SECTION 3: CHINA'S OFFENSIVE MISSILE FORCES

Introduction

China's offensive missile forces are integral to its military modernization efforts and its objective of becoming a world-class military capable of projecting power and denying access by adversary forces to China's periphery. The People's Liberation Army's (PLA) ambitions in this area were on display in September 2015 at China's largest-ever military parade, which commemorated the 70th anniversary of the end of World War II. Nine different classes of ballistic and cruise missiles were featured, some of which had never before been publicly unveiled.* The parade highlighted the pace and sophistication of China's missile modernization, and signaled to the world China's seriousness about enhancing both its nuclear and conventional missile capabilities and its ability to hold adversary forces at greater risk.

This section examines China's modernizing missile forces, including several new methods and platforms for missile deployment. Although it includes a brief discussion of Chinese developments in long-range surface-to-air missiles and other defensive measures against adversary missiles, the focus is primarily on China's offensive missile developments. The section discusses the drivers of China's missile modernization; the capabilities and doctrines of its conventional and nuclear missile forces; selected emerging missile technologies; and the challenge of C4ISR† and targeting. Finally, it considers the implications of China's missile force modernization for the United States. This section draws on the Commission's April 2015 hearing on China's offensive missiles; consultations with experts on the Chinese military and international security affairs; and open source research and analysis.

China's Drive to Modernize the Second Artillery

Missile Warfare and the Second Artillery

The PLA's Second Artillery has been responsible for China's missile forces since its establishment in the 1960s—first as a solely nuclear force and since the 1990s as an increasingly lethal conventional missile force as well. Missile warfare is a key component of PLA "joint firepower operations," which combine strike aviation, theater missiles, and long-range artillery. The chief objective of these operations is to asymmetrically hold enemy assets at risk at

*Missiles on display at the parade included the DF–10, DF–15B, DF–16, DF–21D, DF–26, DF–5B, DF–31A, YJ–12, and YJ–83. Andrew Erickson, "Missile March: China Parade Projects Patriotism at Home, Aims for Awe Abroad," *China Real Time Report* (*Wall Street Journal* blog), September 3, 2015.

†C4ISR stands for "command, control, communications, computers, intelligence, surveillance, and reconnaissance."

long range by weakening an adversary at key nodes—such as command and control and logistics hubs—to lay the groundwork for air, sea, and information superiority in wartime. In particular, China's theater missiles—those missiles with ranges meant to support Pacific theater operations—create a more favorable environment for subsequent PLA Air Force and PLA Navy operations. According to PLA campaign theory, seizing the advantage in the air, maritime, and information domains are prerequisites for achieving operational objectives and terminating a military conflict on China's terms.[1]

China's growing conventionally-armed missile inventory is taking center stage in its strategic and warfighting calculus. The Second Artillery provides China with a decisive operational advantage over regional militaries competing with China to defend maritime claims in China's "near seas,"* as China gains a superior ability to hold its adversaries' assets at risk.[2] China's long-range precision strike capabilities also improve its ability to engage the U.S. military at longer distances from China's coastline, eroding the United States' ability to access the Western Pacific freely in the event of a conflict.[3]

China has come to view a flexible, survivable, and lethal offensive missile force as a force multiplier in achieving its strategic objectives. The Second Artillery's conventional missiles provide an increasingly robust deterrent against other military powers, and its nuclear-armed missiles serve as a guarantor of state survival. Moreover, as Mark Stokes, executive director of the Project 2049 Institute, testified to the Commission, "China's long-range precision strike capabilities ... support the [Chinese Communist Party's (CCP)] quest for legitimacy. The PLA functions as the armed wing of the CCP, and the Second Artillery is the party's instrument for achieving strategic effects through direct targeting of enemy centers of gravity."[4]

As the Second Artillery's missions have expanded, so has its bureaucratic status within the PLA. The 2004 promotion of the Second Artillery commander, along with the commanders of the PLA Air Force and PLA Navy, to membership on the Central Military Commission, China's top military decision-making body, reflects efforts to make PLA operations more "joint" and less ground-force-dominated. As a result the Second Artillery, like the PLA Air Force and PLA Navy, has taken on an elevated bureaucratic stature in the decade since its promotion to the Central Military Commission,[5] and today it plays a key role in PLA planning and operations.[6] In addition to providing a variety of "fire support" missions for the PLA services, Second Artillery Doctrine also envisions the possibility of implementing an "independent conventional missile strike campaign" without significant coordination with the PLA services.[7] According to Andrew Erickson, associate professor at the U.S. Naval War College, China's upcoming military restructuring—outlined in 2013 and initiated by the 300,000-personnel troop cut announced at the September 2015 military parade—will likely not result in any demotion to the Second Artillery's status.[8]

*China's "near seas" are the Bohai, Yellow Sea, East China Sea, and South China Sea regions.

Context and Drivers of China's Missile Force Development

In the 1990s, China's military modernization efforts prioritized capabilities that could deter, delay, and deny the likely intervention of the United States military in a Taiwan contingency. This sole strategic emphasis has since diversified. In 2004, Beijing issued a directive to the PLA to prepare for nontraditional missions beyond China's immediate periphery, including humanitarian assistance/disaster relief, counterterrorism, and international peacekeeping operations. Such missions reflect China's strategic interest in protecting its economic development and increasing its global footprint. As the PLA's operational fluency has improved, its naval, air, and ground forces—all of which are increasingly armed with long-range missiles or integrated with the Second Artillery's missile operations—have begun to prepare for and familiarize themselves with operations beyond the Chinese mainland and near seas, demonstrating an improving ability to project power throughout the Asia Pacific region and beyond.[9]

According to Mr. Stokes, the Second Artillery's growth, modernization, and departure from its origins as a solely nuclear force have proceeded and will continue to proceed in phases. Preparation for a Taiwan contingency through the development and deployment of short-range ballistic missiles (SRBMs) with a 600 kilometer (372 mile) range along the Taiwan Strait from the late-1980s to the mid-1990s constituted the first phase. A second phase has been the expansion of SRBM ranges to 1,500–2,000 kilometers (932–1,242 miles) to develop a basic capability to strike longer-range targets on land and moving targets at sea. The next phase, which Mr. Stokes anticipates China could reach by the end of 2015, is an extension of its conventional precision strike capability to a range of 3,000 kilometers (1,864 miles) and beyond.* Finally, China could pursue an even greater extension of the Second Artillery's conventional precision strike capability to 8,000 kilometers (4,971 miles) and eventually a global conventional precision strike capability, which Mr. Stokes estimates could take place by 2020 and 2030, respectively.[10]

In the post-Cold War nuclear realm, China's chief strategic concern has been the United States, particularly the U.S. nuclear arsenal and modernization of missile defenses. (For more information on Chinese concerns about U.S. missile defenses, see "Increasing the Penetrability of Adversary Missile Defenses," later in this section.) Of note, China is surrounded by a number of nuclear-capable states, many of which experience varying degrees of instability or enmity with each other. In South Asia, India and Pakistan are relatively recently-declared nuclear states with mutual deep-seated tensions. In Northeast Asia, prospects for North Korea's denuclearization appear increasingly unlikely,† while Japan's recent defense reforms have led China to raise concerns about Japan's nuclear weapons potential.[11] Finally, although Taiwan does not itself

*The DF–26 intermediate range ballistic missile's inclusion in China's September 2015 military parade may represent the achievement of this phase; see "Ballistic Missiles: Antiship Missiles," later in this section.

†For more information on the denuclearization issue in China-North Korea relations, see U.S.-China Economic and Security Review Commission, *2014 Annual Report to Congress*, November 2014, 455–459.

maintain nuclear weapons, China recognizes that a conflict with Taiwan could involve the intervention of the nuclear-armed United States.[12]

Nuclear Strike: Doctrine and Capabilities

China's nuclear strike capabilities have modernized only gradually in comparison to its conventional capabilities. Moreover, China's nuclear doctrine remains largely unchanged since its establishment as a nuclear state in the 1960s. Although modern China's early leaders, especially Mao Zedong, appreciated the political utility of nuclear weapons as a deterrent, they did not view nuclear capability as a significant warfighting tool. This philosophy appears to have guided the development of China's nuclear doctrine as well as the size of China's nuclear arsenal, which is estimated to be of moderate size in comparison to other major declared nuclear states such as the United States and Russia.[13] Nevertheless, China is improving its nuclear-armed missile capabilities and moderately increasing the size of its arsenal. Beijing does not release official data about its nuclear arsenal and its pronouncements regarding its doctrine are limited and vague. Opacity in this area helps China maintain and strengthen strategic ambiguity, and, by extension, the value of its strategic arsenal.[14]

China's Nuclear Doctrine

Nuclear Deterrence

The chief roles of China's nuclear arsenal are to deter an adversary from undertaking a nuclear first strike and to reduce the pressure on China to yield to an adversary's demands, or desist from aggression, under threat of nuclear attack.[15] China's nuclear deterrent is premised on the concept of assured retaliation, which is the idea that "a small number of survivable weapons would be enough to accomplish deterrence by threatening retaliation and, thus, unacceptable damage on an adversary," according to M. Taylor Fravel, Associate Professor in the Department of Political Science at the Massachusetts Institute of Technology, and Evan S. Medeiros, then Director for China, Taiwan, and Mongolian Affairs at the U.S. National Security Council.* [16]

As the PLA has increasingly incorporated the Second Artillery into joint campaign planning, the Second Artillery's nuclear missile force is likely to be considered a backstop to support conventional missions. In a conventional conflict, the PLA could fight with the confidence that its nuclear weapons—and therefore the threat of nuclear retaliation—could prevent the conflict from escalating too far. In this sense, China believes the Second Artillery's nuclear arsenal could constrain an adversary's options in a conventional conflict, providing China with greater flexibility to conduct conven-

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*Because China's declarations on its nuclear policy are vague and kept to a minimum, this assessment of China's nuclear strategy does not necessarily represent China's official views. Furthermore, some scholars, such as Wu Riqiang, associate professor at the School of International Studies at Renmin University, disagree that assured retaliation is what drives China's nuclear deterrent. Wu Riqiang, "Remarks" (Chinese Thinking on Nuclear Weapons, Carnegie Endowment for International Peace, Washington, DC, May 11, 2015); and Wu Riqiang, "Certainty of Uncertainty: Nuclear Strategy with Chinese Characteristics," *Journal of Strategic Studies* 36:4 (2013), 579–614.

tional military operations.[17] However, this belief could encourage China to be more risk-acceptant during a crisis because it may not fear the prospect of escalating a conventional fight into the nuclear realm as much as it otherwise would.[18]

Dr. Christopher Yeaw, founder and director of the Center for Assurance, Deterrence, Escalation, and Nonproliferation Science & Education, testified to the Commission that this doctrine has been shifting.[19] In an interview with Commission staff, he further explained:

> *I don't believe China fears nuclear coercion from the United States as it did in the Cold War years, nor does it primarily fear a highly unlikely U.S. nuclear first strike—what China fears most is losing to the United States in a "politically necessary" conventional conflict. I believe this leads [China] to desire a way to deescalate the United States out of a high-intensity regional conflict, particularly one in which the United States is imposing severe costs from a purely conventional perspective and China's victory appears elusive or in grave doubt.*[20]

Potential Reconsideration of No-First-Use

China has long pledged a policy of "no-first-use" for its nuclear weapons. As stated in Beijing's most recent defense white paper: "China has always pursued the policy of no first use of nuclear weapons and adhered to a self-defensive nuclear strategy that is defensive in nature. China will unconditionally not use or threaten to use nuclear weapons against non-nuclear-weapon states or in nuclear-weapon-free zones, and will never enter into a nuclear arms race with any other country."[21] China's no-first-use pledge appears designed to convey China's preference for using nuclear weapons for deterrence rather than warfighting purposes, as well as its stated view that nuclear warfighting is strictly firewalled from conventional warfighting.[22]

It is unclear, however, under what circumstances China would use nuclear weapons and what China would consider "first use." As a result, the outer bounds of the pledge have been under debate for some time among outside observers.[23] For example, although China's 2013 defense white paper indicates China will use nuclear weapons to respond to a nuclear *attack* but not a nuclear *threat*, it does not articulate at what point China will consider a nuclear threat to have ended and a nuclear attack to have begun.*[24] The 2013 *Science of Military Strategy*, an authoritative PLA doctrinal source, indicates China will not wait to absorb a nuclear strike before launching a retaliatory nuclear strike of its own: "We can, under conditions confirming the enemy has launched nuclear missiles against us, before the enemy nuclear warheads have reached their targets and effectively exploded, before they have caused us

*China's 2013 defense white paper differentiates between responses to a nuclear threat and a nuclear attack. A nuclear threat will prompt China's nuclear missile force to "go into a higher level of readiness, and get ready for a nuclear counterattack to deter the enemy from using nuclear weapons against China." In response to a nuclear attack, however, "the nuclear missile force of the [Second Artillery] will use nuclear missiles to launch a resolute counterattack either independently or together with the nuclear forces of other services." China's Information Office of the State Council, *The Diversified Employment of China's Armed Forces*, April 2013.

actual nuclear damage, quickly launch a nuclear missile retaliatory strike." [25]

No-first-use has generated debate within China as well.[26] In a 2013 opinion piece, PLA Major General Yao Yunzhu of the Academy of Military Science, the PLA's preeminent research institute, acknowledged speculation in Chinese media about a possible change to no-first-use, attributing it to two concerns:

- Ballistic missile defense systems developed by the United States and its allies "would be capable of intercepting retaliatory Chinese nuclear weapons launched after [China] has already been attacked, thus potentially negating the effectiveness of China's nuclear arsenal as a deterrent." [27]
- The United States' increasingly advanced conventional capabilities could strike China's nuclear arsenal and nullify China's no-first-use policy.[28] Both Western and Chinese scholars have suggested the threshold for China's nuclear retaliation may not be limited to a nuclear first strike, but could also include a conventional threat to its own nuclear arsenal.[29]

The U.S. Department of Defense (DOD) has also identified additional areas of ambiguity in China's no-first-use policy, including whether demonstration strikes, high-altitude bursts,* or strikes on what China considers its territory would constitute a first use.[30]

Chinese and Western experts seem to agree China officially will adhere to a no-first use policy, while allowing healthy debate about the circumstances of its applicability in unofficial channels.[31] The policy considerations shaping Beijing's decision–making regarding when to use nuclear weapons are likely to remain unknown to the public.[32]

Potential Changes to Nuclear State of Alert

Due to China's opacity about its nuclear program, the typical state of its nuclear forces is unclear to outsiders. Most analysts assume China keeps its nuclear warheads stored separately from its missiles rather than continuously deploying a number of warheads on missiles as done by France, Russia, the United Kingdom, and the United States.† This "de-alerting"‡ policy would be in line with Beijing's preference for highly centralized command and control over its nuclear weapons but would leave room for vulnerability to a first strike: whereas it takes additional time to ready de-alerted

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*DOD is likely referring to a high-altitude nuclear explosion that creates an electromagnetic pulse, which is an intense energy field that can overload or disrupt electrical systems such as those used in critical civilian infrastructure. Non-nuclear means can also generate an electromagnetic pulse effect. U.S. Department of Defense, *Department of Defense Dictionary of Military and Associated Terms*, November 8, 2010 (as amended through June 15, 2015), 103; and Clay Wilson, "High Altitude Electromagnetic Pulse (HEMP) and High Power Microwave (HPM) Devices: Threat Assessments," July 21, 2008, *Congressional Research Service*, Summary.

†This assumption about China's nuclear policy is not unanimously held. Dr. Yeaw, for example, challenges the notion that China keeps the entirety of its forces de-alerted at all times, given the immense lengths it has gone to in order to acquire a more survivable force. Christopher Yeaw (Director, Center for Assurance, Deterrence, Escalation, Nonproliferation Science & Education), interview with Commission staff, June 15, 2015.

‡"De-alerting" generally refers to the adoption of measures that extend the amount of time required to launch a nuclear weapon once the order to launch is given. Storing warheads separately from delivery systems, as China does, is one of a range of possible de-alerting measures. Andrew Brown and Jeffrey Lewis, "Reframing the Nuclear De-alerting Debate: Toward Maximizing Presidential Decision Time," *Nuclear Threat Initiative*, December 11, 2013.

nuclear weapons and launch them, nuclear weapons on "high alert"* could be launched within minutes of a launch order.[33]

Experts have debated the effect of de-alerting policies such as China's on strategic stability. Advocates of de-alerting express concerns about the risk of escalation, arguing that maintaining high-alert status removes the option of preparation and deliberation prior to firing a nuclear weapon. In their view, keeping nuclear weapons de-alerted also minimizes the risk of their accidental use, unauthorized use, and use due to miscalculation.[34] Advocates of high-alert status, however, reject the notion that a constant high state of nuclear readiness is destabilizing. Rather, they argue, it creates certainty for adversaries about the kind of response they should expect from a state maintaining nuclear weapons on high alert. Another argument in favor of high-alert status is that it provides the executive decision maker time to consider various responses during a crisis, knowing that nuclear weapons would be ready for launch within minutes of the decision to fire them.[35]

In testimony to the Commission, James Acton, senior associate and co-director of the Nuclear Policy Program at the Carnegie Endowment for International Peace, suggested China's presumptive de-alerting policy could change. As noted in the previous excerpt from the 2013 *Science of Military Strategy*, evidence in doctrinal writings indicates the PLA has considered the idea of a nuclear launch in response to an incoming nuclear attack prior to the missiles actually reaching their targets, or "launch on warning." This suggests Chinese nuclear forces would at least be alerted in the event of a crisis. China's stated interest in enhancing its strategic early-warning capabilities also suggests an interest in launch on warning: such capabilities, intended to provide China with the time to react to an incoming threat, would be "of little value" to a de-alerted force during a crisis, according to Dr. Acton.[36] Finally, the policy would change if China decides to mate nuclear warheads to its submarine-launched ballistic missiles (SLBMs)—a "potentially huge shakeup for the Chinese forces for command and control."[37] For more information on China's SLBMs, see "Submarine-Launched Ballistic Missiles," later in this section.

