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**NAVAL
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MONTEREY, CALIFORNIA

THESIS

**CHINA'S NUCLEAR MODERNIZATION: ASSESSING
STRATEGY AND INADVERTENT ESCALATION**

by

Michael C. Canavati

December 2021

Thesis Advisor:

Christopher P. Twomey

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**CHINA'S NUCLEAR MODERNIZATION: ASSESSING STRATEGY AND
INADVERTENT ESCALATION**

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Lieutenant, United States Navy
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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

Chinese nuclear modernization has continued since China became a nuclear weapons state in 1964. As China's nuclear arsenal and nuclear-related infrastructure progressed, Chinese declaratory strategies of active defense and no-first-use (NFU) have remained resolute. This thesis examines how Chinese strategies may or may not be driving China's nuclear modernization from the years 2000 through 2020. In order to determine the extent to which strategy has influenced China's nuclear modernization, this thesis explores Chinese nuclear capabilities, training and exercises, and declaratory policy. Additionally, this thesis also addresses the prospect of Chinese nuclear escalation based on related theoretical approaches.

After taking into account each factor considered for China's nuclear modernization, this thesis concludes that China's nuclear modernization is not solely driven by its existing strategies of NFU or active defense. Though China remains consistent in advertising its espoused strategies, its nuclear modernization raises some concerns regarding its continued adherence to NFU. Additionally, Chinese ambiguity of strategy and more forward-leaning modernization suggests that active defense incorporates both deterrence and, now, the potential use of nuclear weapons to achieve coercive outcomes. Due to China's robust nuclear modernization that has resulted in additional warfighting options, this thesis finds that escalation across the nuclear threshold is more likely.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABM	anti-ballistic missile
ALBM	air-launched ballistic missile
C2	command and control
C3	command, control, and communications
C3ISR	command, control, communications, intelligence, surveillance, and reconnaissance
C4ISR	command, control, communications, computers, intelligence surveillance, and reconnaissance
CBRN	chemical, biological, radiological, and nuclear
CEP	circular error probable
CLTC	China Launch and Tracking Control
CMC	Central Military Commission
CPGS	Conventional Prompt Global Strike
D&D	denial and deception
DOD	Department of Defense
EMP	electromagnetic pulse
GEO	geosynchronous orbit
HGV	hypersonic glide vehicle
ICBM	intercontinental ballistic missile
INF	Intermediate-range Nuclear Forces
IRBM	intermediate-range ballistic missile
ISR	intelligence, surveillance, and reconnaissance
LEO	low earth orbit
LOW	launch-on-warning
LPAR	large-phased array radar
MARV	maneuverable reentry vehicle
MIRV	multiple independent reentry vehicle
MRBM	medium-range ballistic missile
NC3	nuclear command, control, and communications
NCO	non-commissioned officer

NFU	no-first-use
PLA	People's Liberation Army
PLAAF	People's Liberation Army Air Force
PLAN	People's Liberation Army Navy
PLARF	People's Liberation Army Rocket Force
PLASAF	People's Liberation Army Second Artillery Force
PRC	People's Republic of China
SBIRS	Space Based Infrared System
SLBM	submarine-launched ballistic missile
SSA	space situational awareness
SSBN	ballistic missile submarine
TT&C	telemetry, tracking, and command and control

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I. INTRODUCTION

A. MAJOR RESEARCH QUESTION

The most recent United States Department of Defense (DOD) annual report on China to the U.S. Congress, *Military and Security Developments Involving the People's Republic of China 2020*, details the complexity of China's nuclear modernization and considers the potential of nuclear force modernization bringing changes to China's nuclear strategy.¹ In addition to the U.S. government's report on China's military power, a 2017 RAND report notes that the modernization of China's nuclear force can lead to "previously unavailable policy options for military strategists."² Multiple defense analysts and scholars have noted that China's military strategy is based on the concept of *active defense*, which broadly covers strategic defense and an effective counterattack capability.³ Furthermore, China maintains a no-first-use (NFU) policy that means it will not use its nuclear weapons against another country first.

However, quantitative and qualitative Chinese nuclear-force related developments may fit within or outside of an espoused strategy. Some have considered China's nuclear-force developments indicating a deliberate move towards an unprecedented launch-on-warning (LOW) posture, for example.⁴ The debate of which strategy or posture China's nuclear modernization truly reflects has been persistent and also entails how Chinese security concerns may have affected nuclear modernization. Given the grave security ramifications of nuclear weapons that may come from inadvertent escalation, and that

¹ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2020* (Washington, DC: Department of Defense, 2020), 85.

² Eric Heginbotham et al., *China's Evolving Nuclear Deterrent: Major Drivers and Issues for the United States* (Santa Monica, CA: RAND Corporation, 2017), xii, <http://www.rand.org/t/RR1628>.

³ Pan Zhenqiang, "China's No First Use of Nuclear Weapons," in *Understanding Chinese Nuclear Thinking*, ed. Li Bin and Tong Zhao (Washington, DC: Carnegie Endowment for International Peace, 2016), 51; Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2020* (Washington, DC: Department of Defense, 2020), vi.

⁴ Christopher Twomey, "China's Nuclear Doctrine and Deterrence Concept," in *China's Strategic Arsenal: Worldview, Doctrine, and Systems*, ed. James Smith and Paul Bolt (Washington, DC: Georgetown University Press, 2021), 45, 52–53; Department of Defense, *2020 DOD China Military Power Report*, ix.

nuclear weapons appear to be a core component ensuring China's security, it is critical to understand the interaction between strategy and modernization.⁵ Thus, the major research question to be considered by this thesis is: How are Chinese strategies driving China's nuclear modernization?

In addition to the major research question, this thesis intends to address how China's recent nuclear related-developments could affect the possibility of its nuclear escalation. Some have found that because U.S. conventional capabilities pose a threat to China's strategic weapons, Chinese nuclear escalation in a conflict is possible.⁶ Conversely, others argue that since advancement in nuclear force developments can increase deterrence, it is less likely that a conflict will surpass nuclear thresholds.⁷ By examining what Chinese nuclear force-related developments have occurred, this thesis intends build on to previous scholarship for assessing nuclear escalation risk.

B. SIGNIFICANCE OF THE RESEARCH QUESTION

The possibility of great powers such as China and the United States breaching nuclear thresholds during a conflict is certainly terrifying. Just as with any nuclear weapon-holding state, China possesses nuclear weapons that undoubtedly pose a perilous threat to global security if nuclear thresholds are crossed.⁸ Nuclear states such as China will look to secure national interests just as non-nuclear states do.⁹ Understanding why nuclear weapons are developed and how they can support a national policy objective helps frame why states pursue nuclear weapons. However, the possibility of inadvertent nuclear

⁵ Heginbotham et al., "China's Evolving Nuclear Deterrent," 23.

⁶ Caitlin Talmadge, "Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States," *International Security* 41, no. 4 (April 2017): 90, https://doi.org/10.1162/ISEC_a_00274.

⁷ Talmadge, 91.

⁸ Twomey, "China's Nuclear Doctrine and Deterrence Concept," 58.

⁹ Twomey, 49.

escalation is ever-present and can lead to a disastrous nuclear war.¹⁰ Reviewing China's nuclear development may help avoid the dire consequences of crossing nuclear thresholds. Likewise, thinking through nuclear modernization outcomes may prevent further loss of life in the unfortunate event of a conflict that does transcend nuclear thresholds.

C. LITERATURE REVIEW

There is a vast amount of literature covering China's nuclear strategy and modernization. In reviewing the literature surrounding previous nuclear dynamics between Great Powers and China's nuclear forces, the first section of the literature review broadly examines historical perspective and theory to give background to great powers and security complications. The second and third sections review nuclear and military strategy in the literature pertaining to China to understand possible explanations for nuclear related force development. Finally, the fourth section surveys literature pertaining to nuclear and conventional force entanglement.

1. Historical Perspective and Theory

Scholars have used historical perspectives to explain, or understand, nuclear weapons and national strategies between great powers during the Cold War. The Cold War showed that nuclear weapons may help deter another belligerent's capabilities such as conventional weapons.¹¹ Nuclear weapons, while dangerous, can also create stability; how a country uses nuclear weapons is important.¹² There is a divide between perspectives on nuclear weapons use: some scholars believe that nuclear weapons can produce peace and others believe it is sheer luck which has prevented a nuclear catastrophe.¹³

¹⁰ John Lewis and Litai Xue, "Making China's Nuclear War Plan," *Bulletin of the Atomic Scientists* 68, no. 5 (2012): 61–62, <https://doi.org/10.1177/0096340212459155>; Fiona Cunningham and M. Taylor Fravel, "Dangerous Confidence? Chinese Views on Nuclear Escalation," *International Security* 44, no. 2 (2019): 102, 108, https://doi.org/10.1162/isec_a_00320.

¹¹ Francis Gavin, *Nuclear Statecraft: History and Strategy in America's Atomic Age*, *Cornell Studies in Security Affairs* (Ithaca: Cornell University Press, 2012), 160.

¹² Gavin, 169.

¹³ Gavin, 159–60.

Scholars have used different theoretical lenses to cope with force modernization and highlight different outcomes. For example, some scholars would favor nuclear weapons since they can act as a deterrent.¹⁴ Even more dangerous because of its implications for security, however, one scholar notes that states may also look to always maximize their relative power for security rather than seek a balance.¹⁵ Because a state may maximize its relative power, a state's nuclear weapons development could surpass an asserted nuclear weapons strategy according to scholars.¹⁶

Multiple perspectives and dynamics contribute to nuclear security competition such as states seeking mutual vulnerability.¹⁷ According to one scholar, policy analysts have noted that a first strike capability can produce strategic instability, whereas a secure second strike capability between countries can produce mutual vulnerability and produce greater strategic stability.¹⁸ However, scholars argue because states may look to take defensive measures, defensive countermeasures will follow and create additional instability.¹⁹ Great Powers may have conflicting views on nuclear and conventional capabilities.²⁰ Consequently, countries see value in expanding their own military capabilities as a form of deterrence though other countries may primarily see this progress as a means of military superiority during a potential conflict.

2. Active Defense and Counterstrike

Starting with China's overarching active defense military strategy and related nuclear counterstrike force, though nuclear development may be perilous, there is a general

¹⁴ Gavin, 159; Terence Roehrig, "The U.S. Nuclear Umbrella over South Korea: Nuclear Weapons and Extended Deterrence," *Political Science Quarterly* 132, no. 4 (2017): 656, 671, <https://doi.org/10.1002/polq.12702>.

¹⁵ John Mearsheimer, *The Tragedy of Great Power Politics* (W.W. Norton & Company, 2001), 53.

¹⁶ Twomey, "China's Nuclear Doctrine and Deterrence Concept," 52; David C. Logan, "Are They Reading Schelling in Beijing? The Dimensions, Drivers, and Risks of Nuclear-Conventional Entanglement in China," *Journal of Strategic Studies*, 2020, 27–29, <https://doi.org/10.1080/01402390.2020.1844671>.

¹⁷ Gavin, *History and Strategy in America's Atomic Age*, 123–24.

¹⁸ Gavin, 123–24.

¹⁹ Gavin, 124.

²⁰ Kristin Ven Bruusgaard, "Russian Nuclear Strategy and Conventional Inferiority," *Journal of Strategic Studies*, 2020, 11, 19, <https://doi.org/10.1080/01402390.2020.1818070>.

agreement among Chinese scholars that nuclear modernization is critical for China's security.²¹ However, other scholars argue that while nuclear force modernization may boost the effectiveness, it can also indicate a shift in nuclear posture.²² This being said, scholars reviewed have also identified how China has sought to modernize its forces for future war efforts since at least the mid-20th century.²³

Scholars have attempted to use various theoretical approaches to rationalize China's nuclear modernization. *Minimum deterrence* is one western strategy that has been used to justify modernization. According to one Chinese scholar, minimum deterrence fits best because it qualitatively pledges nuclear force invulnerability, a counterattack capability, and assured retaliation.²⁴ This western approach to nuclear strategy has also been reviewed by western scholars for China.²⁵ *Limited deterrence* is another approach and has been rejected in describing China's nuclear posture since it would mean an ability to win, rather than deter, a nuclear conflict.²⁶

Adding on to China's nuanced active defense strategy, scholars have attempted to interpret Chinese thinking by leveraging Chinese publications. Based on three types of deterrence strategies from China's 2001 *Zhanlue Xue*, a Chinese military strategy publication, some scholars such as Taylor Fravel and Evan Medeiros believe that *moderate intensity deterrence* best explains China's nuclear strategy because it is characterized as a nuclear force that is "sufficient and effective...to threaten an opponent by imposing on him

²¹ Sun Xiangli, "The Development of Nuclear Weapons in China," in *Understanding Chinese Nuclear Thinking* (Washington, DC: Carnegie Endowment for International Peace, 2016), 84.

²² M. Taylor Fravel and Evan S. Medeiros, "China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure," *International Security* 35, no. 2 (October 2010): 84–85, https://doi.org/10.1162/ISEC_a_00016; John Wilson Lewis and Litai Xue, "China's Search for a Modern Air Force," *International Security* 24, no. 1 (1999): 82–83, <https://doi.org/10.1162/016228899560059>.

²³ John Lewis and Litai Xue, *China Builds the Bomb* (Stanford: Stanford University Press, 1988), 35–36; John Lewis and Litai Xue, *China's Strategic Seapower: The Politics of Force Modernization in the Nuclear Age* (Stanford: Stanford University Press, 1994), 212–14.

²⁴ Yao Yunzhu, "Chinese Nuclear Policy," in *Perspectives on Sino-American Strategic Nuclear Issues*, ed. Christopher Twomey (New York: Palgrave Macmillan, 2008), 116–17.

²⁵ Fravel and Medeiros, "China's Search for Assured Retaliation," 50; Alastair Iain Johnston, "China's New 'Old Thinking': The Concept of Limited Deterrence," *International Security* 20, no. 3 (1995): 19–20, 35, <https://doi.org/10.2307/2539138>.

²⁶ Yunzhu, "Chinese Nuclear Policy," 117.

an unbearable destruction to a certain extent so as to attain the objective of one's deterrent."²⁷ This seems to be related to China's overall active defense military strategy for a capable nuclear counterstrike force. Scholars have noted that part of an effective and credible nuclear strategy for China is the ability to convince an opponent of its resolve to use nuclear weapons when needed.²⁸

Complicating the notion of active defense are the broad terms of *lean* and *effective*, which China's Defense White Papers have used consistently to characterize Chinese nuclear arsenal and reasoning for modernization.²⁹ In explaining Chinese nuclear modernization, Chinese scholars and defense officials have reiterated Chairman Mao Zedong's guideline for the use of force which characterizes a defensive posture, boasting China's active defense strategy; Chairman Mao Zedong states, "We will never attack unless we are attacked; and if we are attacked, we will certainly counterattack."³⁰ China's last three Defense White Paper display countenance for counterattack.³¹ In the 2006 Defense White Paper, China connected its nuclear service with deterrence value and the prospect to improve its nuclear and conventional forces.³²

In the opinion of Chinese scholars, a lean and effective force suggests there is both adequate technology and deployments methods to ensure the deterrence of an enemy's

²⁷ Fravel and Medeiros, "China's Search for Assured Retaliation," 78.

²⁸ Nan Li, "China's Evolving Nuclear Strategy: Will China Drop 'No First Use?,'" *The Jamestown Foundation: China Brief* 18, no. 1 (January 2018): 9.

²⁹ Amy F Woolf, *Conventional Prompt Global Strike and Long Range Ballistic Missiles: Background and Issues*, Report no. R41464 (Washington, DC: Congressional Research Service, 2020), 221, <https://crsreports.congress.gov/product/pdf/R/R41464>.

³⁰ Yunzhu, "Chinese Nuclear Policy," 116.

³¹ The State Council Information Office of the People's Republic of China, "2000 Defense White Paper," Andrew S. Erickson, China Analysis From Original Sources, 2000, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2000_English.pdf; The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," Andrew S. Erickson, China Analysis From Original Sources, 2015, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2015_English-Chinese_Annotated.pdf; The State Council Information Office of the People's Republic of China, "2019 Defense White Paper," Andrew S. Erickson, China Analysis From Original Sources, 2019, <https://www.andrewerickson.com/2019/07/full-text-of-defense-white-paper-chinas-national-defense-in-the-new-era-english-chinese-versions/>.

³² Lewis and Xue, "Making China's Nuclear War Plan," 49.

nuclear first-strike.³³ This means that China's nuclear weapons should not be judged just by the quantity, but also by the quality of nuclear weapons that can achieve an operational outcome. In this context, other Chinese scholars have emphasized that China's nuclear weapons development will be restrained in the framework of being lean and effective in order to achieve high survivability and offer a deterrence value.³⁴ Thus, if there is no nuclear weapons effectiveness to achieve deterrence, there is no value to nuclear weapons; similarly, if nuclear weapons are not lean, they will not achieve their deterrence value.³⁵

According to multiple scholars, concealment, security, mobility, and low levels of alert during peacetime are considered guidelines for China's nuclear forces.³⁶ These guidelines are probably most associated with the foundation of survivability. In referencing the 1987 *Zhanlue Xue*, another Chinese scholar states that for survivability, increasing increase the number of bases for operations in order to increase the targeting difficulty for the enemy.³⁷ The different areas identified alone may give a more solid foundation to advocate for active defense and counterattack, making it more difficult to provide an accurate assessment that would argue against China's long-term strategy that can bolster its nuclear deterrence.

Scholars have noted how areas of modernization could signal a change in China's strategy of active defense and NFU. Studies have focused on ways to identify how current modernization fits into the continuation of China's nuclear policy and strategy.³⁸ Similarly,

³³ Li Bin, "Differences Between Chinese and U.S. Nuclear Thinking and Their Origins," in *Understanding Chinese Nuclear Thinking*, ed. Li Bin and Tong Zhao (Washington, DC: Carnegie Endowment for International Peace, 2016), 13.

³⁴ Xiangli, "The Development of Nuclear Weapons in China," 84.

³⁵ Xiangli, 84.

³⁶ Xiangli, 89; Wu Riqiang, "Living with Uncertainty: Modeling China's Nuclear Survivability," *International Security* 44, no. 4 (2020): 117–18, https://doi.org/10.1162/isec_a_00376; Wu Riqiang, "Certainty of Uncertainty: Nuclear Strategy with Chinese Characteristics," *Journal of Strategic Studies* 36, no. 4 (2013): 587, <https://doi.org/10.1080/01402390.2013.772510>; Lewis and Xue, *China's Strategic Seapower*, 236.

³⁷ Fravel and Medeiros, "China's Search for Assured Retaliation," 70.

³⁸ Fiona Cunningham and M. Taylor Fravel, "Assuring Assured Retaliation: China's Nuclear Posture and U.S.-China Strategic Stability," *International Security* 40, no. 2 (2015): 26, https://doi.org/10.1162/ISEC_a_00215; Cunningham and Fravel, "Dangerous Confidence? Chinese Views on Nuclear Escalation," 91–92.

scholars have also attempted to identify areas of modernization that may signal a change in China's nuclear posture in response to China's national security concerns.³⁹

3. No-First-Use (NFU) and Launch-on-Warning (LOW)

Next, some scholars have identified how NFU and LOW contain overlap between the two strategies.⁴⁰ Starting with NFU, China's commitment to NFU may be overshadowed by its force modernization and complex crisis scenarios. One scholar assessed that, based on emerging capabilities, China's last barrier to establishing a nuclear war fighting posture is its NFU commitment.⁴¹ In suspecting the possibility of a Chinese nuclear first strike, the same scholar critiques China's long-held commitment to its NFU policy by pointing to Chinese strategists which have attempted to address the range of conditions which would threaten China's commitment to NFU. Chinese defense officials have reviewed how threatening conditions could prompt a nuclear first strike from China.⁴² If NFU is caveated with just a handful of these conditions, there seems to be an immense amount of scenarios in which conflict would probably lead to nuclear escalation. In addition to this, some Chinese scholars have contradicted the characterization of China's nuclear weapons philosophy.⁴³

Research has shown how nuclear-related modernization efforts to support managing a nuclear threshold could indicate China's attempts to caveat or manage its nuclear threshold. For example, tactical nuclear weapons give additional nuclear warfare options for Chinese decision-makers to use nuclear weapons pre-emptively instead of only committing to NFU and reserving strategic nuclear weapons until after an opponent's first strike.⁴⁴ The same scholar believes that nuclear-capable intermediate-range ballistic

³⁹ Fravel and Medeiros, "China's Search for Assured Retaliation," 84–85.

⁴⁰ Cunningham and Fravel, "Assuring Assured Retaliation," 30–31.

⁴¹ James Samuel Johnson, "Chinese Evolving Approaches to Nuclear 'War-Fighting': An Emerging Intense US–China Security Dilemma and Threats to Crisis Stability in the Asia Pacific," *Asian Security* 15, no. 3 (2019): 221, <https://doi.org/10.1080/14799855.2018.1443915>.

⁴² Li, "Will China Drop 'No First Use?,'" 10.

⁴³ Li, 56–57.

⁴⁴ Johnson, "Chinese Evolving Approaches to Nuclear 'War-Fighting,'" 222.

missiles (IRBMs) and medium-range ballistic missiles (MRBMs) present China a range of military options in this regard as well.

Another debate among scholars is what exactly constitutes first use for China. One scholar explains that some Chinese strategists have noted that a counterattack, also known as second strike, is not necessarily indicative of a passive approach to first use, as China could consider employing nuclear weapons before approaching nuclear weapons explode.⁴⁵ Another scholar has noted that China's Defense White Papers since 2004 mentioned the importance of nuclear quick-response, and another has mentioned that the 2015 white paper is the first instance of a nuclear early warning capability being mentioned.⁴⁶ Possibilities of a nuclear counterattack capability could depend on a near-real time early warning system.⁴⁷ In addition, observing what space-based intelligence, surveillance, and reconnaissance capabilities support such an early warning system and if there have been improvements in command, control, and communications could be indicative for this type of posture.⁴⁸ This has implications for the erosion of NFU as well as a possible LOW posture.

Still, there is a level of difficulty to determine whether nuclear capabilities signal a movement to launch-on-warning. Multiple scholars differ on whether a launch-on-warning posture is necessary to uphold China's strategy of counterattack.⁴⁹ In describing the counterattack posture, which includes elements of a defensive posture and survivability, one Chinese scholar states that China's warheads are usually separated from the

⁴⁵ Johnston, "China's New 'Old Thinking,'" 22.

⁴⁶ The State Council Information Office of the People's Republic of China, "2015 Defense White Paper"; Tong Zhao, "Changes in and the Evolution of China's Nuclear Thinking," in *Understanding Chinese Nuclear Thinking*, ed. Li Bin and Tong Zhao (Washington, DC: Carnegie Endowment for International Peace, 2016), 269; Johnson, "Chinese Evolving Approaches to Nuclear 'War-Fighting,'" 219.

⁴⁷ Johnston, "China's New 'Old Thinking,'" 22.

⁴⁸ Heginbotham et al., "China's Evolving Nuclear Deterrent," 143; Johnson, "Chinese Evolving Approaches to Nuclear 'War-Fighting,'" 219.

⁴⁹ Pan Zhenqiang, "The Changing Strategic Context of Nuclear Weapons and Implications for the New Nuclear World Order," in *Perspectives on Sino-American Strategic Nuclear Issues*, ed. Christopher Twomey (New York: Palgrave Macmillan, 2008), 117; Cunningham and Fravel, "Assuring Assured Retaliation," 30–31.

intercontinental ballistic missile (ICBM) launchers.⁵⁰ The same scholar describes China's nuclear technological developments such as the development of a nuclear triad being in step with NFU as China does not participate in arms races and holds to its foundational tenets previously mentioned.

4. Nuclear Entanglement and Conventional Capabilities

It is difficult to determine the nuclear strategy of an opaque country such as China, and the debate among scholars on whether China will prioritize its conventional or nuclear forces exacerbates this issue. According to these scholars, states may look to overcome conventional inferiority with nuclear weapons; similarly, states may look to overcome nuclear inferiority with conventional weapons.⁵¹ One Chinese scholar has noted that its NFU policy restrains China from relying on nuclear weapons despite the possibility of conventional inferiority.⁵² This is contrasted with western scholars who argue that China's opacity of its nuclear forces, as a dilemma of survivability, and the entanglement with conventional weapons complicate the intricacies of crisis scenarios and possibility for crossing nuclear thresholds.⁵³

There is considerable discussion on how mutual vulnerability concerns can initiate force modernization. For example, Chinese scholars and defense analysts have noted concerns over United States conventional weapons capabilities such as the Conventional Prompt Global Strike (CPGS) program to deliver precision guided munitions.⁵⁴ The CPGS program ultimately intends to give conventional options to the United States so as to not

⁵⁰ Pan Zhenqiang, "A Study of China's No-First-Use Policy on Nuclear Weapons," *Journal for Peace and Nuclear Disarmament* 1, no. 1 (January 2, 2018): 117–18, <https://doi.org/10.1080/25751654.2018.1458415>.

⁵¹ Ven Bruusgaard, "Russian Nuclear Strategy and Conventional Inferiority," 25–26.

⁵² Zhenqiang, "A Study of China's No-First-Use Policy on Nuclear Weapons," 119.

⁵³ David C. Logan, "Career Paths in the PLA Rocket Force: What They Tell Us," *Asian Security* 15, no. 2 (2018): 2, 4, 13, <https://doi.org/10.1080/14799855.2017.1422089>; Cunningham and Fravel, "Dangerous Confidence? Chinese Views on Nuclear Escalation," 106; Heginbotham et al., "China's Evolving Nuclear Deterrent," 548.

⁵⁴ Brad Roberts, "Taking Stock: U.S. China Track 1.5 Nuclear Dialogue" (Livermore, CA: Center for Global Security Research - Lawrence Livermore National Laboratory, 2020), 10.

resort to nuclear weapons.⁵⁵ Similar concerns can be noted for the United States as Chinese and Russian technological advancements may be a causal factor for United States' force modernization.⁵⁶

In addition to CPGS, treaty expirations and improvements in surveillance applications are security concerns for China. The expiration of the Anti-Ballistic Missile (ABM) Treaty in 2002 and Intermediate-Range Nuclear Forces (INF) Treaty in 2019 are concerns for China due to ongoing improvements and potential advancements in U.S. conventional and nuclear capabilities that could threaten China's security.⁵⁷ For surveillance capabilities, improvements in United States intelligence, surveillance, and reconnaissance (ISR) may help improve targeting against China's nuclear forces and further pressure modernization efforts.⁵⁸ The same scholars note how ISR improvements can lead to inadvertent escalation since C3I systems are often entangled with conventional and nuclear weapons. Thus, China's force modernization can possibly be explained as a counterbalance to another country's nuclear and conventional capabilities.⁵⁹

D. POTENTIAL EXPLANATIONS AND HYPOTHESES

There are three hypotheses that I have chosen to examine in reviewing the extent to which China's nuclear strategy has affected its nuclear modernization. All three

⁵⁵ Woolf, "Conventional Prompt Global Strike and Long Range Ballistic Missiles," 48.

