing for Peace?," 70.
- 769 Adil Sultan, "Nuclear Security in Pakistan" (meeting, International Institute for Strategic Studies, London, July 7, 2015), cited in Ahmed, "Pakistan's Tactical Nuclear Weapons and Their Impact on Stability."
- 770 Feroz Hassan Khan, "Nuclear Command, Control and Communications (NC3): The Case of Pakistan," Nautilus Institute for Security and Sustainability, September 26, 2019, <https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-nc3-the-case-of-pakistan/>.
- 771 Usman Ansari, "Pakistan Unveils VLF Submarine Communications Facility," *Defense News*, November 16, 2016, <https://www.defensenews.com/naval/2016/11/16/pakistan-unveils-vlf-submarine-communications-facility/>.
- 772 See, for example, Ashraf Jehangir Qazi, "Whatever It Takes," *Dawn*, December 2, 2019.
- 773 The interactive dynamics involved in the U.S-China nuclear relationship are usefully summarized in Caitlin Talmadge, "The US-China Nuclear Relationship: Why Competition Is Likely to Intensify," Brookings Institution, Washington, DC, September 2019, [https://www.brookings.edu/wp-content/uploads/2019/09/FP\\_20190930\\_china\\_nuclear\\_weapons\\_talmadge-2.pdf](https://www.brookings.edu/wp-content/uploads/2019/09/FP_20190930_china_nuclear_weapons_talmadge-2.pdf).
- 774 U.S. Department of Defense, Office of the Secretary of Defense, *The Military Power of the People's Republic of China, 2005*, July 30, 2005, 28; and U.S. Department of Defense, Office of the Secretary of Defense, *Military Power of the People's Republic of China, 2006*, May 23, 2006, 26.
- 775 For an extended discussion, see Tellis, *India's Emerging Nuclear Posture*, 117–250.
- 776 Feroz Hassan Khan, "Pakistan's Perspective on the Global Elimination of Nuclear Weapons," in *National Perspectives on Nuclear Disarmament*, eds. Barry M. Blechman and Alexander K. Bollfrass (Washington, DC: Stimson Center, 2010), 211–241.
- 777 The multiple factors implicated in this chain are surveyed in Sharad Joshi, "Nuclear Proliferation and South Asia: Recent Trends," Nuclear Threat Initiative, Report, July 31, 2007, <https://www.nti.org/analysis/articles/nuclear-proliferation-south-asia/>.
- 778 Manjeet S. Pardesi, "The Initiation of the Sino-Indian Rivalry," *Asian Security* 15, no. 3 (2019): 253–284.
- 779 For an excellent overview, see John Garver, *Protracted Contest: Sino-Indian Rivalry in the Twentieth Century* (Seattle: University of Washington Press, 2002), 3–109.
- 780 Harry Harding, "The Evolution of the Strategic Triangle: China, India, and the United States," in *The India-China Relationship: What the United States Needs to Know*, eds. Frankel and Harding, 321–350. See also, Tellis, "China and India in Asia," 135–137.
- 781 Susan L. Shirk, "One-Sided Rivalry: China's Perceptions and Policies Toward India," in *The India-China Relationship*, 95.
- 782 Tellis, "China and India in Asia," 139.
- 783 Ibid.
- 784 Gary Klintworth, "Chinese Perspectives on India as a Great Power," in *India's Strategic Future*, eds. Ross Babbage and Sandy Gordon (New York: St. Martin's Press, 1992), 96.
- 785 John Garver, "Asymmetrical Indian and Chinese Threat Perceptions," *Journal of Strategic Studies* 25, no. 4 (2002): 110.
- 786 Dr. Saji Abraham, *China's Role in the Indian Ocean: Its Implications on India's National Security* (New Delhi: Vij Books India, 2015), 93.
- 787 Andrew Small, *The China-Pakistan Axis: Asia's New Geopolitics* (Mumbai: Random House India, 2015), 1.

- 788 Tellis, "China and India in Asia," 139.
- 789 Garver, "Asymmetrical Indian and Chinese Threat Perceptions," 109–134.
- 790 Gill and Mulvenon, "The Chinese Strategic Rocket Forces: Transition to Credible Deterrence," 38–45; and Gertz, "New Chinese Missiles Target All of East Asia."
- 791 Tellis, "The Changing Political-Military Environment: South Asia," 205.
- 792 Rajesh Basrur, "India and China: Nuclear Rivalry in the Making?," S. Rajaratnam School of International Studies, Policy Brief, October 2013, 7.
- 793 Kartik Bommakanti and Suyash Desai, "China's Nuclear Ambiguity and Its Implications for India," Observer Research Foundation, Occasional Paper, Issue No. 309, April 2021, [https://www.orfonline.org/wp-content/uploads/2021/04/ORF\\_OccasionalPaper\\_309\\_ChinaAmbiguity.pdf](https://www.orfonline.org/wp-content/uploads/2021/04/ORF_OccasionalPaper_309_ChinaAmbiguity.pdf).