Nuclear Escalation Philosophy

Another factor that sheds light on how and when China might employ nuclear weapons is its nuclear escalation philosophy—how a state might use nuclear weapons to escalate or deescalate a conflict. Dr. Yeaw testified to the Commission that China views the use of nuclear weapons not "in a warfighting fashion intended to defeat the adversary on the battlefield," but "in the high-intensity political management of an escalating and perhaps unsustainable conflict."[38] According to this escalation philosophy, China would punctuate non-nuclear operations with tactical- or theater-level nu-

*"High alert"—often termed "hair-trigger alert" by critics—generally describes the status of nuclear weapons ready for launch within minutes, or the shortest possible length of time, of a launch order. Currently the United States and Russia maintain nuclear forces on high alert while France and the United Kingdom maintain nuclear forces on "alert" but at a lower level; the nuclear forces of China, India, North Korea, and Pakistan are believed to be de-alerted. Andrew Brown and Jeffrey Lewis, "Reframing the Nuclear De-alerting Debate: Toward Maximizing Presidential Decision Time," *Nuclear Threat Initiative*, December 11, 2013; and Hans M. Kristensen and Matthew McKinzie, "Reducing Alert Rates of Nuclear Weapons," *United Nations Institute for Disarmament Research*, 2012, 1–8.

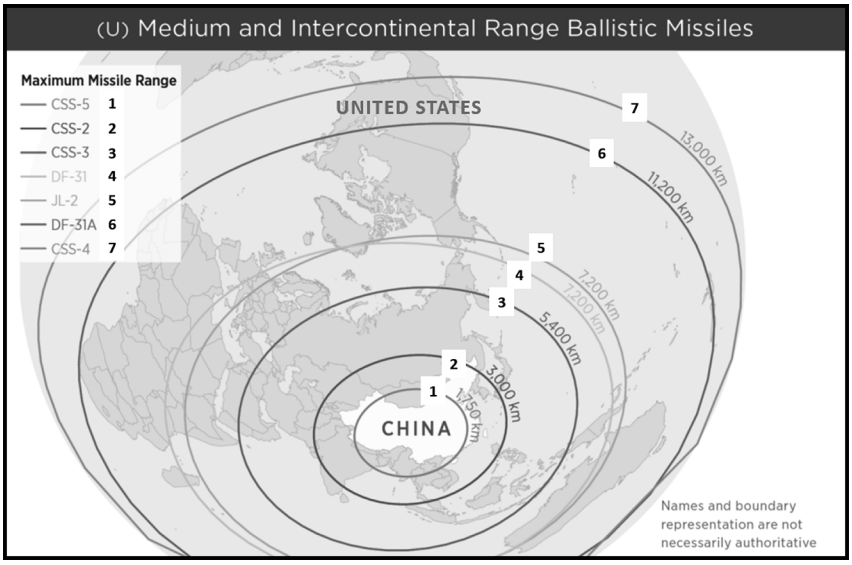
clear strikes to seek deescalation on terms favorable to China. Unlike strategic nuclear weapons, which target an adversary's homeland and population centers, tactical and theater nuclear weapons (also known as nonstrategic nuclear weapons) are designed for missions at shorter ranges, and usually carry lower-yield warheads. Because their use does not invite overwhelming nuclear retaliation in the same way as would strategic nuclear strikes on a country's homeland, tactical and theater nuclear weapons are considered to be a stronger deterrent and a more credible threat.[39]

Elbridge Colby, senior fellow at the Center for a New American Security, elaborated on the impact of China's burgeoning theater nuclear force on the nuclear escalation dynamic between China and the United States in testimony to the Commission:

> *[China's] ability to use nuclear weapons in more limited and tailored ways will make China's threats—explicit or implicit—to use nuclear forces more credible. . . . This does not mean that China will reach for the nuclear saber early or often. But a more sophisticated force will give China better options for how it might seek to use these weapons not only, as in the past, as a desperate last resort, but also to deter U.S. escalation of a conflict—escalation the United States might need to resort to if it is to prevail.*[40]

A key implication of China's approach for the United States, according to Dr. Yeaw, is that China "may escalate across the nuclear threshold at a time and manner, and for a purpose, that we do not expect."[41]

Figure 1: China's Medium and Intercontinental Range Ballistic Missiles



Note: DOD uses a mix of both Chinese and North Atlantic Treaty Organization (NATO) designators in the above graphic. See Table 2, "Ranges of China's Nuclear Ballistic Missiles (Selected)" for a list of Chinese and NATO designators of ballistic missiles.

Source: Figure adapted from U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 88.

China's Nuclear Strike Capabilities

China describes its nuclear force structure and composition as "lean and effective," though this guiding principle, like no-first-use, is subject to variables that enhance China's strategic ambiguity. China does not release official data on its nuclear forces, but unofficial sources estimate China has approximately 250 nuclear warheads.* [42] As a result of Beijing's pursuit of a more modern nuclear force, China's nuclear weapons are undergoing moderate quantitative increases.[43] These increases are such that the chief limitation on China's nuclear force development in the near future could be China's stockpile of fissile material (material capable of releasing nuclear energy) rather than its number of delivery vehicles.† [44]

As it seeks to maintain an "effective" nuclear force guided by a no-first-use doctrine, China is pursuing a credible second-strike capability with an emphasis on survivability against an adversary's first strike. By diversifying its nuclear strike capabilities away from liquid-fueled silo-based systems, China seeks to ensure its ability to absorb a nuclear strike and retaliate in kind.[45]

Finally, China appears to be enhancing its theater nuclear force. Such a development would facilitate the theater-range strikes envisioned in a regional de-escalatory nuclear doctrine, as described earlier.‡ [46]

Road-Mobile Ballistic Missiles

According to the U.S. Defense Intelligence Agency, China's nuclear arsenal consists of 50–60 intercontinental ballistic missiles (ICBMs).[47] China's silo-based, liquid-fueled DF–5 (12,000 kilometer/7,456 mile range) and longer-range DF–5A (13,000 kilometer/8,078 mile range) have formed the core of China's nuclear arsenal since the early 1980s.[48] With the deployment of the DF–31 in 2006 and DF–31A in 2007, the Second Artillery fielded a second generation of road-mobile, solid-fueled ICBMs.[49] The road mobility of these missiles would make it more difficult for an adversary to target them with a first strike. Solid-fueled missiles provide advantages over the liquid-fueled missiles of past generations because they do not require lengthy fueling time and their fewer and more stable fueling elements enjoy greater safety and stability over long periods of storage.[50] While the range of the DF–31 at 7,200 kilometers (4,474 miles) does not quite reach the continental United States, the DF–31A has an estimated range of 11,200 kilometers (6,959 miles), giving it the ability to target almost all of the continental United States from launch areas in China.[51] Beyond these

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*The Commission discussed other estimates on the size of China's nuclear arsenal—some as high as 1,800, some as low as 100—in the 2012 *Annual Report to Congress*. U.S.-China Economic and Security Review Commission, *2012 Annual Report to Congress*, November 2012, 176–177.

†This view is not universally held. For example, in 2012, Mark B. Schneider, senior analyst at the National Institute for Public Policy, testified to the Commission, "I do not think the availability of fissile material will be a significant constraint on China. . . . With the massive Chinese nuclear energy program now underway, China should be able to produce as many nuclear weapons as needed." U.S.-China Economic and Security Review Commission, *Hearing on Developments in China's Cyber and Nuclear Capabilities*, written testimony of Mark B. Schneider, March 26, 2012.

‡The United States maintained a theater nuclear strike capability in the 1980s with its ground-launched cruise missiles, but withdrew these missiles under the terms of the Intermediate Range Nuclear Forces Treaty. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015.

established systems, a new generation of ICBMs is undergoing development in China, with a possible incorporation of survivability- or penetrability-enhancing attributes such as: multiple reentry vehicles (whether independently-targetable or not), reentry maneuverability, greater accuracy, greater range, and overland mobility by rail (as opposed to by road).[52] These developments are discussed in "Increasing the Penetrability of Adversary Missile Defenses," later in this section.

China also deploys nuclear-armed intermediate-range ballistic missiles (IRBMs) and medium-range ballistic missiles (MRBMs) for regional nuclear deterrence. These include the limited-mobility, liquid-fueled DF–3A IRBM, which is likely in the process of being phased out by the Second Artillery, as well as the road-mobile, solid-fueled DF–21 and DF–21A MRBMs.*[53] Official commentary during China's September 2015 military parade indicated that the newer DF–26 IRBM, also road-mobile and solid-fueled, is nuclear-capable.[54]

Submarine-Launched Ballistic Missiles

China is expected to deploy its first nuclear deterrence submarine patrols of the JIN-class (Type 094) nuclear-powered ballistic missile submarine (SSBN) by the end of 2015, marking its first credible at-sea second-strike nuclear capability.†[55] The JIN SSBN carries the nuclear JL–2 SLBM, which has a range of at least 7,400 kilometers (4,598 miles), or far enough to strike the continental United States depending on the location of the launch.[56] DOD has estimated the PLA Navy currently has three to four operational JIN SSBNs, and up to five additional JIN SSBNs will enter service by 2020.[57] In contrast with the opacity of its other nuclear capabilities, China openly touts the development of the JIN/JL–2. PLA Navy Commander Admiral Wu Shengli wrote in a CCP magazine, "This is a trump card that makes our motherland proud and our adversaries terrified. It is a strategic force symbolizing our great-power status and supporting national security."[58]

Some analysts have suggested China cannot rely upon the JIN SSBN as a survivable second-strike capability, given its noisy acoustic signature that lends itself to detection.[59] China may seek to improve on these deficiencies in its successor to the JIN SSBN and JL–2 SLBM, the Type 096 SSBN and JL–2 follow-on SLBM (official sources have confirmed the development of the submarine, but not the missile).[60]

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*For a description of ballistic missile ranges, as defined by the U.S. Department of Defense, see Table 1.

†The Commission's *2014 Annual Report to Congress* predicted China would deploy its first nuclear deterrence submarine patrols in 2014, citing DOD and intelligence community assessments. DOD has since revised this timeline to "sometime in 2015," which informs the Commission's current assessment. An unconfirmed report from independent Hong Kong-based news outlet *Ming Pao* asserted in September 2015 that the first of these patrols had taken place. At the time of the writing of this report, there had been no official confirmation that the patrol had taken place. Ming Pao, "First Armed Patrols of New Nuclear Submarine," September 30, 2015. Staff translation; and U.S. Department of Defense, *Annual Report to Congress: Military Power of the People's Republic of China 2015*, April 2015, 9.

Air-Launched Land-Attack Cruise Missiles

Although not explicitly confirmed in official sources, China may be developing a nuclear-capable air-launched cruise missile, the CJ–20, for use with a modernized version of China's longtime primary bomber, the H–6. This variant, the H–6K, has the ability to carry six land-attack cruise missiles (LACMs) and is equipped with powerful turbofan engines, giving it extended range—potentially out to the second island chain, including Guam.*[61] The CJ–20 is an air-launched version of the currently fielded CJ–10 (also known as the DH–10), a theater-range LACM that appears both conventional- and nuclear-capable.[62] A nuclear-capable CJ–20 would indicate China is developing new, air-delivered theater nuclear strike capabilities, in addition to its formidable ballistic missile theater nuclear forces and the strategic nuclear strike capability it has maintained since it became a nuclear state.

Conventional Strike: Doctrine and Capabilities

Conventional Missile Doctrine and Employment Concepts

The Second Artillery has since the mid-1990s added conventional strike capabilities to an arsenal that previously had comprised only nuclear ballistic missiles. The PLA has achieved "extraordinarily rapid" growth in its conventional missile capability, according to DOD. One decade ago, the Second Artillery only possessed the ability to target Taiwan, as well as a basic ability to strike targets within the first island chain. Today, China is fielding and developing a wide range of conventional ballistic and cruise missiles to hold targets at risk throughout the region—even as far as the second island chain.[63] No longer solely a nuclear force intended to be employed in the most dire of circumstances, the Second Artillery has taken on a mission of "dual deterrence, dual operations," in which it is responsible for nuclear deterrence and nuclear counterstrikes, as well as conventional deterrence and conventional precision strikes.[64]

Conventional Deterrence

According to Second Artillery doctrine, nuclear weapons serve as the ultimate deterrent; however, conventional missiles, as less destructive weapons, have fewer restraints on their use from an international public opinion perspective and are therefore more flexible instruments of deterrence and strike. The Second Artillery's concept of deterrence includes elements of what Western political scientists understand as "compellence," or the threat or use of force to persuade an adversary to comply with demands.[65] "Campaign deterrence" is defined in the chief Second Artillery doctrinal publication as employing military activities in which units display

*The first island chain refers to a line of islands running through the Kurile Islands, Japan and the Ryukyu Islands, Taiwan, the Philippines, Borneo, and Natuna Besar. The second island chain is farther east, running through the Kurile Islands, Japan, the Bonin Islands, the Mariana Islands, and the Caroline Islands. PLA strategists and academics have long asserted the United States relies primarily on the first island chain and the second island chain to strategically "encircle" or "contain" China and prevent the PLA Navy from operating freely in the Western Pacific. Open Source Center, "PRC Article Surveys China's Naval Rivals, Challenges," January 6, 2012. ID: CPP20120109671003; Bernard D. Cole, *The Great Wall at Sea* (Second Edition), Naval Institute Press, 2010, 174–176.

the ability to demonstrate overwhelming force to accomplish strategic objectives and "force an enemy to accept our will or contain an enemy's hostile actions."[66] Examples of these military activities include using conventional missiles as a show of force to intimidate the adversary or executing "surgical strikes" against important assets to coerce the adversary to yield to Chinese demands.[67] In other words, whereas the United States uses "deterrence" to mean deterring aggression, China's use of "deterrence" includes the concept of deterring resistance to demands.

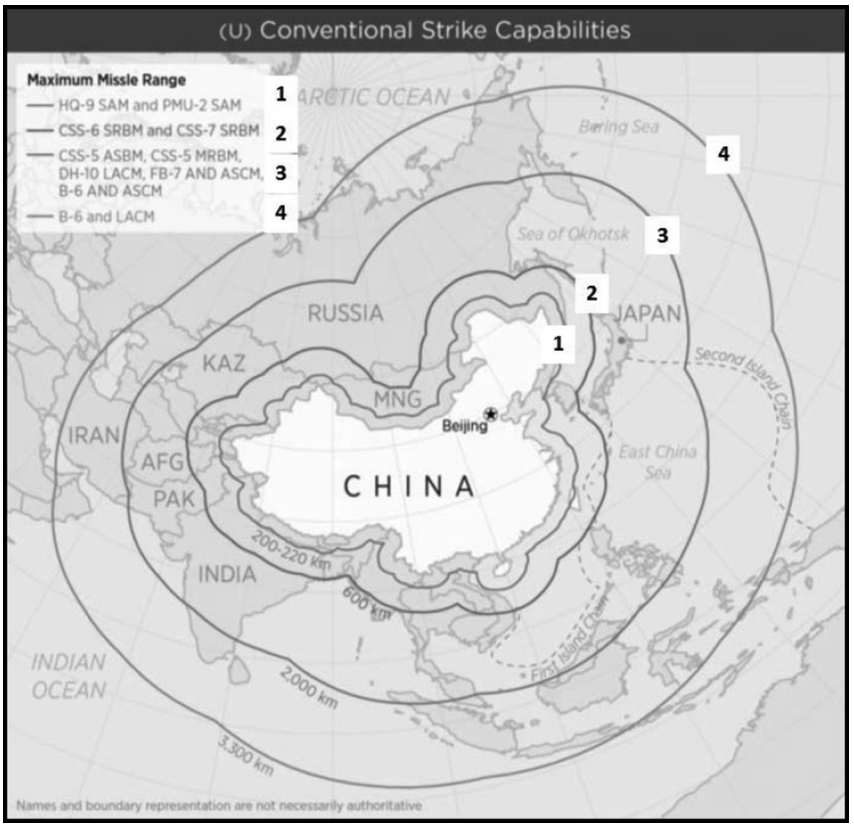
Conventional Strike

Mr. Medeiros, then senior political scientist at the RAND Corporation, writes of PLA conventional missile operations:

> *The PLA emphasizes using conventional missiles to strike first, strike hard, strike precisely, and strike rapidly. The aim of this approach is to "seize the initiative" and quickly gain "campaign control" in order to speed up the process of warfare leading to the adversary's quick capitulation.*[68]

If deterrence fails, the Second Artillery would likely weaken key enemy targets with network attack and electronic warfare before launching conventional missile strikes.[69] Potential targets for conventional missile strikes, which are outlined in authoritative publications, support this theme. These include C4ISR hubs, missile positions, military transportation and logistical hubs such as ports and airfields, key military facilities, critical infrastructure, and carrier strike groups. These targets are both critical and vulnerable, and would, if destroyed, severely impede the ability of adversary forces to function and communicate smoothly.[70] In a Taiwan scenario, for example, Chinese missile strikes on such targets could suppress Taiwan air defenses as a precursor to PLA Air Force operations over the Taiwan Strait.[71]

Figure 2: Select Conventional Strike Capabilities



Note: DOD uses a mix of both Chinese/Russian and NATO designators in the above graphic. CSS–6 and CSS–7 are the NATO designators for the DF–15 and DF–11, respectively. CSS–5 refers to the DF–21 ballistic missile. FB–7 is the NATO designator for the PLA's JH–7 fighter bomber, and B–6 is the designator for the PLA's H–6 bomber. See Table 3, "Ranges of China's Conventional Ballistic Missiles (Selected)," for a list of Chinese and NATO designators of ballistic missiles.