⁵⁶ Woolf, 46–47.

⁵⁷ "The Effects of NMD on Chinese Strategy," Jane's, March 1, 2001, <https://customer.janes.com/Janes/Display/jir00121-jir-2001>; Zhenqiang, "The Changing Strategic Context of Nuclear Weapons and Implications for the New Nuclear World Order," 59; Information Office of the State Council, "White Paper on China's National Defense in 2002" (China, 2002), <http://en.people.cn/features/ndpaper2002/nd.html>; Eric Heginbotham, Jacob Heim, and Christopher Twomey, "Of Bombs and Bureaucrats: Internal Drivers of Nuclear Force Building in China and the United States," *Journal of Contemporary China* 28, no. 118 (2019): 545, <https://doi.org/10.1080/10670564.2018.1557945>; Linton Brooks and Mira Rapp-Hooper, "Extended Deterrence, Assurance, and Reassurance in the Pacific during the Second Nuclear Age," in *Strategic Asia 2013–2014: Asia in the Second Nuclear Age*, ed. Ashley Tellis, Abraham Denmark, and Travis Tanner (Seattle: National Bureau of Asian Research, 2013), 297, <https://muse.jhu.edu/book/52368>.

⁵⁸ Riqiang, "Living with Uncertainty," 104–6, 110; Cunningham and Fravel, "Assuring Assured Retaliation," 15; James Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War," *International Security* 43, no. 1 (2018): 57–58, 97–98, https://doi.org/10.1162/isec_a_00320; Avery Goldstein, "First Things First: The Pressing Danger of Crisis Instability in U.S.-China Relations," *International Security* 37, no. 4 (2013): 67–69, https://doi.org/10.1162/ISEC_a_00114.

⁵⁹ Kenneth Waltz, *Theory of International Politics* (Long Grove: Waveland Press, 1979), 95.

hypotheses are derived from various contemporary theoretical and analytical approaches to China's nuclear modernization which have possibly been influenced by nuclear strategies. The three competing hypotheses are:

1. China's nuclear modernization is representative of its overall active defense strategy for a capable nuclear counterstrike force.
2. China's nuclear modernization reflects the adoption of, or moving towards, a more offensive strategy through the adoption of a launch-on-warning (LOW) posture.
3. China's nuclear modernization is restrained because of NFU, making it hesitant to modernize aspects of its nuclear force.

The first hypothesis argues that China's nuclear modernization is consistent with its overall active defense military strategy. A nuclear modernization consistent with active defense would signal China's resolve to stay committed to its overarching military strategy. Both the concept of assured retaliation and developing a retaliatory force which can survive a first strike is indicative of maintaining an overarching active defense strategy.⁶⁰ A possible shift from active defense would highlight a change from previous analysis signifying China's consistency despite nuclear modernization.⁶¹ Though active defense is strategically defensive, it may incorporate operational and tactical offensive actions.⁶²

If China has maintained consistent declaratory policy of active defense, its force modernization should mainly consist of survivability for a deterrence value. In examining the survivability of nuclear forces, aspects of mobility, concealment, penetrability, and alert levels are aspects to consider. Shifts from an active defense strategy would be open source analysis and secondary sources indicating less concealment and possibly heightened alert levels. Penetrability advancements should be pursued to overcome an enemy's capability

⁶⁰ Taylor Fravel, *Active Defense: China's Military Strategy Since 1949* (Princeton: Princeton University Press, 2019), 269.

⁶¹ Michael Chase, "China's Transition to a More Credible Nuclear Deterrent: Implications and Challenges for the United States," *Asia Policy* 16, no. 1 (2013): 52, <https://doi.org/10.1353/asp.2013.0028>.

⁶² Department of Defense, *2020 DOD China Military Power Report*, 24.

such as missile defense and maintain a deterrence value. However, nuclear forces maneuvering to respond to a threat during peacetime could signal a more offensive posture.⁶³ Also, mating nuclear warheads with launchers or missiles during peace time would be another indicator of a shift from active defense towards a more offensive posture such as LOW.⁶⁴

The second hypothesis would represent a significant shift in China's nuclear strategy from active defense to a more offensive posture such as a LOW.⁶⁵ Moving towards a LOW posture generally symbolizes that China is taking steps to go beyond minimum deterrence in order to decrease the vulnerability of its forces and nuclear imbalance with an adversary.⁶⁶ Specifically, a LOW posture would indicate that China would launch nuclear weapons following the detection of an incoming nuclear attack before an enemy's nuclear weapon impact.⁶⁷

LOW could also be a move to enhance its nuclear counterstrike force, but this would conflict with the understanding that China's nuclear counterattack would come following an enemy's nuclear strikes.⁶⁸ Enhancing China's nuclear counterstrike could mean that modernization is occurring to mitigate the potential loss of nuclear forces from an enemy's military capability such as CPGS. If China's nuclear force is shifting towards LOW, it should incorporate early warning or ISR capabilities to improve detection of an incoming nuclear attack so that the PLARF can launch a nuclear weapon before impact. Exercises or training that display efforts to work through detect and launch scenarios may be indicative of a move towards LOW.

⁶³ Heginbotham et al., "China's Evolving Nuclear Deterrent," 114.

⁶⁴ Heginbotham, Heim, and Twomey, "Of Bombs and Bureaucrats," 555.

⁶⁵ Christopher Twomey, "Introduction: Dangers and Prospects in Sino-American Strategic Nuclear Relations," in *Perspectives on Sino-American Strategic Nuclear Issues*, ed. Christopher Twomey (New York: Palgrave Macmillan, 2008), 5.

⁶⁶ Roberts, "Taking Stock: U.S. China Track 1.5 Nuclear Dialogue," 48; Christopher Twomey, ed., *Perspectives on Sino-American Strategic Nuclear Issues* (New York: Palgrave Macmillan, 2008), 5.

⁶⁷ Zhao, "Changes in and the Evolution of China's Nuclear Thinking," 268.

⁶⁸ Xu Weidi, "China's Security Environment and the Role of Nuclear Weapons," in *Understanding Chinese Nuclear Thinking*, ed. Li Bin and Tong Zhao (Washington, DC: Carnegie Endowment for International Peace, 2016), 27.

Though the first and second hypotheses have similarities that will be difficult to distinguish, the second hypothesis is distinct from the first hypothesis because it emphasizes detect-to-launch rather than all aspects of survivability. One indicator of a shift in strategy could be specific nuclear forces adopting LOW; this would suggest a move towards a more nuanced LOW posture for some, rather than all, of China's nuclear forces. Exercises, training, or declaratory policy that indicate pre-delegation of launch authority could signal a move towards LOW as well.⁶⁹ In addition, declaratory policy overtones beyond active defense and NFU will be reviewed to see how modernization features may tolerate a shift towards LOW.⁷⁰

The third hypothesis attempts to identify whether China's NFU policy has affected its nuclear modernization. Given the ambiguity behind China's NFU policy, there may be conditions which would force leadership to act outside of NFU.⁷¹ While there are multiple security related discourses which consider the complexity of the fog of war, there has been no official statement from China to indicate a change from NFU.⁷²

Since China still maintains an NFU policy, its nuclear weapons development should be affected by this policy.⁷³ This implies that nuclear weapons development would not go beyond increasing nuclear weapons survivability against an enemy's capability such as missile defense. One example of going beyond NFU could be that China's nuclear force modernization has resulted in a diverse set of offensive capabilities such as tactical nuclear weapons that would give Chinese decision makers options beyond large-scale nuclear strikes. Examining to what extent various nuclear forces participate in exercises will help determine whether there towards expanding military response options.

⁶⁹ Cunningham and Fravel, "Assuring Assured Retaliation," 39.

⁷⁰ Cunningham and Fravel, 31.

⁷¹ Fravel and Medeiros, "China's Search for Assured Retaliation," 79.

⁷² Department of Defense, *2020 DOD China Military Power Report*, 85–86.

⁷³ Fravel and Medeiros, "China's Search for Assured Retaliation," 85–86; Bin, "Differences Between Chinese and U.S. Nuclear Thinking and Their Origins," 11.

Lastly, because of NFU, China should retaliate with nuclear weapons only after it has first been attacked by an enemy with nuclear weapons.⁷⁴ Exercises or training that emphasize nuclear force survivability from a nuclear first strike and preparation for a nuclear counterattack may be an example of China's commitment to NFU.⁷⁵ Additionally, defensive survivability efforts such as concealment would probably strengthen the argument that China's nuclear force modernization has been constrained by NFU.⁷⁶

E. RESEARCH DESIGN

This thesis utilizes several approaches to determine the strengths and weaknesses of the hypotheses presented for China's nuclear modernization, within the constraints of being theoretically informed. Each hypothesis will consider various aspects of capabilities that scholars and analytical reports have discussed to indicate a shift or show consistency in nuclear strategy. In the conclusion, each hypothesis will be assessed based on the information gathered in the second chapter which reviews China's nuclear force modernization.

This thesis will attempt to measure the credibility of current nuclear strategy, and possible changes to it, by focusing on nuclear capabilities, training and exercises, and official defense estimates from China and the United States. In reviewing China's Defense White Papers, it will look for instances of adversary capabilities that signal Chinese concerns of vulnerability and possible reasons for Chinese modernization, as well as declaratory policy of nuclear weapons and strategy. The training and exercises of China's former People's Liberation Army Second Artillery Force (PLASAF) and the current Rocket Force (PLARF) will be reviewed, since China's first mention of the potential abrogation of the ABM treaty in their Defense White Paper in 2000.⁷⁷ Training and

⁷⁴ Fravel and Medeiros, "China's Search for Assured Retaliation," 63.

⁷⁵ Cunningham and Fravel, "Assuring Assured Retaliation," 14, 31, 44-45.

⁷⁶ Heginbotham et al., "China's Evolving Nuclear Deterrent," 33.

⁷⁷ The State Council Information Office of the People's Republic of China, "2000 Defense White Paper."

exercises will be primarily be reviewed through 2020, since that is currently the most recent United States review of China's military power.

Both nuclear arsenal capabilities and military capability developments related to China's nuclear strategy will be considered in this thesis. For example, the development or incorporation of strategic early warning capabilities could indicate a move towards a LOW posture. However, capabilities may be developed to optimize the current Chinese strategy of active defense and counterattack. Combining these capabilities with reasoning from both Chinese and American analysts and defense papers will be crucial in weighing the strengths and weaknesses of each hypothesis. Furthermore, not all capabilities may be utilized through training and exercises, but observing what training and exercises China's nuclear forces have conducted will probably help ascertain the hypotheses presented.

Escalation optimists and escalation pessimists agree that U.S. conventional operations can cause inadvertent nuclear escalation, but the escalation pessimists are much more concerned about the probability for nuclear pressures which can occur.⁷⁸ Applying research from the second and third chapter will help add on to the debate between escalation optimists and escalation pessimists. While the intent of this thesis is not to review U.S. decision-making or conventional capabilities, it will address how China's nuclear related force developments may affect this debate between escalation optimists and escalation pessimists.

For thesis constraints, reviewing all of China's multiple security concerns will not be included, but the thesis may consider the dynamics between modernization and mutual vulnerability. Second, in examination of the weaknesses of each hypothesis, consideration will be given to the application of capabilities and previous military events. Third, since each hypothesis will be assessed according to information from available secondary sources and current open-source analysis, there may be some level of gap in available information due to Chinese national security secrecy. There may be times when there is no alternative analysis from a Chinese or American perspective for specific force

⁷⁸ Talmadge, "Would China Go Nuclear?," 50.

development, so it may be necessary to review whether there have been any elite statements that show concern over nascent or threatening capabilities as well.

F. THESIS OVERVIEW

For the structure of the thesis, following the introduction, the second and third chapters will survey: 1) China's declaratory policy in China's Defense White Papers and the United States' "China military power reports"; 2) nuclear-related weapon systems and supporting infrastructure China is investing in; and, 3) Chinese training and exercises. The second and third chapters will correspond to the first two decades of the 21st century, respectively. After reviewing China's nuclear-related modernization, the fourth chapter will serve as a conclusion. The conclusion will contribute to the possibility of inadvertent nuclear escalation in the escalation pessimist vs escalation optimist debate; analyze the strengths and weaknesses of each hypothesis; outline key impressions of China's nuclear modernization; and, finally, will convey implications for U.S. strategy and posture.

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II. CHINESE NUCLEAR STRATEGY AND FORCE DEVELOPMENT: 2000–2010

A. INTRO

This chapter examines China's nuclear modernization during the years spanning 2000 through 2010. It finds that China's declaratory policy was largely consistent during the first decade (e.g., the first decade examined in this thesis: 2000–2010). China's declaratory policy consists of ambiguous nuclear strategies; ambiguity, however, can strengthen nuclear deterrence though it may also exacerbate perceptions. This means that China, by 2010, bolstered its overall deterrence by not just modernizing its nuclear arsenal to achieve greater survivability, but also ensuring that the modernization of its nuclear forces at least looks consistent with declaratory policy in exercises and training. Technological advancements alone do not necessarily lead to declaratory policy shifts. For example, if strategy drives modernization, it is likely that Chinese decision-maker confidence in its nuclear force personnel to achieve a specific strategy, such as launch on warning (LOW), should occur prior to the strategy implementation. Given that China had taken steps to develop its personnel while simultaneously modernizing its nuclear related forces during the first decade, decision-makers may have not been prepared to adopt a more offensive nuclear posture. Or, for that matter, a posture which would have decentralized the command of its nuclear forces in a centralized C2 structure. While the consideration of personnel is critical, the modernization of China's nuclear forces during the first decade in this thesis does not indicate that China transformed its strategy.

B. PRC NUCLEAR WEAPONS OVERVIEW

China's nuclear modernization efforts from 2000 to 2010 are marked by qualitative improvements rather than an increase in quantity of nuclear weapons. The total numbers by 2010 show a reduction in estimated launchers and a slight increase in estimated warheads. As modernization continued from 2000 to 2010, China developed several nuclear capable missile systems and also reduced the number of older nuclear capable missile systems (Figure 1).

Chinese Nuclear Forces, 2000 to (2010)¹

Type	NATO Designation	Launchers Est.	Year Deployed	Range (km)	Est. Warheads
Land-based missiles					
DF-3A	CSS-2	40 - (17)	1971	3,100	40 - (17)
DF-4	CSS-3	40 - (17)	1980	5,500	20 - (17)
DF-5A	CSS-4 Mod 2	20 - (20)	1981	12,000	20 - (20)
DF-15 ²	CSS-6	?	1990	600	?
DF-21 ³	CSS-5 Mods 1,2	48 - (60)	1991	2,150	48 - (60)
DF-31	CSS-10 Mod 1	0 - (8)	2006	7,200	? - (8)
DF-31A	CSS-10 Mod 2	0 - (13)	2007	11,200	? - (13)
Submarine-launched ballistic missiles					
		Launchers Est. ⁴			
JL-1 ⁵	CSS-NX-3	12 - (12)	1986	1,000+	12 - (12)
JL-2 ⁶	CSS-N-14	0 - (12) ⁷	2016 ⁸	7,200+	? - (12)
Aircraft (AC)					
		Number of AC			
H-6 ⁹	B-6	20 - (20)	1965	3,100	? ¹⁰
Total ¹¹		168 - (155)			128 - (135)

1 Data from Bulletin of the Atomic Scientists Chinese Nuclear Notebooks (2000, 2010, 2013, 2015, 2016, 2018, 2020) and US China Military Power Reports (2010, 2011). All unclassified information - estimates will vary between sources.

2 Possible nuclear capability developed in 1990s; only short-range ballistic missile with possible nuclear capability. 2020 DoD China Military Power Report lists as conventional.

3 Accounts for nuclear DF-21 variants (DF-21 and DF-21A); conventional variants (DF-21C and DF-21D) not accounted for.

4 There are 12x ballistic missile launchers for each XIA and JIN SSEN.

5 Reports suggest XIA SSEN and JL-1 not operational though there is one in service.

6, 7, 8 JL-2 Not fully operational by 2010 though there is one Jin SSEN to enter service by 2010. JL-2 first test launched in 2012-2013. Unconfirmed, but possible, Jin SSEN deterrent patrol in 2016.

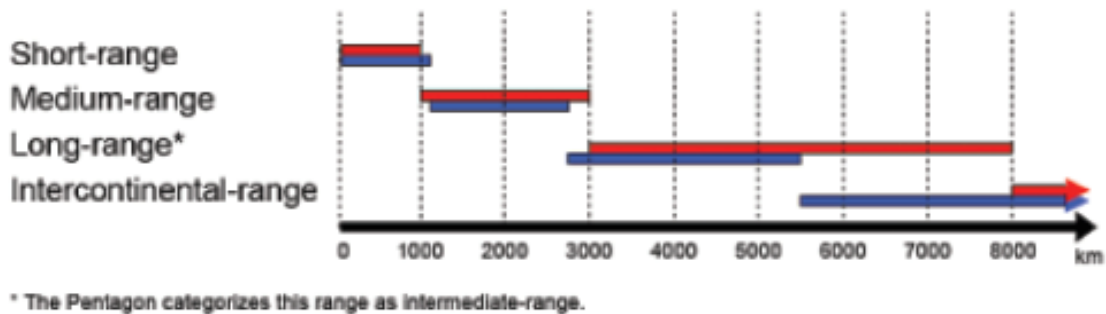
9, 10 H-6 produced in the 1960s. Assessed by Bulletin of the Atomic Scientists that China has retained a small quantity of its nuclear capable bombs for its H-6 force. Only 20 of the 120 H-6s estimated in 2000 are accounted for since the 2006 BAS highlights only a small contingent of the approximate 120 H-6s are likely nuclear capable. All notebooks since 2006 list 20 H-6s.

11 Totals based on available estimates from sources within table. Bulletin of the Atomic Scientists suggest there are up to 65 additional reserve nuclear warheads. JL-1 not accounted for since it is not assessed as operational (Reference note 5). JL-2 not accounted for in totals since it is not yet operational (Reference notes 5, 6).

Figure 1. Modernization of China's Nuclear Forces, 2000 to 2010⁷⁹

⁷⁹ Adapted from Robert Norris and William Arkin, "Chinese Nuclear Forces, 2000," *Bulletin of the Atomic Scientists* 56, no. 6 (2000): 78, <https://doi.org/10.1080/00963402.2000.11457020>; Robert Norris and Hans Kristensen, "Chinese Nuclear Forces, 2006," *Bulletin of the Atomic Scientists* 62, no. 3 (2006): 62, <https://doi.org/10.1080/00963402.2006.11460990>; Robert Norris and Hans Kristensen, "Chinese Nuclear Forces, 2010," *Bulletin of the Atomic Scientists* 66, no. 6 (2010): 139, <https://doi.org/10.1177/0096340210387046>; Hans Kristensen and Robert Norris, "Chinese Nuclear Forces, 2013," *Bulletin of the Atomic Scientists* 69, no. 6 (2013): 80, <https://doi.org/10.1177/0096340213508632>; Hans Kristensen and Robert Norris, "Chinese Nuclear Forces, 2015," *Bulletin of the Atomic Scientists* 71, no. 4 (2015): 78, <https://doi.org/10.1177/0096340215591247>; Hans Kristensen and Robert Norris, "Chinese Nuclear Forces, 2016," *Bulletin of the Atomic Scientists* 72, no. 4 (2016): 206, <https://doi.org/10.1080/00963402.2016.1194054>; Hans Kristensen and Robert Norris, "Chinese Nuclear Forces, 2018," *Bulletin of the Atomic Scientists* 74, no. 4 (2018): 290, <https://doi.org/10.1080/00963402.2018.1486620>; Hans Kristensen and Matt Korda, "Chinese Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* 76, no. 6 (2020): 444, <https://doi.org/10.1080/00963402.2020.1846432>; Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2010* (Washington, DC: Department of Defense, 2010), 34–35; Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2011* (Washington, DC: Department of Defense, 2011), 34–35.

Complicating the understanding of China’s nuclear modernization is the fact that China and the United States have different definitions of ballistic missile ranges (Figure 2).⁸⁰ However, this may be considered a minor point when differentiating between those missiles that are primarily peripheral and those that have a global strike capability.



China (red) and the United States (blue) categorize ballistic missile ranges differently. The discrepancy is most significant for missiles with ranges between 5,500 km (3,418 miles) and 8,000 km (4,970 miles), which China categorizes as long-range missiles but which the Pentagon categorizes as intercontinental ballistic missiles (ICBM).

Figure 2. U.S. and Chinese Definitions for Ballistic Missile Ranges⁸¹

⁸⁰ Kristensen, Norris, and McKinzie, 57, 218. The most prominent difference between the two is that the United States uses the term intermediate range ballistic missile (IRBM) whereas China uses the term long-range ballistic missile. For the United States, IRBM is categorized as a range between 2,750 km and 5,500 km.⁸⁰ For China, a long-range ballistic missile is defined as 3,000 and 8,000 km. Aside from long-range Chinese missiles being of greater range than the United States’ definition of an IRBM, the issue becomes what is defined as intercontinental range. For the United States, intercontinental range starts at 5,500 km; for China, intercontinental range is anything above 8,000 km.

⁸¹ Source: Hans Kristensen, Robert Norris, and Matthew McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Washington, DC: Federation of American Scientists/Natural Resources Defense Council, 2006), 57, <http://www.nukestrat.com/china/chinareport.htm>.

What is not displayed in figures of China's nuclear arsenal is how declaratory policy, *informationalization*,⁸² and exercises and training explain the significance of nuclear modernization. This does not mean that the first decade of modernization has resulted in an explicit modification to China's nuclear strategic thinking, but it is valuable to take into consideration the multiple layers that surely highlight how decision-making may be affected during a conflict. Given that there has been modernization in all aspects of China's nuclear arsenal, to include command, control, communication, intelligence, surveillance, and reconnaissance (C3ISR), it is significant that China's declaratory policy has largely gone unchanged. No shifts in declaratory policy may be reassuring from China's perspective, but while China's consistent ambiguous statements on its military strategy build its deterrence and inherently can increase its security, it also can exacerbate perceptions from other countries as China's nuclear modernization continues.

C. LAND-BASED BALLISTIC MISSILES

Between 2000 and 2010, China's land-based nuclear arsenal modernization impacted both its regional and global range capabilities. While most of China's regional range missile systems were operational before 2000, China did develop the DF-31. Additionally, China phased out older nuclear missile launchers such as the DF-3 and DF-4. So, as described below, there is not necessarily a significant quantitative shift, but there is a qualitative transformation of China's nuclear arsenal with a land-based arsenal that includes predominant technological advancements such as solid-fueled missiles and greater mobility. Regional- and global-range land based systems will be discussed in turn.

⁸² The State Council Information Office of the People's Republic of China, "2006 Defense White Paper," Andrew S. Erickson, *China Analysis From Original Sources*, 2006, 4-8, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2006_English-Chinese_Annotated.pdf; The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 5-9; Charles Rybeck, Lanny Cornwell, and Philip Sagan, "Applying America's Superpowers: How the U.S. Should Respond to China's Informatization Strategy," *War on the Rocks*, September 19, 2018, <https://warontherocks.com/2018/09/applying-americas-superpowers-how-the-u-should-respond-to-chinas-informatization-strategy/>. China refers to the integration, and modernization, of information systems that are taking place in the digitization across its country as *informationalization*. As displayed in China's Defense White Papers, *informationalization* is interchangeable with *informatize*, *informationized*, *informationization*, and *informationized*.

1. Regional Range

Though China still maintained a single DF-3A brigade by 2010, the intermediate range ballistic missile (IRBM) system was largely replaced by the DF-21. Though the DF-3A was considered mobile, it was also vulnerable to a first strike.⁸³ The main contributing factor to the vulnerability of the DF-3A is its preparation time of two and a half hours for a launch that requires the support of multiple trucks to load its liquid fuel after launcher erection.⁸⁴ More ideal to reduce system vulnerability, the DF-21 is a road-mobile, solid-fueled, medium-range ballistic missile (MRBM) system.⁸⁵ Though the DF-21 has a shorter range than the DF-3A, it complements China's nuclear force modernization with increased land-based nuclear weapons mobility and shorter preparation time.⁸⁶ Thus, at the expense of regional range, China's reduction in DF-3A missile systems suggest a focus on technological advancements that enhance nuclear survivability. The DF-3A was reduced to just a single brigade by 2010.⁸⁷

In addition to survivability, the DF-21 gives China increased warfighting capabilities. The follow-on DF-21 system, also known as the CSS-5 Mod 2, has a reported circular error probable (CEP) of 50 m, ultimately increasing the striking accuracy.⁸⁸ In addition to striking accuracy, the same reports indicate that the same system can be fitted with an electromagnetic pulse (EMP) warhead. Such a combination suggests that there is an intent to conduct a high-altitude detonation in order to disable electronics in a specific area.⁸⁹ A high-altitude detonation could also cause satellite interference.⁹⁰ On top of

⁸³ Riqiang, "Certainty of Uncertainty," 594.

⁸⁴ Riqiang, 597.

⁸⁵ Department of Defense, Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2000 (Washington, DC: Department of Defense, 2000), 20.

⁸⁶ Riqiang, "Certainty of Uncertainty," 598.

⁸⁷ Norris and Kristensen, "Chinese Nuclear Forces, 2010," 135.

⁸⁸ "DF-21 (Dong Feng-21 / CSS-5)," CSIS Missile Defense Project: Missile Threat, January 2, 2020, <https://missilethreat.csis.org/missile/df-21/>; "Weapons: Strategic - DF-21," Janes, January 26, 2021, <https://customer-janes-com.libproxy.nps.edu/Janes/Display/JSWS0411-JSWS>. The initial DF-21 system had a circular error probability of 700 m.

⁸⁹ Stephen Younger, *The Bomb: A New History* (New York: HarperCollins Publishers, 2009), 103.

⁹⁰ Younger, 103.

increased accuracy and an EMP option, the CSS-5 Mod 2 has an unprecedented selection of nuclear yield options.⁹¹ Whereas the initial DF-21 has a nuclear warhead between 250 kT and 500 kT, the Mod 2 can have either a 20, 90, or 150 kT selectable yield.⁹² To some nuclear weapons history and development subject matter experts such as Stephen Younger, lower yields—those that are in the tens of kilotons—may be considered tactical weapons.⁹³ To be sure, Chinese strategic decision-making could have led to the development of a lower nuclear yield to increase China’s nuclear deterrence rather than favoring a tactical nuclear warfighting posture. Because the DF-21 has become more accurate, a lower yield can be selected to cause damage to an intended target.⁹⁴ While some targets such as a silo may require a larger yield, others could meet commander’s intent with a lower yield depending on how close the weapon can be placed to the target.⁹⁵ Also, the DF-21 has a reload capability that could give China additional targeting opportunities.⁹⁶ Thus, the DF-21, depending on the mission objective, could, in theory, be used for a variety of military missions. For example, it could be used to degrade an opponent’s command and control capabilities, inhibit ISR systems, or even be used against other military forces.

