People's Liberation Army Rocket Force Order of Battle 2023

CNS

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Highlights

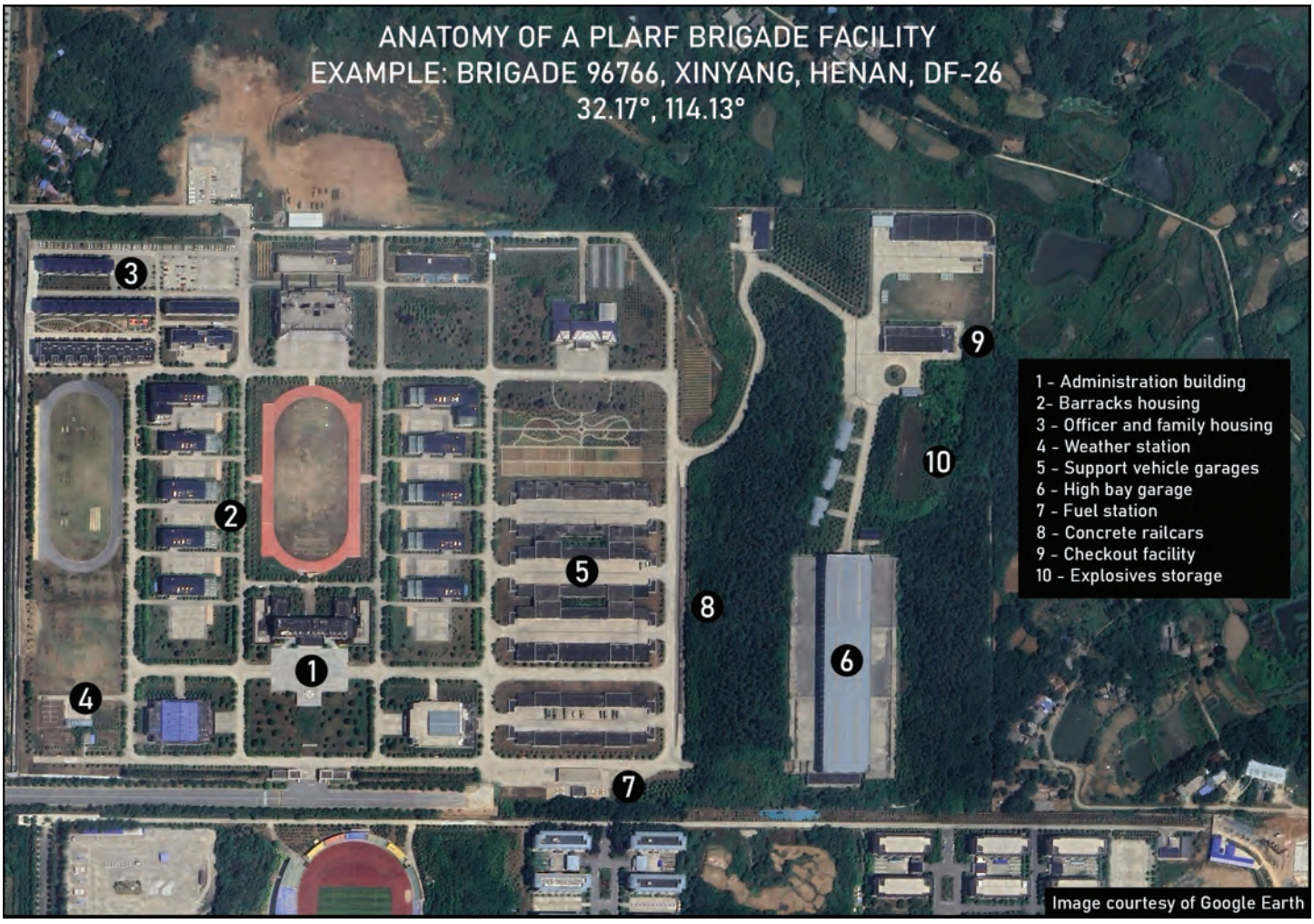
- The People's Liberation Army Rocket Force's (PLARF) combat missile units are organized into six missile "bases," each responsible for six to eight brigades. The PLARF currently has at least forty combat missile brigades. A significant number of these brigades have been added or relocated in the last decade.
- China's medium and intermediate-range missile force is undergoing a significant modernization, with the retirement of older systems (DF-21A, possibly the DF-21C) and the deployments of new systems (DF-17, DF-26).
    - The DF-17 has entered service with at least one PLARF unit and will certainly enter service with three more brigades in the next three years.
    - The nuclear variant of the DF-21, the DF-21A, is in the process of being retired. It has already been largely replaced with the DF-26.
    - The total number of active DF-26 launchers has reached at least 216 and will likely reach 252 within the next three years.
- China's mobile ICBM force is continuing to slowly grow and modernize as the PLARF replaces older DF-31A systems with the DF-31AG. The DF-41 ICBM is deploying to bases across northern China but appears to operate a lower number of launchers per brigade than DF-31 brigades.
    - The original version of the DF-31 has been retired from active service. The majority of DF-31A units have upgraded to the DF-31AG system.
- China's silo-based ICBM force is expanding, with new ICBM silos under construction for multiple ICBM missile systems.
    - The construction of 334 solid-fuel missile silos at Yumen, Hami, and Hanggin Banner, and Jilantai continues. 14 silos at Jilantai are for training and developing concepts of operations.
    - The PLARF is undertaking a large expansion in the number of liquid-fueled DF-5 pattern silos. The number of DF-5 silos will more than double over the next three years from 18 to at least 48 operational missile silos.
- The growing reliance on silo-based ICBMs may require a change in the alert posture of the PLARF. In addition to the possibility that missiles in the solid-fueled silos will be on some form of continuous alert, the PLARF is also constructing new or upgrading existing underground facilities near DF-5 silos. It is possible this indicates a desire to store nuclear warheads closer to the silos to support greater levels of readiness in support of a launch on warning (LOW) capability.