Source: U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 87.

Conventional Missile Capabilities

China's initial development of its conventional missile forces focused heavily on the development of its SRBM force for Taiwan contingencies. In the past decade, China's development of longer-range missiles, pursuit of advanced missile technologies, and diversification of launch platforms have enabled it to hold at risk a wider range of targets farther from its shores. The improved stealth and warhead accuracy of China's expanded range of systems and launch platforms would serve to strengthen the element of surprise if these were used in a potential conflict.

Ballistic Missiles

The PLA's significant investment in modernizing and diversifying its conventional ballistic missile forces beyond short-range

Taiwan missions has continued to bear fruit. The defining features of most ballistic missiles are an initial propulsion phase followed by a ballistic trajectory through the atmosphere, reaching an apogee in space before traveling back into the atmosphere toward a target on Earth's surface.* DOD categorizes ballistic missiles by range as follows:

Table 1: Ballistic Missile Ranges Defined by U.S. Department of Defense

Ballistic Missile Type	Missile Range
Short-Range Ballistic Missile (SRBM)	<1,000 kilometers (621 miles)
Medium-Range Ballistic Missile (MRBM)	1,000–3,000 kilometers (621–1,864 miles)
Intermediate-Range Ballistic Missile (IRBM)	3,000–5,500 kilometers (1,864–3,418 miles)
Intercontinental Ballistic Missile (ICBM)	>5,500 kilometers (3,418 miles)

Source: U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 46; U.S. National Air and Missile Intelligence Center, *Ballistic and Cruise Missile Threat*, 2013, 9.

The following discussion explains China's SRBM, MRBM, and IRBM capabilities in further detail. It also describes China's well-known antiship ballistic missile (ASBM) capability (given their ranges, China's ASBMs are best categorized as MRBMs or IRBMs under the DOD's definitions). China's ICBM force, along with certain MRBM and IRBM systems, are nuclear-armed; for more information on these weapons, see the discussion earlier in this section on China's nuclear strike capabilities.

Short Range Ballistic Missiles. China's SRBM force consists mostly of multiple variants of the DF–11 and DF–15 missiles. One source details the remarkable growth of this force from 30 to 50 missiles in the mid-1990s to approximately 900 missiles in 2006. To achieve this, the inventory grew at a rate of 50 to 100 missiles per year.[72] In 2015, China maintains "at least 1,200" SRBMs, according to DOD.† [73]

The numerical growth rate of China's SRBM force has slowed in recent years as China focuses on qualitative improvements, replacing earlier generation missiles with newer variants that have improved ranges, accuracies, and payloads.[74] The primary value of these missiles for the PLA would be their utility in a Taiwan contingency; indeed, a majority of China's SRBMs are deployed along the Taiwan Strait.[75] However, the PLA could use the extended-range variants of the DF–15 beyond the Taiwan Strait. If deployed along China's eastern coastline, for example, these missiles could target U.S. and Japanese military facilities on Okinawa.[76] Similarly, DOD assesses that the DF–16, China's most recently fielded

*Short-range ballistic missiles generally stay within the Earth's atmosphere throughout the course of their flight.

†For further discussion on varying estimates of China's current SRBM deployments, see Chapter 3, Section 3, "Taiwan."

SRBM, threatens not only Taiwan, but also other regional targets.* [77]

Medium and Intermediate Range Ballistic Missiles. In ten years, China has gone from possessing only a limited ability to reach targets east of Taiwan to developing the ability to conduct precision strikes against land and naval targets within the first island chain. This is enabled by China's growing MRBM inventory and its progress toward developing an IRBM capability.[78]

China fielded its first conventional MRBM, the DF–21C, in 2008. Its maximum range of at least 1,750 kilometers (1,087 miles) allows China to strike a wide range of targets throughout the Western Pacific theater. According to Toshi Yoshihara, chair of Asia-Pacific Studies at the U.S. Naval War College, China's currently modest inventory of DF–21Cs would limit the flexibility of its MRBM employment in a conflict: "If the MRBM inventory remains relatively unchanged, then it can be inferred that the PLA intends to concentrate the missiles against a few bases at the outset of a campaign. If, however, the Second Artillery fields a sizable DF–21C missile force in the coming years, then the PLA may be preparing for a larger-scale undertaking involving more bases across Japan." † [79]

In addition, China's DF–16, known to be an SRBM, appears to have a medium-range variant as well. In testimony to the U.S. Senate Armed Services Committee in 2015, Lieutenant General Vincent Stewart, director of the U.S. Defense Intelligence Agency, stated, "medium-range ballistic missiles, including the DF–16 . . . will improve China's ability to strike regional targets." [80]

The PLA is also developing a new conventional, road-mobile IRBM with a range of up to 4,000 kilometers (2,485 miles) from the Chinese coast. This range covers targets in the second island chain, such as U.S. bases on Guam, and could even include Northern Australia and Alaska.[81] Although not confirmed by official U.S. government sources, some analysts attribute this program to a Chinese designator, DF–26, which is also capable of carrying nuclear warheads.[82] Official commentary during China's September 2015 military parade indicated that the DF–26, clearly road-mobile, has both nuclear and conventional capabilities, fitting these descriptions.[83]

China's advancements in theater-range conventional strike capabilities indicate the PLA's interest in an ability to secure military objectives beyond Taiwan. One of China's earliest efforts at developing a conventional strike capability was its fielding of the DF–25 MRBM in the 1980s. This missile had a reported mission of defending China's Spratly Island outposts in the South China Sea.[84] Unofficial sources have suggested this missile continues to be in

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* China also continues to manufacture new SRBMs with even shorter ranges than those of the DF–11 and DF–15, including the (NATO-designated) CSS–9, CSS–14, CSS–X–16, and CSS–X–15. As discussed in the Commission's *2014 Annual Report to Congress*, these missiles are likely built to appeal to export markets, rather than for use by the PLA. U.S.-China Economic and Security Review Commission, *2014 Annual Report to Congress*, November 2014, 315–316; Richard Fisher (Senior Fellow, International Assessment and Strategy Center), interview with Commission staff, June 20, 2014; and U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, 2013, 13.

† Current numbers of missiles and launchers are not publicly available in official sources. However, naval analyst Jon Solomon in 2014 estimated China had a maximum of 40 DF–21C missiles. Jon Solomon, "The Chinese DF–21 Arsenal: Part 2," *Information Dissemination Blog*, November 11, 2014.

service and can also be armed with a nuclear warhead.[85] As China continues to seek to consolidate and secure its maritime claims in the East and South China seas, theater-range strike capabilities such as this missile would suggest an important Second Artillery role in a near seas maritime contingency beyond the Taiwan Strait.[86]

Antiship Ballistic Missiles. China fielded the world's first ASBM in 2010, a variant of the DF–21 family of MRBMs known as the DF–21D. Its range of at least 1,500 kilometers (932 miles) and maneuverable warhead give it the ability to strike moving adversary ships east of Taiwan from secure sites on the Chinese mainland. According to Mr. Erickson, China's DF–21D capability means that "in a crisis or combat situation, U.S. operators would have to draw a range ring for the DF–21D and then decide whether or not to risk sending [carrier strike groups] into that range ring."[87] Furthermore, because of the complex over-the-horizon targeting and maritime C4ISR required to successfully execute an ASBM strike, Professor Erickson argues the DF–21D is one element of a broader program to track and target ships at sea (see "China's C4ISR and Targeting Challenge," later in this section).[88]

In written testimony to the Commission, Dennis Gormley, senior lecturer at the University of Pittsburgh, raised additional technical questions regarding China's deployment of the DF–21D such as "whether or not China has truly mastered the terminal guidance and maneuvering capability needed to successfully attack a moving aircraft carrier. Particularly demanding is the development of sensors and warheads that can survive the rigors of atmosphere reentry, including high speeds and temperatures, without adversely affecting required seeker and warhead performance."[89] The ability of the Second Artillery to strike its intended target is significant because PLA doctrine appears to consider the possibility of using the DF–21D for precision strikes as well as warning shots.[90] In a tense wartime situation an error in DF–21D targeting, therefore, could mean the difference between deescalation and escalation.

Official commentary at China's September 2015 military parade stated that the DF–26 also has an antiship variant, indicating it has joined the DF–21D as an ASBM. The DF–26 represents an even longer-range option, with a credited range of 3,000–4,000 kilometers (1,800–2,500 miles).[91] According to Mr. Erickson, parading both missiles indicates that they have been "tested carefully and accepted into military service as operational hardware," but "the reconnaissance strike complex [for an antiship capability] that supports them, by contrast, remains a work in progress."[92] The additional range likely complicates the targeting challenge China already faces with the DF–21D.

Cruise Missiles

Unlike ballistic missiles, which require propulsion at launch before entering a ballistic trajectory, cruise missiles are propelled by jet engines and fly at generally level flight paths to their targets. They can be described, as in one recent report, as "pilotless airplanes" whose flights toward preplanned targets can be ad-

justed en route with data from a variety of guidance and navigation systems.[93] Because of their limited radar signature and low-altitude flight, cruise missiles are very stealthy weapons. Many cruise missiles are also designed to execute terminal evasive maneuvers to defeat missile defenses. For these reasons, cruise missiles can be very difficult to detect and defend against, particularly when part of a multi-axis attack of multiple cruise and ballistic missiles.[94]

Cruise missiles also provide the employing force with operational and planning flexibility. One aspect of their flexibility is that cruise missiles can be placed aboard a variety of ground-, sea-, and air-based platforms. Moreover, according to the testimony of Lee Fuell, then technical director for force modernization and employment at the U.S. Air Force's National Air and Space Intelligence Center, "These weapons are likely [intended] to reduce the burden on ballistic missile forces, as well as [to create] somewhat safer strike opportunities for Chinese aircrews, allowing them to engage from much longer distances and/or from advantageous locations of their own choosing."[95] These characteristics have led U.S. defense leadership to consider more closely the threat cruise missiles pose to the homeland. In May 2015, Vice Chairman of the Joint Chiefs of Staff Admiral James Winnefeld stated, "The element of surprise is nearly impossible with an ICBM attack, and we will always have time to react. We can't necessarily say the same thing for a cruise missile attack. . . . [H]omeland cruise missile defense is shifting above regional ballistic missile defense in my mind, as far as importance goes."[96]

While ballistic missiles are mostly categorized by range, cruise missiles are categorized by intended mission and launch mode. The two key types of cruise missiles are land-attack cruise missiles (LACMs) and antiship cruise missiles (ASCMs).

Land-Attack Cruise Missiles. The Second Artillery fielded the CJ–10, China's first ground-launched LACM, in 2007–2008.[97] Because of their stealth, accuracy, and route variation ability, LACMs pose challenges to adversary air and missile defense systems in ways that ballistic missiles do not. In addition to their ability to undertake radar-evading flight at low altitudes, the newest LACMs include additional radar-evading features that make them even more difficult to detect. Moreover, salvos of multiple LACMs can be preprogrammed to approach a target from multiple directions or take circuitous routes toward the target—both methods of employment that have the effect of either overwhelming, evading, or confusing radar and air defenses.[98] With a reported range of at least 1,500 kilometers (932 miles), the CJ–10 has the ability to hold U.S. forces in Japan and South Korea at risk.[99]

In conjunction with developments in China's bomber fleet, China's development of the CJ–20, the air-launched version of the CJ–10, enhances the lethality of China's air-launched cruise missile arsenal. The H–6K variant of China's bomber force, as mentioned earlier in the discussion on China's nuclear capabilities, has the ability to carry six LACMs and a range potentially extending out to the second island chain, including Guam.[100] As described above,

while not confirmed in official sources, there are some indications that the CJ–20 is nuclear-capable.*

China probably is developing a LACM for deployment aboard future PLA Navy ships and submarines, which would give the PLA Navy its first land-attack capability.[101] A sea-based LACM would diversify and potentially extend the range of China's strike options against U.S. facilities in the Indo-Pacific, particularly as the PLA Navy gains proficiency in long-range surface and subsurface patrols.[102]

Antiship Cruise Missiles. As an integral part of the rapid development and extended reach of China's PLA Navy in the past decade, China's ASCM capabilities have advanced significantly. Because there are doubts regarding whether U.S. Navy shipboard systems could reliably and adequately defend against intense salvos of China's advanced Russian-made and indigenous ASCMs, China's advancing ASCM technologies are reason for concern.[103] In a June speech, U.S. Deputy Secretary of Defense Robert Work raised the challenge of defending U.S. ships and bases against adversary missiles in a cost-effective manner:

> *We dominated the guided munitions warfare regime for the past 25 years. There's no question about it: we have. But now big state powers like China and Russia are rapidly catching up. So this is going to require a fundamental rethinking of the way the joint force operates. . . . [A] demonstrated capability to win the emerging guided munitions salvo competition . . . is job number one. This demonstrated ability to win this competition will underwrite our conventional deterrence in the 21st century. . . .*
>
> *We're on the wrong end of the cost equation in this competition right now. We have been for some time. [We have been] using multi-[million]-dollar missiles . . . to defend surface ships and fixed bases against relatively cheap ballistic and cruise missiles.*[104]

The variety of launch platforms for China's ASCMs, in addition to the range and targeting improvements China continues to make to its ASCM inventory, demonstrate China's prioritization of its antisurface warfare mission in its naval modernization efforts. Each of the PLA Navy's major surface combatants, for example, is equipped with ASCMs. As the PLA Navy has grown increasingly confident operating its surface combatants farther afield from the Mainland, it has also sought to ensure ASCM coverage closer to its shores through a rapidly growing fleet of ASCM-equipped corvettes and patrol vessels.[105] These vessels and most other PLA Navy surface combatants carry the subsonic YJ–83 family of ASCMs, a system that has been in service with the PLA Navy since the 1990s. Although missiles in the export versions of the YJ–83 have adver-

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*Other air-launched LACMs include the YJ–63, reportedly deployed in 2004–2005, with a reported range of 200 kilometers (124 miles); and the KD–88. Although the advertised range of the KD–88 is at least 100 kilometers (62 miles), China may be developing a longer-range version of this LACM. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 46; Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 35.

tised ranges of 65–100 nautical miles (74 miles–115 miles), the domestic versions of this system likely have much longer ranges.[106] A more recent addition to China's inventory of ship-launched ASCMs is the 150 nautical mile (173 mile) range YJ–62, a missile China began publicizing in the mid-2000s.[107] China also uses ASCMs for coastal defense, and has utilized a shore-based version of the YJ–62 for this mission.[108]

In addition to their potential use in surface-to-surface engagements, some ASCMs can be submarine-launched. According to the U.S. Navy's Office of Naval Intelligence, the PLA Navy has been increasingly equipping its submarines with modern ASCMs in the past decade: "Given the rapid pace of acquisition, well over half of China's nuclear and conventional attack submarines are now ASCM-equipped, and by 2020, the vast majority of China's submarine force will be armed with advanced, long-range ASCMs."[109] The YJ–18 is a domestically developed and produced ASCM with confirmed submarine- and surface-launched variants. According to DOD, the YJ–18 would extend the ASCM range of China's SONG, YUAN, and SHANG submarines to a maximum of 290 nautical miles (334 miles), which would significantly increase China's antiaccess/area denial* capabilities. Previous Chinese submarine-launched ASCM ranges were 120 nautical miles (138 miles) for the Russian SS–N–27 launched from some of China's KILO submarines, and 20 nautical miles (23 miles) for the YJ–82 launched from SONG, YUAN, and SHANG submarines.[110] The YJ–18's longer range will significantly expand the area U.S. forces must monitor for Chinese submarine activity. The YJ–18 is almost certainly capable of supersonic speeds during the terminal phase of its flight, a feature that reduces the time shipborne defenses have to react to an incoming threat (relative to subsonic missiles).[111] Furthermore, missiles capable of achieving supersonic speeds are more challenging to defeat with hard kill countermeasures. China has fitted a surface-launched variant of the YJ–18 on its LUYANG III DDGs, and likely will deploy the YJ–18 on its Type 095 nuclear attack submarine and Type 055 DDG, which are still under development.[112] In addition, China probably will deploy a ground-launched variant of the YJ–18 to replace the YJ–62 ASCM in shore-based missile units.

Finally, ASCMs are the centerpiece of China's maritime strike missions. PLA Navy Aviation fighter-bombers and bombers carry a 107 nautical mile (124 mile) range version of the YJ–83 family ASCM. PLA Navy helicopters have been observed carrying ASCMs as well, though it is unclear how widespread this practice is.[113] Air-launched ASCMs appear to be an area of development for the PLA Navy, as demonstrated by China's continued upgrades to its H–6 bomber. One improvement is an increase in the number of ASCMs it can carry from two to four; another is the modification

*According to the U.S. Department of Defense, "antiaccess" actions are intended to slow the deployment of an adversary's forces into a theater or cause them to operate at distances farther from the conflict than they would prefer. "Area denial" actions affect maneuvers within a theater, and are intended to impede an adversary's operations within areas where friendly forces cannot or will not prevent access. China, however, uses the term "counterintervention," reflecting its perception that such operations are reactive. U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2013*, 2013, i, 32, 33; U.S. Department of Defense, *Air-Sea Battle: Service Collaboration to Address Anti-Access & Area Denial Challenges*, May 2013, 2.

of some H–6 bombers to serve as tankers, increasing the range of these aircraft. Most notably, China has developed the YJ–12 long-range, supersonic ASCM capable of being launched from the H–6.[114] The YJ–12's long range (unofficial sources have estimated its range to be 215 nautical miles (248 miles)) and ability to conduct evasive approach and maneuvers toward its target pose immense challenges for shipboard defenses, limiting the time a ship has to engage the incoming missile.[115] As Robert Haddick, an expert on Asia Pacific security, stated in testimony to the Commission in 2015:

> *The YJ–12 is the most dangerous antiship missile China has produced thus far, posing an even greater risk to the U.S. Navy's surface forces in the Western Pacific than the much-discussed DF–21D antiship ballistic missile. The arrival of the YJ–12 is just one more indication of how the U.S. Navy is falling further behind in the missile competition against China, exposing flaws in operating concepts that U.S. and allied commanders have relied on for years*.[116]

Taken together, the variety of platforms the PLA Navy has equipped with ASCMs provides China with a multilayered area denial capability in its near seas and beyond. Professor Gormley, along with co-authors Mr. Erickson and Jingdong Yuan, states in a study on Chinese cruise missiles: "ASCMs are increasingly poised to challenge U.S. surface vessels, especially in situations where the quantity of missiles fired can overwhelm Aegis air defense systems through saturation and multi-axis tactics. More advanced future Chinese aircraft carriers might be used to bring ASCM- and LACM-capable aircraft within range of U.S. targets."[117] The U.S. Navy is currently exploring advanced ship defense technologies, such as electromagnetic railguns and directed energy weapons, that could mitigate U.S. surface vulnerability to long-range, supersonic missile strikes.[118]

China's Missile Research and Development

The research and development (R&D) structure behind China's missile programs, which has grown in both scale and capacity to deliver innovative outputs in recent years, merits a brief description on its own. Key players in this structure include:

- Top-level leadership in the Central Military Commission* and State Council,† which develop strategic requirements for aerospace technologies and determine whether each project will enter the crucial engineering R&D phase.[119] On an ad hoc basis, the Central Special Committee—reporting to the

*China's Central Military Commission is the country's top military decision-making body. Congressional-Executive Commission on China, *China's State Organizational Structure*.