China reduced the quantity of its aging DF-4 missile systems by 2010 to an estimated 17 missiles and launchers (Figure 1). Strictly by a measurement of range, the antiquated DF-4 provides China a greater regional deterrence than the DF-3A as well as a limited intercontinental ballistic missile (ICBM) capability.⁹⁷ However, there are several drawbacks to the DF-4 system that make it more susceptible to a first-strike. For one, the

⁹¹ CSIS Missile Defense Project: Missile Threat, “Weapons: Strategic - DF-21.”

⁹² CSIS Missile Defense Project: Missile Threat.

⁹³ Younger, *The Bomb*, 73. According to Stephen Younger, yields that are in the hundreds of kilotons are known to be for longer distances. However, lower yields alone do not necessarily indicate a shift towards favoring tactical nuclear warfighting. Consider that lessons from Cold War nuclear dynamics between the United States and the Soviet Union could be different in the contemporary security environment.

⁹⁴ Younger, *The Bomb*, 106.

⁹⁵ Younger, 106–7.

⁹⁶ CSIS Missile Defense Project: Missile Threat, “Weapons: Strategic - DF-21.”

⁹⁷ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People’s Republic of China 2009* (Washington, DC: Department of Defense, 2009), 24.

DF-4 has poor mobility, which may be why it is primarily silo-based. And, second, the missile is liquid-fueled, causing a two and a half hour prep-to-launch time.⁹⁸ After preparation, the DF-4 is then rolled out of storage to fire.⁹⁹ Similar to the DF-3, the factors of poor mobility and long preparation times highlight vulnerabilities that reduce the chances of a counterattack. The shortcomings of the DF-3 and DF-4 are likely to have been reasons for China to produce the regional range DF-31.¹⁰⁰

2. Global Range

The advent of the DF-31A ICBM enhanced China's ICBM arsenal which previously consisted of just the DF-5. China's road-mobile and solid-fueled missile system, the regional range DF-31 and upgraded range variant DF-31A, became operational in 2007.¹⁰¹ The solid fuel capability of the DF-31 missile system provides China with a greater counterstrike capability given its condensed pre-launch preparation time compared to those missile systems such as the DF-3A, DF-4, and DF-5 with liquid fueled systems.¹⁰² Coupled with the DF-31A's extended range, the solid-fueled missile strengthens China's assured retaliation in the event of an enemy's strike. Moreover, the combination of the solid-fueled DF-21 with the DF-31 provides a more robust nuclear deterrence and nuclear strike capability.

By 2010, China improved its regional nuclear deterrence capability and supplemented its ICBM capability (Figure 3). Nuclear missiles such as the DF-31, DF-31A, and DF-5 contribute to China's nuclear deterrence outside of its regional periphery. Certainly, the positioning of land-based missiles can be just as important in determining

⁹⁸ Riqiang, "Certainty of Uncertainty," 597; Shirley Kan, "China: Ballistic and Cruise Missiles" (Washington, DC: Congressional Research Service, 2000), 8, <https://carnegieendowment.org/pdf/npp/CRSChinamissilesupdated081000.pdf>.

⁹⁹ Riqiang, "Certainty of Uncertainty," 597.

¹⁰⁰ Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning*, 68, 71.

¹⁰¹ Michael Chase, Andrew Erickson, and Christopher Yeaw, "Chinese Theater and Strategic Missile Force Modernization and Its Implications for the United States," *Journal of Strategic Studies* 32, no. 1 (2009): 73, <https://doi.org/10.1080/01402390802407434>; Riqiang, "Certainty of Uncertainty," 598.

¹⁰² Riqiang, "Certainty of Uncertainty," 598.

what is within range for a nuclear missile system. Calculated range rings are not necessarily accurate, since it takes a point of origin for all systems in China, but it does show that China maintains overlapping coverage provided by its nuclear missile systems that are capable of conducting nuclear strikes within its periphery.

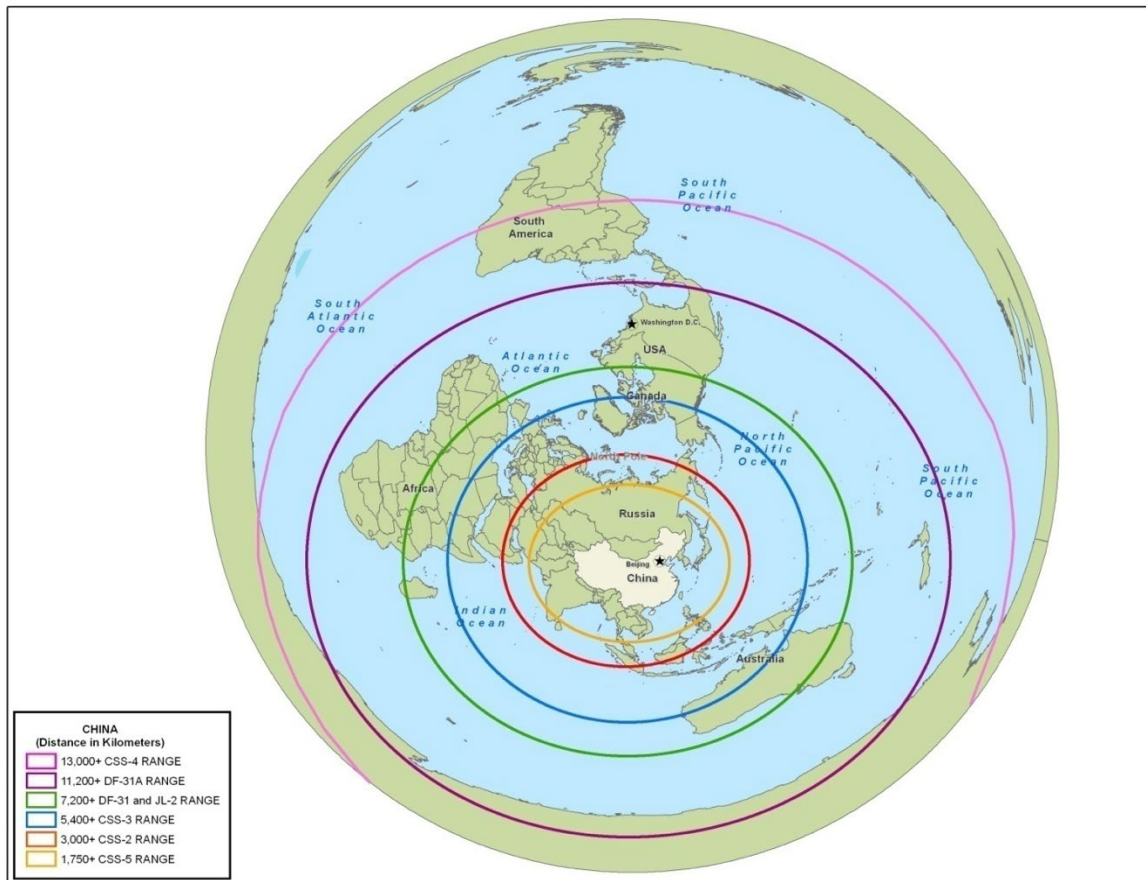


Figure 3. 2010—Medium and Intercontinental Range Ballistic Missiles, China¹⁰³

D. PRC SEA-BASED NUCLEAR WEAPONS

Though not successful, the Type 092 program—also known as the XIA-class ballistic missile submarine (SSBN)—was just the first step to organically create an

¹⁰³ Source: Department of Defense, *2010 DOD China Military Power Report*, 35.

effective at sea nuclear deterrent as part of China's nuclear arsenal.¹⁰⁴ The Type 092 SSBN is China's initial ballistic missile submarine.¹⁰⁵ Following its launch into China's Navy, it was subsequently based in China's North Sea Fleet at Qingdao.¹⁰⁶ Though China's XIA-class SSBN was operational in 1983, it never conducted a deterrent patrol with the JL-1 submarine-launched ballistic missile (SLBM).¹⁰⁷ More interesting is the fact that the XIA never sailed beyond China's regional waters.¹⁰⁸ China may have intended to develop more than one XIA, but the program likely suffered multiple setbacks since its service inception.¹⁰⁹ Other difficulties probably included the nuclear reactor of the XIA submarine. In 2005, for example, the XIA was seen in dry dock with an open reactor compartment.¹¹⁰ This is significant in that the previous overhaul of the XIA was just seven years before from 1995 until 1998.¹¹¹ Another noted inadequacy of the XIA-class is its high-noise levels that would make it vulnerable to detection.¹¹² While a high noise level does not necessarily inhibit the SSBN from conducting operations, it does compound the issues of how effective the submarine would have been if it was fully operational. The Type 092 was not a survivable option for China's sea-based nuclear deterrence.

¹⁰⁴ Lyle Goldstein, "Conclusion," in *China's Nuclear Force Modernization*, ed. Lyle Goldstein (Newport: Naval War College Press, 2005), 95.

¹⁰⁵ "Type 092 Xia Class SSBN," GlobalSecurity.org, accessed March 17, 2021, https://www.globalsecurity.org/wmd/world/china/type_92.htm.

¹⁰⁶ Robert Loewenthal, "Cold War Insights into China's New Ballistic-Missile Submarine Fleet," in *China's Future Nuclear Submarine Force*, ed. Andrew Erickson et al. (Annapolis: Naval Institute Press, 2007), 297.

¹⁰⁷ Paul Godwin, "China's Emerging Military Doctrine: A Role for Nuclear Submarines?," in *China's Future Nuclear Submarine Force*, ed. Andrew Erickson et al. (Annapolis: Naval Institute Press, 2007), 46; William Murray, "An Overview of the PLAN Submarine Force," in *China's Future Nuclear Submarine Force* (Annapolis: Naval Institute Press, 2007), 64.

¹⁰⁸ Robert Norris and William Arkin, "Chinese Nuclear Forces, 2001," *Bulletin of the Atomic Scientists* 57, no. 5 (2001): 72, <https://doi.org/10.1080/00963402.2001.11460497>.

¹⁰⁹ Norris and Arkin, "Chinese Nuclear Forces, 2000," 79; Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning*, 80; "Type 092 Xia Class SSBN." Reports indicate a second XIA SSBN may have been developed but was subsequently lost in 1985 as a result of an unknown accident. Some reports attribute this loss to a fire.

¹¹⁰ Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning*, 81–82.

¹¹¹ Kristensen, Norris, and McKinzie, 82.

¹¹² Hans Kristensen, "China's Noisy Nuclear Submarines," Federation Of American Scientists (blog), November 21, 2009, <https://fas.org/blogs/security/2009/11/subnoise/>; "Type 092 Xia Class SSBN."

China's quest to develop a submarine that could provide an effective at sea nuclear counterattack capability shifted to the Type 094, *Jin*-class SSBN. The first *Jin*-class SSBN was launched in 2004 and subsequently underwent sea trials.¹¹³ The second of the *Jin*-class submarines launched in 2006.¹¹⁴ However, by 2010, only one *Jin*-class SSBN entered service.¹¹⁵ Given China's previous issues with submarine development, the introduction of just one *Jin* SSBN into the People's Liberation Army Navy (PLAN) is not necessarily a surprise.

China's sea-based ballistic missile program is based on its land-based missile development. Generally, China has previously prioritized the development of its nuclear land-based ballistic missiles over the nuclear sea-based variants.¹¹⁶ The JL-1 is the sea-based variant of the DF-21.¹¹⁷ Similarly, China's follow-on SLBM to the JL-1, the JL-2, is gleaned from development of the DF-31 ICBM.¹¹⁸ While the JL-2 project was adopted in the 1970s along with a land-based variant, China prioritized the development of the DF-31 during the 1980s due to updated JL-2 operational design research directives and to replace the aging DF-4.¹¹⁹ This means that, aside from the development of the missile system itself, the PLAN's sea-based operational proficiency probably lags that of the land-based PLARF. It's difficult to attain a sea-based nuclear capability if issues with technological advancements encase the associated programs.

¹¹³ Chase, Erickson, and Yeaw, "Chinese Theater and Strategic Missile Force Modernization and Its Implications for the United States," 79.

¹¹⁴ Chase, "China's Transition to a More Credible Nuclear Deterrent," 79.

¹¹⁵ Department of Defense, *2010 DOD China Military Power Report*, 2–3.

¹¹⁶ Jeffrey Lewis, "JL-2 SLBM Flight Test," Arms Control Wonk, June 25, 2005, <https://www.armscontrolwonk.com/archive/200651/jl-2-slbm-flight-test/>.

¹¹⁷ "JL-1 [CSS-N-3]," GlobalSecurity.org, accessed March 18, 2021, <https://www.globalsecurity.org/wmd/world/china/jl-1.htm>.

¹¹⁸ "JL-2 (Ju Lang-2/CSS-NX-14)," CSIS Missile Defense Project: Missile Threat, October 7, 2019, <https://missilethreat.csis.org/missile/jl-2/>.

¹¹⁹ Lewis and Xue, *China's Strategic Seapower*, 122; "Weapons: Strategic - JL-2," Janes, March 22, 2021, <https://customer.janes.com/Janes/Display/JSWS0424-JSWS>; "Weapons: Strategic - DF-31," Janes, March 26, 2021, <https://customer.janes.com/Janes/Display/JSWS0415-JSWS>.

The JL-2, China's follow-on SLBM to the JL-1, was assessed to enter service between 2007 and 2010,¹²⁰ but failed several flight tests.¹²¹ In 2001, the JL-2 conducted its first submerged launch from a *Golf*-class submarine.¹²² Early tests such as the one in 2001 were primarily focused on the capability to eject the missile out of the submarine launch tube rather than a missile test flight. The Jin-class was launched in 2004, but the JL-2 flight tests that occurred that same year were unsuccessful.¹²³ There were some successful assessed test launches of the JL-2 that did occur during the first decade. At least one successful test launch occurred sometime in 2004 or 2005, and was possibly from a *Golf*-class submarine based on previous testing.¹²⁴ While there are conflicting reports on whether a JL-2 test launch from a Jin SSBN was successful in 2009, the 2010 China Military Power Report suggests that flight tests of the JL-2 caused a delay in the SLBM becoming operational.¹²⁵ By 2010, the JL-2 was still not operational.

E. AIR-BASED NUCLEAR WEAPONS

Although there is no official air-based nuclear capability, reports on China's nuclear arsenal from the Bulletin of the Atomic Scientists consistently address China's nuclear gravity bomb capability.¹²⁶ China's air-leg is the oldest component to its nuclear arsenal based on the timeline of Chinese nuclear tests. In 1965, China conducted its second nuclear test using one of its bombers.¹²⁷ China does not discuss whether it has or has not

¹²⁰ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2006* (Washington, DC: Department of Defense, 2006), 27.

¹²¹ Department of Defense, *2010 DOD China Military Power Report*, 34.

¹²² GlobalSecurity.org, "Type 092 Xia Class SSBN."

¹²³ Dominic DeSciolo, "China's Space Development and Nuclear Strategy," in *China's Nuclear Force Modernization*, ed. Lyle Goldstein (Newport: Naval War College Press, 2005), 52.

¹²⁴ Murray, "An Overview of the PLAN Submarine Force," 64; Lewis, "JL-2 SLBM Flight Test."

¹²⁵ Xavier Vavasseur, "Did China Conduct The First Test Flight of Its New JL-3 SLBM?," *Naval News* (blog), June 24, 2019, <https://www.navalnews.com/naval-news/2019/06/did-china-conduct-the-first-test-flight-of-its-new-jl-3-slbm/>; The State Council Information Office of the People's Republic of China, "2010 Defense White Paper," Andrew S. Erickson, *China Analysis From Original Sources*, 2010, 34, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2010_English-Chinese_Annotated.pdf.

¹²⁶ Norris and Arkin, "Chinese Nuclear Forces, 2000," 78.

¹²⁷ Lewis and Xue, *China Builds the Bomb*, 244–45.

sustained its air-based capability, but the potential for China to have maintained its residual nuclear bomber force must be considered. This is especially since China gave preference to conduct nuclear weapons tests from bombers until a transition to nuclear underground tests starting in the 1980s.¹²⁸ Of course, the fact that China did not discuss an air-based nuclear capability from 2000–2010 does tamp down some expectations that it maintained an air-based nuclear capability.

F. SUPPORTING TECHNOLOGY DEVELOPMENT—C3ISR

China has underscored its recognition of information’s role in military competition and has taken efforts to *informationalize* the PLA.¹²⁹ The 2000 Defense White Paper briefly mentions the need to adopt informationalized systems and modernize for operations under high-tech conditions.¹³⁰ China started to incorporate informationalization into its military security strategy starting in 2004.¹³¹ Specifically, the 2004 Defense White Paper states that “the PLA strives to comprehensively push forward informationalization with military information systems and informationalized main battle weapon systems as the mainstay and with military informationalization infrastructure development supported and guaranteed.”¹³² The same Defense White Paper signals command, control, and

¹²⁸ Jeffrey Lewis, *Paper Tigers: China’s Nuclear Posture* (New York: Routledge, 2014), 51.

¹²⁹ The State Council Information Office of the People’s Republic of China, “2006 Defense White Paper.”

¹³⁰ The State Council Information Office of the People’s Republic of China, “2000 Defense White Paper”; The State Council Information Office of the People’s Republic of China, “2002 Defense White Paper,” Andrew S. Erickson, China Analysis From Original Sources, 2002, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2002_English-Chinese_Annotated.pdf; The State Council Information Office of the People’s Republic of China, “2004 Defense White Paper,” Andrew S. Erickson, China Analysis From Original Sources, 2004, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2004_English-Chinese_Annotated.pdf; The State Council Information Office of the People’s Republic of China, “2006 Defense White Paper”; The State Council Information Office of the People’s Republic of China, “2008 Defense White Paper,” Andrew S. Erickson, China Analysis From Original Sources, 2008, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2008_English-Chinese.pdf; The State Council Information Office of the People’s Republic of China, “2010 Defense White Paper.” All of China’s Defense White Papers from 2000 through 2010 call for high-tech weaponry.

¹³¹ The State Council Information Office of the People’s Republic of China, “2004 Defense White Paper.”

¹³² The State Council Information Office of the People’s Republic of China.

communications (C3) *informationalization* for the PLA. All services are undertaking *informationalization* as part of China's force modernization.¹³³

Though China has certainly recognized the need to *informationalize* the PLA, China's efforts to construct an effective C3ISR network predates Defense White Papers from 2000 to 2010. The Second Artillery Corps, issued multiple directives from the 1970s through the 1990s to increase the survivability of nuclear forces and retain a second-strike capability of those nuclear weapons.¹³⁴ During this time, multiple hardened underground bunkers were constructed that included communications gear, power generators, and other supporting equipment to sustain nuclear missile units during a war.¹³⁵ As bunkers were constructed, a plethora of redundant communication linkages were adopted to make sure that the largely inflexible, and highly central command authority, of the Central Military Commission over nuclear forces was sustained.¹³⁶ Some of these redundant communications include fiber optic cables, microwave communications, and efforts to construct a ballistic missile early warning system.¹³⁷ In addition to the multiple directives, China adopted a command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) effort called *Qu Dian* in the 1990s to enhance the information and communication flows between Chinese C2 nodes and military equipment.¹³⁸ According to the China Aerospace Studies Institute, *Qu Dian* was intended to "link together airborne sensors with satellites, buried fiber-optic cable networks, and microwave transmission nodes."¹³⁹ Thus, by 2010, China likely had the necessary infrastructure to command and control its operational nuclear forces.

¹³³ The State Council Information Office of the People's Republic of China, "2008 Defense White Paper."

¹³⁴ John Lewis and Litai Xue, *Imagined Enemies: China Prepares for Uncertain War* (Stanford: Stanford University Press, 2006), 198.

¹³⁵ Lewis and Xue, 198.

¹³⁶ Lewis and Xue, 197.

¹³⁷ Lewis and Xue, 135–39, 143–44, 199.

¹³⁸ Peter Wood, Alex Stone, and Taylor Lee, "China's Ground Segment: Building the Pillars of a Great Space Power" (Montgomery: China Aerospace Studies Institute, 2021), 12.

¹³⁹ Wood, Stone, and Lee, 12.

The installation of fiber optic cables throughout a nation's military is one piece to possibly secure uninterrupted communications during a time of war.¹⁴⁰ As noted by Professors Jamal Deen and Shiva Kumar from the Department of Electrical and Computer Engineering at McMaster University, fiber optic cables have three advantages over copper cables that increase the survivability of communications: capability to transmit greater quantities of information, ability to propagate information farther, and protection from electromagnetic interference.¹⁴¹ The PLA has purchased and installed large amounts of fiber optic cables since at least the 1990s.¹⁴² Specifically, due to the sensitivity of nuclear weapons, the Second Artillery was the first service to install fiber optic cables at one of its bases. In 1995, the Second Artillery Corps enacted a plan to replace electric cables with fiber optic cables throughout all of its bases. Installation of fiber optic cables at missile base units seem to be extensive.¹⁴³ The combination of higher data throughput capacity that can extend over longer ranges seems to be fairly significant in China's decision to install fiber optic cables. Even if previously installed copper cables can transmit information over long distances as well, fiber optic cable installation suggests a step to create a foundation for potential future system processing requirements. It is possible that China's extensive fiber optic installation could infer changes to nuclear strategy.

While it may be questionable as to why China determined fiber optic cables were needed for the command and control of its forces, since copper cabling does enable communication between military nodes, the timeline of technological advancements seems to have overlapped with China's decision to install fiber optic cables. To compare the relative adoption timeline of fiber optic technology, the United States government started to apply fiber optic technology to military applications in 1973, and subsequently tested

¹⁴⁰ Lewis and Xue, *Imagined Enemies*, 199.

¹⁴¹ Shiva Kumar and M. Jamal Deen, "Optical Fiber Transmission," in *Fiber Optic Communications: Fundamentals and Applications* (West Sussex: John Wiley & Sons, 2014), 35–36.

¹⁴² Lewis and Xue, *Imagined Enemies*, 199.

¹⁴³ According to John Lewis and Xue Litai in *Imagined Enemies*, one Second Artillery Base had 335 km of fiber optic cables installed by 1998.

fiber optic communication efficacy.¹⁴⁴ Furthermore, in 1977, United States telecommunications companies started to use fiber optic cables commercially.¹⁴⁵ However, it was not until the 1990s that fiber optic systems became more common in multiple communication industries involving information systems.¹⁴⁶ For China, its universities did not start to incorporate fiber optic technology studies into its graduate education programs until 1978.¹⁴⁷ Furthermore, during the 1980s and in the early 1990s, Chinese universities developed expertise in fiber optic communication systems.¹⁴⁸ Thus, the timeline of organic technological expertise developed in Chinese educational institutions predates a Chinese national military decision to incorporate fiber optic cables to support Second Artillery Corps communications.

In addition to fiber optic cables, the General Staff Communications Department developed a microwave communications system that was likely adopted by all Second Artillery units.¹⁴⁹ Part of this included microwave communications equipment that could receive and transmit messages in complex weather environments.¹⁵⁰ In addition to an all-weather capability, the microwave communications system included encrypted communications.¹⁵¹ In order ensure command communications between command centers and the Central Military Commission (CMC), a team of Chinese technicians developed transceivers capable of optimizing signals to overcome the challenge of penetrating layers of hard rock.¹⁵² Because China maintains an extensive underground tunnel system for its

¹⁴⁴ Andrew Oliviero and Bill Woodward, “History of Fiber Optics and Broadband Access,” in *Cabling: The Complete Guide to Copper and Fiber-Optic Networking*, 5th ed. (Indianapolis: John Wiley & Sons, 2014), 514.

¹⁴⁵ Oliviero and Woodward, 514.

¹⁴⁶ Oliviero and Woodward, 514.

¹⁴⁷ Hsu Chang, “Graduate Education on Optical Fiber Communication Technology in China,” *IEEE Transactions on Education* 31, no. 3 (1988): 148, <https://doi.org/10.1109/13.2304>.

¹⁴⁸ Peida Ye and Xiaomin Ren, “Coherent Optical Fiber Communications Research in China,” *Fiber and Integrated Optics* 12, no. 1 (1993): 4–6, <https://doi.org/10.1080/01468039308204205>.

¹⁴⁹ “Command and Control - China Nuclear Forces,” Federation of American Scientists, June 2000, <https://fas.org/nuke/guide/china/c3i/index.html>; Lewis and Xue, *Imagined Enemies*, 199–200.

¹⁵⁰ “Command and Control - China Nuclear Forces.”

¹⁵¹ Department of Defense, *2000 DOD China Military Power Report*, 12.

¹⁵² Lewis and Xue, *Imagined Enemies*, 200.

nuclear forces, the ability to assure orders to its nuclear forces is critical for command and control (C2).¹⁵³ Redundant communications provided by microwave communications may help Second Artillery missile units during operations. Chinese nuclear experts John Lewis and Xue Litai find that these Chinese communications advancements in the late 1990s were part of China's development of a "blast- and jam-proof underground communications network."¹⁵⁴ This communications advancement to ensure China is able to command its nuclear forces largely resembles an effort to build the resiliency of its C3 network, and is not, alone, indicative of a transformation of Chinese nuclear strategy.

From 2000 through 2010, China continued to modernize and build-up its 20th century established tracking and detection ground network. China's ground network processes signals and transmits information to various data centers.¹⁵⁵ The various China Launch and Tracking Control (CLTC) sites represent the backbone of China's space tracking network.¹⁵⁶ From 2000 to 2010, several subordinate ground stations to satellite control centers were constructed or added equipment to support satellite operations. For example, two newly identified stations were built in 2008 at Lingshui and 2010 at Menghai.¹⁵⁷ Also, the Qingdao station added satellite receiving dishes to support satellite communications.¹⁵⁸

China has a set of large-phased array radars (LPARs) that enable it to conduct limited ballistic missile early warning. It is difficult to discern exactly when China

¹⁵³ Mark Stokes, "China's Nuclear Warhead Storage and Handling System" (Arlington, VA: Project 2049, March 12, 2010), 11–12, https://project2049.net/wp-content/uploads/2018/05/chinas_nuclear_warhead_storage_and_handling_system.pdf.

¹⁵⁴ Lewis and Xue, *Imagined Enemies*, 200.

¹⁵⁵ Wood, Stone, and Lee, "China's Ground Segment," 22. According to John Lewis in Xue Litai in *Imagined Enemies*, The modernization of China's ground-based C3ISR network is partly rooted in previous organic ballistic missile research and development. China's first efforts to construct a telemetry ground station started in the 1970s. Ground segment radars tracked foreign satellites and ballistic missile telemetry during tests.