Introduction

The People's Republic of China is currently in the process of radically expanding its arsenal of conventional and nuclear land-based missile launchers. Over the past decade China has doubled the number of combat missile brigades in the People's Liberation Army Rocket Force (PLARF), and has unveiled a myriad of new capabilities, including missiles capable of firing both conventional and nuclear warheads, and missiles equipped with hypersonic glide vehicles designed to evade missile defenses. The technologies and deployment patterns of these weapons are important indicators of the direction of China's force posture: they not only indicate China's military capabilities, but also its fears and its conceptions about how future wars in the region will be conducted. Deployment of particular systems with certain capabilities to certain regions can inform us of what, how, and when China might strike certain targets, which in turn can help us understand what China prioritizes as a threat. The current expansion of China's missile forces suggests a possible departure from China's previously restrained second-strike nuclear posture to a posture capable of deterring at multiple levels of conflict and an increased shift towards nuclear warfighting. As the Sino-American relationship becomes increasingly volatile over the status of Taiwan, gaining accurate data on China's conventional and nuclear missile forces becomes more important than ever.

Since China first established a ballistic missile force, that force has historically been quite small, kept at low levels of readiness, and constrained by a policy forswearing the first use of nuclear weapons. A little over a decade ago, China only possessed around 50 intercontinental ballistic missiles (ICBMs), of which only the 18 DF-5 ICBMs in silos and 12 DF-31A mobile launchers could reliably reach the contiguous United States.[1] After Xi Jinping elevated China's missile forces into a full branch of the People's Liberation Army in 2015, the number of missile launchers deployed by the PRC has increased rapidly. The PLARF, responsible for the operation of all non-tactical ground-based surface-to-surface missile systems in China's inventory, operates both conventional and nuclear missiles for a variety of strategic missions. This could include utilizing short, medium, and intermediate-range missiles to neutralize Taiwanese defensive installations, striking US warships at long-range while those warships are at sea or in port, or a retaliatory nuclear strike mission. The PLARF is now on track to deploy more than 1,000 ballistic missile launchers by 2028, including at least 507 nuclear capable launchers, 342 to 432 conventional launchers, and 252 dual-capable launchers. At least 320 solid-fueled fixed ICBM silos and 30 liquid-fueled fixed ICBM silos are currently under construction in addition to China's growing arsenal of mobile ICBM launchers. And this tally does not even touch launchers operated by the People's Liberation Army Air Force (PLAAF) and the People's Liberation Army Navy (PLAN).