†China's State Council, headed by Premier Li Keqiang, presides over China's ministries, commissions, and direct offices. It is responsible for executing laws, supervising the government bureaucracy, and carrying out the administrative functions of the Chinese government. Congressional-Executive Commission on China, *China's State Organizational Structure*.

China's Missile Research and Development—*Continued*

Politburo Standing Committee, Central Military Commission, and State Council and historically led by China's top political leaders—evaluates and provides recommendations on certain strategic dual-use high-technology programs, potentially including military programs such as ballistic missiles as well.* [120]

- The PLA General Staff Department and PLA Second Artillery, which develop operational and technical requirements for China's missile programs. After approval by the Central Military Commission and State Council, the Second Artillery likely develops short- to long-term (e.g., 5- to 15 or more-year) acquisition programs for missile systems.[121]
- The PLA General Armaments Department, which oversees the procurement process and approves contracts for these programs' four R&D stages: preliminary research, concept development and program validation, engineering R&D, and design finalization.[122]
- Research institutes within the General Armaments Department, the Second Artillery, the defense industry, or civilian universities, which can all compete for preliminary research contracts.[123] The Second Artillery handles concept development, and one of the academies within China's two defense industry conglomerates—the China Aerospace Science and Industry Corporation and China Aerospace Science and Technology Corporation—conducts engineering R&D, with a Second Artillery unit embedded inside. Both the academy and the embedded unit are involved in testing, which is required before a program can proceed to design finalization.† [124]

A joint Central Military Commission and State Council standing office ultimately approves the finalized design.[125] Overall, the heavy involvement of senior Chinese leaders throughout the process indicates the pervasiveness of central leadership guidance and approval authority while the proliferation of actors involved demonstrates China's commitment to pushing for increased civil-military integration.

China's missile R&D efforts have likely benefited from consistent funding increases concurrent with its growth in overall military spending. China likely allocates at least 10 percent and potentially up to 15 percent of its overall defense budget to R&D, comparable to that of the United States, which has allocated

*For more information regarding the Central Special Committee, see Chapter 2, Section 2, "China's Space and Counterspace Programs."

†As with all defense conglomerates, the State Administration of Science, Technology, and Industry for National Defense, part of the State Council's Ministry of Industry and Information Technology, exercises administrative oversight over these companies. Mark Stokes, "China's Evolving Space and Missile Industry: Seeking Innovation in Long-Range Precision Strike," in Tai Ming Cheung, *Forging China's Military Might: A New Framework for Assessing Innovation*, Johns Hopkins University Press, 2014, 246.

China's Missile Research and Development—*Continued*

roughly 10–11 percent in recent years.* [126] Further, in step with other Chinese defense conglomerates, the two corporations each now encompass numerous publicly-listed firms, enabling them to raise funds from multiple sources, including state funding, capital markets, and corporate activities.[127] Yet persistent structural challenges may limit the impact of these large cash inflows: China's defense companies produce far lower revenues per worker than U.S. counterparts, and the civilian sector's track record shows marketization to be of limited benefit to the improvement of firms' efficiency.[128]

In contrast to China's first ballistic and cruise missile systems, which relied on foreign technologies and expertise, today's PLA missile development is focused on conservative, incremental upgrades to existing missile variants.[129] This indicates that China's missiles are at a low-to-medium level of innovation—one that emphasizes incremental improvements to indigenous systems originally based on foreign technology.[130] However, as Mr. Stokes states, China's defense aerospace industry may now be poised to deliver surprising breakthroughs in "disruptive technology" in some cases.[131] The DF–21D ASBM, if demonstrated to perform as promised, would be the initial example of this newfound innovative capacity.[132]

Increasing the Penetrability of Adversary Missile Defenses

China has steadily developed its offensive missile forces over the past two decades to pursue the capabilities necessary to fully execute its conventional and nuclear missions, but recognizes that adversary missile defenses pose a major challenge to the success of these operations. As a result, China is considering quantitative and qualitative measures to improve penetrability of adversary missile defenses.

Chinese Views on U.S. Missile Defense and Prompt Global Strike

Official U.S. statements emphasize that its ballistic missile defense capabilities are intended to defend the U.S. homeland from states such as North Korea and Iran and do not threaten the efficacy of China's strategic nuclear deterrent.[133] Nevertheless, China views these systems as a shield that could render its relatively limited nuclear arsenal impotent.[134] As Christopher Twomey, asso-

*Using new methodology created by the University of California Institute on Global Conflict and Cooperation to measure Chinese defense R&D spending, these totals are revised upward from the Commission's *2014 Annual Report to Congress*. As a ratio of China's official defense budget, the institute assesses that China's defense R&D allocation in 2013, the latest year for which numbers are available, was 18.4 percent. However, as many items not in China's official defense budget contributed to this R&D spending measurement, a more accurate share relative to China's actual defense spending is likely 10–15 percent. Tai Ming Cheung (Director, University of California Institute on Global Conflict and Cooperation), interview with Commission staff, June 12, 2015; Tai Ming Cheung, "How Much Does China Spend on Defense-Related Research and Development" (2015 Workshop on Chinese Defense Science, Technology, and Innovation in a Period of Major Change, Washington, DC, February 9, 2015).

ciate professor at the U.S. Naval Postgraduate School, testified to the Commission, "There is a sense in Beijing that U.S. missile defense undermines a relatively stabilizing phenomenon of mutual vulnerability between the U.S. and China. . . . Other Chinese [analysts] attack missile defense as a way to escape mutual vulnerability on the grounds that it is an attempt to achieve 'absolute security' for the United States. By implication, this means absolute insecurity for others, China included." [135]

The 2013 *Science of Military Strategy* indicates China views the U.S. conventional prompt global strike program, envisioned to provide the United States the ability to conduct a precision strike anywhere on Earth within one hour, as a threat to China's nuclear retaliatory capability as well.[136]

In addition to its views on the strategically destabilizing effects of U.S. homeland missile defense, China has objected to the enhancement of U.S. theater missile defense in Asia.[137] It has particularly criticized the U.S. sale of the Patriot anti-missile system to Taiwan in the 1990s, as well as subsequent upgrades to the system.[138] More recently, China has objected to the potential U.S. deployment of the Terminal High-Altitude Area Defense system to South Korea, despite U.S. assurances that it would be a purely defensive system aimed at North Korea.[139] In a March 2015 press conference, a Chinese Ministry of National Defense spokesperson stated: "We think [the deployment of a] missile defense system by some countries in the Asia Pacific region is neither conducive to strategic stability and mutual trust, nor to regional peace and stability. And we hope relevant countries can be prudent in taking actions." [140] The nature of China's objections to theater missile defense suggest that its broader opposition to missile defense systems in general may be pretextual; theater missile defenses do not protect the homeland of another country from retaliatory attack and therefore do not reduce the value of China's nuclear arsenal, the stated reason for China's general opposition to missile defense. Theater missile defense does, however, reduce the value of China's missile inventory in support of its regional ambitions, a more likely reason for its objections.

Advancements in Warhead Delivery Systems and Penetrability

China's views on U.S. missile defense strongly influence its development of technologies intended to counter, overwhelm, or defeat missile defenses. China continues to research and develop both passive and active countermeasures in an effort to ensure penetrability against adversary missile defenses. Passive countermeasures include deploying chaff and decoys to confuse missile defenses and jamming missile defense radars and sensors to render them inoperable. Active countermeasures include more advanced technologies such as kinetic "hit-to-kill" intercept and directed energy intercept technologies, as well as early warning radar.[141] These active countermeasure technologies, still under development by China, have much in common with those being developed under China's counterspace program. For more information, see Chapter 2, Section 2, "China's Space and Counterspace Programs."

Sheer numbers of missiles fired in salvos, in combination with the deployment of other airborne threats, can overwhelm adversary missile defenses and act as an aid to warhead penetration as well.[142] As Jeffrey Haworth, director of intelligence and security in the missile defense component of U.S. Strategic Command, stated at a 2015 conference on U.S. Army air and missile defense, "Regardless of whether we are talking about unmanned aerial systems, whether we're talking about aircraft, whether we're talking about missile systems . . . there is more of everything. . . . There is more of everything at every range; there is more of everything at every capability; there is more of everything at every category of threat."[143] In short, as Professor Yoshihara testified, "quantity matters." Moreover, "targets that survived previous raids must be struck again. In wartime, missiles could fall prey to malfunction, outright misses, interception by enemy ballistic missile defense systems, and other low-tech methods by defenders to defeat the incoming missiles. Possessing adequate inventory to account for attrition is thus particularly crucial for ballistic missiles that can only be used once."[144]

Multiple Independently-Targetable Reentry Vehicles

In 2015, DOD confirmed that China's DF–5 ICBMs have a multiple independently-targetable reentry vehicle (MIRV) capability.[145] Rather than containing a single warhead per missile, a MIRV-equipped missile allows for a payload of several miniaturized warheads, each of which can be targeted independently. The DF–5's characteristics—liquid-fueled and silo-based, with a long lead-time required for fueling—make it less survivable and more susceptible to adversary attack than its road-mobile counterpart, the DF–31 ICBM. Nevertheless, these elements, combined with the DF–5's relatively large size, also provide the missile with greater "throw weight," or weight it is capable of launching to its target (currently between 3,000 and 3,200 kilograms (6,614 and 7,055 pounds)). China appears to have taken advantage of these characteristics of the DF–5—a missile that can definitively reach the continental United States—to deploy MIRVs in its strategic missile force, increasing its ability to penetrate adversary missile defenses and enhancing the credibility of its nuclear forces as a deterrent.[146]

Other systems in development may also be MIRV-equipped. The DF–41, an ICBM currently in development with a reported range of 12,000 kilometers (7,456 miles), could also be capable of carrying MIRVs.[147] Additionally, in February, Admiral Cecil D. Haney, commander of U.S. Strategic Command, testified to the House Subcommittee on Strategic Forces that China is "[modernizing] its strategic forces by . . . developing a follow-on mobile system capable of carrying multiple warheads."[148] One U.S. media report interpreted this statement to refer to the DF–31B system reportedly in development.[149] U.S. and Chinese government sources have not confirmed the program, but unofficial sources have suggested the DF–31B could include multiple reentry vehicles.[150] Finally, some analysts have speculated that the JL–2 follow-on SLBM in development may be MIRV-capable as well.[151]

Maneuverable Reentry Vehicles

China's progress in developing maneuverable warheads suggests it is also pursuing maneuverable reentry vehicle (MaRV) technology. Because MaRV-equipped warheads are capable of performing preplanned flight maneuvers during reentry, they are more difficult to intercept and better able to penetrate adversary missile defenses.[152] One example of China's progress in this area is its development of the DF–21D ASBM, which features a maneuverable warhead.[153] The ability of DF–21D sensors and warheads to survive atmospheric reentry remains uncertain, calling into question its MaRV capability in the absence of successful tests against a moving target at sea.[154] Nevertheless, the missile's deployment suggests the PLA finds some utility in this technology for its missile forces. Some Western analysts and media reports identify reentry maneuverability as a possible attribute of the ongoing DF–41 and DF–26 and reported DF–31B missile programs as well.[155]

Hypersonic Weapons

Three countries—the United States, China, and Russia—currently have programs underway to develop hypersonic weapons, which can sustain flight in the Mach 5 to Mach 10 speed range (roughly 3,840 to 7,680 miles per hour) and theoretically strike any target on earth in under one hour.* The very high speeds of these weapons, combined with their maneuverability and ability to travel at lower, radar-evading altitudes, would make them far less vulnerable than existing missiles to current missile defenses.[156]

Due to limited public information, high-confidence assessments of China's hypersonic weapons program are not possible; however, it appears China's hypersonic weapons program is in its developmental stages and is progressing rapidly.[157] China's research into hypersonic weapons has likely focused on two types of propulsion: (1) a boost-glide weapon, which like a ballistic missile is launched from a large rocket on a relatively flat trajectory that either never leaves the atmosphere or reenters it quickly, before being released and gliding unpowered to its target; or (2) a "supersonic combustion ramjet" or scramjet engine, efficient at hypersonic speeds, which could also be activated after release from a rocket or even launched by aircraft.[158] According to one unconfirmed media source, China reportedly conducted a fifth glide vehicle test in August 2015, potentially its second in 2015 following three tests in 2014.[159] Mr. Stokes estimates China may be able to field a hypersonic glide vehicle by 2020 and a scramjet-propelled cruise vehicle with global range before 2025.[160]

Scramjets would theoretically be slower than boost-glide vehicles, operate at shorter ranges, and present a significant engineering challenge, but would also be cheaper, more maneuverable, and, because of their non-ballistic flight profiles, potentially less prone to

*While some ballistic missiles travel in this speed range already, they do not sustain this speed for the duration that these new weapons would. In general, a "hypersonic weapon" is viewed as one able to fly at hypersonic speeds for "significant distances" and a period of time measured in minutes, meaning it reaches its target—anywhere on Earth—in under one hour. Harry Kazianis, "The Real Military Game-Changer: Hypersonic Weapons 101," *Lowy Institute for International Policy Interpreter Blog*, March 14, 2014; Robert Farley, "A Mach 5 Arms Race? Welcome to Hypersonic Weapons 101," *National Interest*, December 31, 2014.

miscalculations arising from a conventional missile launch that could be interpreted as a nuclear strike.[161]

Boost-glide vehicles are part of the same family of technologies as the terminally guided reentry vehicles on China's existing ballistic missiles. Therefore, given the relatively short ranges of China's known glider tests—such as a test in 2014 with an apparent range of 1,750 kilometers (1,087 miles), roughly the same range as the DF–21D ASBM—Dr. Acton assessed that "it is possible, though by no means certain, that the glider is essentially a 'souped-up' version of an existing type of terminally guided re-entry vehicle" at present.[162] China likely faces significant engineering challenges in developing gliders with longer ranges of a few thousand kilometers or more; another challenge will be to ensure the reception of navigation data given the high speeds of the gliders.[163] While a 500–2,000 kilometer (311–1,243 mile) total range for the glider in 2020 would be "ambitious but not unreasonable," the existing glider model likely could not simply be placed on an ICBM to achieve intercontinental range.[164]

Whether China arms its hypersonic weapons with a nuclear or conventional payload will hint at how China intends to incorporate hypersonic weapons into PLA planning and operations.

- A nuclear payload could indicate the program is based on China's efforts to assure retaliatory strike capabilities against adversary missile defenses. The National Air and Space Intelligence Center assesses the glide vehicle is associated with China's nuclear program, and 2015 saw no developments that would alter this assessment.[165]
- A conventional payload, in conjunction with an intercontinental range, could indicate a growing role for very long-range conventional weapons in PLA doctrine, according to Dr. Acton.[166] Hypersonic weapons are more effective at penetrating area missile defenses, such as those protecting the U.S. homeland, than are regional point defenses,* suggesting that shorter-range hypersonic weapons would likely not alter the regional balance of power in the Western Pacific.[167]
- Alternatively, China may intend its hypersonic program for both nuclear and conventional purposes, or may simply be following the United States in pushing the technological frontier and is not yet certain which it will pursue.[168]

*James Acton explained the distinction between area and regional defenses in testimony to the Commission as follows: "In broad terms, defenses can be divided into area defenses, which are capable of protecting large swathes of territory, and point defenses, which are capable of protecting particular targets or small clusters of targets. The Ground-Based Mid-Course Defense system deployed in Alaska and California to protect the United States against a North Korean ICBM by intercepting warheads as they pass through outer space is an example of an area defense. Patriot missiles, which are designed to intercept short-range missiles in their terminal phase, are examples of point defenses." U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015.