- 794 On the issue of whether the nuclear balance matters, see Rajesh Basrur, "India and China: A Managed Nuclear Rivalry?," *Washington Quarterly* 42, no. 3 (2019): 151–170; and for a larger examination of the question that corroborates New Delhi's intuitions, see David C. Logan, "Nuclear Superiority Is What States Make of It," unpublished manuscript, Princeton University, June 25, 2020, [https://scholar.princeton.edu/sites/default/files/dlogan/files/logan\\_david\\_-\\_nuclear\\_superiority\\_is\\_what\\_states\\_make\\_of\\_it\\_-\\_june\\_2020\\_3.pdf](https://scholar.princeton.edu/sites/default/files/dlogan/files/logan_david_-_nuclear_superiority_is_what_states_make_of_it_-_june_2020_3.pdf).
- 795 For a discussion as this pertains to China, see Vipin Narang, "Nuclear Deterrence in the China-India Dyad," in *The China-India Rivalry in the Globalization Era*, ed. T. V. Paul (Washington, DC: Georgetown University Press, 2018), 187–201.
- 796 Sundarji, *Blind Men of Hindoostan*, 141–157.
- 797 Tellis, "The Changing Political-Military Environment: South Asia," 207–208.
- 798 For useful, though not always conclusive, overviews of the Sino-Indian military balance, see Oriana Mastro, and Arzan Tarapore, "Asymmetric but Uneven: The China-India Conventional Military Balance," in *Routledge Handbook of China-India Relations*, eds. Bajpai, Ho, and Miller, 235–247; and Daniel Kliman, Iskander Rehman, Kristine Lee, and Joshua Fitt, "Imbalance of Power," Center for a New American Security, October 23, 2019, <https://www.cnas.org/publications/reports/imbalance-of-power>. An insightful discussion of how current Indian military investments should be modified for success against China can be found in Chris Dougherty, "Force Development Options for India by 2030," Center for a New American Security, October 23, 2019, <https://www.cnas.org/publications/reports/force-development-options-for-india-by-2030>.
- 799 For confirming Chinese views on this question, see Toby Dalton and Tong Zhao, "At a Crossroads? China-India Nuclear Relations After the Border Clash," Carnegie Endowment for International Peace, August 19, 2020, <https://carnegieendowment.org/2020/08/19/at-crossroads-china-india-nuclear-relations-after-border-clash-pub-82489>, 7–8.
- 800 Tellis, *India's Emerging Nuclear Posture*, 710–712.
- 801 Bharat Karnad, *Why India Is Not a Great Power (Yet)* (New Delhi: Oxford University Press, 2015), 389.
- 802 Gill and Mulvenon, "The Chinese Strategic Rocket Forces," 38–45.
- 803 *Ibid.*, 39–40.
- 804 Kristensen and Korda, "Chinese Nuclear Forces, 2021," 325.
- 805 Karnad, *India's Nuclear Policy*, 63–77.
- 806 See for example, Gregory S. Jones, "From Testing to Deploying Nuclear Forces: The Hard Choices Facing India and Pakistan," 7; and Bharat Karnad, "A Disruptive Nuclear China and India's Imperatives," *Security Wise*, April 7, 2017, <https://bharatkarnad.com/2017/04/07/a-disruptive-nuclear-china-and-indias-imperatives/>.
- 807 Rudolph Rummel, *China's Bloody Century: Genocide and Mass Murder Since 1900* (New York: Routledge, 1991).
- 808 Subrahmanyam and Arunachalam, "Deterrence and Explosive Yield"; and Manpreet Sethi, "Nuclear Numbers: Assessing China's Threshold of 'Unacceptable Damage,'" *Sunday Guardian*, February 6, 2021, <https://www.sundayguardianlive.com/opinion/nuclear-numbers-assessing-chinas-threshold-unacceptable-damage>.
- 809 Menon, *Choices*, 112. See also Masahiro Kurita, "China-India Relationship and Nuclear Deterrence," *NIDS Journal of Defense and Security* 19 (December 2018): 37–61.

- 810 In their “Worldwide Deployments of Nuclear Weapons, 2017,” Hans M. Kristensen and Robert S. Norris note that “As with Pakistan, we have found little reliable information that indicates where India’s 120–130 nuclear warheads are stored. Based on available unclassified sources and satellite imagery, we cautiously estimate that India stores nuclear weapons at at least five locations. India is thought to keep its nuclear warheads and bombs in central storage locations rather than on bases with operational forces.” See Hans M. Kristensen and Robert S. Norris, “Worldwide Deployments of Nuclear Weapons, 2017,” *Bulletin of the Atomic Scientists* 73, no. 5 (2017): 295.