[1] "Military and Security Developments Involving the People's Republic of China 2010." Department of Defense, 2010. The original modification of the DF-31 only has the range to hit certain parts of the Pacific Northwest from bases in northeast China, and in 2010 no such launchers were positioned in this location.



DF-15B launchers of Brigade 96714. *Xinhua News Agency*.

The dramatic multiplication in missile forces, both in terms of those missiles capable of reaching the United States, and those missiles that offer China new capabilities in a regional war, have serious implications for the strategic balance in East Asia as well as the future direction of China's nuclear posture. The direction of the posture is difficult to assess due to the lack of sources coming out of China. As the Chinese government has not officially commented on the buildup or acknowledged its scope, any concrete data, like statements and records from the PLARF itself or Chinese strategists, is hard to come by. Because of this, analysis of what the PLARF is actually deploying and in what quantity is one of our only windows into developments into how the PRC thinks about its nuclear weapons arsenal and how to use it. Open-source intelligence techniques allow researchers to collect this data. By utilizing publicly available information and commercial satellite imagery, researchers can examine foreign military organizations in a level of detail that was previously only available to state intelligence agencies.

All Chinese military units have an assigned numerical cover designator, and these designators are commonly referenced by Chinese state media. Because the

designators are ordered in a way that allows one to know what a unit does just based on the designator, one can build an order of battle of PLA units partly by searching through Chinese state media and identifying those unit cover designators and, if imagery is present in that reporting, geolocate the unit in question. Exploitable information available on the internet can be matched to infrastructure signatures visible on commercial satellite imagery. Chinese state media publications on the PLA commonly reference what city or county the unit resides in. Once an analyst knows how the Chinese military generally build their units and can identify certain infrastructure signatures as being PLARF specific, even units that do not appear on Chinese state media can be easily identified. Different PLA facilities with different purposes are built to different specifications and standards. Armored vehicle units in the People's Liberation Army Ground Force are easily identifiable because of the unique way the PLA builds armored vehicle garages. People's Liberation Army Air Force units equipped with cruise missiles and air-launched ballistic missiles are identifiable by the unique checkout facilities built to service those munitions. Combat missile brigades of the PLARF can be identified via similar signatures. ICBM units need garages big enough to host ICBM launchers and checkout facilities big enough to service ICBMs. PLARF units need to have weather stations to help them assess whether or not current conditions are suitable for operations. These facilities – built to standards across all PLARF units – can indicate whether or not a facility is related to the PLA and what role that facility plays. Combined, this information allows us to identify PLARF bases, brigades, and support facilities, and place them in a broader order of battle for all Chinese missile forces. This information not only allows us to evaluate the PLARF's force strength, but also gain clues about how the PLARF envisions utilizing their nuclear and conventional forces in a conflict. A close examination of the PRC's land-based nuclear and conventional missile forces enables us to examine possible changes in Chinese military strategy.

The structure of this report is as follows: we will begin with an examination of the land-based ballistic and cruise missile systems, detailing their capabilities individually. We will then briefly detail the history and structure of the PLARF before diving into the order of battle, before ending with a discussion of what changes in the PLARF's order of battle could indicate about China's posture, their strategic concerns, their thought processes on deterring the United States and other adversaries, and the future direction of China's missile order of battle.

The People's Liberation Army Rocket Force Arsenal

Ballistic missiles are generally divided into categories based on range. Short-range ballistic missiles (SRBM) have ranges under 1000 km, while medium-range missiles (MRBM) have ranges between 1000 km and 3000 km. Intermediate-range missiles (IRBM) have ranges between 3000 km and 5500 km. Any missile that is capable of hitting targets beyond 5500 km is classified as an intercontinental ballistic missile (ICBM).