China's Developing Missile Defense Capabilities

China ramped up its ballistic missile defense development efforts following the United States' withdrawal from the Anti-Ballistic Missile Treaty in 2002, culminating in several ballistic missile defense technology tests.* [169] China's efforts in this area are not entirely new. China began a ballistic missile defense research program soon after developing nuclear weapons in 1964,[170] and maintained this research even after the United States and Soviet Union signed the treaty in 1972, despite China's consistent rhetoric condemning ballistic missile defense systems during this time.[171] Even after Deng Xiaoping reportedly canceled the program in 1983 due to technical feasibility concerns, Chinese writings indicate this research continued.[172] During the past decade, Beijing's rhetoric aside, Chinese research has increasingly included efforts to develop China's own ballistic missile defense systems in addition to existing efforts to develop countermeasures to adversaries' systems.[173]

Based on its intensifying research in this area, China is rapidly developing more robust missile defense capabilities to supplement its existing array of long-range surface-to-air missiles, which provide only a limited capability against ballistic missiles.[174] China has continued working to develop a kinetic energy intercept capability for intercepts of ballistic missiles and other aerospace vehicles at exo-atmospheric altitudes. For intercepts within the upper atmosphere, China is developing a ground-based midcourse interceptor, conducting two successful tests in 2010 and 2013.† China faces several remaining technical challenges in deploying an effective ballistic missile defense system: developing the capacity to resist electronic attack, developing the ability to respond to multiple warheads, and fielding a space-based early warning system.[175]

Reflecting on the United States' experience with developing the Ground-based Midcourse Defense System, Frank Rose, Assistant Secretary of State for Arms Control, Verification and Compliance, stated that the State Department expects a comparable system in development in China to "provide at most a limited defense of the Chinese homeland, which would not counter the U.S. strategic deterrent and therefore would not undermine strategic stability." [176]

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*The United States announced its withdrawal from the Anti-Ballistic Missile Treaty on December 13, 2001, based on President Bush's assessment that the Treaty hindered the United States' ability to develop ways to defend against future terrorist or rogue-state missile attacks. In the Bush Administration's view the emergence of these new threats, in light of a more cooperative strategic relationship with Russia, necessitated the deployment of territorial defense systems specifically prohibited under the Treaty. George W. Bush, "Remarks by the President on National Missile Defense, ABM Withdrawal" (Rose Garden, Washington, DC, December 13, 2001); Office of the White House Press Secretary, "Announcement of Withdrawal from the ABM Treaty," December 13, 2001.

†China's government publicly described another test conducted on July 23, 2014, as a "land-based missile interception test," but the United States government assesses with "high confidence" that this was instead an anti-satellite missile test. Frank A. Rose, "Ballistic Missile Defense and Strategic Stability in East Asia" (Federation of American Scientists workshop, Washington, DC, February 20, 2015).

China's C4ISR and Targeting Challenge

ISR: Understanding the Battlespace and Obtaining Targeting Data for Precision Strike

To realize the full potential of its long-range precision strike capabilities, China requires detailed awareness of a potential battlespace as well as the ability to obtain targeting data at increasingly far distances from the Chinese mainland. As Mr. Fuell of the National Air and Space Intelligence Center stated, "One key dependency inherent to missile warfare is targeting: effective and timely target selection is an absolutely critical part of the kill chain. We have little insight into this key phase, but it is quite possible that, as with overall joint integration, it may represent an overall structural weakness, and training at the unit level may not help address it." [177]

The PLA's primary strategic preoccupation, Taiwan, consists mostly of stationary targets located across the Taiwan Strait. However, as China has sought to project power further from its shores and developed missiles to engage targets at longer ranges, maritime C4ISR—understanding the activity taking place in waters and airspace off China's coast and integrating this data into actionable information for distribution to operational forces—has become an increasingly critical component of PLA operations. The U.S. Office of Naval Intelligence states that even building a detailed air and maritime picture of China's 875,000-square-nautical-mile "near seas" is a daunting task; the addition of the Philippine Sea, a key interdiction area in a Taiwan or South China Sea conflict, adds 1.5 million square nautical miles to the vast area China would need to monitor.[178] Moreover, a wide range of military, law enforcement, and commercial shipping, fishing, and oil and natural gas vessels operate in these waters, further complicating target discrimination in a potential conflict.

It remains unclear whether China can obtain targeting data and pass it to missile launch units in a timely manner, particularly for targets beyond the first island chain, according to DOD.[179] However, China is engaged in an effort to improve its overall C4ISR capability.[180] At present, China builds a maritime C4ISR picture from a variety of sources:

Tactical reporting. China's ability to track activities along its coast originates from the PLA Navy's initial operational emphasis on coastal defense.[181] As the PLA Navy has operated farther from Chinese shores, China's maritime law enforcement agencies have taken up greater littoral-area responsibilities, mostly supplanting the role of the navy in this area. Both naval and law enforcement assets at sea directly report information to contribute to China's maritime C4ISR. However, this data is limited to the operating areas and sensor ranges of these ships and aircraft.[182]

Ground-based radars. In addition to ground-based coastal radars to monitor coastal areas, China is relying on more advanced ground-based sensors to enable over-the-horizon surveillance, a necessity for the successful targeting of long-range missiles. China operates ground-based surface-wave and sky-wave radars, which can

track targets at distances much farther than conventional radars can—perhaps 1,600 nautical miles (1,841 miles) or more.[183]

Airborne ISR. A variety of airborne platforms contribute to China's ability to discern air and maritime activity in its near seas and beyond. A growing fleet of fixed-wing maritime patrol, airborne early warning, and surveillance aircraft currently serve as the core of China's airborne ISR capability, but other airborne assets are also poised to play a key role. Ongoing naval shipbuilding efforts indicate prioritization of surface combatants capable of embarking helicopters, a feature that will augment China's over-the-horizon targeting capability.[184] Additionally, the PLA Navy is incorporating unmanned aerial vehicles into its fleet for maritime ISR missions. Unmanned aerial vehicles have a long loiter time and can provide persistent surveillance beyond the ability of manned assets. Unmanned aerial vehicle sensors could support conventional SRBM missions, and possibly MRBM, ASBM, and battle damage assessment missions as well.[185] Furthermore, some developmental unmanned aerial vehicles, such as the Yilong, Sky Saber, and Lijian platforms, will likely have the ability to integrate strike weapons, although no testing or employment of such systems has yet been revealed.[186]

Space-based ISR. A maturing space-based ISR infrastructure will provide higher resolution for the PLA's tracking of air and naval activity out to the second island chain, as well as improve its ability to guide missiles to moving targets at sea. For more information on China's ISR satellites, see Chapter 2, Section 2, "China's Space and Counterspace Programs." There are also indications the Second Artillery is interested in using the near space region—the area between the atmosphere and space at 20–100 kilometers (12–62 miles) in altitude—for surveillance, communications relay, electronic warfare, and precision strike through the use of near space vehicles.[187]

Data Fusion and Command and Control

Both data fusion and command and control are critical for the timely passing of up- and down-echelon information—such as targeting data, battle damage assessments, and launch orders—that inform missile operations.

In addition to collecting accurate targeting data, the PLA has the additional challenge of fusing the data and disseminating it to Second Artillery missile launch units. Although an ideal scenario would fuse data from all of China's ISR sensors into a single display and disseminate it to all PLA units, this scenario requires far more coordination and standardization across multiple units than exists at this time.[188]

Command and control ensures that required information is passed in a timely manner to the appropriate units, in order to lay the groundwork for operational efforts such as missile launches. As the PLA continues to strive toward joint operations, the difficulty of managing targeting information across multiple PLA services and branches will grow significantly. Additionally, the relatively recent involvement of PLA services other than the Second Artillery in missile employment will increase the complexity of the command

and control of such missile launches. Nuclear weapons in particular have a tightly centralized release authority running from China's Central Military Commission, of which Xi Jinping is the chairman, directly to the Second Artillery. The pending deployment of submarine-launched and possible air-launched nuclear-armed missiles introduces the PLA Navy and the PLA Air Force into nuclear chains of command, potentially lengthening and complicating the decision-making and launch process in a nuclear scenario.[189]

The limited public information about Beijing's nuclear command and control could make it more likely that an adversary's actions in a crisis could, in Beijing's view, cross the nuclear threshold, even if this was not the adversary's intent. China so highly values its nuclear command and control that the destruction or degradation of this function has been raised by outside analysts as a possible trigger for its use of nuclear weapons.[190] In an interview with Commission staff, Professor Twomey stated, "It assumes a lot to expect the Chinese interpret an attack on their command and control systems in an intense crisis as solely a conventional attack. A significant loss of such capabilities might appear to Beijing to presage an escalation across the strategic threshold [into the nuclear realm], whatever U.S. intentions in that regard might have been." [191]

Second Artillery Training Developments

In conjunction with technical developments to China's offensive missile forces, the Second Artillery has focused on improving training to employ its relatively new capabilities to the fullest extent. In line with PLA reforms under Xi Jinping that have emphasized training under "realistic combat scenarios," the Second Artillery in the past three years has sought to ensure its training conditions mirror those it would face in combat. As emphasized in official PLA media, the Second Artillery has sought to shift training away from scripted, predictable exercises by including features such as: unique geographic environments and extreme weather conditions, year-round training, long-range mobility operations, precision-strike practice using live fire, deviation from prepared plans, "complex electromagnetic environments," and greater usage of maneuvers and camouflage to increase survivability.[192]

Additionally, based on the PLA's broader effort to master integrated joint operations, the Second Artillery has expanded training in support of or in conjunction with the PLA Army, Navy, and Air Force.[193] Second Artillery units were involved in each of China's three large-scale military-wide exercises held in 2014: Stride, Joint Action, and Firepower. DOD described these exercises, which involved multiple evolutions across all of China's seven military regions, as a "significant milestone in the PLA's long-term goal of developing into a modern, professional, and capable military force." [194] A July 2015 PLA Navy exercise also shed light on the role of the Second Artillery in a joint environment. Held in the South China Sea, the exercise reportedly involved over 100 naval vessels and several Second Artillery launch battalions, in addition to several PLA aircraft and information warfare forces. Official Chinese press indicated the Second Artillery likely coordinated with the PLA Navy to suppress key targets on land as well as ship targets at sea. Media reports also highlighted the PLA Navy's suc-

cess in antiship missile interception during the exercise.[195] Finally, of note, press on the exercise indicates training was conducted in "transporting and deploying whole units of onshore missile forces," suggesting the significance of logistics to the Second Artillery's operations.[196] As the Second Artillery has taken part in more multiservice exercises, it has also emphasized cross-region mobility and logistics, necessary skills for the coordinated and timely movement of multiple PLA elements across China.[197]

Finally, the Second Artillery appears to be emphasizing the frequency of its training exercises, according to PLA media sources.[198] As the PLA seeks to shift from a training cycle based on traditional annual conscription schedules to a more continuous training cycle emphasizing year-round readiness, the Second Artillery and other services will follow suit. The increasing professionalization of PLA personnel and a growing corps of non-commissioned officers will also contribute to the ability of the Second Artillery to maintain year-round readiness.[199]

Implications for the United States

The increasing numbers, diversity, survivability, lethality, and penetrability of China's offensive missile forces deeply and negatively affect U.S. security interests, particularly those related to its military force structure and planning, regional alliance commitments, treaty obligations, and approach to deescalating potential crises in the U.S.-China relationship. China's growing offensive missile capabilities are clearly intended to support its nuclear threat posture and aggressive assertions of sovereignty in the East and South China seas, which the Commission documents in other sections of this Report. Unless the United States understands China's evolving missile doctrine and growing capabilities and responds vigorously, it runs a growing risk of being unable to deter deliberate aggression and reduce the risk of miscalculations that could lead to an escalating armed conflict.

U.S. Military Force Structure and Planning

China's offensive missile force can threaten increasingly large portions of the Western Pacific—where the U.S. military has operated uncontested since the end of the Cold War—requiring significant alterations to U.S. military planning assumptions. China is rapidly introducing to its ballistic and cruise missile inventories weapons capable of hitting targets out to the first and second island chains, covering Guam as well the territory of U.S. allies. Some of these weapons are able to target a widening diversity of platforms, including aircraft carriers. These developments strengthen China's ability to carry out its antiaccess/area denial strategy in the event of a conflict and complicate Washington's efforts to promote and advance U.S. goals and objectives in Asia.

The United States faces both financial and strategic costs in defending against these new capabilities. Because it is so expensive and technically challenging to defend against relatively low-priced and high-impact missiles, a spending competition between additional Chinese offensive missiles and U.S. defensive systems would not be favorable for the United States.[200] To address this problem, the United States is currently working to develop innovative and

lower-cost-per-shot methods to defend against the missiles of potential adversaries, including China.[201] Some U.S. defense analysts have also called for the United States to reconsider its current force structure's emphasis on short-range aircraft, and instead emphasize the procurement of long-range stealth bombers that would allow the United States to operate beyond the reach of advanced Chinese missiles.[202] Additionally, due to China's heavy and growing reliance on C4ISR for the targeting and guidance of its missiles, solutions to disrupt networks that would support Chinese missile and aerospace forces could be a realistic disabling option for the United States in a conflict. Rear Admiral Jesse Wilson (U.S. Navy), director of the Joint Integrated Air and Missile Defense Organization, stated in 2015, "We need to look left of launch . . . if I can disrupt other [parts] of the adversary's kill chain, I don't have to fire an SM–3, I don't have to fire a Patriot, I don't have to fire a [Terminal High-Altitude Area Defense missile]," and, because of the finite and limited number of U.S. interceptors, "I don't have the numbers to do it anyway."[203] The United States, however, is similarly reliant on its sensors and communications networks for its military operations, particularly those far from home—a potential drawback to this approach. As Mr. Haddick testified, "In a potential conflict in East Asia, such an exchange of blows against both sides' ISR and command networks could favor the Chinese 'home team' which could have an easier task of restoring these functions than would U.S. expeditionary forces."[204]

U.S. defense strategy, policy, planning, and budgeting must take these stark realities into account. Specifically, U.S. planners must evaluate the adequacy of U.S. national and theater missile defense policies and capabilities, as well as U.S. offensive strike policies and capabilities, to deter and deny the threat that emanates from China's evolving missile competencies.

Alliance Management

The PLA's growing inventory of theater-range missiles—both conventional and nuclear—affect the strategic calculations of U.S. allies in the region as they consider how to adjust their military strategies to account for a rising China. According to Professor Yoshihara, "For some time to come, the missile will be China's best answer to U.S. forward presence, power projection, and security commitments to treaty allies and friends."[205] China's increasing ability to use its missile arsenal to threaten U.S. partners and allies supports its regional ambitions, improves its coercive ability, weakens the value of deterrence efforts targeted against it, and widens the range of possibilities that might draw the United States into a conflict. The nascent theater nuclear missile capability China appears to be developing could introduce uncertainty to U.S. extended deterrence in Asia, as U.S. allies falling under the U.S. nuclear umbrella likely will look to the United States for reassurance regarding the seriousness of its treaty commitments.*[206]

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*For more information on the impact of China's growing influence and military modernization on U.S. alliances and security partnerships in Asia, see Chapter 3, Section 1, "China and Asia's Evolving Security Architecture," of the Commission's *2014 Annual Report to Congress*.

U.S. Treaty Obligations

China's missile force modernization has contributed to a U.S. policy debate regarding U.S. obligations as a signatory to the Intermediate Range Nuclear Forces (INF) Treaty.* The U.S. State Department confirmed in 2014 and 2015 that Russia had violated its treaty obligations by testing a prohibited missile.[207] Meanwhile China, uninhibited by treaty obligations, has engaged in a relatively low-cost build-up of land-based theater-range missiles, giving it the ability to target a large portion of the Pacific theater. These developments have raised questions about the modern-day relevance of the INF Treaty for the United States.

Although most analysts seem to agree that completely abrogating the INF Treaty would be an overreach,[208] given its continuing benefits for the United States,† some have argued that modifications should be made. Evan Braden Montgomery, senior fellow at the Center for Strategic and Budgetary Assessments, has suggested altering the treaty so that ground-based theater-range missiles might be permitted only in Asia. In testimony to the Commission, Dr. Montgomery offered three benefits of this "Asia option": (1) it could enable the U.S. deployment of ground-based missiles in the Western Pacific, enhancing deterrence and improving crisis stability as China's military becomes more powerful; (2) it could provide both the United States and Russia bargaining leverage against China, which currently has no incentive to accept any limits on its offensive missile forces; and (3) it could drive a wedge between China and Russia, since Russian missile developments under such an "Asia option" would very likely be aimed at China.[209] Other analysts, skeptical that the United States would benefit from the opportunity to re-introduce ground-based theater-range missiles and concerned that such a development would destabilize rather than stabilize the strategic balance for the United States and its allies, advocate for the maintenance of the status quo of the INF Treaty.[210] As China continues to expand its intermediate-range missile capabilities, and Russia determines whether to proceed in devel-

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*Signed by the United States and Soviet Union in 1987, the INF Treaty required "destruction of both parties' ground-launched ballistic and cruise missiles with ranges between 500 and 5,500 kilometers (310 and 3,418 miles), along with their launchers and associated support structures and support equipment," altogether eliminating 846 U.S. and 1846 Soviet missiles. Although titled a "Nuclear Forces" Treaty, INF's prohibition of conventional systems is more relevant to the current discussion—China's buildup of conventional intermediate-range ballistic and cruise missiles has been a driving force behind this debate in recent years. Amy F. Woolf, "Russian Compliance with the Intermediate Range Forces (INF) Treaty," *Congressional Research Service*, June 2, 2015, 8; U.S. Department of State, *Treaty Between The United States Of America and The Union Of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (INF Treaty)*, December 8, 1987.

†The treaty is regarded as both a keystone of U.S.-Russia security relations and an arms control success, having eliminated an entire class of weapons between the United States and Russia; this limited each nation's nuclear missile arsenal to its strategic deterrent of ICBMs and removed the need to compete in deploying INF-accountable systems. Moreover, the treaty is essential to NATO's deterrence posture, preventing Russia, at least in legal terms, from deploying inexpensive short- and medium-range ballistic and cruise missiles on its European border for purposes of political coercion, as China has done on the Taiwan Strait. Evan Braden Montgomery, "China's Missile Forces Are Growing: Is It Time to Modify the INF Treaty?" *National Interest*, July 2, 2014; Steven Pifer, "Don't Scrap the INF Treaty," *National Interest*, June 9, 2014; Elbridge Colby, "The Real Trouble with Russia: Moscow Might Have Violated the Intermediate-Range Nuclear Forces Treaty—Here's How to Respond," *Foreign Affairs*, April 7, 2014; and Michael R. Gordon, "U.S. Says Russia Tested Missile, Despite Treaty," *New York Times*, January 29, 2014.

oping weapons in violation of the treaty, this issue will likely continue to grow in importance.