- 811 The effectiveness of earth-penetrating nuclear weapons is discussed in National Research Council, *Effects of Nuclear Earth-Penetrator and Other Weapons* (Washington, DC: National Academies Press, 2005), 18–29.
- 812 M. McDonnell and J. McGahan, “Target Descriptions and Damage Levels for the SBM SAWG,” March 1976, Science Applications, Inc.
- 813 The Defense Intelligence Agency’s Physical Vulnerability System is described in detail in Gilbert C. Binniger, Paul J. Castleberry, Jr., and Patsy M. McGrady, “Mathematical Background and Programming Aids for the Physical Vulnerability System for Nuclear Weapons,” Defense Intelligence Agency, DI-550–27–74, November 1, 1974.
- 814 If it is assumed, for example, that all China’s missiles and warheads function perfectly, that its missiles attack simultaneously and warhead fratricide is irrelevant, and that each warhead’s probability of kill is independent rather than interdependent, twenty missiles each carrying a single 150-kiloton warhead would be required to achieve a 90 percent probability of kill. If the warhead yield is increased to 500 kilotons, eight single warhead missiles would be similarly required to achieve a 90 percent probability of kill. Even using 3-megaton warheads requires two missiles per target to achieve a 90 percent probability of kill, which on balance implies a high expenditure of weapons to targets.
- 815 Again, if it is assumed, for example, that all China’s missiles and warheads function perfectly, that its missiles attack simultaneously and warhead fratricide is irrelevant, and that each warhead’s probability of kill is independent rather than interdependent, twenty-five missiles each carrying a single 150-kiloton warhead would be required to achieve a 90 percent probability of kill against targets located at a depth of 25 meters. If the warhead yield is increased to 500 kilotons, eight single warhead missiles would be similarly required to achieve a 90 percent probability of kill. Even using 3-megaton warheads requires three missiles per target to achieve a 90 percent probability of kill, which on balance also implies a high expenditure of weapons to targets in all these scenarios. Against targets at 100 meters, the numbers of weapons necessary to achieve a 90 percent probability of kill are similarly daunting: forty-five weapons of 150 kilotons, twelve weapons of 500 kilotons, and three weapons of 3 megatons would be required in this instance, all because of the large 700-meter circular error probable of the attacking missiles.
- 816 National Research Council, *Effects of Nuclear Earth-Penetrator and Other Weapons*, 3–51.
- 817 Debak Das, “China’s Missile Silos and the Sino-Indian Nuclear Competition,” War on the Rocks, October 13, 2021, <https://warontherocks.com/2021/10/chinas-missile-silos-and-the-sino-indian-nuclear-competition/>.
- 818 Manpreet Sethi, “Why India and China Haven’t Used the ‘N’ Word Throughout the Ladakh Conflict,” *The Print*, August 3, 2020, <https://theprint.in/opinion/india-china-nuclear-doctrine-ladakh-conflict/473444/>.
- 819 Despite some Indian speculation to the contrary, the movement of China’s H-6K bombers within its Western Theater Command was only meant to bolster conventional—not nuclear—deterrence against India. See Minnie Chan, “China Sends Long-Range Bomber to Border With India,” *South China Morning Post*, November 16, 2021, <https://www.scmp.com/news/china/military/article/3156258/china-sends-long-range-bomber-border-india>.
- 820 Yogesh Joshi, “Angles and Dangles: Arihant and the Dilemma of India’s Undersea Nuclear Weapons,” War on the Rocks, January 14, 2019, <https://warontherocks.com/2019/01/angles-and-dangles-arihant-and-the-dilemma-of-indias-undersea-nuclear-weapons/>.
- 821 Kania, “China’s Strategic Situational Awareness Capabilities,” 2–4.
- 822 Vinayak Bhat, “Where do China’s Missile Early Warning Capabilities Stand? Eye in the Sky Tells You,” *India Today*, August 11, 2020, <https://www.indiatoday.in/world/story/china-missile-early-warning-capabilities-satellite-images-1709882-2020-08-11>.

- 823 For a useful survey of China's programs, see Mark Stokes, Gabriel Alvarado, Emily Weinstein, and Ian Easton, "China's Space and Counterspace Capabilities and Activities," paper prepared for The U.S.-China Economic and Security Review Commission, Project 2049 Institute and Pointe Bello, March 30, 2020, [https://www.uscc.gov/sites/default/files/2020-05/China\\_Space\\_and\\_Counterspace\\_Activities.pdf](https://www.uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf).
- 824 Gunter D. Krebs, "TJS 2, 5, 6 (Huoyan-1?)," Gunter's Space Page, [https://space.skyrocket.de/doc\\_sdat/tjs-2.htm](https://space.skyrocket.de/doc_sdat/tjs-2.htm); and "Chinese Ballistic Missile Early Warning," Global Security, May 3, 2020, <https://www.globalsecurity.org/space/world/china/warning.htm>.