¹⁵⁶ Wood, Stone, and Lee, 22.

¹⁵⁷ Wood, Stone, and Lee, 27.

¹⁵⁸ Wood, Stone, and Lee, 28.

constructed its LPARs,¹⁵⁹ but most open sources identify four LPARs.¹⁶⁰ However, the importance is rooted in China's continued efforts to modernize its space situational awareness (SSA) ground segment since the inception of its first phase of radars which supported ballistic missile testing.¹⁶¹ Ground-based radar capabilities can vary depending on the missile system to be detected.¹⁶² China's LPARs today may be similar in concept to the United States' missile early warning PAVE PAWS radars.¹⁶³ One interesting thing to note about China's four LPAR radars, however, is the assessed coverage area based on their radar alignment.¹⁶⁴ Two of the radars are assessed to provide coverage to the South and East China Seas since the radar is aligned in the southeasterly direction. One LPAR is in western China and has been characterized as supporting missile test-firings.¹⁶⁵ However, the western LPAR that was probably completed sometime in the mid-2000s, while it is located on a missile test complex, can rotate.¹⁶⁶ This means that the western located LPAR could support different areas as needed. Based on its location, for example, it could support missile warning detection to the south to cover India.¹⁶⁷

¹⁵⁹ The lack of information on exact dates of construction and identification of the LPARs make it difficult to characterize when each project was started and finished.

¹⁶⁰ Andrew Tate, "Russia Assists Development of Chinese Missile Warning System," *Janes*, October 8, 2019, https://customer-janes-com.libproxy.nps.edu/Janes/Display/FG_2411345-JDW; Andrew Tate, "China Integrates Long-Range Surveillance Capabilities," *Janes*, November 1, 2017, https://customer-janes-com.libproxy.nps.edu/Janes/Display/FG_673420-JIR; "China - Strategic Weapon Systems," *Janes*, March 1, 2021, <https://customer-janes-com.libproxy.nps.edu/Janes/Display/CNAA015-CNA>.

¹⁶¹ Wood, Stone, and Lee, "China's Ground Segment," 25–28.

¹⁶² Wood, Stone, and Lee, 16, 25, 40–41.

¹⁶³ Department of Defense, *2020 DOD China Military Power Report*, 89.

¹⁶⁴ Tate, "China Integrates Long-Range Surveillance Capabilities."

¹⁶⁵ Tate, "Russia Assists Development of Chinese Missile Warning System."

¹⁶⁶ "Korla, Xinjiang LPAR [Large Phased Array Radar]," *GlobalSecurity.org*, accessed April 19, 2021, <https://www.globalsecurity.org/space/world/china/korla.htm>; Catherine Dill, "Korla Missile Test Complex Revisited," *Arms Control Wonk*, March 26, 2015, <https://www.armscontrolwonk.com/archive/605030/the-korla-missile-test-complex-revisited/>.

¹⁶⁷ Tate, "China Integrates Long-Range Surveillance Capabilities."

China has also continued to build out its space capabilities through the 2000s. National projects were initiated to build satellites before the year 2000.¹⁶⁸ After years of research and development, China's first communications satellites were launched in the 1980s.¹⁶⁹ The early development of China's space operations is rooted in China's efforts to build ballistic missiles. Building on its space-based development, Chinese communications satellites were launched to support tactical and strategic communications for the PLA in 2000 and 2003.¹⁷⁰ By 2003, China's development of satellite reconnaissance and communications were characterized by United States reports as mainly regional ISR capabilities.¹⁷¹ China's regional focus is best explained when the 2009 China Military Power Report explains China's C3ISR developments to operate within a complex electromagnetic environment as "campaign and tactical command networks as a means to fuse communications, intelligence and reconnaissance, electronic countermeasures, and early warning systems."¹⁷² China's ground based and space based C3ISR capabilities by 2010 seems to have remained focused on peripheral situational awareness.

Lastly, the development of China's nascent SSBN fleet has implications for the command and control of its nuclear arsenal and management of conflict escalation. While one Jin-class SSBN entered service by 2010, the JL-2 was not fully operational by the end of the first decade (Figure 1). Caitlin Talmadge notes that China's very low frequency transmitters are used to communicate with both its fleet of SSNs and SSBNs.¹⁷³ Given that China's SSN fleet predates the operational capability of its SSBN force, it is likely the very low frequency transmitters were in service between 2000 and 2010. There is no further information on whether there has been substantial development to decouple

¹⁶⁸ Wood, Stone, and Lee, "China's Ground Segment," 77. According to a CASI report on China's ground segment of its space capabilities, Project 651 was China's first satellite program and was based on the DF-4's two stages of flight.

¹⁶⁹ Wood, Stone, and Lee, 77.

¹⁷⁰ Wood, Stone, and Lee, "China's Ground Segment," 20.

¹⁷¹ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2003* (Washington, DC: Department of Defense, 2003), 32.

¹⁷² Department of Defense, *2009 DOD China Military Power Report*, 26.

¹⁷³ Talmadge, "Would China Go Nuclear?," 79.

communication interlinkages between conventional and nuclear forces of the PLAN during the first decade. If China intends to ensure that the C2 of its SSBN fleet is tightly controlled, it would probably benefit Chinese leadership to direct the modernization goal of *informationalization* to include communications with its maturing sea-based nuclear leg.

G. SECOND ARTILLERY: EXERCISES AND TRAINING

Second Artillery exercises and training from 2000 through 2010 have generally focused on becoming an effective operational force capable of conducting counterattack operations. Aspects of exercises and training that are highlighted include inter-service exercises, mobility, realistic training, joint training, and education reforms. Based on China's attempts to revamp the Second Artillery's overall training and exercises during the first decade, it is clear that China is consistently looking for ways to increase the operational capacity of its nuclear missile forces.

China's 2006 Defense White Paper notes that the 2006 PLA training conference looked for ways to enhance PLA training by leveraging *informationization* and creating training standards that would resemble "actual combat."¹⁷⁴ Additionally, according to American analysts examining China's nuclear force modernization and how China is trying to achieve more realistic training, they note that China's 2007 PLA training guidelines include incorporating opposing forces, joint training, electromagnetic environment conditions, and informatization.¹⁷⁵ The realistic conditions are meant to help the Second Artillery enhance their operational effectiveness in combat.¹⁷⁶ As explained by Michael Chase, Andrew Erickson, and Christopher Yeaw, the Second Artillery was also taking part in combat training that includes "electronic warfare, nighttime training, air defense and counter-ISR tactics, and more rigorous evaluations."¹⁷⁷ There are, then, multiple ways in

¹⁷⁴ The State Council Information Office of the People's Republic of China, "2006 Defense White Paper," 21.

¹⁷⁵ Chase, Erickson, and Yeaw, "Chinese Theater and Strategic Missile Force Modernization and Its Implications for the United States," 88.

¹⁷⁶ Chase, Erickson, and Yeaw, 89.

¹⁷⁷ Chase, Erickson, and Yeaw, 89.

which China is looking to increase its nuclear missile force capability to more effectively conduct operations during crisis scenarios.

It is possible that China's review of its training guidelines from 2006 through 2007 resulted in a training system that hopes to achieve a qualitative nuclear force capable of operating under complex conditions. For example, the 2008 and 2010 Defense White Papers both discuss the PLASAF's networked and on-base training, adoption of unit rating and personnel accreditation systems, missile safety training, opposing force training, and training with complex electromagnetic environments.¹⁷⁸ As a part of PLA training, education development has also been part of China's nuclear force building.¹⁷⁹ It is not necessarily a surprise that the gradual modernization that comes with China's *informationization* of its military forces certainly has been highlighted in training reforms given the fact that new systems and equipment will likely lead to new processes and the creation of a more robust C3 network. However, it is interesting to see China's repeated emphasis on incorporating an opposing force under the context of complex conditions and realistic training. As a part of China's training guidelines and review of its exercise reforms, it is striking to see that a more realistic opposing force is stressed. This is particularly because that if China is emphasizing a realistic opposing force not until the mid-2000s, this calls into question how credible its previous training and exercises have been before. For example, if scripted Chinese training and exercises have overlaid both the PLA *and* an opposing force, this would mean that Chinese forces have not been training to realistic conditions or scenarios that would be important for the prospects of nuclear escalation.

The bulk of the PLASAF's missiles are conventionally armed, but the service has incorporated nuclear missile launches during inter-service exercises that perhaps show a willingness to use nuclear weapons. In 2001, an extensive PLA four-month long exercise

¹⁷⁸ The State Council Information Office of the People's Republic of China, "2008 Defense White Paper"; The State Council Information Office of the People's Republic of China, "2010 Defense White Paper."

¹⁷⁹ The State Council Information Office of the People's Republic of China, "2008 Defense White Paper"; The State Council Information Office of the People's Republic of China, "2010 Defense White Paper."

whose apparent objective was to simulate a possible invasion of Taiwan, or at least of contested islands between China and Taiwan, included, at least, the Chinese Navy, Air Force, and Second Artillery.¹⁸⁰ The Second Artillery tested a DF-3 nuclear capable missile towards the end of the exercise.¹⁸¹ It is worth noting that the domestic DF-3 is only nuclear capable whereas the export variant is solely conventionally armed.¹⁸² Chinese bombers and amphibious landings were some of the events that occurred during the exercise prior to the DF-3 testing. The DF-3 was erected multiple times for at least two weeks prior to the launch.¹⁸³ China's Vice Foreign Minister, Li Zhaoxing characterized the importance of Taiwan to China as "The Taiwan question remains the most important and most sensitive issue at the heart of China-U.S. relations, and it concerns China's sovereignty and territorial integrity."¹⁸⁴ The nuclear missile test launch at the end of a joint exercise possibly displays China's war gaming efforts to manage escalation. Certainly, however, the exercise also shows how nuclear missiles may be used during times of ascending escalation such as a sensitive Taiwan Strait Scenario.

China's growing real-world training and exercise focus is explained in 2002 by the United States as "Beijing's military training exercises have taken on an increasingly real-world focus emphasizing rigorous practice and operational capabilities, and improving actual ability to use force. This is aimed not only at Taiwan, but also at increasing the risk to U.S. forces and to the United States itself in any future Taiwan contingency."¹⁸⁵ Even with the DF-3 nuclear missile being phased out from 2000 to 2010, exercises that include the use of Chinese nuclear missiles helps reveal some of the training focus for future

¹⁸⁰ James Hackett, "China's Military Training Sends Very Clear Signals: [1,2,3 Edition]," *The San Diego Union - Tribune*, August 26, 2001, <http://search.proquest.com/usnews/docview/271856258/BC9AADC4D96C49EBPQ/3>.

¹⁸¹ *South China Morning Post*, "PLA Tests Nuclear Missile in War Games," August 28, 2001, <http://search.proquest.com/usnews/docview/265728830/abstract/666EC01469AB40B5PQ/1>.

¹⁸² "Weapons: Strategic - DF-3 (CSS-2)," Janes, June 14, 2021, <https://customer.janes.com/Janes/Display/JSWS0408-JSWS>.

¹⁸³ *South China Morning Post*, "PLA Tests Nuclear Missile in War Games."

¹⁸⁴ James Hughes, "China's Ballistic Missile Threat," *The Journal of Social, Political, and Economic Studies* 27, no. 1 (2002): 15-16.

¹⁸⁵ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2002* (Washington, DC: Department of Defense, 2002), 50.

conflicts. Moreover, China's 2004 Defense White Paper states the PLASAF "conducts missile-launching training and readiness exercises in near-real conditions and constantly enhances its quick-response and precision-strike capabilities."¹⁸⁶ The combination of Chinese crisis scenario training that involves sensitive contingencies such as a conflict over the status of Taiwan combined with a willingness to launch a nuclear missile is worrisome for nuclear escalation if PLASAF forces are being conditioned for potential nuclear use in salient conflicts.

Joint exercises involving the Second Artillery display China's emphasis to take advantage of the mobility of its forces during training evolutions. For example, during China's North Sword-07 exercise in 2006, opposing forces were incorporated.¹⁸⁷ The Second Artillery worked alongside the People's Liberation Army Air Force (PLAAF) and People's Armed Police during the joint PLA exercise. According to the 2006 China Military Power Report, North Sword-07 exercised tactics such as "long-distance maneuver, intelligence acquisition, and mobile counterattack operations."¹⁸⁸ Exercises such as North Sword-07 are used to conduct counter-targeting efforts as well.¹⁸⁹ This shows that Second Artillery forces are participating in joint PLA exercises to increase counter-targeting capabilities and identify optimal launch locations for a possible counter-attack.¹⁹⁰ Based on the U.S. reporting of North Sword exercises that highlight the combination of intelligence collection and maneuverability between branches of the PLA, it is likely that China is seeking out ways to increase its targeting processes all the while ensuring the survivability of its mobile launchers.

News sources from China try to highlight how exercises conform to advertised Chinese strategies. For example, Xinhua, a Chinese news service, has reported that nuclear

¹⁸⁶ The State Council Information Office of the People's Republic of China, "2004 Defense White Paper," 11.

¹⁸⁷ Department of Defense, *2006 DOD China Military Power Report*, 24.

¹⁸⁸ Department of Defense, 24.

¹⁸⁹ Chase, Erickson, and Yeaw, "Chinese Theater and Strategic Missile Force Modernization and Its Implications for the United States," 91.

¹⁹⁰ Chase, Erickson, and Yeaw, 91–92.

war simulations apply NFU policy and China's counterattack capabilities.¹⁹¹ One way these two strategies have been exercised are shown through training that includes Second Artillery forces staying in underground areas for an extended period of time before conducting a nuclear counterattack.¹⁹² Another Chinese article explains how a nuclear counterattack exercise in 2004 caused future improvements in PLA logistics.¹⁹³ During the exercise, Second Artillery troops developed symptoms of nausea that were caused from the stored food supply. At least by 2008, new logistical systems have been used to improve support to Second Artillery operations.¹⁹⁴ This is important because Second Artillery forces may need to stay underground for an extended period of time in order to eventually conduct a nuclear retaliatory strike. While it is important to recognize that state-directed media is willing to show how its Second Artillery forces are training to China's advertised strategies, it is worth noting as well that exercises which underscore staying underground for extended periods of time are technically opposite of a LOW posture. Of course, however, while there is no open-source information on Chinese exercises that may indicate a move towards a LOW posture, China did not necessarily have the necessary technological capabilities to train to LOW by 2010.

In parallel with logistical reforms that enhance Second Artillery capabilities to conduct nuclear launch operations, training emphasized mobility during the first decade. For example, out of area deployments within China¹⁹⁵ have probably increased missile unit mobility. In addition to mobility training, out of area deployments indicate that China is exercising its ability to C2 its nuclear missile forces away from traditional basing locations. Also, mobility exercises and training do not stop at day-time operations; Second Artillery units have also conducted night time maneuverability training.¹⁹⁶ China's

¹⁹¹ Kristensen, Norris, and McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning*, 21.

¹⁹² Kristensen, Norris, and McKinzie, 21–22.

¹⁹³ Kristensen, Norris, and McKinzie, 21–22.

¹⁹⁴ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2008* (Washington, DC: Department of Defense, 2008), 36.

¹⁹⁵ Chase, Erickson, and Yeaw, "Chinese Theater and Strategic Missile Force Modernization and Its Implications for the United States," 90–91.

¹⁹⁶ Chase, Erickson, and Yeaw, 90–91.

mobility training has incorporated diverse terrain operations¹⁹⁷ that include remote deployment locations.¹⁹⁸ Various terrain conditions include mountainous and desert regions within China.¹⁹⁹ Chinese nuclear forces that are included are probably those that have more mobility such as the DF-21 or DF-31.²⁰⁰ This means that a portion of Chinese nuclear forces could mobilize to increase chances of survivability and also even conduct launch operations away from garrison.

The presence of more mobile nuclear systems has resulted in training and exercises that have looked to address command and control scenarios.²⁰¹ The 2008 Defense White Paper notes that during scenarios in which China is at risk of being struck by a nuclear weapon, the Second Artillery will “go into a state of alert, and get ready for a nuclear counterattack to deter the enemy from using nuclear weapons against China.”²⁰² There is no information from 2000 through 2010 that explains exactly how the PLAN will manage its expanding SSBN fleet. For land-based nuclear forces, however, an emphasis on loss of communications has been incorporated into exercises.²⁰³ Examples of this in the same source are missile launch units losing communications with higher echelons and subsequently moving to alternative launch locations. This probably indicates that nuclear forces are using mobility as a means to reestablish communications up-echelon. Furthermore, these reports could be examples of China exercising its strategic alert system of Second Artillery nuclear missiles operating under heightened alert levels.²⁰⁴ While

¹⁹⁷ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People’s Republic of China 2004* (Washington, DC: Department of Defense, 2004), 26.

¹⁹⁸ Stephen Polk, “China’s Nuclear Command and Control,” in *China’s Nuclear Force Modernization*, ed. Lyle Goldstein and Andrew Erickson (Newport: Naval War College Press, 2005), 18.

¹⁹⁹ Kenneth Allen and Jana Allen, *Building a Strong Informatized Strategic Missile Force: An Overview of the Second Artillery Force with a Focus on Training in 2014* (Washington, DC: The Jamestown Foundation, 2014), 2.

²⁰⁰ Li Bin, “Tracking Chinese Strategic Mobile Missiles,” *Science & Global Security* 15, no. 1 (May 11, 2007): 10, <https://doi.org/10.1080/08929880701350197>.

²⁰¹ Department of Defense, *2008 DOD China Military Power Report*, 25–26.

²⁰² The State Council Information Office of the People’s Republic of China, “2008 Defense White Paper,” 39.

²⁰³ Department of Defense, *2008 DOD China Military Power Report*, 25–26.

²⁰⁴ Lewis and Xue, *Imagined Enemies*, 202–3.

heightened alert levels will determine the preparation and readiness leading up to a potential launch, the Second Artillery has long operated under a precoordinated condition and scenario system.²⁰⁵ Significantly, while China's nuclear force mobility does not necessarily deviate from espoused strategy, it does show that scripted scenarios which focus on centralized command and control continues to permeate throughout training and exercises.

The PLA has leveraged educational reforms to become a more capable military with an increased presence of a professional non-commissioned officer corps.²⁰⁶ A U.S. report explains that many of China's conscripted noncommissioned officers had the equivalent of an 8th grade education.²⁰⁷ The PLA has attempted to increase education standards across the services through digital education opportunities.²⁰⁸ For the Second Artillery specifically, it is difficult to track what improved outcomes have come based on the educational reforms. However, China's 2006 Defense White Paper does explain the importance of education and training reforms when it states, "The Second Artillery Force is striving to build a streamlined and effective strategic force...deepening the reform of training, enhancing integrated training, using scientific and technological achievements to raise training quality."²⁰⁹ Adoption of new technology advancements such as operation simulators has helped these efforts by introducing more training and exercises.²¹⁰ Thus, educational reforms are taking place within the Second Artillery with the intent, of course, to increase its operational capacity. This being said, one must consider when determining how China's educational reforms will lead to a greater operational capacity for China's nuclear missile forces to conduct operations is the fact that the 2008 Defense White Paper details that the Second Artillery has had supporting educational institutions since the dawn

²⁰⁵ Lewis and Xue, 206.

²⁰⁶ Department of Defense, *2008 DOD China Military Power Report*, 46; Department of Defense, *2004 DOD China Military Power Report*, 25.

²⁰⁷ Department of Defense, *2008 DOD China Military Power Report*, 46.

²⁰⁸ Department of Defense, 46.

²⁰⁹ The State Council Information Office of the People's Republic of China, "2006 Defense White Paper," 20.

²¹⁰ Department of Defense, *2008 DOD China Military Power Report*, 47.

of its nuclear missile forces.²¹¹ This means that while China is taking steps towards educational reforms for its services, there is uncertainty with definitively saying that educational reforms will lead to the Second Artillery's ability to become an operational nuclear force capable of operating within the confines of qualitative force developments and realistic crisis scenarios.

H. DECLARATORY POLICY ANALYSIS AND DOCTRINE

China's Defense White Papers offer consistent statements on its military strategies of active defense and NFU. In addition, as China has modernized its nuclear arsenal, as well as its military more broadly, it has found ways to champion its existing military strategies. With the ongoing modernization of its nuclear-related arsenal, China has also updated its declaratory policy to generate greater deterrence. To be sure, this does not mean that China's nuclear arsenal will solely conform to publicly available strategies during a conflict. At the very least, however, China's nuclear modernization did not significantly change the way its forces operate by the end of the first decade. Thus, if strategies are viewed as a set of directives that should guide modernization, China had certainly pushed for greater deterrence by continuing to develop its nuclear arsenal. This development of an improved nuclear arsenal exacerbates the desire to understand exactly what Chinese strategies signal to the U.S., and how those may impact conflict scenarios.

1. Active Defense and Counterattack

China consistently highlights its *active defense* military strategy in its Defense White Papers. The 2000 Defense White Paper explains implementing an active defense military strategy as:

Strategically, China pursues a principle featuring defensive operations, self-defense and gaining mastery by striking only after the enemy has struck. Such defense combines efforts to deter war with preparations to win self-defense wars in time of peace, and strategic defense with operational and tactical offensive operations in time of war. While basing themselves on existing weaponry and carrying forward their fine traditions, China's armed

²¹¹ The State Council Information Office of the People's Republic of China, "2008 Defense White Paper," 40.

forces seek to adapt to profound changes in the world's military sphere, and prepare for defensive operations under modern, especially high-tech, conditions.²¹²

China's statement on active defense broadly covers the entirety of its military force. A first analysis of China's statement highlights a defensive prioritization during peace-time for deterrence, counterattack capabilities, and force modernization as required for national security.

In addition to active defense, China's counterattack component to active defense is mentioned in most of its Defense White Papers. In 2000, China explained its nuclear weapons using a counterattack strategy under active defense as:

China possesses a small number of nuclear weapons entirely for self-defense. China undertakes not to be the first to use nuclear weapons... China maintains a small but effective nuclear counterattacking force in order to deter possible nuclear attacks by other countries. Any such attack will inevitably result in a retaliatory nuclear counterstrike by China. China has always kept the number of its nuclear weapons at a low level. The scale, composition and development of China's nuclear force are in line with China's military strategy of active defense.²¹³

The United States mentions China's active defense strategy in its annual assessments of China's military forces, but it was not until 2004 that attempts were made to explain the scope of its meaning during the first decade examined in this thesis. In 2000, active defense would have been characterized broadly as modern warfare with high technology, rapid response, and preemptive strikes.²¹⁴ It is important to note that while China did have one ICBM, China's nuclear arsenal primarily consisted of regional range missile systems (Figure 1). In addition to largely having a single-leg capability all the while undergoing nuclear modernization, China did not incorporate informationalization in its Defense White Paper until 2004. In 2004, the United States described China's active

²¹² The State Council Information Office of the People's Republic of China, "2000 Defense White Paper," 5.

²¹³ The State Council Information Office of the People's Republic of China, 6.

²¹⁴ Department of Defense, *2000 DOD China Military Power Report*, 8–9.

defense strategy as ambiguous due to the declared defensive military posture that is associated with vague counterattack statements.²¹⁵

Understanding exactly when hostilities have begun seems to be the important driver to complicate the active defense strategy. For example, the 2009 China Military Power Report underscores how Chinese documents may be incompatible with a defensive posture.²¹⁶ For this, the report states that China's *Science of Military Strategy* text indicates how an enemy's first strike could also serve political objectives. None of the China Military Power Reports refute that China's military strategy is active defense, rather, the reports indicate that active defense is more nuanced than just simply operating under a benign and defensive appearance. Of course, China's policy documents are another way to build a greater overall deterrence.

China uses its Defense White Papers to bolster its deterrence and signal its resolve to launch a nuclear counterattack. For example, the 2002 Defense White Paper conditions a possible nuclear counterattack, under the command of the Central Military Commission (CMC), when it explains the Second Artillery's mission.²¹⁷ Specifically, the 2002 Defense White Paper states "The Second Artillery Force of the PLA...primary missions are to deter the enemy from using nuclear weapons against China, and, in the case of a nuclear attack by the enemy, to launch an effective counterattack in self-defense independently or jointly with the strategic nuclear forces of other services, at the order of the supreme command."²¹⁸ For China, since the statement takes place under the counterattack umbrella, launching a nuclear strike would mean it has taken a defensive measure against an aggressor.

²¹⁵ The State Council Information Office of the People's Republic of China, "2004 Defense White Paper," 20.

²¹⁶ Department of Defense, *2009 DOD China Military Power Report*, 12.

²¹⁷ Godwin, "China's Emerging Military Doctrine," 46.

²¹⁸ The State Council Information Office of the People's Republic of China, "2002 Defense White Paper," 10.

2. NFU

China's NFU policy is prevalent throughout the United States' China Military Power Reports, but there is a level of U.S. skepticism on whether China will uphold its commitment to NFU of nuclear weapons. For example, the United States' reports on China's military strategy underscore China's possible preemption in a conflict, but do not go so far as to say explicitly that nuclear weapons would be used in a preemptive strike. It is assessed that China's preemptive use of military force would be for core national interests such as Taiwan.²¹⁹ The 2009 report does say that a preemptive strike at the operational or tactical level could be considered at moments of core national interests.²²⁰ This is confounded by the general opaqueness of China's NFU policy that should discredit a nuclear preemptive strike at any level of warfare.²²¹ To be sure, Chinese joint service exercises such as the four-month long Taiwan scenario in 2001 have shown that the use of a nuclear weapon would be towards the end of a conflict. However, the circumstances of which led to China to use a nuclear capable DF-3 missile in the exercise is unknown. Knowing exactly what caused the launch of a nuclear capable missile is important for future conflicts between great powers to understand what actions would cross a nuclear threshold.

In later United States reports during the first decade on China's military forces, China's assertion of NFU is described as ambiguous and unclear whether the NFU policy would still apply to its nuclear forces.²²² Also highlighted is the debate between Chinese scholars and People's Republic of China (PRC) military leaders on whether NFU bolsters or detracts from China's nuclear deterrence.²²³ This is especially concerning given that

²¹⁹ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2005* (Washington, DC: Department of Defense, 2005), 15; Department of Defense, *2006 DOD China Military Power Report*, 13.

²²⁰ Department of Defense, *2009 DOD China Military Power Report*, 12.

²²¹ Department of Defense, 2003 DOD China Military Power Report, 31; Department of Defense, *2010 DOD China Military Power Report*, 34–35.

²²² Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2007* (Washington, DC: Department of Defense, 2007), 19–20; Department of Defense, *2008 DOD China Military Power Report*, 26–27.