Nuclear Strategy and Crisis Management

China's development of long-range precision strike capabilities, coupled with its assertion of sovereignty in its near seas, has resulted in a strategic environment susceptible to crisis instability. According to Avery Goldstein, professor and director for the Center for the Study of Contemporary China at the University of Pennsylvania:

> *In a crisis, China or the United States might believe it valued what was at stake more than the other and would therefore be willing to tolerate a higher level of risk. But because using conventional forces would only be the first step in an unpredictable process subject to misperception, missteps, and miscalculation, there is no guarantee that brinksmanship would end before it led to unanticipated nuclear catastrophe. . . . China, moreover, apparently believes that nuclear deterrence opens the door to the safe use of conventional force. Since both countries would fear a potential nuclear exchange, the Chinese seem to think that neither they nor the Americans would allow a military conflict to escalate too far.*[211]

Since the end of the Cold War, the United States has not been faced with an adversary capable of seriously contesting U.S. dominance of a battlespace, and has had little imperative to consider how nuclear escalation could factor into a potential conflict.[212] As multiple witnesses testified at the Commission's April hearing, the United States should consider carefully how to constrain and bring an end to hostilities in a limited conflict under the specter of nuclear escalation.[213] As China continues to modernize its conventional and nuclear missile forces, these questions will only become more pressing.

Table 2: Ranges of China's Nuclear Ballistic Missiles (Selected)*

Chinese Designator and Missile Type	NATO Designator	Deployment Mode	Approximate Maximum Range in kilometers (miles)
DF–3A IRBM	CSS–2	Transportable	3,000 (1,864)
DF–4 ICBM	CSS–3	Transportable	5,500 (3,418)

*The JL–1 SLBM was omitted from this chart because the Xia-class SSBN, the only Chinese submarine on which the JL–1 has been deployed, is likely currently incapable of conducting operational missions. DOD noted in 2010 that the Xia's operational status was in question, and in 2015 omitted any mention of the Xia in discussing China's SSBNs in its "Annual Report to Congress on Military and Security Developments Involving the People's Republic of China." U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 9; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16; Kyle Mizokami, "Asia's Submarine Race," *US Naval Institute News*, November 13, 2013; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2010*, April 2010, 34; Bud C. Cole, *The Great Wall at Sea*, Naval Institute Press, 2010, 108; and Richard Halloran, "Is There a Plan Behind China's Subs?" *Taipei Times*, May 2, 2007.

Table 2: Ranges of China's Nuclear Ballistic Missiles (Selected)—*Continued*

Chinese Designator and Missile Type	NATO Designator	Deployment Mode	Approximate Maximum Range in kilometers (miles)
DF–5A ICBM	CSS–4 Mod 2	Silo	13,000 (8,078)
DF–5B ICBM	CSS–4 Mod 3	Silo	13,000 (8,078)
DF–21 MRBM	CSS–5 Mod 1	Road Mobile	1,750 (1,087)
DF–21A MRBM	CSS–5 Mod 2	Road Mobile	1,750 (1,087)
DF–26 IRBM	Unknown	Road Mobile	3,000–4,000 (1,800–2,500)
DF–31 ICBM	CSS–10 Mod 1	Road Mobile	7,000–7,200 (4,349–4,474)
DF–31A ICBM	CSS–10 Mod 2	Road Mobile	11,000–12,000 (6,834–7,455)
JL–2 SLBM	CSS–NX–14	SSBN	7,000–7,400 (4,349–4,597)

Note: China likely is in the process of phasing out the DF–3A IRBM.
Source: Commission judgments and estimates based on analysis by nongovernmental experts on China's military, consecutive versions of the annual DOD *Report to Congress on Military and Security Developments Involving the People's Republic of China*, the 2013 National Air and Space Intelligence Center report on cruise and ballistic missiles, the 2015 U.S. Office of Naval Intelligence report on the PLA Navy, and U.S. and Asian media reporting.

Table 3: Ranges of China's Conventional Ballistic Missiles (Selected)

Chinese Designator and Missile Type	NATO Designator	Deployment Mode	Approximate Maximum Range in kilometers (miles)
DF–11 SRBM	CSS–7 Mod 1	Road Mobile	300 (186)
DF–11A SRBM	CSS–7 Mod 2	Road Mobile	600 (373)
DF–15 SRBM	CSS–6 Mod 1	Road Mobile	600 (373)
DF–15A SRBM	CSS–6 Mod 2	Road Mobile	850 (528)
DF–15B SRBM	CSS–6 Mod 3	Road Mobile	725 (450)
DF–16 SRBM	CSS–11 Mod 1	Road Mobile	1,000 (621)
DF–16 MRBM	Unknown	Road Mobile	1,200 (746)
DF–21C MRBM	CSS–5 Mod 3	Road Mobile	1,750 (1,087)
DF–21D ASBM	CSS–5 Mod 5	Road Mobile	1,500 (932)
DF–26 IRBM/ASBM	Unknown	Road Mobile	3,000–4,000 (1,800–2,500)

Source: Commission judgments and estimates based on analysis by nongovernmental experts on China's military, consecutive versions of the annual DOD *Report to Congress on Military and Security Developments Involving the People's Republic of China*, the 2013 National Air and Space Intelligence Center report on cruise and ballistic missiles, the 2015 U.S. Office of Naval Intelligence report on the PLA Navy, and U.S. and Asian media reporting.

Table 4: Ranges of China's Cruise Missiles (Selected)

Chinese Designator and Missile Type	NATO or Export Designators	Launch Platform	Approximate Maximum Range in kilometers or nautical miles (nm) (miles)
KD–88 LACM	Unknown	Air	100 kilometers (62)
YJ–63 LACM	C603	Air	200 kilometers (124)
CJ–10/DH–10 LACM	Unknown	Road-mobile	1,500–2,000 kilometers (932–1,242)
CJ–20 LACM	Unknown	Air	1,500 kilometers (932)
YJ–83 ASCM Family	CSS–N–8, C802, C802A	Ship, ground, and air	100 nm (115)
YJ–62 ASCM Family	C602	Ship and ground	150 nm (172)
YJ–8 ASCM Family	CSS–N–4, C801	Ship, submarine, and air	22 nm (26)
YJ–8A ASCM Family	C801A	Ship and air	65 nm
[None; Russian Export to China]	SS–N–27B ASCM	Submarine	120 nm (138)
[None; Russian Export to China]	SS–N–22 ASCM	Ship	65–130 nm (75–150), depending on variant
YJ–12 ASCM	Unknown	Air	215 nm (250)
YJ–18 ASCM	CH–SS–NX–13	Submarine, ship	290 nm (334)

Source: Commission judgments and estimates based on analysis by nongovernmental experts on China's military, consecutive versions of the annual DOD *Report to Congress on Military and Security Developments Involving the People's Republic of China*, the 2013 National Air and Space Intelligence Center report on cruise and ballistic missiles, the 2015 U.S. Office of Naval Intelligence report on the PLA Navy, and U.S. and Asian media reporting.

Conclusions

- The chief roles of China's nuclear arsenal are to deter an adversary from undertaking a nuclear first strike and to reduce the pressure on China to yield to an adversary's demands, or desist from aggression, under threat of nuclear attack. China's belief that its nuclear arsenal would deter an adversary from taking a conventional fight into the nuclear realm could encourage it to be more adventurous in its risk-taking during a crisis because it may not sufficiently fear the prospect of nuclear escalation.

- China is secretive about the details of its official nuclear policy, leading to uncertainty regarding key principles of its nuclear weapons doctrine. Key elements of China's nuclear policy, such as its "no-first-use" pledge and presumptive de-alerting policy, may be under reconsideration but are unlikely to change officially.

- China appears to be pursuing a theater nuclear capability in addition to the strategic nuclear capability it has maintained since it became a nuclear state in the 1960s. In a conflict, China's maturing theater nuclear capability could provide it with the means to flexibly employ nuclear weapons to deescalate or otherwise shape the direction of conflict.
- China is pursuing a credible second-strike capability with an emphasis on survivability against an adversary's first strike. By diversifying its nuclear strike capabilities away from solely land-based systems in silos, China seeks to ensure its ability to absorb a nuclear strike and retaliate in kind. Examples of this diversification include road-mobile intercontinental ballistic missiles, submarine-launched ballistic missiles, and potentially air-launched land-attack cruise missiles.
- China's initial development of its conventional missile forces focused heavily on expanding its short-range ballistic missile force for Taiwan contingencies. In the past decade, China's development of longer-range missiles, pursuit of advanced missile technologies, and diversification of its launch platforms have enabled it to hold at risk a wider range of targets farther from its shores.
- China is developing cruise missiles that are increasingly difficult for the U.S. military to detect and defend against. The PLA has fielded its first ground-launched land-attack cruise missile, and also appears to be developing air-, ship-, and submarine-launched cruise missiles with land-attack and antiship missions. China is in the midst of improving the qualitative aspects of its cruise missile technologies; in the meantime, the quantitative strength of its cruise missiles poses a formidable challenge to existing U.S. Navy defenses.
- China recognizes that adversary missile defenses—particularly the U.S. ballistic missile defense architecture—pose a major challenge to the success of its missile operations. As a result, China is developing measures to improve its forces' ability to penetrate opposing missile defenses, such as multiple independently-targetable reentry vehicles, maneuverable reentry vehicles, and hypersonic weapons.
- To realize the full potential of its long-range precision strike capabilities, China requires detailed awareness of a potential battlespace as well as the ability to obtain targeting data at increasingly far distances from the Chinese mainland. Effective and timely target selection and information coordination is an area the PLA continues to seek to improve.

ENDNOTES FOR SECTION 3

1. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Mark Stokes, April 1, 2015; and Mark A. Stokes, "The Chinese Joint Aerospace Campaign: Strategy, Doctrine, and Force Modernization," in James Mulvenon and David Finkelstein, eds., *China's Revolution in Doctrinal Affairs: Emerging Trends in the Operational Art of the Chinese People's Liberation Army*, CNA Corporation, 2005, 243.

2. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Toshi Yoshihara, April 1, 2015.

3. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Mark Stokes, April 1, 2015.

4. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Mark Stokes, April 1, 2015.

5. Michael Chase (Senior Political Scientist, RAND Corporation), interview with Commission staff, May 12, 2015; and James Mulvenon, "The King Is Dead! Long Live the King! The CMC Leadership Transition from Jiang to Hu," *China Leadership Monitor* 13 (Winter 2005): 6.

6. Andrew S. Erickson, Michael S. Chase, "China's Strategic Rocket Forces: Upgrading Hardware and Software (Part 2 of 2)," *China Brief*, July 17, 2014; and Andrew S. Erickson, Michael S. Chase, "China's Strategic Rocket Force: Sharpening the Sword (Part 1 of 2)," *China Brief*, July 3, 2014.

7. Ron Christman, "Conventional Missions for China's Second Artillery Corps," *Comparative Strategy* 30 (2011), 207; and Evan Medeiros, "Minding the Gap": Assessing the Trajectory of the PLA's Second Artillery," in Roy Kamphausen and Andrew Scobell, *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military*, U.S. Army Strategic Studies Institute, September 2007, 166–167.

8. Andrew S. Erickson, "Showtime: China Reveals Two 'Carrier-Killer' Missiles," *National Interest*, September 3, 2015.

9. U.S.-China Economic and Security Review Commission, *2014 Annual Report to Congress*, November 2014, 283.

10. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Mark Stokes, April 1, 2015; and Mark Stokes, "The Second Artillery Force and the Future of Long-Range Precision Strike," in Ashley Tellis and Travis Tanner, eds., *Strategic Asia 2012–2013: China's Military Challenge*, National Bureau of Asian Research, October 2012, 143–146.

11. China's Ministry of Foreign Affairs, *Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference*, February 17, 2014. Staff translation.

12. U.S. Senate Armed Services Subcommittee on Strategic Forces, *Hearing on Regional Nuclear Dynamics*, written testimony of Ashley Tellis, February 25, 2015; and Michael Glosny, Christopher Twomey, and Ryan Jacobs, "U.S.-China Strategic Dialogue, Phase VIII Report," *U.S. Naval Postgraduate School/Center on Contemporary Conflict/Defense Threat Reduction Agency*, August 2014, 6–8.

13. U.S.-China Economic and Security Review Commission, *Hearing on Developments in China's Cyber and Nuclear Capabilities*, written testimony of Phillip C. Saunders, March 26, 2012.

14. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015; and M. Taylor Fravel and Evan S. Medeiros, "China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure," *International Security* 35:2 (Fall 2010): 57–66.

15. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Twomey, April 1, 2015; Michael Chase, "China's Transition to a More Credible Nuclear Deterrent: Implications and Challenges for the United States," *Asia Policy* 16 (July 2013): 77–85; and M. Taylor Fravel and Evan S. Medeiros, "China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure," *International Security* 35:2 (Fall 2010): 58.

16. M. Taylor Fravel and Evan S. Medeiros, "China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure," *International Security* 35:2 (Fall 2010): 57–66.

17. Michael Chase, "China's Transition to a More Credible Nuclear Deterrent: Implications and Challenges for the United States," *Asia Policy* 16 (July 2013): 79–80; and Andrew S. Erickson, Michael S. Chase, "China's Strategic Rocket Force: Upgrading Hardware and Software (Part 2 of 2)," *China Brief* 14:2 (July 17, 2014).

18. Avery Goldstein (Professor and Director of the Center for the Study of Contemporary China, University of Pennsylvania), interview with Commission staff, June 8, 2015; and Avery Goldstein, "First Things First: The Pressing Danger of Cri-

sis Instability in U.S. China Relations," *International Security* 37:4 (Spring 2013): 65–66.

19. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Yeaw, April 1, 2015.

20. Christopher Yeaw, (Director, Center for Assurance, Deterrence, Escalation, and Nonproliferation Science & Education), interview with Commission staff, June 14, 2015.

21. China's State Council Information Office, *China's Military Strategy*, May 2015.

22. Avery Goldstein (Professor and Director of the Center for the Study of Contemporary China, University of Pennsylvania), interview with Commission staff, June 8, 2015; and Xu Weidi, "Remarks" (Chinese Thinking on Nuclear Weapons, Carnegie Endowment for International Peace, Washington, DC, May 11, 2015).

23. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015; Bates Gill, James Mulvenon, and Mark Stokes, "The Chinese Second Artillery Corps: Transition to Credible Deterrence," in James C. Mulvenon and Andrew N.D. Yang, *The People's Liberation Army as Organization*, RAND Corporation, 2002, 516; and Larry Wortzel, "China's Nuclear Forces: Operations, Training, Doctrine, Command Control, and Campaign Planning," *U.S. Army War College Strategic Studies Institute*, May 2007, 14–18.

24. China's Information Office of the State Council, *The Diversified Employment of China's Armed Forces*, April 2013.

25. Gregory Kulacki, "The Chinese Military Updates China's Nuclear Strategy," *Union of Concerned Scientists*, March 2015, 4, citing PLA Academy of Military Science, *Science of Military Strategy*, 2013; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Twomey, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015.

26. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015; and Michael Chase, "China's Transition to a More Credible Nuclear Deterrent: Implications and Challenges for the United States," *Asia Policy* 16 (July 2013): 85–88.

27. Yao Yunzhu, "No First Use of Nuclear Weapons," *China Daily*, April 25, 2013.

28. Yao Yunzhu, "No First Use of Nuclear Weapons," *China Daily*, April 25, 2013.

29. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015; Rong Yu and Peng Guangqian, "Nuclear No-First-Use Revisited," *China Security* 5:1 (Winter 2009): 81–90; and Evan S. Medeiros, "Minding the Gap: Assessing the Trajectory of the PLA's Second Artillery," in Roy Kamphausen and Andrew Scobell, eds., *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military*, U.S. Army War College Strategic Studies Institute, 2007, 157–158.

30. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, April 2014, 28.

31. Michael Chase (Senior Political Scientist, RAND Corporation), interview with Commission staff, May 12, 2015; Xu Weidi, Wu Riqiang, and Li Bin, "Remarks," (Chinese Thinking on Nuclear Weapons, Carnegie Endowment for International Peace, Washington, DC, May 11, 2015); Christopher Twomey (Associate Professor, U.S. Naval Postgraduate School), interview with Commission staff, May 7, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015.

32. Christopher Yeaw (Director, Center for Assurance, Deterrence, Escalation, Nonproliferation Science & Education), interview with Commission staff, May 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Twomey, April 1, 2015; and Open Source Center: Wei Fenghe and Zhang Haiyang, "Vigorously Push Forward the Cause of Building the Strategic Missile Force—Thoughts Derived from Studying and Implementing Chairman Xi's Major Strategic Thinking on Building and Development of the Second Artillery," *Huojianbing Bao (Strategic Rocket Forces News)*, January 4, 2014. ID: CHR2014021251519724.

33. Mark Stokes, "China's Nuclear Warhead Storage and Handling System," *Project 2049 Institute*, March 12, 2010, 2–3, 8; and Jeffery Lewis, "China's Nuclear Modernization: Surprise, Restraint, and Uncertainty," in Ashley J. Tellis, Abraham M. Denmark, and Travis Tanner, eds. *Asia in the Second Nuclear Age*, National Bureau of Asian Research, 2013, 76–77.

34. Gregory Kulacki, "NPT Brief: Keeping Chinese Nuclear Weapons off Hair Trigger Alert," *All Things Nuclear* (Union of Concerned Scientists blog), May 18,

2015; Global Zero Commission on Nuclear Risk Reduction, *De-Alerting and Stabilizing the World's Nuclear Force Postures*, April 2015; and Andrew Brown and Jeffrey Lewis, "Reframing the Nuclear De-alerting Debate: Toward Maximizing Presidential Decision Time," *Nuclear Threat Initiative*, December 11, 2013.