All Chinese land-based missiles are given the name "Dongfeng" (East Wind) followed by a number. The PLARF's early liquid-fueled systems, like the DF-4 and DF-5, are numbered sequentially, but this pattern is broken by subsequent solid-fueled systems. Single-stage solid-fueled systems like the DF-11, DF-15, and DF-16 are numbered DF-1X. Two-stage solid-fueled systems like the DF-21 and DF-26 are numbered DF-2X, and China's only three-stage solid-fueled ICBM is numbered DF-31. China's newest solid-fueled ICBM, the DF-41, is probably numbered in the DF-4X class because of its post-boost vehicle.[2] These numerical designations are followed by the missile's mod number, denoting unique versions of the missile in question. For example, the DF-21D MRBM is numbered as such because it is a two-stage, solid-fueled ballistic missile with three previous variants. In addition to its DF number, the United States Intelligence Community also assigns each missile an internal reporting designation. PLARF missiles have the designation "China-Surface-to-Surface" or CSS. This designation is followed by a number and, if applicable, by the missile's mod letter, identifying the particular variant of the missile. For example, the DF-21 series of missiles has been assigned the designation "CSS-5," and the DF-21D has been assigned the designation "CSS-5 Mod 5."

[2] Thanks to Jeffrey Lewis for pointing this out to me.

DF-11 (CSS-7)

14 DF-11A launchers of Brigade 96714. *China Military*.

Fuel	Solid
Stages	1
Range	~600 km[3]
Length	~8.5 m
Diameter	~0.8 m
Number Deployed	~54 to 72 Launchers
IOC	~1992

The DF-11 is a conventional, single-stage, solid-fuel, road-mobile short-range ballistic missile with a diameter of 0.8 meters and a length of 8.5 meters. The original variant of this missile, thought to have a 300 km range, entered service with the Second Artillery Corps in the mid-1990s. The PLARF has now entirely replaced the DF-11 with the DF-11A (CSS-7 Mod 2) which has an extended range of 600 km and an aeroballistic warhead. A ground-penetrating subvariant of the DF-11A, the DF-11AZT, is deployed alongside the A.

At least one brigade of the DF-11A will be replaced soon with the DF-17. It is likely given the PLARF's sizable inventory of DF-11A missiles that the this system will continue to be available to the PLARF, even if in a reserve role, for the foreseeable future.

[3] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

DF-15 (CSS-6)

DF-15B launchers of Brigade 96714. *Xinhua News Agency*.

Fuel	Solid
Stages	1
Range	~600-725 km[4]
Length	~9 m
Diameter	~1 m
Number Deployed	~54 to 72 Launchers
IOC	1992

The DF-15 is a conventional, single-stage, solid-fuel, road-mobile short-range ballistic missile with a diameter of around 1 meter and a length of around 9 meters. Several variants of the DF-15 exist, but only two are currently thought to be in service with PLARF brigades: the aeroballistic DF-15B with a range of 850 km or more, and the DF-15C, a ground-penetrating version with a range of 725 km or more.

At least one brigade of the DF-15 will be replaced soon with the DF-17. It is likely given the PLARF's sizable inventory of DF-15missiles that the this system will continue to be available to the PLARF, even if in a reserve role, for the foreseeable future.

[4] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

DF-16 (CSS-11)

Six DF-16 launchers at Brigade 96736. *China Military*.

Fuel	Solid
Stages	2
Range	~700+ km[5]
Length	~10 m
Diameter	~1.1 m
Number Deployed	~54 to 72 Launchers
IOC	2012

The DF-16 is a conventional, single-stage, solid-fuel, road-mobile short-range ballistic missile with three known variants. One version has no fins on the warhead, while two others with different lengths have aeroballistic warheads capable of maneuvering in the terminal phase of their flight to evade missile defense. It is unknown how the different variants match up to the DF-16's different modification designations. We know of DF-16A, DF-16B, and DF-16G designations. The DF-16B is capable of launching warheads with cluster munitions, while the DF-16G has been described by Chinese state media as a medium-range ballistic missile with greater accuracy and a more maneuverable warhead.[6]

[5] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

[6] Lin, Jeffrey, and Singer, P.W. "New Chinese Ballistic Missile Crashes the Battlefield Party With Cluster Munitions." *Popular Science,* February 19th, 2016.