- 825 The importance of space-based early warning for missile defense operations is illustrated in Lieutenant General Larry J. Dodgen, "Flattening With the New Common of Space," *Army Space Journal*, 2006 Winter Edition, 4–5, 44–47.
- 826 See "Chinese and Russian Missile Defense: Strategies and Capabilities," [https://media.defense.gov/2020/Jul/28/2002466237/-1/-1/1/CHINESE\\_RUSSIAN\\_MISSILE\\_DEFENSE\\_FACT\\_SHEET.PDF](https://media.defense.gov/2020/Jul/28/2002466237/-1/-1/1/CHINESE_RUSSIAN_MISSILE_DEFENSE_FACT_SHEET.PDF).
- 827 For a good discussion of these issues, see Dean Wilkening and Kenneth Watman, *Strategic Defenses and First-Strike Stability* (Santa Monica: RAND Corporation, 1986).
- 828 Tellis, *Are India-Pakistan Peace Talks Worth a Damn?*, 11–23.
- 829 Narasingha P. Sil, "India-Pakistan Conflict: An Overview," *Education About Asia* 14, no. 3 (2009): 9–13.
- 830 Ayesha Jalal, "The Past as Present," in *Pakistan—Beyond the Crisis State*, ed. Lodhi, 7–20.
- 831 Tellis, *Are India-Pakistan Peace Talks Worth a Damn?*, 38–42.
- 832 Cohen, *The Pakistan Army*, 90.
- 833 T. V. Paul, "Why Has the India-Pakistan Rivalry Been So Enduring? Power Asymmetry and an Intractable Conflict," *Security Studies* 15, no. 4 (2006): 600–630.
- 834 For more on this issue, see T. V. Paul, "Causes of the India–Pakistan Enduring Rivalry," in *The India-Pakistan Conflict—An Enduring Rivalry*, ed. T. V. Paul (Cambridge: Cambridge University Press, 2005), 3–24.
- 835 Cohen, *The Pakistan Army*, 152–158.
- 836 Rohan Mukherjee and Yogesh Joshi, "The Cost of Restraint: India's Differential Response to China and Pakistan as Nuclear Rival" (unpublished manuscript, n.d.).
- 837 Fair, *Fighting to the End: The Pakistan Army's Way of War*, 27.
- 838 Ashley J. Tellis, C. Christine Fair, and Jamison Jo Medby, *Limited Conflicts Under the Nuclear Umbrella: Indian and Pakistani Lessons From the Kargil Crisis* (Santa Monica: RAND Corporation, 2001).
- 839 Lavoy, "Pakistan's Nuclear Posture: Security and Survivability," 2–3.
- 840 Tellis, *Stability in South Asia*, vii–x; and S. Paul Kapur, *Jihad as Grand Strategy* (New York: Oxford University Press, 2017), 51–80.
- 841 Tellis, *ibid.* See also, S. Paul Kapur, "Ten Years of Instability in a Nuclear South Asia," *International Security* 33, no. 2 (2008): 71–94.
- 842 Tellis, *Stability in South Asia*, 44–46.
- 843 The costs of even modest Pakistani nuclear use are elucidated in Sankaran, "Pakistan's Battlefield Nuclear Policy: A Risky Solution to an Exaggerated Threat," 118–151.
- 844 See the discussion in Kapur, "Ten Years of Instability in a Nuclear South Asia," 71–94.
- 845 Robert Legvold, "The Challenges of a Multipolar Nuclear World in a Shifting International Context," in *Meeting the Challenges of the New Nuclear Age: Nuclear Weapons in a Changing Global Order*, eds. Steven E. Miller, Robert Legvold, and Lawrence Freedman (Cambridge: American Academy of Arts and Sciences, 2019), 28–61; and Toon et al., "Rapidly Expanding Nuclear Arsenals in Pakistan and India Portend Regional and Global Catastrophe."
- 846 Cf. Vipin Narang, "Posturing for Peace? Pakistan's Nuclear Postures and South Asian Stability," 38–78, from which some of the terms in this sentence are drawn.
- 847 For an extended discussion of the consequences, see Aparna Pande, *Explaining Pakistan's Foreign Policy: Escaping India* (New York: Routledge, 2017).
- 848 Manpreet Sethi, "Pakistan's Nuclear Posturing and India's Nuclear Doctrine," Center for Land Warfare Studies, New Delhi, *Scholar Warrior*, Spring 2016, 63–69, [https://archive.claws.in/images/journals\\_doc/717038032\\_ManpreetSethi.pdf](https://archive.claws.in/images/journals_doc/717038032_ManpreetSethi.pdf).

- 849 Tellis, *Stability in South Asia*, 49–50.