²²³ Department of Defense, *2009 DOD China Military Power Report*, 25.

scholars such as Eric Heginbotham, Jacob Heim, and Christopher Twomey, have examined how the combination of China's bureaucratic-military relationship, regional and international security, and nuclear related force developments could lead to a more robust nuclear warfighting posture.²²⁴ To be sure, the same scholars note that China may not change its NFU policy, but the decision-making within China could change as nuclear-force developments continue.²²⁵

3. Modernization and Deterrence

Generally, the United States sees how China's nuclear force developments bolster its credible nuclear deterrent and counterattack capability.²²⁶ For example, a report from the United States in 2002 states that China's nuclear forces are used strictly for nuclear deterrence, and that a retaliatory strike would ensue after a first strike from an enemy.²²⁷ In addition, the same report describes China's nuclear force as limited. The 2010 report concludes that China will continue to invest in its nuclear forces to maintain a credible nuclear deterrence.²²⁸ This is further explained as being able to deter conventional force strikes and limit an enemy's ability to coerce China.²²⁹

More nuanced is the U.S.'s recognition on how deterrence varies regionally and globally. For example, Chinese nuclear force improvements are also recognized as bolstering a credible regional deterrence capability by shifting China's nuclear force structure to be more survivable. This is particularly because of the decrease in DF-3 and DF-4 missile systems and more reliance on the DF-21 mobile medium-range ballistic missile (MRBM) system.²³⁰ Moreover, the DF-31 also is mobile and provides China with a greater regional deterrence capability (Figure 1). As well, United States reports also

²²⁴ Heginbotham, Heim, and Twomey, "Of Bombs and Bureaucrats," 553.

²²⁵ Heginbotham, Heim, and Twomey, 553.

²²⁶ Department of Defense, *2005 DOD China Military Power Report*, 28.

²²⁷ Department of Defense, *2000 DOD China Military Power Report*, 19.

²²⁸ Department of Defense, *2010 DOD China Military Power Report*, 35.

²²⁹ Department of Defense, *2007 DOD China Military Power Report*, 20.

²³⁰ Department of Defense, *2004 DOD China Military Power Report*, 37; Department of Defense, *2009 DOD China Military Power Report*, 24.

display how China's nuclear forces could conduct nuclear strikes beyond China's regional periphery.²³¹ This is especially important given the advent of China's DF-31A in 2007 that supplemented China's ICBM force that solely consisted of the DF-5. New nuclear-force related capabilities such as maneuverable reentry vehicle (MaRV) and multiple independent reentry vehicle (MIRV) are also recognized as pieces to increase China's nuclear deterrence.²³² However, though China had the technology to MIRV missiles for at least a few decades, none of its nuclear forces by 2010 had such technology.²³³ China's decision to not MIRV nuclear missiles before 2010 perhaps shows some restraint in the modernization of its nuclear forces.²³⁴ Thus, though there may be some opaqueness behind China's active defense strategy and NFU policy, nuclear force developments are consistently recognized by the United States as a way to increase China's nuclear deterrence.

China's previously mentioned statement on active defense and counterattack in its 2000 Defense White Paper suggests that China will continue to build a qualitative nuclear force that is indicative of maintain a credible nuclear deterrent.²³⁵ However, what is considered a low-level of nuclear weapons to maintain deterrence and a nuclear counterattack capability is not specified. Generally, Defense White Papers focus on qualitative modernization. For example, the 2000 Defense White Paper states that China's modernization is focused on shifting the PLA from a quantitative to qualitative military.²³⁶ Correspondingly, the 2002 and 2004 Defense White Papers reference new technological

²³¹ Department of Defense, *2008 DOD China Military Power Report*, 26.

²³² Department of Defense, 25.

²³³ Hans Kristensen, "Pentagon Report: China Deploys MIRV Missile," Federation Of American Scientists (blog), May 11, 2015, <https://fas.org/blogs/security/2015/05/china-mirv/>.

²³⁴ Jeffrey Lewis, *Paper Tigers: China's Nuclear Posture* (New York: Routledge, 2014), 45. In addition to not MIRVing nuclear missiles prior to 2010, China tested neutron bombs during the 1980s. China never deployed neutron bombs and also stopped nuclear-explosive tests after the enactment of the Comprehensive Nuclear Test Ban Treaty.

²³⁵ Rather than quantitative.

²³⁶ The State Council Information Office of the People's Republic of China, "2000 Defense White Paper," 5.

developments required for PLA modernization.²³⁷ However, the 2006 Defense White Paper characterizes PLA modernization as a combination of phasing out old equipment and leveraging the potential of existing equipment.²³⁸ Thus, nuclear modernization may be a combination of quality and quantity if existing equipment is modernized with technological advancements to extend service life.

In parallel with deterrence and China's modernization of its nuclear forces, the development of a sea-based nuclear leg has largely resulted in China determining how to explain how the PLAN will fit within its existing military strategy. Starting in 2002, Defense White Papers underscore the PLAN's nuclear counterattack mission for its submarine force.²³⁹ In addition to a nuclear counterattack capability for its submarine force, the Defense White Papers prescribe an *offshore defense* strategy for the PLAN.²⁴⁰ China never explicitly tied this strategy to its nuclear force, but this suggests that China is working to complement its nuclear deterrence capability with naval operations that can operate beyond its coast. Interestingly, while the 2004 and 2006 papers did recognize the PLAN's nuclear counterattack capability, strategic deterrence was not assigned to the PLAN until the 2008 and 2010 Defense White Papers.²⁴¹ China's slight shift in wording could be because of advancements in the PLAN's nuclear capabilities. However, by 2010, China did not have a credible sea-based nuclear capability. Given that China did not have a viable nuclear sea-leg by 2010, the offshore defense strategy is one way for China to

²³⁷ The State Council Information Office of the People's Republic of China, "2002 Defense White Paper," 18–19, 30; The State Council Information Office of the People's Republic of China, "2004 Defense White Paper," 7, 12.

²³⁸ The State Council Information Office of the People's Republic of China, "2006 Defense White Paper," 26.

²³⁹ The State Council Information Office of the People's Republic of China, "2002 Defense White Paper," 8.

²⁴⁰ The State Council Information Office of the People's Republic of China, "2000 Defense White Paper," 22; The State Council Information Office of the People's Republic of China, "2004 Defense White Paper," 10; The State Council Information Office of the People's Republic of China, "2006 Defense White Paper," 9; The State Council Information Office of the People's Republic of China, "2008 Defense White Paper," 20, 31; The State Council Information Office of the People's Republic of China, "2010 Defense White Paper," 17.

²⁴¹ The State Council Information Office of the People's Republic of China, "2006 Defense White Paper," 26.

direct the modernization of its forces with the goal of increasing power projection capabilities. This suggests that China's publicly available strategy may shift prior to the completion of nuclear related advancements.

4. LOW

There is no explicit declaratory statements from China that signals a resolve to construct a LOW capability during the first decade. While the C3ISR development is noteworthy, the available information on the development of China's nuclear arsenal and their exercises do not indicate a move towards a LOW posture. Specifically, the survivability of China's nuclear forces and ability to conduct a counterattack is emphasized in Chinese exercises. To be sure, China's modernization of its C3ISR system that includes the buildout of a more robust ground network may be indicative of a goal to achieve LOW posture. The presence of LPARs certainly gives China some ballistic missile early warning capability. However, exercises during the first decade show that China largely conforms with its espoused military strategies. Lastly, it is interesting to consider the fact that China's Qu Dian effort that started in the 1990s could have been ongoing between 2000 and 2010. Thus, instead of a transformation to LOW, China's efforts to informationalize its forces could be rooted in the goal of achieving a more modern C3ISR network.

I. FINDINGS

This chapter has served as a baseline to contrast potential changes that may have occurred within the 2011 through 2020 decade. From 2000 through 2010, China had largely placed its nuclear-related force modernization within the confines of its strategies. While qualitative force improvements of mobility and reduced preparation times can certainly produce changes to operational tactics, training and exercises suggest that nuclear forces have focused on survivability and centralized command and control. This indicates that by the end of the first decade examined in this thesis, China's training and exercises were consistent with a top-down approach to the command of its nuclear forces. Furthermore, mobility is another aspect to China's nuclear arsenal which was bolstered by the end of the first decade with the introduction of the DF-31 and phasing out of older less-mobile nuclear systems. Though mobility of nuclear forces can possibility weaken the ability to maintain

centralized command and control of nuclear forces, mobility gave the Second Artillery more survivability. Since China has a quantitatively smaller nuclear arsenal than that of the United States or Russia, survivability seems to be an important consideration for China in the development of its nuclear forces.

Though China's regional C3ISR focus does not indicate a change in strategy, it has increased its overall capability to maintain situational awareness, conduct C2, and probably monitor for incoming ballistic missiles. The modernization of C3ISR hardware and the development of unprecedented technology helps China achieve a more capable nuclear force, and also bolsters the survivability of its arsenal. Given that China, by the end of the first decade, was likely still figuring out ways to incorporate more realistic training for its military forces, it remains to be seen exactly how C3ISR improved the Second Artillery in practice by 2010. It is easy to say that the modernization of C3ISR and their technological advancements only improves the operational effectiveness of forces. However, without having the full capacity to train realistically and exercise the Second Artillery's nuclear forces and supporting infrastructure, modernization may only lead to more growth challenges. To be sure, China's modernization of C3ISR and land-based nuclear missile technology certainly bolstered China's nuclear arsenal qualitatively by 2010.

While China may have increased its warfighting options in a contingency, it has maintained its long-held strategies in its declaratory policy. It does appear that the 2000 through 2010 decade may have been some sort of adjustment period focused on increasing the operational effectiveness of nuclear forces given the technological advancements of nuclear forces, supporting C3ISR infrastructure, and enhanced training. While the first decade of modernization examined in this thesis probably created plenty of challenges for China's decision-makers to determine how best to move forward with developing a future nuclear force, it does seem that by the end of the decade, the Second Artillery had maintained training and exercises that are consistent with China's espoused strategies. Additionally, while China certainly modernized its nuclear arsenal during the first decade, China also showed some restraint in not incorporating MIRV technologies or producing a neutron bomb. Both of which, as previously mentioned, China already had the technological know-how to produce. This suggests that China's leaders possibly limited

the extent of nuclear modernization at the expense of maintaining consistent declaratory policy.

Well-rounded analysis of China's nuclear forces must consider the effect that personnel had on China's decision to not alter its declaratory policy of nuclear strategies and decision-making. Certainly, if China is still lacking confidence in its personnel, why would Chinese leaders change their strategy to decentralize during conflicts or even adopt a more forward leaning nuclear posture such as LOW? China's educational reforms started around the middle of the first decade. This is approximately the same time that the DF-31 was introduced into China's nuclear arsenal, and follows China's development of a ground-based C3ISR infrastructure. Thus, China may not have a cadre of personnel that provides China's decision-makers with enough confidence to consider a significant shift in military strategy. While China's nuclear related hardware of missiles and supporting C3ISR nodes continues to have implications for the future of Chinese strategy, it seems to be much easier to consistently embrace ambiguous declaratory policy than to excite counterbalancing efforts against China. Even if Chinese leadership desired a shift in strategy, timing of the development of personnel may have also been a consideration in not shifting declaratory policy despite some internal arguments against the efficacy of NFU, for example.

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III. CHINESE NUCLEAR STRATEGY AND FORCE DEVELOPMENT: 2011–2020

A. INTRODUCTION

This chapter finds that China’s nuclear modernization is not just evident in its physical hardware and supporting infrastructure. China’s declaratory policy statements in its Defense White Papers from 2011 to 2020 (e.g., the second decade this thesis examines) signal that China’s espoused active defense strategy looks to accommodate the growth of its qualitative nuclear arsenal. Surely, China continued to strengthen its credible deterrence as well. However, deterrence is not necessarily just a means of defensive capability; modernization in technological advancements can Simultaneously support stronger defenses, secure second strike forces, and offensive strategies as well.

B. PRC NUCLEAR WEAPONS PRIMER

China’s nuclear modernization efforts differ from those of the first decade in that both qualitative and quantitative improvements, rather than just qualitative improvements, occurred from 2011 to 2020. The total number of launchers during the second decade more than doubled by 2020 and warheads nearly doubled (Figure 4). In its annual review of China’s military, the United States Department of Defense assesses that China’s current nuclear warhead stockpile is in the low-200s.²⁴² However, what exactly is considered *low-200s* is not detailed in the report. Also not detailed in the same 2020 report is what forces are accounted for that equate to being in the low-200s.²⁴³

²⁴² Department of Defense, *2020 DOD China Military Power Report*, ix.

²⁴³ The numbers in Figure 4 are limited by the available information between China Military Power Reports and available, and credible, open-source reporting such as the Bulletin of the Atomic Scientists. Another limitation is not knowing the exact information cut-off date of the 2020 China Military Power Report though it was released in 2020.

Chinese Nuclear Forces, 2010 to (2020)¹

Type	NATO Designation	Launchers Est.	Year Deployed	Range (km)	Est. Warheads
Land-based missiles					
DF-3A	CSS-2	17 - (0)	1971	3,100	17 - (0)
DF-4	CSS-3	17 - (6)	1980	5,500	17 - (6)
DF-5A	CSS-4 Mod 2	20 - (10)	1981	12,000	20 - (10)
DF-5B	CSS-4 Mod 3	0 - (10)	2015	13,000	0 - (50)
DF-5C	CSS-4 Mod 4 ²	0 - (?)	? ³	13,000	0 - ? ⁴
DF-15 ⁵	CSS-6	?	1990	600	?
DF-17	N/A	0 - (18) ⁶	2021 ⁷	1,800	?
DF-21A/B ⁸	CSS-5 Mods 2, 6	60 - (40)	1991	2,150	60 - (40) ⁹
DF-26	N/A	0 - (100)	2016	4,000	0 - (20) ¹⁰
DF-31	CSS-10 Mod 1	8 - (6)	2006	7,200	8 - (6)
DF-31A	CSS-10 Mod 2	13 - (36)	2007	11,200	13 - (36)
DF-31AG	CSS-10 Mod 2 ¹¹	0 - (36)	2018	11,200	0 - (36)
DF-41	CSS-X-20	0 - (18) ¹²	2021 ¹³	12,000	0 - (54) ¹⁴
Submarine-launched ballistic missiles					
		Launchers Est. ¹⁵			
JL-1 ¹⁶	CSS-NX-3	12 - (0)	1986	1,000	12 - (0)
JL-2 ¹⁷	CSS-N-14	12 - (48)	2016	7,200	12 - (48)
Aircraft (AC)					
		Number of AC			
H-6 ¹⁸	B-6	20 - (20)	1965	3,100	? - (?) ¹⁹
Total ²⁰		155 - (330)			135 - (252)

1 Data from Bulletin of the Atomic Scientists (BAS) Chinese Nuclear Notebooks (2010, 2019, 2020) and US China Military Power Reports (2010, 2019, 2020). All unclassified information - estimates will vary between sources.

2, 3, 4 In development. Flight tested in 2017; not reported as operational. Unknown quantity.

5 Possible nuclear capability developed in 1990s; only short range ballistic missile with possible nuclear capability. 2020 DoD China Military Power Report lists as conventional.

6, 7 Assessed as nuclear-capable by US STRATEGIC COMMAND. Reportedly advertised by China as conventional.

8, 9 Accounts for DF-21 nuclear variants. Probable reload capability and capacity not accounted for.

10 BAS Nuclear Notebook assesses 100 DF-26s to support China's base infrastructure, and also references INDO-PACOM's accounts for 100 DF-26. DF-26s 20 nuclear warheads is an estimate based on its assessed primary conventional missile mission.

11 DF-36 assessed as being upgraded to DF-31AG variant. Numbers possibly reflect duplication.

12, 13, 14 DF-41 not assessed as operational yet though at least 18 DF-41s participated in training in 2019 near Khamai. Since the DF-41 is not yet operational, the BAS estimated 54 warheads in production are not accounted for in total.

15 There are 12x ballistic missile launchers for each XIA and JIN SSBN.

16 JL-1 not and XIA SSBN not assessed as operational.

17 Not operational until 2016 though at least one JIN SSBN entered service in 2010.

18, 19 H-6 produced in the 1960s. Assessed by BAS that China has retained a small quantity of its nuclear capable bombs for its H-6 force. PLAAF assigned a nuclear mission. H-6N assessed as the nuclear variant, ALBM testing conducted since at least 2016.

20 Totals based off available estimates from sources within table. BAS 2020 Nuclear Notebook suggests a stockpile in the 300s whereas the 2020 US China Military Power Report lists the nuclear stockpile as being in the low 200s. Both sources indicate increasing amounts of nuclear weapons, however. BAS also notes the DF-41, but it is not accounted for since it is not operational (Reference notes 12-14). JL-1 not accounted for (Reference note 15).

Figure 4. Modernization of Chinese Nuclear Forces, 2011 to 2020²⁴⁴

²⁴⁴ Adapted from Department of Defense, *2010 DOD China Military Power Report*, 34–35; Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2019* (Washington, DC: Department of Defense, 2019), 65–67; Department of Defense, *2020 DOD China Military Power Report*, 55–60; Norris and Kristensen, "Chinese Nuclear Forces, 2010," 139; Hans Kristensen and Matt Korda, "Chinese Nuclear Forces, 2019," *Bulletin of the Atomic Scientists* 75, no. 4 (2019): 172, <https://doi.org/10.1080/00963402.2019.1628511>; Kristensen and Korda, "Chinese Nuclear Forces, 2020," 444; "Type 094 Jin-Class Program," *GlobalSecurity.org*, accessed April 14, 2021, https://www.globalsecurity.org/wmd/world/china/type_94-program.htm.

C. LAND-BASED BALLISTIC MISSILES

From 2011 through 2020, China's land-based nuclear arsenal modernization resulted in a preponderance of nuclear force missile systems capable of increased mobility and varying warfighting capabilities. These developments are evident in China's inventory of regional and global range missile systems.

1. Regional Range

Continuing the trend of modernization, the 2016 China Military Power Report indicates that China has continued modernization of the DF-21 system and developed the CSS-5 Mod 6.²⁴⁵ There is no current open-source information available that details the full extent of modernization for the new DF-21 variant. It is unknown how the new variant could be utilized in future conflict, but it may carry an upgraded missile.²⁴⁶

Adding to the opacity behind China's nuclear modernization efforts are conflicting reports on whether China's upcoming DF-17 MRBM is nuclear or not.²⁴⁷ While there are limited sources reporting on whether the DF-17 is conventional or nuclear, it would only require China to produce a small enough warhead to field such a system.²⁴⁸ The DF-17 has a hypersonic glide vehicle (HGV) which can make it difficult for defensive systems such as anti-ballistic missile (ABM) to intercept.²⁴⁹ This is especially interesting given the reported accuracy of the system during a flight test.²⁵⁰ Given the DF-17's range, its list of potential targets is confined to those within China's periphery. The high level of accuracy

²⁴⁵ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2016* (Washington, DC: Department of Defense, 2016), 58.

²⁴⁶ Department of Defense, *2020 DOD China Military Power Report*, 448.

²⁴⁷ In his earlier testimony to the Senate Armed Services Committee, Admiral Charles Richard, Commander of United States Strategic Command, indicates the DF-17 MRMB is a nuclear weapon. However, Chinese state media has described the DF-17 as a conventional, not nuclear, weapon.

²⁴⁸ Malcolm Claus, "China Extends Range of Its Hypersonic Missile System," *Janes*, November 2, 2020, https://customer.janes.com/Janes/Display/FG_3778569-JIR.

²⁴⁹ Claus.

²⁵⁰ "China Tests New DF-17 with Hypersonic Glide Vehicle," CSIS Missile Defense Project: Missile Threat, January 4, 2018, <https://missilethreat.csis.org/china-tests-new-df-17-hypersonic-glide-vehicle/>.

and application of the weapon could indicate a move towards counterforce operations with a possible nuclear warhead.²⁵¹

In addition to new DF-21 and possible DF-17 developments, China fielded its first dual-capable missile system, the DF-26, in 2016.²⁵² On top of being dual-capable, the DF-26 is road-mobile and solid-fueled.²⁵³ Also, the DF-26 is reported to have a navigation system capable of achieving up to 150 m circular error probable (CEP).²⁵⁴ The 2020 China Military Power Report states that the DF-26, because of its accuracy, may “field a lower-yield warhead in the near-term.”²⁵⁵ This means that the weapon could also be utilized against soft point targets such as missile launchers.²⁵⁶ The DF-26 continues China’s trend of developing nuclear missile systems that are capable of striking regional targets.

2. Global Range

In addition to China’s regional range modernization, China has also modernized its global nuclear range capabilities. China upgraded its aging liquid-fueled DF-5A force rather than seek out its retirement.²⁵⁷ The follow-on to the DF-5A silo-based missile system is the DF-5B.²⁵⁸ The DF-5B remains silo-based, but includes an unprecedented multiple independent reentry vehicle (MIRV) capable silo based missile system capable of

²⁵¹ Whereas counterforce indicates launching a nuclear missile to target a military target, counter-nuclear force specifically targets nuclear-related military equipment. Though there could be collateral damage, both are intended to target military targets, nuclear or conventional. Thus, the polar opposite of countervalue targeting is inherently counterforce targeting and not just counter-nuclear force targeting.

²⁵² “Weapons: Strategic - DF-26,” Janes, January 26, 2021, <https://customer.janes.com/Janes/Display/JSWSA399-JSWS>. Dual-capable means that the DF-26 can launch conventional or nuclear missiles.

²⁵³ Janes, “Weapons: Strategic - DF-26.”

²⁵⁴ Janes.

²⁵⁵ Department of Defense, *2020 DOD China Military Power Report*, 88.

²⁵⁶ Younger, *The Bomb*, 101.

²⁵⁷ “Weapons: Strategic - DF-5,” Janes, April 6, 2021, <https://customer.janes.com/Janes/Display/JSWS0410-JSWS>.

²⁵⁸ The exact status of retrofitting DF-5A to MIRV capable DF-5B nuclear missile systems is unknown.

carrying five warheads.²⁵⁹ In order to increase the chances of achieving a desired effect with MIRV technology, system accuracy improvements may be incorporated.²⁶⁰ Lawrence Freeman and Jeffrey Michaels explain the importance of coupling accuracy and MIRV technology when they state that “If MIRVed missiles were to have as high a kill probability against hardened targets as single warhead missiles, accuracy would have to be improved.”²⁶¹ Indeed, China’s DF-5 missile system CEP has been improved to 500 meters, an overall decrease by 300 meters.²⁶² In addition to the DF-5B, China may be developing a DF-5C.²⁶³ Of course, depending on the commander’s intent and type of target, greater improvements in CEP accuracy could be needed. For example, the United States’ Trident D5 solid-fueled submarine-launched ballistic missile has the capability to destroy hardened targets, in part, due to its approximate 90 meter CEP accuracy.²⁶⁴ Essentially, China’s DF-5 modernization has resulted in its first intercontinental ballistic missile (ICBM) system with a counterforce capability that focuses on destroying military equipment rather than urban areas or populations.²⁶⁵

The upcoming DF-41 provides China with a range of nuclear posture options for survivability and warfighting.²⁶⁶ First, the solid-fueled and road-mobile DF-41 is more survivable than DF-5, which is liquid-fueled, silo-based, and therefore not mobile.²⁶⁷ Additionally, the DF-41 is MIRV capable just like the DF-5B; however, the DF-41 is

²⁵⁹ Janes, “Weapons: Strategic - DF-5”; Department of Defense, *2020 DOD China Military Power Report*. The significance of the MIRV capability is its offensive nature. A MIRVed warhead consists of multiple nuclear warheads that are distributed to either attack multiple targets or overwhelm anti-ballistic missile systems.

²⁶⁰ Lawrence Freedman and Jeffrey Michaels, “The Evolution of Nuclear Strategy,” in *The Evolution of Nuclear Strategy*, 4th ed. (London: Palgrave Macmillan, 2019), 425.

²⁶¹ Freedman and Michaels, 425.

²⁶² Janes, “Weapons: Strategic - DF-5.”

²⁶³ Department of Defense, *2020 DOD China Military Power Report*, 56.

²⁶⁴ “Trident D5,” CSIS Missile Defense Project: Missile Threat, July 30, 2021, <https://missilethreat.csis.org/missile/trident/>.

²⁶⁵ Younger, *The Bomb*, 100. Countervalue targeting focuses on targeting urban areas or populations.

²⁶⁶ The 2020 China Military Power Report states that the DF-41 will soon be operational.

²⁶⁷ “Weapons: Strategic - DF-41,” Janes, March 26, 2021, <https://customer.janes.com/Janes/Display/JSWS0416-JSWS>.

assessed to be able to carry up to 10 nuclear warheads of varying 20, 90, and 150 kT yield options.²⁶⁸ Though the DF-41 may be primarily based at silos, it has multiple launch options due to its mobility.

Accompanying the DF-41 is China's modernization of the DF-31 which also gives China increased survivability and nuclear warfighting capabilities. A third variant of the DF-31, the DF-31AG, was launched in 2018 (Figure 4). China's DF-31As are being upgraded to a more maneuverable launch vehicle as the DF-31AG.²⁶⁹ For its maneuverability, Kristensen and Korda note that the DF-31AG has "an improved off-road capability."²⁷⁰ This is important because previous iterations of the DF-31 were restricted to improved surfaces such as paved roads.²⁷¹ The off-road capability will enable the DF-31AG to maneuver through various terrain and possibly conduct launches from a wider range of pre-prepared launch sites and, potentially, unprepared off-road locations.

3. Land-Based Missile Summary

By 2020, China's nuclear modernization resulted in a greater nuclear arsenal quantity, and it also consequentially increased China's qualitative nuclear capabilities as well. In doing so, China created a more robust regional and global strike capability (Figure 5). China's nuclear deterrence capabilities are bolstered by the introduction of new land-based nuclear missile systems and the modernization of older nuclear missile systems. Newer nuclear missile systems such as the DF-26 and DF-31AG are more survivable due to their mobility. Meanwhile, China's modernization of its older DF-5 nuclear missile capable system also bolsters its nuclear arsenal with a more capable missile system.

²⁶⁸ Janes.

²⁶⁹ Kristensen and Korda, "Chinese Nuclear Forces, 2020," 443, 448.

²⁷⁰ Kristensen and Korda, 448.

²⁷¹ "DF-2 / CSS-1," GlobalSecurity.org, July 24, 2011, <https://www.globalsecurity.org/wmd/world/china/df-2.htm>.