DF-17 (CSS-22)

Three DF-17 launchers at the 2019 China National Day Parade. *China Military*.

Fuel	Solid
Stages	1
Range	Unknown
Length	~11 m
Diameter	~1 m
Number Deployed	~27 to 36 Launchers
IOC	2021

The DF-17 is a single-stage, solid-fuel, road-mobile medium-range ballistic missile equipped with a hypersonic glide vehicle. This allows the DF-17's payload to glide to its target, avoiding adversary radar and ballistic missile defenses. The PLARF is currently in the process of widely deploying the DF-17 in both the Taiwan and Korea areas. The system is currently operational with the DF-17's OT&E brigade, 96727, while three other brigades, 96714, 96716, and 96755, are currently in the process of upgrading to the DF-17.

CJ-10 (DF-10)

Multiple DF-10 launchers at the 2009 China National Day Parade. *China Military*.

Fuel	Liquid (With Solid Booster)
Stages	N/A
Range	~1,500–2,000 km
Length	Unknown
Diameter	Unknown
Number Deployed	~54 to 72 Launchers
IOC	2006

The CJ-10 has been at various times interchangeably referred to as the CJ-10, DH-10, and DF-10. The CJ-10 is a subsonic surface-to-surface medium-range cruise missile with two variants, the CJ-10 and the CJ-10A. Each CJ-10 launcher is capable of carrying three CJ-10 missiles and can be reloaded in the field. Cruise missiles have never been as widely deployed as other system types among the PLARF, but still allow the PLARF to launch accurate low emission strikes against regional targets. The original version of the CJ-10 is possibly in the process of being retired as its only brigade, Brigade 96735, is probably in the process of upgrading to a new missile. An upgraded version of the DF-10, the DF-10A, is also deployed by a single brigade.

DF-100

Twelve DF-100 launchers at the 2019 China National Day Parade. *China Military*.

Fuel	Liquid (With Solid Booster)
Stages	N/A
Range	~2000 km
Length	Unknown
Diameter	Unknown
Number Deployed	~24
IOC	Unknown

The DF-100 is a supersonic long-range cruise missile unveiled in the 2017 China National Day Parade with a range of approximately 2000 km.[7] The system's OT&E brigade is Brigade 96756 in Jinan, Shandong.[8]

[7] "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2021," Department of Defense, Sept 1st 2021.

[8] "First PLA Rocket Force CJ-100 Unit Likely Identified." China Aerospace Studies Institute, November 2020.

DF-21A (CSS-5 Mod 2)

A DF-21A launcher. *China Military*

Fuel	Solid
Stages	2
Range	~1,750 km[9]
Length	~11 m
Diameter	~1.4 m
Number Deployed	~12 Launchers
IOC	1990s

The DF-21A is a two-stage, solid-fuel, road-mobile medium-range ballistic missile. The DF-21 began as the JL-1 submarine-launched ballistic missile, but owing to the failure of the Xia class of ballistic missile submarines, the JL-1 was adapted for using on land.[10] The DF-21A is an upgrade of the original DF-21 and has a larger nose cone. The DF-21A is a dedicated nuclear system, capable of launching a single nuclear warhead to a range of around 1,750 km. The DF-21A's intended target sets includes Japan and strategic targets in southern Russia.[11] This variant has been slowly retired as operational brigades shift to more modern missiles like the DF-26.

9 "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

10 Xue, Litai, and John Wilson Lewis. *China's Strategic Seapower : The Politics of Force Modernization in the Nuclear Age. Stanford, Calif. : Stanford University Press, 1994.*

11 Because of the DF-21's antiquated guidance system, the launching positions for the system had to be built positioned in a certain way relative to the intended target. This allows us to deduce the firing arc of any set of DF-21A launch positions.