- 850 Kapur, “Ten Years of Instability in a Nuclear South Asia,” 71–94; and Walter C. Ladwig III, “A Cold Start for Hot Wars? The Indian Army’s New Limited War Doctrine,” *International Security* 32, no. 3 (2007/08): 158–190.
- 851 Krepon, “Pakistan’s Nuclear Strategy and Deterrence Stability,” 53.
- 852 Congressional Research Service, “Pakistan’s Nuclear Weapons,” *CRS Report*, RL 34248, August 1, 2016, 11.
- 853 Tellis, *India’s Emerging Strategic Posture*, 206.
- 854 Rajat Pandit, “India Behind China and Pakistan in Nuclear-warheads but Not Worried,” *Times of India*, June 15, 2021, <https://timesofindia.indiatimes.com/india/india-behind-china-pakistan-in-nuclear-warheads-but-not-worried/articleshow/83524404.cms>.
- 855 P. K. Singh, “The India-Pakistan Nuclear Dyad and Regional Nuclear Dynamics,” *Asia Policy*, No. 19 (January 2015): 37–44.
- 856 For a sophisticated survey, see Colin S. Gray, “The Arms Race Phenomenon,” *World Politics* 24, no. 1 (1971): 39–79.
- 857 Waheguru Pal Singh Sidhu, “A Languid but Lethal Arms Race,” *Disarmament Forum* 2 (2004): 7.
- 858 Gaurav Sharma and Marc Finaud, “The South Asian Nuclear Posture: A Vicious Nuclear Arms Race,” Geneva Centre for Security Policy, Strategic Security Analysis, Issue 3, November 2018, <https://dam.gcsp.ch/files/2y10Nk365YrCrjQuyRhRpYDWeOaiz0LZU1WKSv5AGiHWXOfFyVtx>.
- 859 Ashley J. Tellis, “Deterrence vs. Coercion,” Cipher Brief, May 25, 2016; and Toby Dalton and Jaclyn Tandler, “Understanding the Arms ‘Race’ in South Asia,” Carnegie Endowment for International Peace, September 13, 2012, <https://carnegieendowment.org/2012/09/13/understanding-arms-race-in-south-asia-pub-49361>.
- 860 On Pakistan’s absorption of the lessons of the nuclear revolution, which is different from India’s, see Diana Wueger, “Pakistan’s Nuclear Future: Continued Dependence on Asymmetric Escalation,” *Nonproliferation Review* 26, nos. 5–6 (2019): 449–463.
- 861 A.H. Nayyar and Zia Mian, “Pakistan and the Nasr Missile: Searching for a Method in the Madness,” *Economic and Political Weekly* 50, no. 39 (2015): 65.
- 862 Tellis, *Stability in South Asia*, 19–25. The Indian Army’s force posture has changed somewhat since this RAND study was published but not so fundamentally as to vitiate this conclusion.
- 863 For a good discussion, see Lieutenant General (retd.) V. K. Sood and Pravin Sawhney, *Operation Parakram: The War Unfinished* (New Delhi: Sage, 2003).
- 864 The force ratios described in the following paragraphs owe much to Ravi Rikhye who shared his insights pertaining to the Indo-Pakistani order of battle. Further details are found in Ravi Rikhye, *Analysis of India’s Ability to Fight a 2-Front War 2018* (n.p.: Tiger Lily Books, 2018). Very useful historical information on the posturing of the Indian and Pakistani armies by sector can be found in Ravi Rikhye, *The War That Never Was* (New Delhi: Chanakya Publications, 1988), 95–124; and Ravi Rikhye, *The Fourth Round* (New Delhi: ABC Publishing House, 1982), 55–151, with more recent, albeit speculative, data available at Richard A. Rinaldi and Ravi Rikhye, *Indian Army Order of Battle* (n.p.: Tiger Lily Books, 2011). I am grateful to Ravi Rikhye and to another U.S. Government reader for reviewing this section and correcting the errors.
- 865 Ajai Shukla, “Army Able to Launch Faster Response Against Pakistan,” *Business Standard*, January 13, 2012.
- 866 Tellis, *Stability in South Asia*, 19–22.
- 867 Kidwai and Lavoy, “A Conversation With Gen. Khalid Kidwai,” 7.
- 868 Adil Sultan, “Challenges in Nuclear Posture and Deterrence From Pakistan’s Perspective,” *National Security Journal*, December 2021, 4, <https://nationalecurityjournal.nz/wp-content/uploads/sites/13/2021/12/NSJ-2021-December-Sultan.pdf>.
- 869 Tellis, *India’s Emerging Nuclear Posture*, 133–134; and Nayyar and Mian, “The Limited Military Utility of Pakistan’s Battlefield Use of Nuclear Weapons in Response to Large Scale Indian Conventional Attack,” 9.