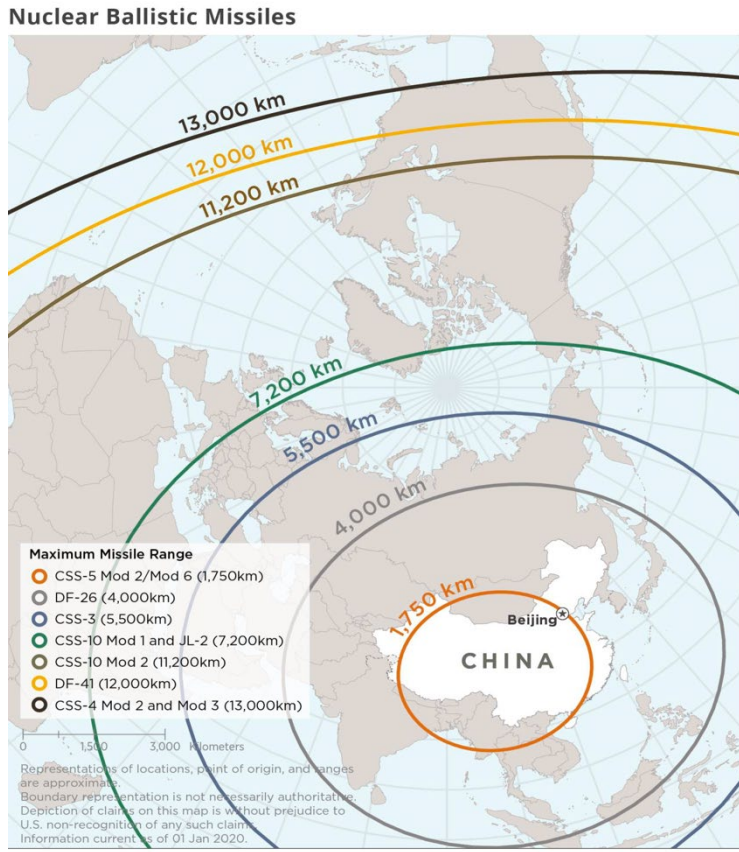


Figure 5. 2020—Nuclear Ballistic Missiles, China²⁷²

D. NUCLEAR WEAPONS STORAGE AND SILOS

There appears to have been a transformation of nuclear storage hardening to increase the survivability of nuclear weapons in underground and hardened facilities. In 2013, one academic’s opinion was that despite China’s nuclear weapons storage protection, bunker buster weapons could perforate hardened underground facilities and probably destroy stored weapons.²⁷³ However, China seems to have hardened its nuclear weapons facilities. In 2018, a Chinese engineer was awarded an award for designing China’s “Underground Steel Great Wall.” According to Chinese state media, the project will “guarantee the security of the country’s strategic arsenal against potential attacks, including

²⁷² Source: Department of Defense, *2020 DOD China Military Power Report*, 58.

²⁷³ Riqiang, “Certainty of Uncertainty,” 585.

those from hypersonic weapons.”²⁷⁴ The probable nuclear storage handling hardening highlights a need to ensure the survivability of its nuclear stockpile, especially for areas closer to operational missile base units and launching locations.

Along with hardening nuclear storage facilities, China is building new silos as it continues to modernize its forces. The 2020 China Military Power Report notes that China may be building new silos for the DF-5 ICBM.²⁷⁵ However, open source analysis of geospatial imagery finds that more silos are being built for the upcoming DF-41 ICBM rather than for the DF-5.²⁷⁶ Specifically, all but one of the 16 newly constructed silos at the People’s Liberation Army Rocket Force (PLARF) Jilantai training area are assessed to accommodate the DF-41.²⁷⁷ Moreover, the recent discovery of China’s construction of a second nuclear missile silo field certainly has implications for Chinese nuclear forces and strategy as well, but it is beyond the scope of this paper, since it is after 2020.²⁷⁸ Additionally, an open-source analysis report assesses that spoil piles near DF-4 ICBM launch structures indicate probable DF-41 silo construction.²⁷⁹ At the very least, this shows that the DF-41, while mobile, may be primarily located at newly developed silos. Combined with the modernization of C3I, the construction of new silos could indicate a move towards a launch on warning posture.²⁸⁰ This is because a siloed ICBM could be on an alert status rather than just simply in a storage facility or underground bunker awaiting

²⁷⁴ Liu Xuanzun, “Chinese Rocket Force Exercise Ensures Nuclear Counterattack Capability,” *GlobalTimes*, January 16, 2020, <https://www.globaltimes.cn/content/1177156.shtml>. The strategic arsenal likely refers to nuclear force facilities such as missile storage locations at missile bases or the central underground storage complex for nuclear weapons.

²⁷⁵ Department of Defense, *2020 DOD China Military Power Report*, 89.

²⁷⁶ Hans Kristensen, “China’s Expanding Missile Training Area: More Silos, Tunnels, and Support Facilities,” *Federation Of American Scientists* (blog), February 24, 2021, <https://fas.org/blogs/security/2021/02/plarf-jilantai-expansion/>.

²⁷⁷ Kristensen.

²⁷⁸ Matt Korda and Hans Kristensen, “China Is Building A Second Nuclear Missile Silo Field,” *Federation Of American Scientists* (blog), July 26, 2021, <https://fas.org/blogs/security/2021/07/china-is-building-a-second-nuclear-missile-silo-field/>.

²⁷⁹ Scott LaFoy, “Possible ICBM Modernization Underway at Sundian,” *Arms Control Wonk*, February 5, 2020, <https://www.armscontrolwonk.com/archive/1208828/possible-icbm-modernization-underway-at-sundian/>.

²⁸⁰ Department of Defense, *2020 DOD China Military Power Report*, 90.

orders to roll out and launch. Also, a siloed ICBM on an alert status reduces the vulnerability of being hit in a first strike.

E. PRC SEA-BASED NUCLEAR WEAPONS

China has continued to make progress on the development of its sea-based nuclear deterrent. China's follow-on to the JL-1, the JL-2, became operational in 2016, which is around the same time of the first assessed Jin-ballistic missile submarine (SSBN) deterrent patrol.²⁸¹ Though China introduced the JL-2 into its nuclear arsenal in 2016, the number of operational JIN SSBNs is important to determine the potential capability of China's submarine launched ballistic missiles. According to the 2020 China Military Power Report, there are "four operational and two outfitting at Huludao Shipyard."²⁸² Some reports, however, suggest there are now six in-service Jin SSBN.²⁸³ The significance is that the continued production of JIN SSBNs suggests that China has made significant advancements in its sea-based nuclear program.

Though the Jin and JL-2 have improved China's sea-based nuclear capabilities, it does have several vulnerabilities. For one, if the Jin operates closer to China, the JL-2 is only capable of reaching regional targets, to include Alaska and Hawaii, thereby reducing its deterrent capability.²⁸⁴ Just like any sea-launched nuclear missile system, naval positioning is important to limit the risk of being detected and reducing vulnerability to an enemy's strike.²⁸⁵ Another associated vulnerability with the Jin SSBN is its reported loudness.²⁸⁶ So, if China were to operate the Jin SSBN further from its coast, it could risk

²⁸¹ "Weapons: Strategic - JL-2." The 2011 China Military Power Report is the last report to mention the JL-1.

²⁸² Department of Defense, *2020 DOD China Military Power Report*, 86.

²⁸³ Peter Suci, "China Now Has Six Type 094A Jin-Class Nuclear Powered Missile Submarines," Text, The National Interest (The Center for the National Interest, May 6, 2020), <https://nationalinterest.org/blog/buzz/china-now-has-six-type-094a-jin-class-nuclear-powered-missile-submarines-151186>.

²⁸⁴ Kristensen and Norris, "Chinese Nuclear Forces, 2018," 292.

²⁸⁵ Kristensen, "China's Noisy Nuclear Submarines."

²⁸⁶ "Submarine Noise," Submarine Matters, accessed April 16, 2021, <https://gentleseas.blogspot.com/2016/10/submarine-noise.html>.

being detected sooner than it would be able to come within range of targets outside of its periphery (Figure 6).



Figure 6. 2020—JL-2 SLBM Range Inhibits Targeting the U.S. from China’s Periphery²⁸⁷

Currently, the operational Jin SSBNs are based primarily out of the South Sea Fleet on Hainan Island.²⁸⁸ Based on previous reporting, the next two Jin SSBNs could be based in the North Sea Fleet near Qingdao.²⁸⁹ Or, alternatively, China could base the Jin SSBNs out of the East Sea Fleet where a demagnetizing facility may have been built south of Ningbo.²⁹⁰ As Hans Kristensen explains, demagnetization is important since it removes “residual magnetic fields in the metal of a vessel to make it harder to detect by other submarines and surface ships.”²⁹¹ Still, in order for China’s sea-launched nuclear missiles to be able to strike the contiguous United States, its Jin SSBNs would need to venture past

²⁸⁷ Source: Kristensen and Korda, “Chinese Nuclear Forces, 2018,” 293.

²⁸⁸ “Jin Class (Type 094),” Janes, February 25, 2021, https://customer.janes.com/Janes/Display/jfs_6016-jfs_.

²⁸⁹ Hans Kristensen, “China SSBN Fleet Getting Ready – But For What?,” Federation Of American Scientists (blog), April 25, 2014, <https://fas.org/blogs/security/2014/04/chinassbnfleet/>.

²⁹⁰ Hans Kristensen, “Second Chinese Naval Demagnetization Facility Spotted,” Federation Of American Scientists (blog), April 19, 2010, <https://fas.org/blogs/security/2010/04/demag/>.

²⁹¹ Kristensen.

regional waters. To be sure, China's sea-based nuclear capabilities could strike targets within its periphery.

Though it is beyond the scope of this paper, China is in the process of developing a more capable SSBN and submarine-launched ballistic missile (SLBM). The follow-on Type 096 SSBN and JL-3 SLBM are not yet mission capable, but their development shows that China is continuing to advance its sea-based nuclear capabilities.²⁹²

F. PRC AIR-BASED NUCLEAR WEAPONS

The People's Liberation Army Air Force (PLAAF) may have preserved a nuclear bombing capability since the development of its nuclear weapons program, but the third leg of its nuclear triad has recently gained more attention.²⁹³ Though China's Air Force was not formally assigned a nuclear mission until 2019, it is assessed that it has at least maintained a portion of its nuclear gravity bombs for potential contingencies.²⁹⁴ China's nuclear triad was formally recognized when the PLAAF's bombers were assigned a nuclear mission in 2019.²⁹⁵ Specifically, the PLAAF introduced its nuclear capable, long-range, bomber, the H-6N, that may not be completed until the mid-2020s.²⁹⁶

There are several factors behind the significance of the H-6N. First, reporting indicates that China is developing an air-launched ballistic missile (ALBM) for the H-6N.²⁹⁷ There have been reports that show the H-6N flying with a ballistic missile under its

²⁹² Department of Defense, *2020 DOD China Military Power Report*, 45, 86; H I Sutton, "Chinese-Navy-Submarine=Construction-Bohai," *Covert Shores*, November 3, 2020, <http://www.hisutton.com/Chinese-Navy-Submarine=Construction-Bohai.html>; "Weapons: Strategic - JL-2"; Kristensen and Korda, "Chinese Nuclear Forces, 2020," 452.

²⁹³ Kristensen and Korda, "Chinese Nuclear Forces, 2019," 176. China's nuclear weapons program, in part, started with the testing of nuclear bombs from H-6 bombers in the 1960s. There is no official air-based capability today, but some reports such as those from the *Bulletin of the Atomic Scientists* suggest that China has a reserve of nuclear gravity bombs. China does not discuss its probable air-leg extensively either.

²⁹⁴ Kristensen and Korda, "Chinese Nuclear Forces, 2020," 453.

²⁹⁵ Department of Defense, *2020 DOD China Military Power Report*, 50.

²⁹⁶ Department of Defense, 51.

²⁹⁷ Department of Defense, 51.

fuselage.²⁹⁸ The reports do not indicate that ALBM has been equipped with a nuclear payload just yet, but it is speculated the ALBM will eventually have such a capability.²⁹⁹ Second, the H-6N will host an air-to-air refueling capability.³⁰⁰ Both of these factors, combined, provide China with the capability to project power beyond its periphery with another source of nuclear weapons capability. Like any other aircraft, since the H-6N is mobile, it may provide China with increased nuclear weapons survivability. Similarly, though China may opt for increased survivability for its nuclear weapons, it could forward deploy H-6Ns in strategic locations to provide greater reach. For example, previous H-6 operations in the South China Sea atolls display China's willingness to possibly maneuver long-range aviation assets forward in a contingency.³⁰¹ With the potential for additional ALBM basing and unprecedented striking angles, United States missile defense becomes more complicated.

G. SUPPORTING TECHNOLOGY DEVELOPMENT—C3ISR

China has continued to press forward on developing a command, control, communications, intelligence, surveillance, and reconnaissance (C3ISR) structure capable of conducting strategic situational awareness.³⁰² In discussing critical force modernization areas related to China's nuclear forces, the 2015 Defense White Paper, states, "China has always kept its nuclear capabilities at the minimum level required for maintaining its national security. China will optimize its nuclear force structure, improve strategic early warning, command and control [and]...rapid reaction."³⁰³ The emphasis on rapid reaction

²⁹⁸ Mainz Andreas Rupprecht and Essen Gabriel Dominguez, "PLAAF's New H-6N Bomber Seen Carrying Large Missile," Janes, October 19, 2020, https://customer.janes.com/Janes/Display/FG_3772109-JDW.

²⁹⁹ Michael Chase, "Nuclear Bomber Could Boost PLAAF Strategic Role, Create Credible Triad," The Jamestown Foundation, July 6, 2017, <https://jamestown.org/program/nuclear-bomber-boost-plaaf-strategic-role-create-credible-triad/>.

³⁰⁰ Department of Defense, *2020 DOD China Military Power Report*, 51.

³⁰¹ "China Lands First Bomber on South China Sea Island," Asia Maritime Transparency Initiative, May 18, 2018, <https://amti.csis.org/china-lands-first-bomber-south-china-sea-island/>.

³⁰² Department of Defense, *2019 DOD China Military Power Report*, 89.

³⁰³ The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 15.

is interesting because of its implications. China could always launch a nuclear counterattack after detonation. But, rapid reaction could indicate a move towards launch-on-warning (LOW).

China's ground based segment is one element that has worked to modernize its C3ISR. In addition to China's modernization of ground based radars that have resulted in Chinese large-phased array radars (LPAR) today, other ground based radars that can probably detect ballistic missiles are the JL-1A and JY-27A.³⁰⁴ China's ground based segment also includes the YLC-8B and SLC-7 transportable ballistic missile detection radars.³⁰⁵ According to a Chinese state media source, the YLC-8B and SLC-7 help China detect "virtually any aerial target including...ballistic missiles and rockets."³⁰⁶ At the very least, this shows that Chinese military technological advancements emphasize the need to maintain a robust surveillance network capable of alerting forces prior to a first strike. Thus, China is continuing to expand its ballistic missile early warning network and seems to have an emerging ballistic missile early warning capability.

Another aspect to China's C3ISR modernization is its space segment. China continues to grow its already robust satellite architecture.³⁰⁷ There is not a lot of information on Chinese satellite payloads, but there is enough to know that China is striving to achieve a rapid detection capability.³⁰⁸ This is, in part, evident by China's satellite

³⁰⁴ "X-Band Large Phased Array Radar," Janes, accessed April 19, 2021, <https://www.globalsecurity.org/wmd/world/china/lpar-x.htm>; Tate, "China Integrates Long-Range Surveillance Capabilities"; Elsa Kania, *China's Strategic Situational Awareness Capabilities* (Washington, DC: Center for Strategic and International Studies, 2019), 2–3, <https://res.cloudinary.com/csiasideaslab/image/upload/v1564246946/on-the-radar/China%20strategic%20SA.pdf>. One LPAR that may have been constructed after 2010 could have the capability to detect ballistic missiles from the north that are on a polar trajectory. Also, there is some debate on exactly which ground based radars have ballistic missile detection capability. For example, the JY-27A is known to be an air-search radar (GlobalSecurity), but the 2017 China Military Power Report lists the system as a part of China's ground-based ballistic missile detection network as well.

³⁰⁵ "Surveillance Radar - CETC Land-Based Air Defence Radars," Janes, March 30, 2021, <https://customer.janes.com/Janes/Display/JREWA124-JC4IL#YLC-8B>.

³⁰⁶ Zhao Lei, "New Radars Displayed at Trade Show," *China Daily*, June 22, 2017, https://www.chinadaily.com.cn/china/2017-06/22/content_29839549.htm.

³⁰⁷ "UCS Satellite Database," Union of Concerned Scientists, January 1, 2021, <https://www.ucsusa.org/resources/satellite-database>.

³⁰⁸ Tate, "Russia Assists Development of Chinese Missile Warning System."

launches over the past decade. Specifically contributing to a faster detection of ballistic missile launches is China's remote sensing capabilities onboard the satellites being launched.³⁰⁹ The Yaogan, Gaofen, and LKW series of satellites are just a few of the satellite constellations that have been developed to support military applications such as remote sensing.³¹⁰ These few satellite constellations all largely operate in the low-earth orbit constellation (LEO).³¹¹ LEO satellites can provide space situational awareness (SSA) to detect missiles and transport information to ground segments.³¹² At the very least, some of the Gaofen series satellites have infrared sensors that may be able to support ballistic missile detection.³¹³

While most of the Gaofen series is in LEO, the Gaofen 4 is China's first SSA geosynchronous orbit (GEO) satellite.³¹⁴ This is significant because while some of China's Beidou positioning, navigation, and timing satellites have been in geosynchronous orbit since perhaps the end of the first decade, heavier synthetic aperture radar payloads that could support target identification from geosynchronous orbit would be, according to one Janes analyst, "a significant technological milestone for China."³¹⁵ While not necessarily a direct comparison of equivalent capability, the United States' Space-Based Infrared System (SBIRS) is comprised of infrared sensor technologies with some satellites in GEO.³¹⁶ According to a Janes article, there are currently four geosynchronous satellites in

³⁰⁹ Kania, China's Strategic Situational Awareness Capabilities, 7–8.

³¹⁰ Kania, 7–8.

³¹¹ "Space Systems - Gaofen Series," Janes, February 8, 2021, https://customer.janes.com/Janes/Display/JSD_A400-JSD_; "Space Systems - Ludikancha Weixing Series," Janes, February 9, 2021, https://customer.janes.com/Janes/Display/JSD_A680-JSD_; "Space Systems - Yaogan Series," Janes, February 4, 2021, https://customer.janes.com/Janes/Display/JSD_A201-JSD_.

³¹² Wood, Stone, and Lee, "China's Ground Segment," 6.

³¹³ "Space Systems - Gaofen Series."

³¹⁴ "Gaofen 4," NASA Space Science Data Coordinated Archive, April 13, 2021, <https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=2015-083A>.

³¹⁵ Tate, "China Integrates Long-Range Surveillance Capabilities."

³¹⁶ "Space Based Infrared Surveillance," Lockheed Martin, accessed April 18, 2021, <https://www.lockheedmartin.com/en-us/products/sbirs.html>.

the United States' SBIRS series.³¹⁷ In addition to probable organic intelligence capabilities onboard satellites, China has continued to develop its space-based communications capabilities.³¹⁸ Thus, China's new and expanding satellite architecture will continue to provide China with increased C3ISR capabilities such as the detection of ballistic missiles.

China continued to modernize its domestic ground stations to support satellite operations. The Menghai telemetry, tracking and command and control (TT&C) ground station reportedly grew to double its size from 2012 to 2016.³¹⁹ Additionally, the Minxi TT&C) ground station that was previously retired may have restarted operations in 2019.³²⁰ In addition to a build up of ground stations, some ground stations received updated equipment. In 2014, for example, the Xiamen TT&C ground station received new equipment to support satellite operations.³²¹ Overall, the Chinese ground segment likely became more capable with redundant communications linkages and upgraded equipment to support satellite operations.

Complementing China's domestic space segment is an expansion of ground-based facilities that are capable of processing and transferring data from satellites.³²² Indeed, China has constructed data processing infrastructure in other countries; Chinese ground stations have been built in Sweden and Finland, for example, as early as 2016 and 2018, respectively (Figure 7).³²³ The ground stations will help China process and transport information collected from its satellite architecture. This is important because it means that remote sensing capabilities, and other collected data, onboard satellites can be integrated with China's ballistic missile defense system. Not all ground stations in other countries

³¹⁷ "Space Systems - Space Based Infrared System (SBIRS)," Janes, February 11, 2021, https://customer.janes.com/Janes/Display/JSD_A042-JSD_.

³¹⁸ Kania, China's Strategic Situational Awareness Capabilities, 11–12.

³¹⁹ Wood, Stone, and Lee, "China's Ground Segment," 27.

³²⁰ Wood, Stone, and Lee, 28.

³²¹ Wood, Stone, and Lee, 29.

³²² Wood, Stone, and Lee, 22; Kania, China's Strategic Situational Awareness Capabilities, 8.

³²³ Kania, China's Strategic Situational Awareness Capabilities, 8.

may have military applications,³²⁴ but, as one CASI report put it, China now possesses a ground segment capable of “providing global control, downlink, and tracking operations of objects from low Earth orbit to deep space.”³²⁵ Already a capable space power, Chinese space operations will become more efficient at providing space situational awareness as Beijing develops redundant networks capable of supporting military applications.

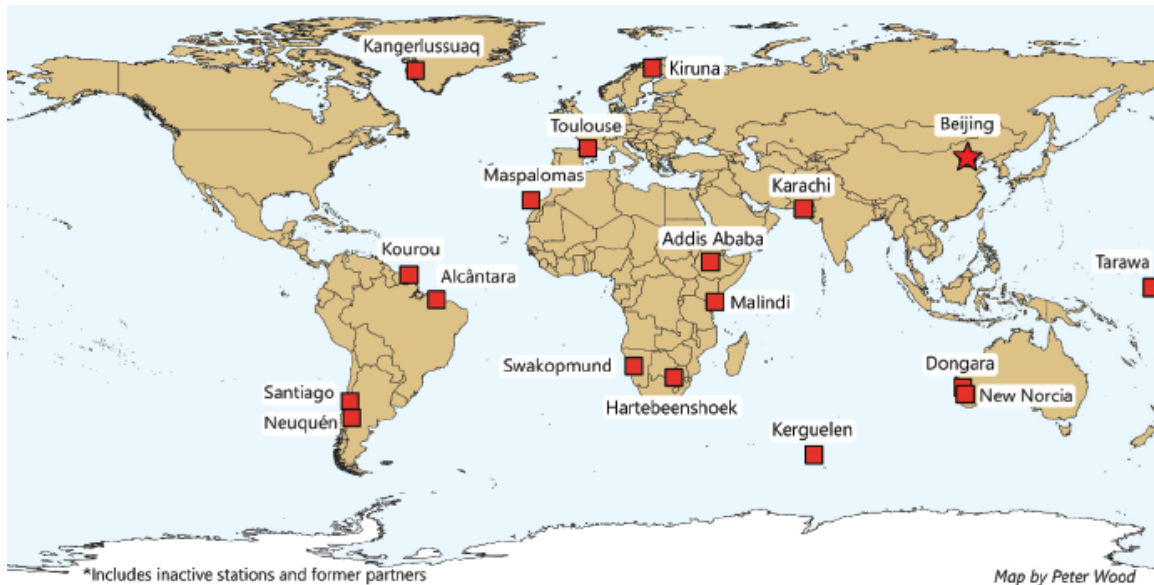


Figure 7. China’s International Ground Segment—Tracking Stations, 2021³²⁶

China’s modernization goal for its C3ISR architecture may be expressed in its collaboration with Russia. According to the 2020 China Military Power Report, Russian President Vladimir Putin announced in 2019 that Russia is assisting China in its development of a “missile-attack early warning network, including aiding the development of ground-based radars and potentially extending to space-based sensors.”³²⁷ In President Putin’s announcement of Russian assistance to help China develop such a system, he

³²⁴ Wood, Stone, and Lee, “China’s Ground Segment,” 64.

³²⁵ Wood, Stone, and Lee, 76.

³²⁶ Source: Wood, Stone, and Lee, 66.

³²⁷ Department of Defense, *2020 DOD China Military Power Report*, 89.

explained that, “currently only the United States and Russia have such systems.”³²⁸ This signals that China is lacking substantial components of a SSA program that would support ballistic missile early warning. However, as previously explained, China does seem to have at least some of the ground and space based components to have support a missile-attack early warning network. At the very least, Russia’s vast experience with developing SSA can probably help China continue its C3ISR modernization to achieve a fully functioning early warning missile system if it does not already have one.³²⁹ If China does have a SSA system, it can continue to improve upon the network that it has organically built.³³⁰

H. SECOND ARTILLERY: EXERCISES AND TRAINING

China’s focus on military training is a significant component to the People’s Liberation Army’s (PLA) modernization. To hopefully develop personnel that are capable of operating under *informatized*³³¹ conditions, the 2015 Defense White Paper mentions that the PLA is deepening “the reform of military education institutions and improve the triad training system for new-type military personnel — institutional education, unit training and military professional education, so as to pool more talented people and cultivate more personnel who can meet the demands of *informationized* warfare.”³³² The 2019 Defense White Paper notes that training is continuously being evaluated and adopted to increase realism.³³³ For example, according to the same Defense White Paper, a system of training evaluators promote PLA readiness by supervising combat training and exercises. The 2015 Defense White Paper explains this as setting up “a training supervision

³²⁸ Tate, “Russia Assists Development of Chinese Missile Warning System.”

³²⁹ Tate.

³³⁰ There are a couple of issues that are noteworthy. For one, it is difficult to ascertain how effectively trained China’s personnel are at operating such a complex network of sensors. And, two, the extent to which the network is capable of conducting integrated SSA between both of China’s ground and space segment is not fully known.

³³¹ As previously noted in Chapter 2, *informatized* is a Chinese translation for information system integration and modernization. The term is interchangeable with other variants such as *informationalization* and *informationized*, for example.

³³² The State Council Information Office of the People’s Republic of China, “2015 Defense White Paper,” 16.

³³³ The State Council Information Office of the People’s Republic of China, “2019 Defense White Paper,” 12.

and inspection system, so as to incorporate real-combat requirements into training.”³³⁴ In addition, the PLA has leveraged competitive service training contests to encourage more effective training.³³⁵ It is clear that China recognizes the importance of personnel training to meet the requirements of a complex battlefield.

The PLARF is using various education opportunities and technology applications to enhance its human talent pool. The PLARF has developed technical training and adopted training models to increase the quality of servicemembers.³³⁶ However, according to coverage of PLARF training, many units “still suffer from shortage of high quality personnel, including junior commanders, non-commissioned officers (NCOs), and technical staff for its new equipment.”³³⁷ On top of gaps in qualified personnel, the PLARF continues face several complications with its force that it is working to address. For example, two analysts note the training issues with the PLARF by stating that it continues to “encounter problems, such as... physical and psychological issues associated with training in underground facilities, ‘training for the test,’ a lack of standardized equipment among units, and equipment breakdowns.”³³⁸ For example, for training evaluation, PLARF units have postponed exercises due to adverse weather conditions.³³⁹ Additionally, in order to make Chinese military training more realistic, Chinese military services have incorporated opposition forces during exercises.³⁴⁰ Still, it is not explicit to

³³⁴ The State Council Information Office of the People’s Republic of China, “2015 Defense White Paper,” 21.