35. Hunter Hustus, "Keeping ICBMs 'On Alert' Enhances Presidential Decision-Making," *War on the Rocks*, July 9, 2015; and Andrew Brown and Jeffrey Lewis, "Reframing the Nuclear De-alerting Debate: Toward Maximizing Presidential Decision Time," *Nuclear Threat Initiative*, December 11, 2013.

36. China's State Council Information Office, *China's Military Strategy*, May 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015.

37. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015.

38. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015.

39. Christopher Yeaw (Director, Center for Assurance, Deterrence, Escalation, Nonproliferation Science & Education), interview with Commission staff, May 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Elbridge Colby, April 1, 2015; and Amy Woolf, "Nonstrategic Nuclear Weapons," *Congressional Research Service*, February 23, 2015, 6–8.

40. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Elbridge Colby, April 1, 2015.

41. Christopher Yeaw (Director, Center for Assurance, Deterrence, Escalation, Nonproliferation Science & Education), interview with Commission staff, May 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015.

42. Hans M. Kristensen and Robert S. Norris, "Chinese Nuclear Forces, 2013," *Bulletin of the Atomic Scientists*, November 1, 2013; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Twomey, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015.

43. Hans M. Kristensen and Robert S. Norris, "Chinese Nuclear Forces, 2013," *Bulletin of the Atomic Scientists*, November 1, 2013; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Twomey, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015.

44. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015; and Jeffery Lewis, "China's Nuclear Modernization: Surprise, Restraint, and Uncertainty," in Ashley J. Tellis, et al., eds. *Asia in the Second Nuclear Age*, National Bureau of Asian Research, 2013, 77.

45. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Twomey, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015.

46. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015.

47. U.S. Senate Armed Services Committee, *Hearing on Worldwide Threats*, written testimony of Vincent R. Stewart, February 26, 2015.

48. Michael Chase, "China's Transition to a More Credible Nuclear Deterrent: Implications and Challenges for the United States," *Asia Policy* 16 (July 2013) 89–90.

49. U.S. Department of Defense, *Annual Report to Congress: Military Power of the People's Republic of China 2009*, March 2009, 24.

50. Matthew Fargo, "Ballistic Missile Technology 101—Rocket Fuel," *Center for Strategic and International Studies*, August 8, 2012.

51. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, April 2014, 7; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015.

52. Christopher P. Twomey and Michael S. Chase, "Chinese Attitudes Toward Missile Defense," in Catherine M. Kelleher and Peter J. Dombrowski, eds., *Missile Defense: The Fourth Wave and Beyond*, Stanford University Press, 2015, forthcoming; and U.S.-China Economic and Security Review Commission, *Hearing on*

China's Offensive Missile Forces, written testimony of Christopher Yeaw, April 1, 2015.

53. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 32; Ethan Meick, "China's Reported Ballistic Missile Sale to Saudi Arabia: Background and Potential Implications," *U.S.-China Economic and Security Review Commission*, June 16, 2014, 2; Hans M. Kristensen, "Chinese Nuclear Missile Upgrade Near Dalian," *Missile Threat*, May 22, 2014; and U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, 2013, 14.

54. Andrew S. Erickson, "Showtime: China Reveals Two 'Carrier-Killer' Missiles," *National Interest*, September 3, 2015; and Richard D. Fisher, Jr., "DF–26 IRBM May Have ASM Variant, China Reveals at Military Parade," *Jane's Defence Weekly*, September 2, 2015.

55. U.S. Senate Armed Services Committee, *Hearing on U.S. Pacific Command and U.S. Forces Korea*, April 16, 2015, written testimony of Samuel J. Locklear III; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 19–20; and U.S. Department of Defense, *Annual Report to Congress: Military Power of the People's Republic of China 2015*, April 2015, 9.

56. U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 19–20.

57. U.S. Senate Armed Services Committee, *Hearing on U.S. Pacific Command and U.S. Forces Korea*, written testimony of Samuel J. Locklear III, April 16, 2015; and U.S. Department of Defense, *Annual Report to Congress: Military Power of the People's Republic of China 2015*, April 2015, 9.

58. Jeremy Page, "Deep Threat: China's Submarines Add Nuclear-Strike Capability, Altering Strategic Balance," *Wall Street Journal*, October 24, 2014.

59. Hans M. Kristensen, "Is China Planning to Build More Missile Submarines?" *FAS Strategic Security Blog*, April 23, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015; and U.S. Office of Naval Intelligence, The People's Army Liberation Navy: A Modern Navy with Chinese Characteristics, July 2009, 22.

60. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 9; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015; Liu Kun, "Media Reveals China's Julang-3 Guided Missile, Developed from the Dongfeng-41, Ranges All of U.S., Europe," *Hubei Daily*, August 26, 2013. Staff translation; and U.S. House Armed Services Subcommittee on Strategic Forces, *Hearing on Nuclear Weapons Modernization in Russia and China: Understanding Impacts to the United States*, written testimony of Richard D. Fisher, Jr., October 14, 2011.

61. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 12, 36, 40; U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; and U.S. House Armed Services Subcommittee on Strategic Forces, *Hearing on Nuclear Weapons Modernization in Russia and China: Understanding Impacts to the United States*, written testimony of Richard D. Fisher, Jr., October 14, 2011.

62. Hans M. Kristensen and Robert S. Norris, "Chinese Nuclear Forces, 2015," *Bulletin of the Atomic Scientists*, 71:4 (2015): 83; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 46; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015; Japan's Ministry of Defense, *Defense of Japan 2014*, 2014, 36–37; Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 31–32; U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, 2013, 27–29; Hans M. Kristensen and Robert S. Norris, "Chinese Nuclear Forces, 2013," *Bulletin of the Atomic Scientists*, 69:6 (2013); and Hans M. Kristensen, "Air Force Briefing Shows Nuclear Modernizations But Ignores US and UK Programs," *FAS Strategic Security Blog*, May 29, 2013.

63. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 33–34; Ron Christman, "Conventional Missions for China's Second Artillery Corps," *Comparative Strategy* 30 (2011): 207; and Michael S. Chase and Andrew S. Erickson,

"The Conventional Missile Capabilities of China's Second Artillery Force: Cornerstone of Deterrence and Warfighting," *Asian Security* 8:2 (2012): 125.

64. Michael Chase, "Second Artillery in the Hu Jintao Era: Doctrine and Capabilities," in Roy Kamphausen, et al., eds., *Assessing the People's Liberation Army in the Hu Jintao Era*, U.S. Army Strategic Studies Institute, April 2014, 303.

65. Thomas Schelling, *Arms and Influence*, Yale University Press, 1966, 71–78; and Michael S. Chase and Andrew S. Erickson, "The Conventional Missile Capabilities of China's Second Artillery Force: Cornerstone of Deterrence and Warfighting," *Asian Security* 8:2 (2012), 117–118.

66. Michael S. Chase and Andrew S. Erickson, "The Conventional Missile Capabilities of China's Second Artillery Force: Cornerstone of Deterrence and Warfighting," *Asian Security* 8:2 (2012), 123.

67. U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; and Ron Christman, "Conventional Missions for China's Second Artillery Corps," *Comparative Strategy* 30 (2011), 205–206.

68. Evan Medeiros, "Minding the Gap": Assessing the Trajectory of the PLA's Second Artillery," in Roy Kamphausen and Andrew Scobell, *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military*, U.S. Army Strategic Studies Institute, September 2007, 167–168.

69. Michael S. Chase and Andrew S. Erickson, "The Conventional Missile Capabilities of China's Second Artillery Force: Cornerstone of Deterrence and Warfighting," *Asian Security* 8:2 (2012): 124.

70. Daniel J. Kostecka, "Aerospace Power and China's Counterstrike Doctrine in the Near Seas," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 52–55; U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; and Michael S. Chase and Andrew S. Erickson, "The Conventional Missile Capabilities of China's Second Artillery Force: Cornerstone of Deterrence and Warfighting," *Asian Security*, 2012, 124.

71. Ian Easton, "Able Archers: Taiwan Defense Strategy in an Age of Precision Strike," *Project 2049 Institute*, September 2014, 5; U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and its Implications for the United States*, written testimony of Roger Cliff, January 30, 2014; and Randall Schriver and Mark Stokes, "The Chinese People's Liberation Army: Consequences of Coercive Aerospace Power for United States Conventional Deterrence," *Project 2049 Institute*, August 2008, 11–12.

72. Evan Medeiros, "Minding the Gap": Assessing the Trajectory of the PLA's Second Artillery," in Roy Kamphausen and Andrew Scobell, *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military*, U.S. Army Strategic Studies Institute, September 2007, 171.

73. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 8; and U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014.

74. U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2011*, 2011, 30.

75. U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014.

76. Evan Medeiros, "'Minding the Gap': Assessing the Trajectory of the PLA's Second Artillery," in Roy Kamphausen and Andrew Scobell, *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military*, U.S. Army Strategic Studies Institute, September 2007, 171.

77. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, May 2015, 8.

78. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 34; U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and its Implications for the United States*, written testimony of Roger Cliff, January 30, 2014; and U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, 2013, 14.

79. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, written testimony of Toshi Yoshihara, April 1, 2015.
80. U.S. Senate Armed Services Committee, *Hearing on Worldwide Threats*, written testimony of Vincent Stewart, February 26, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, written testimony of Mark Stokes, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, written testimony of Toshi Yoshihara, April 1, 2015.
81. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 34, 46; and Ian Easton, *China's Evolving Reconnaissance-Strike Capabilities: Implications for the U.S. Alliance*, February 2014, 7.
82. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, written testimony of Mark Stokes, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, written testimony of Christopher Yeaw, April 1, 2015; Baohui Zhang, *China's Assertive Nuclear Posture: State Security in an Anarchic International Order*, Routledge, 2015, 54–55; Bill Gertz, "China Fields New Intermediate-Range Nuclear Missile: DF–26C Deployment Confirmed," *Washington Free Beacon*, March 3, 2014; and Sina News, "Dongfeng-26 Advancement: Unmasking the PLA's Solid-Fuelled Medium-Range Missile's Development," September 15, 2014.
83. Andrew S. Erickson, "Showtime: China Reveals Two 'Carrier-Killer' Missiles," *National Interest*, September 3, 2015; and Richard D. Fisher, Jr., "DF–26 IRBM May Have ASM Variant, China Reveals at Military Parade," *Jane's Defence Weekly*, September 2, 2015.
84. Ron Christman, "China's Second Artillery Force: Capabilities and Missions for the Near Seas," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 42; and John Wilson Lewis and Xue Litai, *China's Strategic Seapower: The Politics of Force Modernization in the Nuclear Age*, Stanford University Press, 1993, 227.
85. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, written testimony of Christopher Yeaw, April 1, 2015; Baohui Zhang, *China's Assertive Nuclear Posture: State Security in an Anarchic International Order*, 2015, 54–55; and Open Source Center, "PRC Military BBS Carries Photos of 'New' Missile Transporter," December 10, 2013. OSC ID: CHO20131210 50298255.
86. Ron Christman, "China's Second Artillery Force: Capabilities and Missions for the Near Seas," in Peter Dutton Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 42–43.
87. Andrew S. Erickson, "Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategic Implications," *Jamestown Foundation*, May 2013, 119.
88. Andrew Erickson, "Chinese Anti-Ship Ballistic Missile Development: Drivers, Trajectories, and Strategic Implications," *Jamestown Foundation*, May 2013, 10; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, 2013, 29; and Mark A. Stokes and Ian Easton, "Evolving Aerospace Trends in the Asia-Pacific Region: Implications for Stability in the Taiwan Strait and Beyond," *Project 2049 Institute*, May 27, 2010, 16.
89. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, written testimony of Dennis Gormley, April 1, 2015.
90. Andrew Erickson, "Chinese Anti-Ship Ballistic Missile Development: Drivers, Trajectories, and Strategic Implications," *Jamestown Foundation*, May 2013, 61; and Ron Christman, "China's Second Artillery Force: Capabilities and Missions for the Near Seas," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 41.
91. Andrew S. Erickson, "Showtime: China Reveals Two 'Carrier-Killer' Missiles," *National Interest*, September 3, 2015; and Richard D. Fisher, Jr., "DF–26 IRBM May Have ASM Variant, China Reveals at Military Parade," *Jane's Defense Weekly*, September 2, 2015.
92. Andrew S. Erickson, "Showtime: China Reveals Two 'Carrier-Killer' Missiles," *National Interest*, September 3, 2015.
93. Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 2.

94. Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 2; and U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, 2013, 26.

95. U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014.

96. James Winnefeld, "Remarks," (Missile Defense and U.S. National Security, Center for Strategic and International Studies, Washington, DC, May 19, 2015).

97. U.S. Department of Defense, *Annual Report to Congress: Military Power of the People's Republic of China 2009*, March 2009, 20; and Ian Easton, "The Assassin Under the Radar: China's DH–10 Cruise Missile Program," *Project 2049 Institute*, October 2009, 1.

98. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Dennis Gormley, April 1, 2015; and U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, 2013, 26–27; and Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 1–3.

99. Ian Easton, "China's Evolving Reconnaissance-Strike Capabilities," *Project 2049 Institute*, February 2014, 8.

100. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 12, 36, 40; U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; and U.S. House Armed Services Subcommittee on Strategic Forces, *Hearing on Nuclear Weapons Modernization in Russia and China: Understanding Impacts to the United States*, written testimony of Richard D. Fisher, Jr., October 14, 2011.

101. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, May 2014, 36.

102. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Dennis Gormley, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

103. Robert Haddick, *Fire on the Water: China, America, and the Future of the Pacific*, Naval Institute Press, 2014, 94; Vitaliy O. Pradun, "From Bottle Rockets to Lightning Bolts: China's Missile Revolution and PLA Strategy Against U.S. Military Intervention," *U.S. Naval War College Review* 64:2 (Spring 2011): 22–27; and U.S. Government Accountability Office, *Comprehensive Strategy Needed to Improve Cruise Missile Ship Defense*, July 11, 2000.

104. Robert Work, "Speech," (China Aerospace Studies Institute, RAND Corporation, Arlington, VA, June 22, 2015).

105. U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; John Patch, "Chinese Houbei Fast Attack Craft: Beyond Sea Denial," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 3–4; and U.S. Office of Naval Intelligence, *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics*, July 2009, 27.

106. U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16; Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 16; and William S. Murray, "Underwater TELs and China's Antisubmarine Warfare: Evolving Strength and a Calculated Weakness," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 20.

107. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 46; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16; and William S. Murray, "Underwater TELs and China's Antisubmarine Warfare: Evolving Strength and a Calculated Weakness," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 20.

108. Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 17–18; and John Patch, "Chinese Houbei Fast Attack Craft: Beyond Sea Denial," in Peter Dutton Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 3–4.

109. U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

110. *IHS Jane's*, "Jane's Strategic Weapon Systems: C–801, C–802, C–803," July 21, 2015; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 46.

111. U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 19; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, May 2015, 10, 46; William Murray, "Underwater TELs and China's Antisubmarine Warfare: Evolving Strength and Calculated Weakness," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Naval War College, February 2014), 19; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2010*, 2010, 3, 30.

112. U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16.

113. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 46; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 20–22; and Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions*, National Defense University Press, 2014, 58–59.

114. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 46; and U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 21.

115. Robert Haddick, *Fire on the Water: China, America, and the Future of the Pacific*, Naval Institute Press, 2014, 93–94.

116. Robert Haddick, "China's Most Dangerous Missile (So Far)," *War on the Rocks*, July 2, 2014.

117. Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, "A Potent Vector: Assessing China's Cruise Missile Developments," *National Defense University Press, Joint Force Quarterly* 75, September 30, 2015.

118. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Dennis Gormley, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015.

119. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, oral testimony of Mark Stokes, April 1, 2015.

120. Tai Ming Cheung (Director, University of California Institute on Global Conflict and Cooperation), interview with Commission staff, October 1, 2015; Tai Ming Cheung, "Introduction," in Tai Ming Cheung, *Forging China's Military Might: A New Framework for Assessing Innovation*, Johns Hopkins University Press, 2014, 10; U.S.-China Economic and Security Review Commission, *2014 Annual Report*, November 2014, 293; Tai Ming Cheung, ed., *China's Emergence as a Defense Technological Power*, Routledge, 2013, 51; Tai Ming Cheung, "The Special One: The Central Special Committee and the Structure, Process, and Leadership of the Chinese Defense and Strategic Dual-Use Science, Technology and Industrial Triangle" (Conference on the Structure, Process, and Leadership of the Chinese Science and Technology System, San Diego, CA, July 16–17, 2012); Tai Ming Cheung, ed., "New Perspectives On Assessing The Chinese Defense Economy 2011 Industry Overview And Policy Briefs," *University of California Institute on Global Conflict and Cooperation*, 2011; Evan A. Feigenbaum, *China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to Information Age*, Stanford University Press, 2003, 53; and *People's Daily*, "Reason for China's Development of Manned Spacecraft," January 17, 2003.

121. Mark Stokes, "China's Evolving Space and Missile Industry: Seeking Innovation in Long-Range Precision Strike," in Tai Ming Cheung, *Forging China's Military*

Might: A New Framework for Assessing Innovation, Johns Hopkins University Press, 2014, 244–245.

122. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, oral testimony of Mark Stokes, April 1, 2015; and Mark Stokes, "China's Evolving Space and Missile Industry: Seeking Innovation in Long-Range Precision Strike," in Tai Ming Cheung, *Forging China's Military Might: A New Framework for Assessing Innovation*, Johns Hopkins University Press, 2014, 244–245.