- 870 It is unlikely that given Pakistan's conventional military advantages, its nuclear use threshold has now descended so low as to trigger nuclear weapons employment merely because India manages to capture and retain some marginal pieces of Pakistani territory for purposes of bargaining in post-conflict negotiations. The credibility thresholds for effective nuclear threats are simply too high to make Pakistani nuclear use plausible in such circumstances.
- 871 Tellis, Fair, and Medby, *Limited Conflicts Under the Nuclear Umbrella*, 83.
- 872 Salik, "Tactical Nuclear Weapons and Deterrence Stability," 1–2.
- 873 Feroz Hassan Khan, former Director of Arms Control and Disarmament Affairs, Strategic Plans Division, quoted in Ghazala Yasmin Jalil, "Tactical Nuclear Weapons and Deterrence Stability in South Asia," *Strategic Studies* 34, no. 1 (2014): 51.
- 874 Zahir Kazmi, "Nothing Tactical About Nuclear Weapons," *Express Tribune*, May 16, 2014.
- 875 Kidwai and Lavoy, "A Conversation with Gen. Khalid Kidwai," 5.
- 876 See the discussion in Toby Dalton and George Perkovich, "India's Nuclear Options and Escalation Dominance," Carnegie Endowment for International Peace, May 2016, 21.
- 877 Jalil, "Tactical Nuclear Weapons and Deterrence Stability in South Asia," 67.
- 878 For a good analysis of the problem, see Evan Braden Montgomery and Eric S. Edelman, "Rethinking Stability in South Asia: India, Pakistan, and the Competition for Escalation Dominance," *Journal of Strategic Studies* 38, no. 1–2 (2015): 159–182.
- 879 Thomas C. Schelling, *The Reciprocal Fear of Surprise Attack* (Santa Monica: RAND Corporation, 1958).
- 880 Albert Wohlstetter, "The Delicate Balance of Terror," RAND Corporation, 1958, <https://www.rand.org/pubs/papers/P1472.html>.
- 881 Clary and Narang, "India's Counterforce Temptations," 7–52.
- 882 Shyam Saran, "Is India's Nuclear Deterrent Credible?," (speech, New Delhi, India Habitat Centre, April 24, 2013), Research and Information System for Developing Countries, [http://ris.org.in/images/RIS\\_images/pdf/Final%20Is%20India%27s%20Nuclear%20Deterrent%20Credible-%20rev1%202%20.pdf](http://ris.org.in/images/RIS_images/pdf/Final%20Is%20India%27s%20Nuclear%20Deterrent%20Credible-%20rev1%202%20.pdf). On the possibly perverse consequences of Indian proportional retaliation, see Tellis, *India's Emerging Nuclear Posture*, 340–341.
- 883 Menon, *Choices*, 110.
- 884 Menon, *Choices*, 110–123; Rajesh Rajagopalan, "India and Counterforce: A Question of Evidence," Observer Research Foundation, May 2020, [https://www.orfonline.org/wp-content/uploads/2020/05/ORF\\_Occasional\\_Paper\\_247\\_India-Counterforce.pdf](https://www.orfonline.org/wp-content/uploads/2020/05/ORF_Occasional_Paper_247_India-Counterforce.pdf).
- 885 Clary and Narang, "India's Counterforce Temptations," 9.
- 886 Rajagopalan, "India and Counterforce"; Abhijnan Rej, "India Is Not Changing Its Policy on No First Use of Nuclear Weapons," War on the Rocks, March 29, 2017, <https://warontherocks.com/2017/03/india-is-not-changing-its-policy-on-no-first-use-of-nuclear-weapons/>; and Jaishankar, "Decoding India's Nuclear Status." Jaishankar, "Decoding India's Nuclear Status."
- 887 Clary and Narang, "India's Counterforce Temptations," 24.
- 888 Menon, *Choices*, 108.
- 889 Ibid.
- 890 Ibid.
- 891 Ajai Shukla, "Will India Nuke Pakistani Cities, or Go for Its Nuclear Arsenal?," *Business Standard*, March 20, 2017, [https://www.business-standard.com/article/economy-policy/will-india-nuke-pakistani-cities-or-go-for-its-nuclear-arsenal-117031700921\\_1.html](https://www.business-standard.com/article/economy-policy/will-india-nuke-pakistani-cities-or-go-for-its-nuclear-arsenal-117031700921_1.html).
- 892 Clary and Narang, "India's Counterforce Temptations," 24.
- 893 Menon, *Choices*, 117. See the pertinent comments in Rej, "India Is Not Changing Its Policy on No First Use of Nuclear Weapons," on exactly this issue.
- 894 Menon, *Choices*, 110.
- 895 Ibid.
- 896 See, for example, Kristensen and Korda, "Pakistani Nuclear Weapons, 2021"; and Kristensen and Korda, "Indian Nuclear Forces, 2020," 218–219.