³³⁵ The State Council Information Office of the People’s Republic of China, “2019 Defense White Paper,” 12.

³³⁶ Baters Gill and Adam Ni, “China’s New Missile Force: New Ambitions, New Challenges (Part 2),” The Jamestown Foundation, accessed April 22, 2021, <https://jamestown.org/program/chinas-new-missile-force-new-ambitions-new-challenges-part-2/>.

³³⁷ Gill and Ni.

³³⁸ Henry Boyd et al., *PLA Aerospace Power: A Primer on Trends in China’s Military Air, Space, and Missile Forces* (Montgomery: China Aerospace Studies Institute, 2019), 77.

³³⁹ Fiona Cunningham, “Nuclear Command, Control, and Communications Systems of the People’s Republic of China” (Tech4GS Special Reports, July 18, 2019), 10.

³⁴⁰ The State Council Information Office of the People’s Republic of China, “2013 Defense White Paper,” Andrew S. Erickson, *China Analysis From Original Sources*, 2013, 19, http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2013_English-Chinese_Annotated.pdf.

what extent scenario based exercises are realistic because of the presence of an opposing force during scenario-based exercises. Though the PLARF has incorporated opposing forces in exercises, this shows that the purported realistic conditions may continue to be limited to scripted scenarios that can increased simulated rapid response times, but not necessarily combat effectiveness.³⁴¹

All Defense White Papers note that joint training such as scenario based exercises are taking place across the Chinese military services.³⁴² Furthermore, China's Defense White Papers continue the trend of emphasizing enhanced military training that consists of *complex* scenarios and environments.³⁴³ The 2019 Defense White Paper confirms the extent of joint training conducted between services when it states that, "since 2012, China's armed forces have carried out...80 joint exercises."³⁴⁴ The extent of interoperability and coordination in Chinese joint exercises is not detailed in its Defense White Papers. It is also worth noting that the United States Indo-Pacific Command conducts hundreds of joint and combined exercises *annually*.³⁴⁵ Additionally, with reports indicating training issues for the PLARF, reporting the number of joint exercises China has conducted does not necessarily reveal how more or less survivable, or capable, China's nuclear weapons systems and personnel are in a potential conflict alongside other military services.

While China likely has training and exercise issues that could inhibit progress in creating an effective human talent pool, the increased mobility of China's nuclear weapons is reshaping the way in which the PLARF's nuclear forces will likely operate. Exercises that include trans-regional mobility operations have reportedly maneuvered conventional and nuclear missile forces from their home garrison anywhere from 300 to more than 1,000

³⁴¹ Gill and Ni, "China's New Missile Force."

³⁴² The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 21.

³⁴³ The State Council Information Office of the People's Republic of China, "2013 Defense White Paper," 18; The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 21.

³⁴⁴ The State Council Information Office of the People's Republic of China, "2019 Defense White Paper," 12–13.

³⁴⁵ "Exercises - Pacific Command," GlobalSecurity.org, June 30, 2021, <https://www.globalsecurity.org/military/ops/ex-pacom.htm>.

kilometers.³⁴⁶ This may indicate that launch brigades are increasing their chances of survival by practicing their ability to react quickly and training to mobilize. Indeed, Chinese media reports suggest that trans-regional exercises are a part of annual operational training for the PLARF.³⁴⁷ The normalizing of China's mobility exercises suggests that it is working to shift its posture to launch locations further from home-garrison for at least some of their units.³⁴⁸ If Chinese nuclear forces can respond quickly to an early warning of nuclear weapons, they will be able to increase their chances of survivability by avoiding enemy targeting efforts.

The PLA trains to evade enemy detection by using denial and deception (D&D) tactics.³⁴⁹ According to the 2016 China Military Power Report, the PLA's D&D tactics include "camouflage, decoys, and satellite avoidance activities during training events."³⁵⁰ While it is probable that China continues to see camouflage as an importance piece to D&D for a small portion of their nuclear forces, this does not guarantee that nuclear forces will not be detected.³⁵¹ Nevertheless, Chinese media continues to cite camouflage being used during training exercises.³⁵² One subject matter expert on PLARF missile forces noted a Chinese media source stating that camouflage was used during a trans-regional movement to deceptively portray military equipment as postal trucks.³⁵³ Also, DF-26 launchers were stored below a camouflage tent at the Jilantai training complex in 2019 before setting up on a launch pad.³⁵⁴ Generally, this indicates that China will continue to use D&D tactics such as camouflage in future operations. Moreover, though enemy ISR efforts may be able

³⁴⁶ Logan, "Are They Reading Schelling in Beijing?," 20–21.

³⁴⁷ Logan, 21.

³⁴⁸ Logan, 22.

³⁴⁹ Department of Defense, *2016 DOD China Military Power Report*, 74.

³⁵⁰ Department of Defense, 74.

³⁵¹ Lewis, *Paper Tigers: China's Nuclear Posture*, 105–6, 119.

³⁵² Anthony Cordesman and Joseph Kendall, "The PLA Rocket Force: Evolving Beyond the Second Artillery Corps (SAC) and Nuclear Dimension" (Washington, DC: Center for Strategic & International Studies, 2016), 43.

³⁵³ Logan, "Are They Reading Schelling in Beijing?," 21.

³⁵⁴ Hans Kristensen, "Chinese DF-26 Missile Launchers Deploy To New Missile Training Area," Federation Of American Scientists (blog), January 21, 2019, <https://fas.org/blogs/security/2019/01/df-26/>.

to detect forces, it does not necessarily mean that identification of nuclear missile units will be discernible at every moment.

Next, the PLARF also conducts drills to train for incoming nuclear attacks.³⁵⁵ Drills have taken place at training locations in the Gobi desert during exercises.³⁵⁶ These drills included a training audience of “thousands of soldiers and hundreds of military vehicles.”³⁵⁷ In one exercise, training efforts emphasized medical force response and chemical, biological, radiological and nuclear response measures (CBRN).³⁵⁸ Anti-CBRN training shows that the PLARF is preparing for a range of contingencies that could inhibit missile launch operations.

In addition to exercises away from garrison, training also takes place at launch brigade bunkers probably near home garrison.³⁵⁹ Launch units are training to get more comfortable with operating from within sealed environments. Showing some indication that China will adhere to its no-first-use (NFU) policy is evident with training events that condition troops to survival training from within silos.³⁶⁰ One Chinese state media source explains that, following a nuclear strike, troops within the bunker conducted training on carrying “out contingency plans and operated missiles...simulated a situation where missile fuel leaked after a hostile strike...fast missile condition check, rapid logistics, bunker defense and hasty launch.”³⁶¹ Notably, while there is a level of basic unit level training to ensure units are able to operate equipment and within facilities intended for the

³⁵⁵ Minnie Chan, “Chinese Military: Rocket Force Drills Prepare for Possible U.S. Nuclear Weapons Attack,” *South China Morning Post*, August 25, 2020, <https://www.scmp.com/news/china/military/article/3098727/chinese-military-rocket-force-drills-prepare-possible-us>.

³⁵⁶ Chan.

³⁵⁷ Chan.

³⁵⁸ Chan.

³⁵⁹ Li Jiayao, “Chinese Rocket Force Exercise Ensures Nuclear Counterattack Capability,” *China Military*, January 17, 2020, http://eng.chinamil.com.cn/view/2020-01/17/content_9719396.htm.

³⁶⁰ David Logan, “Making Sense of China’s Missile Forces,” in *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms*, ed. Phillip Saunders et al. (Washington, DC: National Defense University Press, 2019), 405.

³⁶¹ Jiayao, “Chinese Rocket Force Exercise Ensures Nuclear Counterattack Capability.”

protection of nuclear forces, the units are conducting exercises to speed up preparation and operational processes.

Still, it is not guaranteed that the first move of all nuclear missile forces will be to seek shelter in an underground bunker. Open-source analysis of PLA media covering a training exercise shows troops responding to a notification of an incoming attack and subsequently deploying away from home garrison.³⁶² In addition, however, the same authors note that a conventional DF-21D missile is launched at night at the end of the video. This would indicate a couple distinctions for China's nuclear forces. For one, Chinese sponsored media highlights that there may be an inclination for select forces such as the DF-31A to mobilize upon alert of an incoming enemy attack. Second, a conventional missile launch could mean that China is possibly restraining the glamorization of using nuclear weapons as a first response option. If China wanted to signal that a DF-31 nuclear capable missile would be launched, maybe Chinese state media would have reported the exercise as such. The mobilization of Chinese nuclear weapons does not necessarily mean China is going to use a nuclear weapon, but it does at least suggest a probable preparation for the use of nuclear weapons. This could be indicative of a modified alert system for mobile Chinese nuclear forces to increase the chances of survivability while simultaneously conditioning those same forces for the possibility of the use of nuclear weapons.

Open-source analysis of the Jilantai training complex highlights brigade unit integration with various launchers and potential basing preferences. One subject matter expert's analysis of commercial satellite imagery of Jilantai shows that, as of 2019, there are "more than 100 launch pads...support base, a landing strip, and at least eight launch unit camp sites covering an area of more than 1,000 square kilometers...along a 90-kilometer...corridor."³⁶³ At the same complex in mid-2019, there were multiple nuclear

³⁶² Catherine Dill, "Spring Festival Launch Festivities," Arms Control Wonk (blog), February 5, 2016, <https://www.armscontrolwonk.com/archive/1200957/spring-festival-launch-festivities/>. The authors of the report identify a DF-31A traveling through snowy roads with other supporting units to a remote location.

³⁶³ Kristensen, "Chinese DF-26 Missile Launchers Deploy To New Missile Training Area."

launch units identified.³⁶⁴ Specifically, Hans Kristensen states that the Jilantai training area was comprised of the “road-mobile launchers of the DF-41 ICBM...launchers for the DF-31AG ICBM, possibly the DF-5B ICBM, the DF-26 IRBM, and the DF-21 MRBM.”³⁶⁵ The amount of mobile nuclear forces at Jilantai may suggest that the forces are taking advantage of integration and mobility exercises that allow the PLARF to train to maneuvering to pre-determined launch sites. Also, the silos at Jilantai could mean that some forces such as the DF-41 and DF-5 would primarily conduct silo-operations while other mobile forces maneuver from central locations.³⁶⁶

Furthermore, the PLARF has inherited unprecedented capabilities through modernization, but may still be gaining unit level efficiency in areas such as rapid response.³⁶⁷ The Jilantai training complex possibly indicates that Chinese nuclear forces are still gaining proficiency in operating from pre-planned locations based on the number of launch pads and units that have been in the location simultaneously. Indeed, aside from the DF-21, all land-based nuclear forces have predominantly been modernized or introduced into the service over the past fifteen years (Figure 4). This means that while China’s forces have modernized, and unprecedented technology is developed, it is still coping with having to master possible tactics that would need to meet the requirements of centralized command and control of nuclear forces.³⁶⁸

Another aspect of PLA training has included informatization; as new information systems and technology are adopted, the services will need to cope with new practices to become more efficient.³⁶⁹ Indeed, China’s Rocket Force is leveraging informatization to

³⁶⁴ Hans Kristensen, “New Missile Silo And DF-41 Launchers Seen In Chinese Nuclear Missile Training Area,” Federation Of American Scientists (blog), September 3, 2019, <https://fas.org/blogs/security/2019/09/china-silo-df41/>.

³⁶⁵ Kristensen.

³⁶⁶ Kristensen.

³⁶⁷ Twomey, “China’s Nuclear Doctrine and Deterrence Concept,” 55.

³⁶⁸ Twomey, 55.

³⁶⁹ The State Council Information Office of the People’s Republic of China, “2013 Defense White Paper,” 18.

improve command and control.³⁷⁰ According to one analyst's review of Chinese media coverage on nuclear command and nuclear command, control, communications (NC3), "media reports from 2014 indicate that communications units have been training to rapidly establish field combat operations communications networks, including telephone, video conferencing, and command networks, within 30 minutes."³⁷¹ While this shows that supporting units are probably becoming more proficient in basic field operations to support missile units, it does not indicate that training has altered launch procedures.³⁷² However, if units are becoming more efficient with setting up NC3, this does at least indicate that China is become more capable of rapid response.

I. DECLARATORY POLICY ANALYSIS: CHINA DEFENSE WHITE PAPERS

There are some noteworthy statements within China's Defense White Papers during the first decade, but China's declaratory policy unflinchingly attempted to fit modernization within its espoused active defense and counterattack military strategy. Consistent with a desire to develop a military capable of winning a future conflict, nuclear modernization does not just contribute to deterrence. Rather, the modernization of military capabilities may also impact China's ability to implement warfighting strategy as well. China's improved nuclear arsenal by the end of the second decade seems to have significant implications for a more forward leaning nuclear posture that China always seems quick to declare is just its *active defense* strategy.

1. Active Defense and Counterattack

China maintained a fairly consistent explanation of active defense between the decades. Counterattack capabilities and vague statements on strategic defense mixed with offense at the operational and tactical levels has been previously mentioned in Defense

³⁷⁰ Gill and Ni, "China's New Missile Force."

³⁷¹ Cunningham, "Nuclear Command, Control, and Communications Systems of the People's Republic of China," 10.

³⁷² Boyd et al., "PLA Aerospace Power: A Primer on Trends in China's Military Air, Space, and Missile Forces," 77.

White Papers from 2000 and 2010 as well. Juxtaposed with China's opaque statements on strategy are the United States' China Military Power Reports which continue to address the ambiguous nature of China's active defense strategy. Several versions of the China Military Power Report from 2016 to 2020 look to define active defense more aggressively than just as a strategically defensive posture. The 2016 China Military Power Report notes that active defense can be characterized as "strategically defensive but operationally proactive in orientation."³⁷³ Being operationally proactive may still mean that China is maintaining a strategically defensive posture, but it does hint at the notion of preemptive strikes. What may be considered unprecedented in China's declaratory policy documents is the notion that military modernization can result in new operational doctrine. China's 2015 Defense White Paper explains this as:

China's armed forces will continue to implement the military strategic guideline of active defense and enhance military strategic guidance as the times so require...To implement the military strategic guideline of active defense in the new situation, China's armed forces will innovate operational doctrine...in line with their current capabilities, the armed forces will adhere to the principles of flexibility, mobility, and self-dependence so that "you fight your way and I fight my way."³⁷⁴

China's language on counterattack is constant between the decades. However, an exact definition of PLA operational doctrine is not clear, making it harder to understand how capabilities could result in novel tactics. Nevertheless, even if this strategy is solely intended for conventional forces, there are implications for China's nuclear forces as well. This is especially relevant for China since scholarship has found that Rocket Force leadership will have served at the conventional missile Base 52.³⁷⁵ This significance is best explained by Heginbotham, Heim, and Twomey when they state that "Because the conventional forces emphasize warfighting, and the early use of their missiles to provide

³⁷³ Department of Defense, *2016 DOD China Military Power Report*, 44.

³⁷⁴ The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 8–9.

³⁷⁵ Logan, "Career Paths in the PLA Rocket Force," 2–5.

decisive advantage, this influence could have dramatic implications for future nuclear strategy.”³⁷⁶

Possibly consistent with innovation in operational doctrine, the 2015 and 2019 Defense White Papers stress military theory that is commensurate with a military capable of winning wars. For example, the 2015 Defense White Paper underscores how military building and the development of military theories are tied together when it states, “China’s armed forces will intensify their studies of military operations, probe into the mechanisms of winning modern wars, innovate strategies and tactics featuring mobility, and flexibility, and develop theories on military building in the new situation, so as to bring into place a system of advanced military theories commensurate with the requirement of winning future wars.”³⁷⁷ It would not be out of line to say that strategy drives military modernization. However, the association of innovation in operational doctrine, theories, and modernization displays how China may look to sustain an effective counterattack capability while possibly transforming its strategy to win future wars. The 2019 Defense White Paper helps explain the military development ties with military theory as well.³⁷⁸ Unsurprisingly, the focus of China’s military modernization is to win future wars. Interestingly, however, the 2019 Defense White Paper highlights how China’s military doctrine has been adopted for Chinese strategies.³⁷⁹ This may indicate that new operational doctrines, whether advertised or not, are defended as unwavering adherence to counterattack and even NFU.

2. NFU

The United States’ annual reports on China’s military state that Chinese military preemption could be used to oppose an adversary’s response to Chinese national security interests. The reports, for example, define these national security interests as political and

³⁷⁶ Heginbotham, Heim, and Twomey, “Of Bombs and Bureaucrats,” 551.

³⁷⁷ The State Council Information Office of the People’s Republic of China, “2015 Defense White Paper,” 17.

³⁷⁸ The State Council Information Office of the People’s Republic of China, “2019 Defense White Paper,” 23.

³⁷⁹ The State Council Information Office of the People’s Republic of China, 23.

territorial issues.³⁸⁰ However, none of the reports state that a nuclear strike would be China's preferred preemptive strike measure. To be sure, similar to the previous decade of the United States annual China Military Power Reports, the reports are skeptical of China's NFU. The introduction of offensive MIRV technology into China's nuclear arsenal could be one reason to be skeptical of NFU. However, MIRV can also be to simply overwhelm missile defenses; interpreting MIRV as just another military capability means that the technology could be consistent with NFU and minimal deterrence. However, the combination of MIRV and increased accuracy capabilities is not necessarily consistent with NFU and minimal deterrence.

In connection with conducting preemptive strikes, though all United States reports recognize that China has maintained a steady cadence of its NFU policy, the reports also note that there is some room for disbelief of China's NFU policy in certain circumstances. The 2011 report does, however, note that China's national leadership has not showed a willingness to shift towards a conditional NFU.³⁸¹ Still, the reports highlight that China could perceptually understand an adversary's action to be *first use* though it may not technically be *nuclear* first use. For example, the 2011 report states that some examples of when China's NFU would not apply may include "strikes on what China considers its own territory, demonstration strikes, or high altitude burst would constitute a first use."³⁸² In addition, the United States' 2013 report notes that Chinese nuclear force security concerns and Chinese regime survival could incite nuclear first use.³⁸³ Giving some credibility to China's NFU, however, is the PLARF's survival training in silos. Additionally, China's construction of new silos will probably make it more difficult to locate and track nuclear missiles; more basing options could mean greater survivability confidence, which could be greater reason to not opt for NFU.

³⁸⁰ Department of Defense, *2011 DOD China Military Power Report*, 24; Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2014* (Washington, DC: Department of Defense, 2014), 28.

³⁸¹ Department of Defense, *2011 DOD China Military Power Report*, 34.

³⁸² Department of Defense, 34.

³⁸³ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2013* (Washington, DC: Department of Defense, 2013), 30.

Expounding further on preemption, the United States' 2018 China Military Power Report explains active defense and counterattack:

It is rooted in a commitment not to launch a strategic offensive but to respond robustly if an adversary challenges China's national unity, territorial sovereignty, or interests. According to this concept, defensive counterattacks can respond to an attack, or be launched to disrupt an adversary's preparations to attack. The PLA interprets active defense to include both de-escalation and seizing the initiative.³⁸⁴

The reports continue to propose that China will seize the initiative in a time where military operations are favorable. By 2020, the China Military Power Report pointedly associates active defense as China's ability to utilize offensive preemptive strikes under its active defense concept.³⁸⁵ The same report references Chinese defense and strategy documents to underscore the importance to China to seek out asymmetric military advantages in order to have the ability to take operational initiatives when desired.³⁸⁶ Thus, if China is looking to gain operational advantages, this would mean that it is expected for China to utilize a strategy that would counter the United States' defensive and offensive capabilities.

3. Modernization and Deterrence

China's military modernization is consistently defended as a means to catch up to balance against other countries for security. For example, following a discourse on the importance of great power countries pursuing military modernization,³⁸⁷ the 2015 Defense White Paper explains that China's military "will work harder to create a favorable strategic posture with more emphasis on the employment of military forces and means, and provide a solid security guarantee for the country's peaceful development."³⁸⁸ The 2019 Defense

³⁸⁴ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2018* (Washington, DC: Department of Defense, 2018), 46.

³⁸⁵ Department of Defense, *2020 DOD China Military Power Report*, 27.

³⁸⁶ Department of Defense, 27–28.

³⁸⁷ The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 2.

³⁸⁸ The State Council Information Office of the People's Republic of China, 6.

White Paper suggests its military security is challenged by high-tech military advancements³⁸⁹ and will thus need to “focus on the capabilities to fight and win.”³⁹⁰ As well, the same Defense White Paper notes that the Chinese military still trails great powers.³⁹¹

All three of China’s Defense White Papers during the second decade endeavor to recognize each service’s respective missions and how military modernization efforts are a reflection of China’s national security requirements. Starting with China’s land-based missile forces of the former Second Artillery Force, now PLA Rocket Force (PLARF), China’s Defense White Paper’s largely highlight previously mentioned mission areas and modernization. For example, the 2013 and 2015 Defense White Papers continue to recognize the trend of *informationization* and improving the “safety, reliability, and effectiveness of its missiles.”³⁹² The same Defense White Papers also mention nuclear counterattack and strategic deterrence. When discussing the PLARF’s missions and importance for China’s security, the 2019 Defense White Paper notes missions of nuclear deterrence and counterattack.³⁹³

The one difference between the 2019 Defense White Paper and other iterations is when it mentions “enhancing strategic counter-balance capability.”³⁹⁴ The exact understanding of what is a counter-balance capability may refer to China’s force modernization that can counter other military-technical advancements. China’s introduction of MIRV technology with the modernization of the DF-5 and the soon to be operational DF-41 could possibly be examples of counter-balancing efforts. Whereas China may have showed some restraint in not integrating MIRV technology during the first

³⁸⁹ The State Council Information Office of the People’s Republic of China, “2019 Defense White Paper,” 6.

³⁹⁰ The State Council Information Office of the People’s Republic of China, 9.

³⁹¹ The State Council Information Office of the People’s Republic of China, 6.

³⁹² The State Council Information Office of the People’s Republic of China, “2013 Defense White Paper,” 10–11; The State Council Information Office of the People’s Republic of China, “2015 Defense White Paper,” 13.

³⁹³ The State Council Information Office of the People’s Republic of China, “2019 Defense White Paper,” 21.

³⁹⁴ The State Council Information Office of the People’s Republic of China, 21.

decade, this is no longer the case. Another aspect to consider which may be a counter-balance capability could be China's largely mobile nuclear force. Enemy intelligence, surveillance, and reconnaissance (ISR) will certainly be challenged with a generation of missiles that is predominantly mobile. Thus, China's nuclear missile modernization does offer more deterrence, but espoused counter-balancing and hardware modernization suggests China is certainly bolstering its relative ability to survive. Survival is not just defensive, however, since MIRV technology is inherently an offensive capability to overcome a defensive anti-ballistic missile system.

Defense white papers from 2011 through 2020 do not highlight the PLAN's nuclear capabilities like previous iterations do, but they do emphasize naval modernization as a means to fulfill its prescribed missions. It is worth emphasizing that while the conventional aspects of the PLAN are highlighted and nuclear capabilities are nonexistent, strategy is largely applicable, of course, to the entirety of the China's Navy. According to the wording of all Defense White Papers, China is accelerating the modernization of its naval forces.³⁹⁵ Missions of strategic deterrence and counterattack are consistently noted in all three Defense White Papers.³⁹⁶ For these two specific missions, the PLAN is improving its strategic deterrence and counterattack capabilities.³⁹⁷ China slightly modified its overarching naval mission of *offshore defense* in its 2015 Defense White Paper to *offshore waters defense* and *open seas protection*.³⁹⁸ The 2019 Defense White Paper then modifies the same mission to *near seas defense* and *far seas protection*.³⁹⁹ The Defense White Papers do not indicate exactly how missions or strategy are evolving, or not, based on its naval modernization. They do, however, indicate China's resolve to justify its naval

³⁹⁵ The State Council Information Office of the People's Republic of China, "2013 Defense White Paper," 9.

³⁹⁶ The State Council Information Office of the People's Republic of China, 9; The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 12; The State Council Information Office of the People's Republic of China, "2019 Defense White Paper," 21.

³⁹⁷ The State Council Information Office of the People's Republic of China, "2019 Defense White Paper," 21.

³⁹⁸ The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 12.

³⁹⁹ The State Council Information Office of the People's Republic of China, "2019 Defense White Paper," 21.

modernization as defensive. What is interesting about naval modernization in China's Defense White Papers is the fact that there is no mentioning of the Jin SSBN and JL-2 SLBM which nearly unprecedentedly gave China a credible nuclear sea-leg. This is contrasted with China's land-based nuclear missiles which are always discussed in Chinese declaratory policy. This may be a lack of Chinese confidence in its SSBN force, but exclusion could also indicate some hesitancy to bring more attention to its, for the most part, nascent SSBN force.

Next, all Defense White Papers stress improving China's air force to have strategic related missions such as strategic early warning and strategic projection.⁴⁰⁰ The only slight difference among the three Defense White Papers is that the 2019 Defense White Paper is the only one that does not associate the PLAAF with a strategic deterrence mission.⁴⁰¹ The year 2013 is the first time the PLAAF was associated with strategic deterrence. The fact that China does not mention the PLAAF's strategic deterrence mission in 2019 may not be significant in and of itself, since strategic projection and strategic early warning are retained. Based on the Defense White Papers, and other than the broad term of *strategic*, there is no clear indication whether missions for the PLAAF indicate current or oncoming nuclear capabilities. This is significant because American annual defense reports, starting in 2017, noted that China is likely developing a nuclear air-based leg to complete its nuclear triad.⁴⁰² Thus, China's exclusion of wording such as *strategic deterrence* in its 2019 Defense White Paper could be its implicit attempt at controlling external perceptions of its growing diversification of its nuclear arsenal.

4. LOW

All of the United States' annual reports on China's military attribute its modernization to maintaining nuclear deterrence, but some explain how modernization can

⁴⁰⁰ The State Council Information Office of the People's Republic of China, "2013 Defense White Paper," 10; The State Council Information Office of the People's Republic of China, "2015 Defense White Paper," 12–13; The State Council Information Office of the People's Republic of China, "2019 Defense White Paper," 21.

⁴⁰¹ The State Council Information Office of the People's Republic of China, "2019 Defense White Paper," 21.