123. Mark Stokes, "China's Evolving Space and Missile Industry: Seeking Innovation in Long-Range Precision Strike," in Tai Ming Cheung, *Forging China's Military Might: A New Framework for Assessing Innovation*, Johns Hopkins University Press, 2014, 248–249.

124. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, oral testimony of Mark Stokes, April 1, 2015.

125. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, oral testimony of Mark Stokes, April 1, 2015.

126. Tai Ming Cheung (Director, University of California Institute on Global Conflict and Cooperation), interview with Commission staff, June 12, 2015; and Tai Ming Cheung, *China's Really Big Military R&D Effort* (Lowy Institute, October 6, 2013).

127. Tai Ming Cheung (Director, University of California Institute on Global Conflict and Cooperation), interview with Commission staff, June 12, 2015; and Tai Ming Cheung, "How Much Does China Spend on Defense-Related Research and Development" (2015 Workshop on Chinese Defense Science, Technology, and Innovation in a Period of Major Change, Washington, DC, February 9, 2015).

128. Tai Ming Cheung, "How Much Does China Spend on Defense-Related Research and Development" (2015 Workshop on Chinese Defense Science, Technology, and Innovation in a Period of Major Change, Washington, DC, February 9, 2015).

129. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, oral testimony of Dennis Gormley, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missiles*, oral testimony of Mark Stokes, April 1, 2015.

130. Commission assessment based on differentiated innovation levels described by Tai Ming Cheung, Thomas G. Mahnken, and Andrew L. Ross, "Frameworks for Analyzing Chinese Defense and Military Innovation," *Forging China's Military Might: A New Framework for Assessing Innovation*, Johns Hopkins University Press, 2014, 30–33.

131. Mark Stokes, "China's Evolving Space and Missile Industry: Seeking Innovation in Long-Range Precision Strike," in Tai Ming Cheung, *Forging China's Military Might: A New Framework for Assessing Innovation*, Johns Hopkins University Press, 2014, 264–265.

132. Mark Stokes, "China's Evolving Space and Missile Industry: Seeking Innovation in Long-Range Precision Strike," in Tai Ming Cheung, *Forging China's Military Might: A New Framework for Assessing Innovation*, Johns Hopkins University Press, 2014, 260, 264–265.

133. Frank A. Rose, "Ballistic Missile Defense and Strategic Stability in East Asia," (Federation of American Scientists Workshop, Washington, DC, February 20, 2015); U.S. Department of Defense, *Ballistic Missile Defense Review Report*, February 2010, 4–6.

134. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015.

135. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Twomey, April 1, 2015.

136. Gregory Kulacki, "The Chinese Military Updates China's Nuclear Strategy," *Union of Concerned Scientists*, March 2015, 6; Amy F. Woolf, "Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues," *Congressional Research Service*, February 6, 2015, Summary; and Lora Saalman, "Prompt Global Strike: China and the Spear," *Asia-Pacific Center for Security Studies*, April 16, 2014, 1, 5.

137. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015.

138. Ian E. Rinehart, Steven A Hildreth, and Susan V. Lawrence, "Ballistic Missile Defense in the Asia-Pacific Region: Cooperation and Opposition," *Congressional Research Service*, April 3, 2015, 17; and Brad Roberts, "China and Ballistic Missile Defense: 1955 to 2002 and Beyond," *Institute for Defense Analyses*, September 2003, 2, 19.

139. Frank A. Rose, "Missile Defense and the U.S. Response to the North Korean Ballistic Missile and WMD Threat" (Institute for Korean-American Studies, Wash-

ington, DC, May 19, 2015); U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015; and Choe Sang-Hun, "South Korea Tells China Not to Meddle in Decision Over Missile System," *New York Times*, March 17, 2015.

140. China's Ministry of National Defense, *Regular Press Conference*, March 26, 2015.

141. U.S. Department of Defense, *Annual Report to Congress on Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 32; Li Bin, "What China's Missile Intercept Test Means," *Carnegie Endowment for International Peace*, February 4, 2013; and Lora Saalman, "China's Evolution on Ballistic Missile Defense," *Carnegie Endowment for International Peace*, August 23, 2012.

142. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Robert Haddick, April 22, 2015.

143. Sydney J. Freedberg, Jr., "Army Explores New Missile Defense Options," *Breaking Defense*, February 18, 2015.

144. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Toshi Yoshihara, April 1, 2015.

145. U.S. Department of Defense, *Annual Report to Congress on Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 8; U.S. Senate Armed Services Committee, *Hearing on Worldwide Threats*, written testimony of Vincent R. Stewart, February 26, 2015; and U.S. Senate Armed Services Committee, *Hearing on Worldwide Threats*, written testimony of James Clapper, February 26, 2015.

146. Jeffrey Lewis, "Great, Now China's Got Multiple Nuclear Warhead Missiles?" *Foreign Policy*, May 26, 2015; U.S. Department of Defense, *Annual Report to Congress on Military and Security Developments Involving the People's Republic of China*, April 2015, 8; David E. Sanger and William J. Broad, "China Making Some Missiles More Powerful," *New York Times*, May 16, 2015; and Hans M. Kristensen, "Pentagon Report: China Deploys MIRV Missile," *FAS Strategic Security Blog*, May 11, 2015.

147. IHS Jane's Strategic Weapon Systems, "DF–41," January 6, 2015; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, April 2014, 7.

148. U.S. House Armed Services Subcommittee on Strategic Forces, *Hearing on Fiscal Year 2016 Budget Request for Strategic Forces*, written testimony of Cecil D. Haney, February 26, 2015.

149. Richard D. Fisher, "Evidence Emerges of Possible DF–31 ICBM Variant," *IHS Jane's Defense Weekly*, March 3, 2015.

150. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 1, 2015; IHS Jane's Strategic Weapon Systems, "DF–31," March 11, 2015; Minnie Chan, "China Puts On Show of Force with the DF–31B Mobile ICBM Missile Test," *South China Morning Post*, October 4, 2014; and Bill Gertz, "China Conducts Flight Test of New Mobile ICBM," *Washington Free Beacon*, October 2, 2014.

151. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 22, 2015.

152. Chairman of the Joint Chiefs of Staff, *Security Classification Policy for Multiple Independently Targetable Reentry Vehicles and Maneuverable Reentry Vehicles*, July 1, 2004. ID: CJCSI 5220.01A.

153. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Twomey, April 22, 2015; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 8.

154. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Dennis Gormley, April 22, 2015; and Ronald O'Rourke, "China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress," *Congressional Research Service*, June 1, 2015, 6–7.

155. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Christopher Yeaw, April 22, 2015; Richard Fisher (Senior Fellow, International Assessment and Strategy Center), interview with Commission staff, June 20, 2014; and William Lowther, "China Developing New Nuclear Missile," *Taipei Times*, March 6, 2014; and Bradley Perrett et al., "U.S. Navy Sees HGV as Part of Wider Threat," *Aviation Week and Space Technology*, January 27, 2014.

156. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015; Harry

Kazianis, "The Real Military Game-Changer: Hypersonic Weapons 101," *Lowy Institute for International Policy Interpreter Blog*, March 14, 2014; and Zachary Keck, "Will Hypersonic Capabilities Render Missile Defense Obsolete?" *Diplomat*, February 7, 2014.

157. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015; and Bill Gertz, "China Secretly Conducts Second Flight Test of New Ultra High-Speed Missile," *Washington Times*, August 19, 2014.

158. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015; and Harry Kazianis, "The Real Military Game-Changer: Hypersonic Weapons 101," *Lowy Institute for International Policy Interpreter Blog*, March 14, 2014.

159. Bill Gertz, "China Conducts Fifth Test of Hypersonic Glide Vehicle," *Washington Free Beacon*, August 21, 2015; and Bill Gertz, "China Confirms Hypersonic Missile Test: Defense Ministry Says Weapon not Directed at U.S.," *Washington Free Beacon*, June 13, 2015.

160. Harry Kazianis, "The Real Military Game-Changer: Hypersonic Weapons 101," *Lowy Institute for International Policy Interpreter Blog*, March 14, 2014; and Mark Stokes, "China's Quest for Joint Aerospace Power: Concepts and Future Aspirations," in Richard P. Hallion, Roger Cliff, and Phillip C. Saunders, eds., *The Chinese Air Force: Evolving Concepts, Roles, and Capabilities*, National Defense University Press, 2012, 50–51.

161. James Acton (Co-Director, Nuclear Policy program, Carnegie Endowment for International Peace), interview with Commission staff, May 26, 2015.

162. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015.

163. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015.

164. James Acton (Co-Director, Nuclear Policy program, Carnegie Endowment for International Peace), interview with Commission staff, May 26, 2015.

165. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Yeaw, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, testimony of Lee Fuell, January 30, 2014.

166. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015.

167. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of James Acton, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Yeaw, April 1, 2015.

168. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015; Lora Saalman, "Prompt Global Strike: China and the Spear," *Asia-Pacific Center for Security Studies*, April 16, 2014, p. 12; and Harry Kazianis, "The Real Military Game-Changer: Hypersonic Weapons 101," *Lowy Institute for International Policy Interpreter Blog*, March 14, 2014.

169. Lora Saalman, "China's Evolution on Ballistic Missile Defense," *Carnegie Endowment for International Peace*, August 23, 2012.

170. Brad Roberts, "China and Ballistic Missile Defense: 1955 to 2002 and Beyond," *Institute for Defense Analyses*, September 2003, 7–8.

171. Lora Saalman, "China's Evolution on Ballistic Missile Defense," *Carnegie Endowment for International Peace*, August 23, 2012.

172. Brad Roberts, "China and Ballistic Missile Defense: 1955 to 2002 and Beyond," *Institute for Defense Analyses*, September 2003, 13–14.

173. Lora Saalman, "China's Evolution on Ballistic Missile Defense," *Carnegie Endowment for International Peace*, August 23, 2012.

174. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 71.

175. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 71.

176. Frank A. Rose, "Ballistic Missile Defense and Strategic Stability in East Asia" (Federation of American Scientists Workshop, Washington, DC, February 20, 2015).

177. U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014.

178. U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 24.
179. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 35.
180. Andrew S. Erickson, "Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategic Implications," *Jamestown Foundation*, May 2013, 84–87.
181. Eric D. Pedersen, "Land- and Sea-Based C4ISR Infrastructure in China's Near Seas," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 77.
182. U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 25.
183. Eric D. Pedersen, "Land- and Sea-Based C4ISR Infrastructure in China's Near Seas," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 77–78.
184. U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 14.
185. Mark Stokes, "The Second Artillery Force and the Future of Long-Range Precision Strike," in Ashley Tellis and Travis Tanner, eds., *Strategic Asia 2012–2013: China's Military Challenge*, October 2012, 149.
186. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 36–37; and U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 22.
187. Open Source Center: Ji Jianchun, Wang Zhixin, Ge Song, "Accelerate Research of Law of Near Space—Proposal by Delegate Zhang Junxiang When Giving a Speech During PLA Delegation Panel Discussion," *Huojianbing Bao* (*Strategic Rocket Forces News*), March 10, 2015. ID: CHO2015051165561304; Ian Easton, "China's Evolving Reconnaissance-Strike Capabilities: Implications for the U.S.-Japan Alliance," *Project 2049 Institute*, 2014, 15; and Mark A. Stokes with Dean Cheng, "China's Evolving Space Capabilities: Implications for U.S. Interests," *Project 2049 Institute*, prepared for the U.S.-China Economic and Security Review Commission, April 26, 2012, 45.
188. Eric D. Pedersen, "Land- and Sea-Based C4ISR Infrastructure in China's Near Seas," in Peter Dutton, Andrew S. Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities*, U.S. Naval War College China Maritime Studies Institute, February 2014, 80–81.
189. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Force*, oral testimony of James Action, April 1, 2015; and Michael S. Chase and Evan Medeiros, "China's Evolving Nuclear Calculus: Modernization and Doctrinal Debate," in James Mulvenon and David Finkelstein, eds., *China's Revolution in Doctrinal Affairs: Emerging Trends in the Operational Art of the Chinese People's Liberation Army*, CNA, 2002, 147–152.
190. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Twomey, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Yeaw, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on Developments in China's Cyber and Nuclear Capabilities*, written testimony of Phillip C. Saunders, March 26, 2012.
191. Christopher Twomey (Associate Professor, U.S. Naval Postgraduate School), interview with Commission staff, July 20, 2015.
192. U.S. Department of Defense, *Annual Report to Congress on Military and Security Developments Involving the People's Republic of China 2014*, April 24, 2014, 12; Michael S. Chase, "The Second Artillery Force in the Xi Jinping Era," *China Brief* 13:7 (March 28, 2013); and Michael S. Chase and Andrew Erickson, "The Conventional Missile Capabilities of China's Second Artillery Force: Cornerstone of Deterrence and Warfighting," *Asian Security* 8:2 (July 12, 2012): 128.
193. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 1–2.
194. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 1–2; Open Source Center, "China Expands Cross-region Training to Artillery, Air Defense Brigades in 'Firepower-2014'" *OSC Media Note*, April 22, 2015. ID: CHL 2015042248214971; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, testimony of Dennis Gormley, April 1, 2015;

U.S. Department of Defense, *Annual Report to Congress on Military and Security Developments Involving the People's Republic of China 2014*, April 24, 2014, 12; and China Military Online, "News Survey Report on 'Joint Operation-2014' Actual-Troop Exercises," November 2, 2014.

195. Open Source Center, "JFJB 'Sidelights' on PLAN's Joint Operations Exercise in South China Sea," July 29, 2015. ID: CHR20150729007161013; and Open Source Center, "PLA Navy Researcher, Other Experts Comment on Role of the 2nd Artillery in South China Sea Exercises," July 30, 2015. ID: CHO2015073055374244.

196. Open Source Center, "Yin Zhuo: SCS Exercises Show PLA ASW Capabilities Improved," July 30, 2015. ID: CHO2015073055948281; and Open Source Center, "PRC: Military Expert on 2nd Artillery Missiles in Antiship Role in South China Sea," July 30, 2015. ID: CHO2015073054565335.

197. Zhang Jian, Qin Tao, and Li Mingri, "PLA 2nd Artillery Base Logistics Department Enhances Planning, Command Capabilities," *Huojianbing Bao Online*, February 27, 2015. Open Source Center translation. ID: CHR 2015033072859388; and U.S.-China Economic and Security Review Commission, *Hearing on China's Military Modernization and Implications for the United States*, written testimony of Lee Fuell, January 30, 2014.

198. Open Source Center: Zhou Yuan and Zhang Baoqi, "JFJB: Jinan MR Artillery Brigade Emphasizes Data Analysis When Replaying War Games," *Jiefangjun Bao Online*, March 30, 2015. ID: CHN2015033006705761; Open Source Center: Yu Juncheng, Zhou Bo, and Song Haijun, "PLA 2nd Artillery Brigade Three-Peats Class-A Title Without Covering Up Defects in Training," *Huojianbing Bao Online*, January 21, 2015. ID: CHL2015042965098205; and Open Source Center: Zhou Bo, "PLA 2nd Artillery Brigade Combines Great Discussion on Combat Power Criterion, Readiness Training," *Huojianbing Bao Online*, October 18, 2014. ID: CHL2015021 865916324.

199. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, April 2015, 2; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, April 24, 2014, 12.

200. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015.

201. Robert Work, "Speech" (China Aerospace Studies Institute, RAND Corporation, Arlington, VA, June 22, 2015); Kenneth Todorov, "Remarks on Policy and Operations," (Next Steps in Missile Defense, Center for Strategic and International Studies, Washington, DC, April 7, 2015); Richard Matlock, "Remarks on Future Directions," (Next Steps in Missile Defense, Center for Strategic and International Studies, Washington, DC, April 7, 2015); U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015; and U.S. Joint Chiefs of Staff, *Joint Integrated Air and Missile Defense: Vision 2020*, December 5, 2013, 3–5.

202. Andrew Krepinevich (President, Center for Strategic and Budgetary Assessments), interview with Commission staff, June 2, 2015; John Stillion (Senior Fellow, Center for Strategic and Budgetary Assessments), interview with Commission staff, June 2, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015; and Harry Kazianis, "The Real Military Game-Changer: Hypersonic Weapons 101," *Lowy Institute for International Policy Interpreter Blog*, March 14, 2014.

203. Sydney J. Freedberg, Jr., "Army Explores New Missile Defense Options," *Breaking Defense*, February 18, 2015.

204. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015.

205. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Toshi Yoshihara, April 1, 2015.

206. Avery Goldstein (Professor and Director of the Center for the Study of Contemporary China, University of Pennsylvania), interview with Commission staff, June 8, 2015.

207. U.S. Department of State, *2015 Report on Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments*, June 5, 2015; and U.S. Department of State, *Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments*, July 31, 2014.

208. Evan Braden Montgomery, "China's Missile Forces Are Growing: Is It Time to Modify the INF Treaty?" *National Interest*, July 2, 2014; Steven Pifer, "Don't Scrap the INF Treaty," *National Interest*, June 9, 2014; and Elbridge Colby, "The Real Trouble with Russia: Moscow Might Have Violated the Intermediate-Range Nuclear Forces Treaty—Here's How to Respond," *Foreign Affairs*, April 7, 2014.

209. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Evan Braden Montgomery, April 1, 2015.

210. Matthew Hallex, "China's Mighty Missile Threat: What Should America Do about It?" *National Interest*, September 13, 2014; and Steven Pifer, "Don't Scrap the INF Treaty," *National Interest*, June 9, 2014.

211. Avery Goldstein, "China's Real and Present Danger," *Foreign Affairs*, August 12, 2013.

212. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Yeaw, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Elbridge Colby, April 1, 2015.

213. U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of James Acton, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, oral testimony of Christopher Yeaw, April 1, 2015; and U.S.-China Economic and Security Review Commission, *Hearing on China's Offensive Missile Forces*, written testimony of Elbridge Colby, April 1, 2015.