- 897 See the pertinent—and fundamentally correct—assessment in Dalton and Perkovich, “India’s Nuclear Options and Escalation Dominance,” 19–26.
- 898 Unlike China’s CSS-18 missiles, which have accuracies measuring in a few tens of meters to make them good counterforce weapons, India’s missiles have accuracies that run into many tens of meters. The accuracy of the Indian Agni-V missile, for example, “is reported to be 80 meters, which is more than sufficient for a nuclear strike.” Although many Indian commentators bestow extravagant accuracies on various Indian ballistic missiles, senior DRDO officials have confirmed in private conversations that these are entirely fictitious because, as one Indian analyst has noted, “for a nuclear role, very high accuracy is not required.” See Arjun Subramanian.P, “Longer Reach and Enabling More Options: AGNI V,” Center for Air Power Studies, Issue Brief, April 30, 2012, 2. Two respected Indian scholars, Ajey Lele and Parveen Bhardwaj in their very useful report, *India’s Nuclear Triad: A Net Assessment* (New Delhi: Institute for Defence Studies & Analyses, 2013), 35, claim that the “majority of Indian missiles have CEP close to 50m which make them highly precise vis-à-vis to Pakistan whose CEP range varies 200–300 meters.” If this claim is correct, it would make India’s missiles almost as accurate as China’s CSS-18s, which is hard to believe. Since the Indian government has not tasked its strategic forces for counterforce missions, it is not surprising that India’s ballistic missiles do not yet possess the high accuracies that its cruise missiles, for example, have in contrast. While India could certainly improve its ballistic missile accuracy if it chose to, executing effective counterforce missions require more than high accuracy weapons, especially if employed for preemptive damage-limiting attacks.
- 899 National Research Council, *Effects of Nuclear Earth-Penetrator and Other Weapons*, 30–42.
- 900 Vinayak Bhat, “Pakistan Is Protecting Its Nuclear Missiles by Building Underground Fortresses,” *The Print*, November 22, 2017, <https://theprint.in/defence/pakistan-plan-to-safeguard-nuclear-storage/17525/>.
- 901 Ibid.
- 902 This calculation assumes sequential targeting where multiple weapons are required. It assumes that sufficient time is taken to assure that the debris generated from the previous shot dissipates before the next shot is taken but no account is taken of the prior shot’s cratering effects. Whatever the limitations of this methodology, or the alternative that assumes simultaneous detonations, the basic conclusion remains unchanged: more Indian warheads than plausibly exist in the arsenal would be required to target all of Pakistan underground sites.
- 903 To be sure, the calculations presented above may not be sufficiently accurate. The real hardness of Pakistan’s nuclear storage sites is unknown except to the Strategic Plans Division, and the methodology used here to calculate the ground shock effects of Indian nuclear employment is still rule-of-thumb. A systematic campaign analysis, which can be undertaken mostly by governments with intelligence information, would therefore be required to establish firm conclusions, but the data gaps that any Indian nuclear planner will have to face about the different technical parameters pertaining to Pakistan’s storage sites will still give New Delhi pause. Such uncertainties, which confront all military planning, matter less however for conventional deterrence, but would have outsized consequences where nuclear operations are concerned.
- 904 On this issue, see Koithara, *Managing India’s Nuclear Forces*, f. 122.
- 905 Clary and Narang, “India’s Counterforce Temptations,” 31–36. By way of further example, Lavoy, “Pakistan’s Nuclear Posture,” 17–18; and Rodney W. Jones, “Conventional Military Imbalance and Strategic Stability in South Asia,” SASSU Research Paper No. 1, March 2005, 33, who however makes the case for “the potential for Indian surprise *conventional* air attacks that could serve a preemptive objective against Pakistan’s nuclear storage facilities, the mobile missile systems prior to their dispersal, and aircraft at air bases” (emphasis added).
- 906 S. Chandrashekar, *Space, War & Security – A Strategy for India* (Bengaluru: National Institute of Advanced Studies, 2015), 42–56; Herbert J. Kramer, “RISAT-2 (Radar Imaging Satellite-2),” European Space Agency Earth Observation Portal, <https://directory.eoportal.org/web/eoportal/satellite-missions/r/risat-2#foot8%29>; and Herbert J. Kramer, “CartoSat-2,” European Space Agency Earth Observation Portal, <https://earth.esa.int/web/eoportal/satellite-missions/c-missions/cartosat-2>.
- 907 *Jane’s All the World’s Aircraft: Unmanned 2020-2021* (Coulsdon: HIS Global, 2021), 132, 137.
- 908 During the 2001–02 crisis, for example, the Pakistan Air Force intercepted and shot down an Indian UAV using a within visual range air-to-air missile. See “Pakistan Claims to Shoot Down Unmanned Indian Aircraft,” Reuters, June 8, 2002, <https://www.rediff.com/news/2002/jun/07war16.htm>.