⁴⁰² Chase, "Nuclear Bomber Could Boost PLAAF Strategic Role, Create Credible Triad."

effect doctrine. The 2011 annual report indicates that China's modernization has been to maintain its deterrence posture in response to other country's technological and military advancements.⁴⁰³ As China's nuclear forces become more capable, it may lead to changes in strategy. For example, the 2017 report notes that China is developing a space-based early-warning capability that could lead to the adoption of a LOW nuclear posture.⁴⁰⁴ According to the United States' 2017 report, PLA documents specify that a LOW posture technically conforms with its NFU policy as well.⁴⁰⁵ The U.S.'s analysis of China's potential LOW strategy does highlight the significance of China's military modernization in C3ISR as discussed above, but it is significant that China's potential space-based early-warning capability did not spring up solely during the second decade. For example, during the first decade, for example, China upgraded and developed some CLTC sites, continued satellite production, and probably constructed at least one LPAR. Even before the first decade, China's installation of fiber optic cables at missile bases could indicate an intentional move to support the likely high data throughput of future upgrades to a C3ISR network. Thus, China's C3ISR modernization during the second decade certainly adds more reason to be concerned with the possibility of a future LOW posture, but it would be a mistake to only attribute more recent modernization efforts to this potential outcome.

J. FINDINGS

This chapter shows that China's qualitative modernization has given China the ability to consider future shifts in posture and tactics. One notable difference between the decades is that, whereas declaratory policy from 2000 through 2010 generally sought to fit modernization into existing strategies, declaratory policy from 2011 through 2020 now shows that capabilities are provoking shifting operational doctrine. China's 2015 Defense White Paper is explicit that active defense is nearly a catch-all strategy that is, in part, determined by military capabilities. Chinese military capabilities, as confirmed by both the

⁴⁰³ Department of Defense, *2011 DOD China Military Power Report*, 34.

⁴⁰⁴ Department of Defense, *Annual Report to Congress: Military and Security Developments Involving The People's Republic of China 2017* (Washington, DC: Department of Defense, 2017), 60.

⁴⁰⁵ Department of Defense, 60.

2015 and 2019 Defense White Papers, will undoubtedly influence operational doctrine, though China will firmly state that its strategy has not necessarily changed. This is interesting given that, from 2011 through 2020, China increased the quantity and quality of its nuclear force. A Chinese nuclear arsenal that has gradually become more capable will very likely have substantial changes to operational doctrine.

China's qualitative growth in its nuclear arsenal by 2020 certainly seems to be more tantamount with the U.S.'s definition of active defense in 2000 that stressed high technology, rapid response, and preemptive strikes. For example, by 2020, China's nuclear arsenal had become predominantly a more capable mobile nuclear force. China's development of an infrastructure capable of enabling rapid response is largely comprised of technology and personnel. Training and exercises that consist of rapid logistics and communications inherently emphasize becoming a quick-response force. To be sure, a nuclear arsenal capable of leveraging its technological advancements and that trains to rapid response also indicates a continued effort to increase the force survivability. Survivability is not unprecedented since it has as long been a tenet of China's nuclear arsenal. At the very least, China's exercises are similar to those of the first decade that consist of training to mobility and communication. The assured command and control of China's nuclear arsenal seems to be critical for a highly centralized C2 structure that has become more capable of dispersing to multiple regions with the intent of survivability. Lastly, ascertaining whether China would conduct a preemptive strike for core national interests is difficult at best, but its qualitative nuclear arsenal development likely helps it survive to conduct a nuclear second-strike. Thus, China's nuclear arsenal growth could possibly encourage its leadership to leverage its nuclear arsenal for core national interests knowing that it would still have the capability for follow-on operations if necessary. Which, of course, has implications for Chinese strategy, since more warfighting options could result in changes to strategy, regardless of what Chinese leadership publicly states.

Continued technological advancements and the construction of nuclear arsenal basing does suggest a potential LOW posture. Just as China continued its technological advancements in C3ISR during the first decade, it continued to make steady progress on its C3ISR infrastructure during the second decade. Undoubtedly, China's efforts to

informationalize its military are evident with the ongoing construction and modernization of SSA that likely bolsters communication redundancy. An increasing amount of communication redundancy should enable units, bases, and commanders to be more capable of relaying orders and attaining situational awareness in the event of a time-sensitive scenario that requires rapid response. Combined with the evidence of China constructing additional silos for at least a portion of its nuclear forces, a LOW posture seems plausible. At least one modernization complication that is inhibiting the progress towards a LOW posture is the development of PLARF personnel. Specifically, if China is constantly outpacing its personnel's ability to become effective at leveraging existing nuclear arsenal capabilities as they are at any given year, Chinese leadership may have reservations about shifting to an unprecedented strategy. However, it is likely that China's leadership believes its C3ISR infrastructure is not capable of achieving such a strategy; China's collaboration with Russia on SSA suggests that Chinese military leadership recognizes gaps in the PLARF's ability to adopt LOW. Additionally, new silo construction could also indicate a move to increase the survivability of a mobile nuclear arsenal.

Lastly, the continued incorporation of an increasing amount of nuclear arsenal capabilities suggests that China's active defense will flexibly incorporate operational doctrine that supports offensive nuclear warfighting options. China's can no longer confidently state it exercises considerable restraint in the development of its nuclear arsenal. The incorporation of MIRV technology, varying yield options, and increased accuracy suggests China is directing the growth of its nuclear force to increase its credible deterrent through an offensive nuclear capabilities. This is not to say that defensive modernization that is inherent in the having a survivable nuclear force does not quell some concerns about where China's nuclear arsenal is heading. However, if China only wanted to have a secure-second strike capability, why develop a nuclear arsenal that would likely require changes in operational doctrine and personnel training? At least one interpretation that is reasonably gleaned from China's modernization is the previous analysis by Heginbotham, Heim, and Twomey in 2019 which elaborate on the elevation of the PLARF under current Chinese President Xi Jinping. Specifically, these subject matter experts believe that "political endorsement of the missile forces, will presumably make the Rocket

Force a more capable advocate for nuclear weapons and delivery systems, for support systems that may still be lacking...and for more flexible interpretation of policy and doctrine.”⁴⁰⁶

⁴⁰⁶ Heginbotham, Heim, and Twomey, “Of Bombs and Bureaucrats,” 551–52.

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IV. FINDINGS AND ANALYSIS

A. INTRODUCTION

China is not the most capable nuclear weapons country in the world, but it is certainly not a *paper tiger* either. China's nuclear modernization has resulted in a qualitatively capable nuclear force that provides an effective nuclear deterrent for China's national security. Though China's nuclear arsenal is smaller than that of the United States, China possesses a robust nuclear arsenal that is a source of national strength. China will continue to modernize its nuclear arsenal to maintain an effective and credible nuclear deterrent. Given the fact that China has focused on technological advancements and the survivability of its nuclear force, concern for strategic stability will likely continue between the United States and countries in Northeast Asia.⁴⁰⁷

As China increases its relative nuclear capabilities, the United States and its allies could seek out ways to improve their own security posture in response. This is problematic for regional security dynamics, since China would likely reciprocate with its own security improvements in order to retain a favorable strategic position. If countries are unable to resolve the issue of complicated security dynamics due to the lack of transparency and desire for relative gains, it is likely that countries will continue to pursue the modernization of national military capabilities such as nuclear weapons to increase their own security standing. Thus, China's nuclear modernization is certainly troubling for strategic stability.

While China will continue to modernize its nuclear arsenal, determining where Chinese strategy is headed is especially difficult to answer due to China's opacity with its nuclear weapons and nuclear strategy. This section will analyze where Chinese strategy is headed then analyze the possibility of inadvertent escalation, and, lastly, outline implications and recommendations for United States strategy and posture.

⁴⁰⁷ Brad Roberts, "Extended Deterrence and Strategic Stability in Northeast Asia," in *The Case of U.S. Nuclear Weapons in the 21st Century* (Stanford: Stanford University Press, 2016), 199.

B. CHINA'S NUCLEAR MODERNIZATION: WHERE IS CHINESE STRATEGY HEADED?

China has largely maintained consistency in its declaratory policy since 2000, but there are some interesting takeaways for the future of Chinese strategy as it pertains to its nuclear arsenal. This section will now turn to discuss each of the three areas which correspond to active defense, launch-on-warning (LOW), and no-first-use (NFU).

1. Active Defense

Modernization should reinforce declaratory policy, but China's ambiguous active defense declaratory policy leaves ample space for its continued nuclear arsenal modernization. China's nuclear modernization over the past two decades has certainly emphasized the tenet of survivability. In fact, most of China's nuclear modernization could be classified as a means to achieve survivability. This is especially since China could argue that foreign military and intelligence capabilities are a driver for the modernization of its nuclear arsenal. Specifically, a predominance of mobile nuclear missile systems should bolster China's second-strike capability, since there is now an increase in survivability. As this thesis has demonstrated, China's nuclear modernization, however, is not solely focused on survivability from a defensive warfighting position. Surely, the introduction of MIRV technology into newer and older missile systems is one aspect to consider when China consistently maintains its active defense strategy. However, while MIRV technology does have an offensive aspect to overcome anti-ballistic missile systems, overcoming missile defense is also a way to ensure that second-strike capability is effective. Thus, China's overarching military strategy of active defense is an ambiguous declaratory statement that enables the incorporation of unprecedented technological advancements.

Moreover, recent, large scale Chinese construction of silos has implications for its active defense as well. Consider that because China has increasingly maintained rapid-response in its exercises, it would make sense for China to have at least some missiles mated under the guise of maintaining a "rapid response" capability. Silo construction does not mean that nuclear warheads will absolutely be mated to missiles at all times, but it does

show how active defense has not necessarily constrained China from building out nuclear warfighting options that could exacerbate external security perceptions.

Because China continues to improve its nuclear arsenal with technological advancements and corresponding quantitative increases of its nuclear arsenal, Chinese nuclear modernization no longer seems to be representative of broad terms such as *lean* and *effective*. Even if China's official declaratory policy and fervent defenders of active defense continue to endorse ongoing nuclear modernization as a way to maintain active defense, there is plenty of room for skepticism as well. After all, China's nuclear arsenal already consists of overlapping regional- and global-range nuclear missiles that inherently have a second-strike capability. Thus, limited deterrence (i.e., an ability to win, rather than deter, a nuclear conflict)—rather than minimum deterrence—seems more representative of China's nuclear strategy under active defense. If China wants to maintain active defense, all it truly needs to do is continue stamping the military strategy into its Defense White Paper, all the while continuing nuclear modernization. However, while active defense continues to be stamped into declaratory policy in the future, Chinese nuclear modernization will probably be a combination of deterrence *and* an ability to win in a conflict. After all, if a nuclear warhead is also a military capability, it is not necessarily unreasonable to believe that a country may cross the nuclear threshold in support of vital national interests such as preservation of regime and territorial sovereignty.⁴⁰⁸

2. LOW

Next, China's development of its command, control, communications, intelligence, surveillance, and reconnaissance (C3ISR) infrastructure, and nuclear arsenal indicates that China is creating favorable conditions for the adoption of a LOW posture. China has consistently modernized its C3ISR infrastructure since before the decades examined. During the decades examined in this thesis, China expanded and modernized its ground infrastructure and collection capabilities, and made considerable progress on its space-

⁴⁰⁸ Kenneth Waltz, "The Spread of Nuclear Weapons: More May Be Better," *Adelphi Papers* 21, no. 171 (1981): 20; Kenneth Waltz, "Nuclear Myths and Political Realities," *American Political Science Review* 84, no. 3 (1990): 737, 739, <https://doi.org/10.2307/1962764>.

based collection system. Further signaling China's intent to achieve a LOW capability is its collaboration with Russia. Specifically, Russia's agreement to help China evolve its missile early warning network bolsters the assessment that China is shifting to a LOW posture. It is important to note that, even in an authoritarian nation-state such as China where the political party guides the development of a nation's military, economy, and even society, party goals are not implemented overnight. The development of a LOW capability requires not just the modernization of C3ISR infrastructure, but also missile infrastructure to support a rapid-response launch. China's construction of unprecedented missile silos during the second decade (i.e., 2011–2020) seems to support the conclusion that nuclear modernization is, in part, aiming for the technical and military achievement of something like a LOW capability.

Even if China's leadership does not currently intend to adopt a LOW posture in the near future, the continued development of its C3ISR infrastructure and nuclear arsenal may attract such an unprecedented strategy. A more complex interconnected information network which effectively processes more data could bolster nuclear warfighting capabilities. The continued modernization of C3ISR and nuclear arsenal could bolster Chinese decision-maker confidence in a potential LOW posture. LOW, then, may simply just be a means of having enough confidence to adopt such a posture that inherently stretches centralized command and control.

3. NFU

Though China continues to uphold its NFU policy, NFU has not constrained the modernization of China's nuclear arsenal. One aspect to consider for nuclear modernization is whether there is a presence of tactical nuclear weapons in China's arsenal. Over the decades examined in this thesis, China maintained and bolstered its regional-range nuclear strike capability while also developing an overlapping global-range nuclear strike capability. Of course, strictly based on missile ranges, China's nuclear arsenal is not necessarily considered *tactical* just because it has the capability to attack another country. In addition to technological advancements such as lower yield selection and multiple independent reentry vehicle (MIRV) technology, analysis must also consider how nuclear

forces may be employed in support of an objective. For example, because modernization has introduced more capabilities such as mobility, there are more nuclear warfighting options for China's decision-makers to consider throughout the continuum of conflict with another country.

The development of an increasingly capable nuclear arsenal is troubling for China's NFU policy. Chinese decision-makers no longer have to resort to just countervalue targeting when formulating operational plans and contingency options; because there are more nuclear weapons capabilities, nuclear warfighting may occur below the threshold of countervalue targeting. For example, China's more recent adoption of MIRV technology is surely a nuclear warhead survivability measure against missile defense capabilities. However, the DF-41's combination of lower yield selectivity and MIRV technology does signal that China's nuclear weapons development is not necessarily constrained by NFU. This suggests that, while China has maintained NFU in its declaratory policy, it has also been willing to develop nuclear weapons to support a range of contingencies as well. Surely, the discussion of whether China would conduct a nuclear first strike for a core national interest such as in a Taiwan conflict will continue to exacerbate the credibility of NFU. At least somewhat reassuring is the observation that Chinese training and exercises so far resemble a commitment to NFU.

Another aspect to consider on how NFU has affected China's nuclear arsenal modernization is survivability. China's development of a nuclear arsenal that is increasingly mobile bolsters the survivability tenet when it relates to an opaque active defense, but more mobility also has implications for NFU. To some extent, the open-source reporting by analysts capable of exploiting commercial imagery and subsequently conducting geospatial analysis is a direct result of China's mobile nuclear arsenal being more vulnerable to detection. Certainly, China still uses camouflage for at least some of its nuclear arsenal, as seen at the Jilantai training complex. However, while camouflage may help with some concealment, mobile nuclear forces still may be more vulnerable if intelligence, surveillance, and reconnaissance (ISR) can locate them. Mobility, then, presents a significant risk for the People's Liberation Army Rocket Force (PLARF) that is also supposed to adhere to NFU; if China truly focused on a second-strike capability for

the entirety of the PLARF, nuclear missile survivability would be prioritized. If there is less concealment because mobile nuclear forces are more vulnerable to ISR, then maybe NFU has not constrained nuclear modernization entirely. China's unprecedented nuclear arsenal mobility is not just a means of survivability, then, but also a more forward leaning posture. Inherently accepting a more forward leaning posture with a portion of its nuclear forces possibly indicates China's increased willingness to accept additional vulnerabilities at the expense of crossing a nuclear threshold. This would mean that, while NFU is certainly a tenet that China espouses today, there is more willingness in China to consider technological advancements that would fit within a flexible active defense but not necessarily NFU. Lastly, a nuance to China's nuclear modernization may be that in order to achieve a greater first strike and nuclear warfighting capability, it is necessary to risk a portion of its second-strike capability. After all, a dispersed nuclear force that presents the capability to strike first and still survive a second-strike probably gives China increased strategic deterrence too.

C. NUCLEAR ESCALATION

Given the increases in China's nuclear arsenal capabilities that have resulted in additional warfighting options, escalation across the nuclear threshold is more likely. Analysis of China's nuclear modernization also finds that escalation optimists' confidence of not crossing the nuclear threshold during a conflict is bolstered by the likely increase in a credible nuclear deterrent. However, while deterrence has surely been bolstered by nuclear modernization, the range of nuclear warfighting capabilities inherently gives China's leadership more options to consider when an unfavorable end to a conventional military conflict appears near.

C3ISR modernization is probably encouraging for Chinese decision-makers in their ability to maintain situational awareness, especially of their own nuclear force with increases in interconnectivity of communications during a conflict. But what happens when situational awareness starts to erode due to a series of joint warfighting capabilities that range from conventional strikes to cyberspace based effects? Surely, eliminating the entirety of Chinese ISR and communications between decision-makers and nuclear forces

is unlikely. However, conflict which results in the establishment of elevated alert readiness and deployment of warfighting forces in support of a core national interest such as a Taiwan conflict certainly is more complicated than just maintaining a credible strategic deterrence. Crossing the nuclear threshold may become even more a possibility, as a conflict that hosts a range of military operations has endless possibilities that could affect a modernized nuclear arsenal.

Certainly, China's nuclear modernization has bolstered both its strategic deterrence and nuclear warfighting options. China's overlapping regional- and global-range nuclear strike capabilities definitely bolster its credible deterrence. Also, the range of survivability inherent with having a predominant mobile nuclear force probably increases the confidence in Chinese leadership's decision-making during a conflict. So long as a conflict which has exclusively consisted of conventional warfighting continues to favor China's ability to achieve a desired end-state, there will be less pressure for nuclear escalation. Implicit in this assumption is the fact that China will need to always retain the advantage in an escalatory conflict. Of course, this is highly unlikely given that a conflict which includes conventional operations between Great Powers is likely to result in overlapping and multiple areas of operations that entails competing sources of national power.

Bolstered confidence in a more survivable force is another consideration for the potential of nuclear escalation. If Chinese leaders believe that their mobile nuclear force is relatively survivable, there could be an inclination to posture mobile nuclear forces for operations with the strict intent of deterrence. For example, nuclear forces could be placed on alert and efforts would be made to conceal their nuclear arsenal in hopes of preventing an enemy from taking actions that would threaten China's core national interests such as regime security or territorial sovereignty. Of course, if China's leadership confidence grows as modernization continues, there is a risk that conventional operations could inadvertently surpass nuclear thresholds. Moreover, posturing nuclear forces probably is no longer just a game of concealment within tunnels; inherent within a mobile nuclear force is the ability to disperse nuclear weapons for survivability. Mobility does not mean that all nuclear forces will be detected, but that is also a cause for concern, since this means that U.S. ISR efforts could detect, but possibly misidentify, conventional and nuclear missile

forces. The possibility that U.S. conventional operations could affect, indirectly or directly, Chinese nuclear forces is concerning for escalation. Thus, Chinese confidence in ability to leverage nuclear force capabilities, even if just for survivability with the intention of limiting conflict escalation, could result in crossing the nuclear threshold as well.

D. IMPLICATIONS FOR U.S. STRATEGY AND POSTURE

China is not likely to simply halt the modernization of its nuclear arsenal, so one challenge China will face in the future is pressure from the United States, through strategic dialogues, to become more transparent with its nuclear strategy and weapons.⁴⁰⁹ Even if China's nuclear weapons are intended solely for deterrence, the United States continues to believe that China's opacity with its nuclear arsenal undermines strategic stability.⁴¹⁰ Furthermore, the 2018 Nuclear Posture Review states that the United States will need to "maintain the capability to credibly threaten intolerable damage."⁴¹¹ This means that the United States will continue to pursue its own military modernization as a means to strengthen its own deterrence and cope with a China that is developing both conventional and nuclear forces. Thus, China will need to determine whether it is more important to become more transparent with its nuclear weapons and its nuclear strategy, or simply continue to seek out military modernization to confront United States capabilities. Due to China's continued nuclear arsenal modernization, it seems likely that future security entanglements will be exacerbated by relative military capabilities between Great Powers.

Another challenge is that, as China seeks to maintain a credible nuclear deterrent, it will confront, from its perception, the challenge that United States missile defense systems poses to China's own national security.⁴¹² One way the United States continues

⁴⁰⁹ Roberts, "Extended Deterrence and Strategic Stability in Northeast Asia," 208–9; Elbridge Colby and Wu Riqiang, "Seeking Strategic Stability for U.S. - China Relations in the Nuclear Domain," NBR Special Report (Seattle: The National Bureau of Asian Research, 2016), 32.

⁴¹⁰ Colby and Riqiang, "Seeking Strategic Stability for U.S. - China Relations in the Nuclear Domain," 30, 40.

⁴¹¹ Department of Defense, "Nuclear Posture Review" (Washington, DC: Department of Defense, 2018), 31.

⁴¹² Colby and Riqiang, "Seeking Strategic Stability for U.S. - China Relations in the Nuclear Domain," 31.

to ensure the security of South Korea and Japan from North Korean nuclear weapons is with U.S. theater missile defense systems.⁴¹³ This is, according to the United States, a form of extended deterrence simply directed at North Korea's belligerence.⁴¹⁴ However, for China, U.S. missile defense systems undermine China's relative military capabilities.⁴¹⁵ As identified in the 2021 Interim National Security Strategy, the United States will continue to work "in common cause with our closest allies and partners."⁴¹⁶ The U.S.'s continued commitment to its allies through extended deterrence in China's regional periphery will likely influence China's nuclear posture. As China looks to improve its nuclear posture, it will certainly justify its nuclear modernization as a means to overcome American security commitments; for example, China's incorporation of MIRV into its nuclear arsenal is one way in which China has sought to overcome U.S. missile defense. China's offensive technological capabilities suggest a more forward leaning nuclear posture. Surely, perceptions of nuclear modernization and military technological capabilities are critical considerations for U.S. security calculations.

China's perceptions of the U.S.'s military capabilities are important for regional security dynamics, but so are the U.S.'s security perceptions of China's nuclear modernization. The United States' 2020 Nuclear Matters Handbook explains that "China...is modernizing and expanding its already considerable nuclear forces, marking the return to Great Power competition."⁴¹⁷ Furthermore, the report goes on to state that, "the United States is embarking on the largest, most complex nuclear modernization effort in its history."⁴¹⁸ To be sure, the United States' nuclear modernization is not just a reaction to China's nuclear capabilities. For example, the U.S. Department of Defense explains that

⁴¹³ Roberts, "Extended Deterrence and Strategic Stability in Northeast Asia," 201–3.

⁴¹⁴ Colby and Riqiang, "Seeking Strategic Stability for U.S. - China Relations in the Nuclear Domain," 32.

⁴¹⁵ Colby and Riqiang, 32.

⁴¹⁶ White House, "Interim National Security Strategic Guidance" (Washington, DC: White House, 2021), 3.

⁴¹⁷ Department of Defense, Nuclear Matters Handbook 2020 (Washington, DC: Department of Defense, 2020), 3.

⁴¹⁸ Department of Defense, 7.

it needs to reconstitute and modernize its nuclear weapons program, since “by 2035, 100% of U.S. nuclear delivery systems will have exceeded their design lives by an average of 30 years. By the early 2040s, 100% of U.S. nuclear delivery vehicles will have reached end of life.”⁴¹⁹ At the very least, however, there is a correlation between U.S. nuclear modernization and the threat that a capable Chinese nuclear arsenal poses to a credible American nuclear deterrence.

E. RECOMMENDATIONS FOR U.S. STRATEGY AND POSTURE

Based on China’s continued nuclear modernization efforts, there are three recommendations for U.S. strategy and posture that may help improve strategic stability. The first recommendation is that the United States must consider how perceptions of military modernization programs and security statements can exacerbate the chances for improved strategic stability. According to the 2021 Interim National Security Strategy, the United States “will engage in meaningful dialogue with Russia and China on a range of emerging military technological developments that implicate strategic stability.”⁴²⁰ Surely, if China does ever consider dialogue with the United States on issues such as arms control, it will likely reference the United States’ military capabilities and the U.S.’s uncompleted nuclear modernization program. Consider that, while the United States details China’s nuclear modernization and its implications for security, China will reference how the United States and even Russia have a much more robust nuclear arsenal. With ongoing nuclear modernization on both sides of the Pacific, strategic stability may be much more complicated than the United States’ simple desire for arms control. Nonetheless, meaningful attempts to foster communication on nuclear arsenals and strategy between the United States and China should improve security perceptions in the long-term.

The second recommendation is for the United States to continue assuring East Asian allies with security commitments despite China’s concern with U.S. extended deterrence in Northeast Asia. To be sure, there will likely be rhetoric from China that opposes American security influence and commitments to peripheral countries such as

⁴¹⁹ Department of Defense, 7–10.

⁴²⁰ White House, “Interim National Security Strategic Guidance,” 13.

Japan and South Korea. However, the United States' ability to maintain a favorable security posture is, in part, rooted in its allies. China's nuclear modernization has resulted in redundant nuclear missile systems as well as offensive technological capabilities. Reducing U.S. military forces and not investing in defense cooperation measures in Northeast Asia could weaken the allies' perceptions of the United States' extended deterrence. This does not mean that the United States should not consider how China's perception is shaped by American security guarantees. However, preconditions of increasing communication with China should not be achieved by means of the United States rescinding its commitment to a Free and Open Indo-Pacific. Certainly, the United States can communicate to China that American security guarantees are probably more stabilizing than nuclear latency countries pursuing their own nuclear weapons for increased security. Thus, open communication and perception management will be critical for the United States' goal of long-term strategic stability.

The third recommendation for the United States is to maintain and bolster its ISR capabilities. The United States could continue to enhance and deploy conventional military and technological capabilities to overcome China's military growth. This is especially since it is unlikely that there will be a complete halt to military modernization within Northeast Asia. For example, based on China's nuclear modernization surveyed in this thesis, its nuclear arsenal will likely continue to expand as it fields a more capable nuclear triad. Additionally, China has already taken measures to conceal its nuclear forces with increased mobility and silo construction. Thus, the United States' understanding of China's warfighting doctrine and strategy will probably not simply be solved by open communication or additional forward deployment of conventional hard power capabilities. In addition to managing perceptions and opening dialogue on nuclear arsenals, the U.S. should invest in a capable ISR program that can overcome China's opacity. ISR is more than just tracking and detecting forces during a conflict; ISR programs can help U.S. policymakers understand the importance of proposed military and nuclear modernization programs. Rather than simply exacerbating the complicated security architecture in Northeast Asia, intelligence programs could also reveal opportunities to improve strategic stability.

F. CONCLUSION

This thesis finds that China's nuclear related modernization over the past two decades is not solely driven by its existing strategies of NFU or active defense. Chinese nuclear modernization has created a more robust nuclear deterrent, but its burgeoning nuclear arsenal has also resulted in more war-fighting options that could empower decision-makers in a future escalatory conflict. Furthermore, because China maintains an ambiguous declaratory policy, it is difficult to discern the exact mission assignment and force posture for the entirety of its nuclear forces. Fundamentally, Chinese nuclear modernization has surely strengthened its deterrence. In addition to deterrence, however, China's nuclear arsenal and infrastructure improvements should also be viewed as more than just a force that solely deters; there is also the possibility that a nuclear arsenal can be used to achieve coercive success. And all of the above exacerbates the potential for inadvertent escalation in any intense conventional conflict.

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