- 909 *The Concise Global Industry Guide to Radar Systems* (Derbyshire: The Shephard Press, 2018), 5.
- 910 Vivek Raghuvanshi, “India Postpones ISTAR Aircraft Purchase From Raytheon,” *Defense News*, September 1, 2016, <https://www.defensenews.com/breaking-news/2016/09/01/india-postpones-istar-aircraft-purchase-from-raytheon/>.
- 911 M.T. Fennell and R.P. Wishner, “Battlefield Awareness Via Synergistic SAR and MTI Exploitation,” *IEEE Aerospace and Electronic Systems Magazine* 13, no. 2 (1998): 39–43.
- 912 Alan J. Vick, Richard M. Moore, Bruce R. Pirnie, and John Stillion, *Aerospace Operations Against Elusive Ground Targets* (Santa Monica: RAND Corporation, 2001), 66–81.
- 913 Factors like surface topology affect the minimum permissible grazing angle—the angle between the surface of the earth and the projection of the radar to a given area—which in turn (in combination with radar altitude) determines the slant range of the radar system. While the ISTAR system that India intends to acquire, the Raytheon Sentinel, has as a practical limit a 2-degree grazing angle, it more often operates at grazing angles between 2.75 and 3 degrees, implying a slant range between roughly 200 and 250 kilometers when operating at an altitude of 30,000–40,000 feet. For more information, see *Sentinel: The Airborne Stand-Off Radio System (ASTOR) – Past, Present and Future* (Harlow: Raytheon UK, 201), 8.
- 914 I am grateful to Damien Symon for permitting the publication of this map in this report.
- 915 Clary and Narang, “India’s Counterforce Temptations,” 9.
- 916 D. C. Kephart, “Damage Probability Computer for Point Targets With P and Q Vulnerability Numbers,” RAND Corporation, February 1977, <https://www.rand.org/pubs/reports/R1380-1.html>.
- 917 McDonnell and McGahan, “Target Descriptions and Damage Levels for the SBM SAWG.”
- 918 Kephart, “Damage Probability Computer for Point Targets with P and Q Vulnerability Numbers.”
- 919 “Q” type targets have a sigma-30 damage function. See Binninger, Castleberry Jr., and McGrady, “Mathematical Background and Programming Aids for the Physical Vulnerability System for Nuclear Weapons,” 34.
- 920 Khan, “India’s Ballistic Missile Defense,” 189–191; and Snehes Alex Philip, “India’s Ballistic Missile Shield Ready, IAF & DRDO to Seek Govt Nod to Protect Delhi,” *The Print*, January 8, 2020, <https://theprint.in/defence/indias-ballistic-missile-shield-ready-iaf-drdo-to-seek-govt-nod-to-protect-delhi/345853/>.
- 921 Clary and Narang, “India’s Counterforce Temptations,” 11.
- 922 McGeorge Bundy, “To Cap the Volcano,” *Foreign Affairs* 48, no. 1 (1969): 9–10.
- 923 Tellis, *India’s Emerging Nuclear Posture*, 311–312.
- 924 Clary and Narang, “India’s Counterforce Temptations,” 10.
- 925 For an even more expansive list of requirements, to include the organizational and cultural requirements to sustain damage-limiting nuclear strategies, see Dalton and Perkovich, “India’s Nuclear Options and Escalation Dominance,” 19–26.
- 926 Shyam Saran, “The Dangers of Nuclear Revisionism,” *Business Standard*, April 22, 2014.
- 927 For a systematic affirmation of this conclusion, see Rajesh Rajagopalan, *Second Strike: Arguments About Nuclear War in South Asia* (New Delhi: Penguin/Viking, 2005).
- 928 Antoine Levesques, Desmond Bowen, and John H. Gill, “Nuclear Deterrence and Stability in South Asia: Perceptions and Realities,” International Institute for Strategic Studies, London, May 20, 2021, <https://www.iiss.org/blogs/research-paper/2021/05/nuclear-deterrence-south-asia>.
- 929 Rajagopalan, *Second Strike: Arguments About Nuclear War in South Asia*, 37.
- 930 “Memorandum From Helmut Sonnenfeldt to Henry A. Kissinger, ‘Nuclear Cooperation With France—Gallery-Schlesinger Meeting September 25, 1973,’” September 24, 1973, History and Public Policy Program Digital Archive, Nixon Presidential Library, National Security Council Files (NSCF), box 960, France Vol XI April 73–31 December 1973. Obtained and contributed by William Burr and included in NPIHP Research Update #2. <http://digitalarchive.wilsoncenter.org/document/113238>; and Richard H. Ullman, “The Covert French Connection,” *Foreign Policy* 75 (Summer, 1989): 9.
- 931 Ullman, “The Covert French Connection,” 3.



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