DF-21C (CSS-5 Mod 4)

A DF-21C launcher in a reload exercise. *China Military*.

Fuel	Solid
Stages	2
Range	~1,500 km+[12]
Length	~13 m
Diameter	~1.4 m
Number Deployed	Possibly retired
IOC	2006

The DF-21C is the conventional variant of the DF-21. This variant has a finned maneuvering reentry vehicle capable of striking targets more accurately and has an estimated range of at least 2,150 km. Because of the variant's new maneuverable reentry vehicle, the DF-21C is significantly longer than the DF-21A. It is possible that this system has been retired, or deployed in low numbers in brigades that also operate the DF-21D. No dedicated DF-21C brigades currently exist.

[12] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

DF-21D (CSS-5 Mod 5)

A DF-21D launcher at the 2015 Victory Day Parade. *China Central Television*.

Fuel	Solid
Stages	2
Range	~1,500 km+[13]
Length	~13 m
Diameter	~1.4 m
Number Deployed	~48 Launchers
IOC	Unknown

Lastly in the DF-21 family, the DF-21D is a dedicated anti-ship ballistic missile in service with two brigades. It reportedly has a range above 1,500 km. It is unknown how effective this weapon is in practice. The DF-21D is not deployed in large numbers and has been eclipsed by the DF-26. It is unlikely that the total number of DF-21Ds will expand beyond this in the short term as there is little brigade space available for them. It is probable that DF-21D brigades also operate other variants in the DF-21 family.

[13] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

DF-26 (CSS-18)

A DF-21D launcher at the 2015 Victory Day Parade. *China Central Television*.

Fuel	Solid
Stages	2
Range	~3,000 km+[14]
Length	~15 m
Diameter	~1.4 m
Number Deployed	216 Launchers
IOC	2018

The DF-26 is a two-stage, solid-fuel, road-mobile intermediate-range ballistic missile. This system can engage land and sea targets at ranges beyond 3,000 km. The PRC has widely deployed this system in a relatively short amount of time, with the system entering into service around 2015. The PLARF now operates at least 6 active DF-26 brigades with a total of at least 252 launchers. Judging from analysis of the design of the launcher itself, it is possible that the DF-26 has swappable warheads, as the DF-26 is reportedly capable of conducting conventional anti-ground and anti-ship missions, as well as nuclear missions.[15] We also know that different variants of the DF-26's stages exist, with different versions of the missile itself apparently offering different capabilities. Precisely what is and is not interchangeable is not known. DF-26 brigades appear to be truly dual-use, capable of launching both nuclear and conventional warheads. A CCTV video described Brigade 97646, a confirmed DF-26 brigade, quickly switching from a conventional to a nuclear mission during an exercise.[16]

[14] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

[15] Pollack, Joshua H. and LaFoy, Scott. "China's DF-26: A Hot-Swappable Missile?" *Arms Control Wonk Blog,* May 17th 2020.

[16] Singer, P.W. and Ma Xiu. "China's Ambiguous Missile Strategy is Risky." *Popular Science,* May 11th 2020.

DF-31 (CSS-10 Mod 1)

A DF-31 launcher of Brigade 96752. *China Military*.

Fuel	Solid
Stages	3
Range	~7,000 km+[17]
Length	15.5 m
Diameter	2.1 m
Number Deployed	Retired
IOC	2006

The DF-31 was China's first mobile ICBM system. The system is a solid-fuel, three-stage ICBM with a range of around 7,000 km and was capable of delivering a single warhead. This system was not off-road mobile and had a significantly long launch time, and could only fire from preprepared sites that can be very easily identified from space. This significantly limited the survivability of the system. With its limited range, the DF-31 could only range the continental United States from bases in north-eastern China near the Korean border. The DF-31 is now retired as its last remaining brigade has upgraded to the DF-31AG or DF-41. The DF-31 has now been completely retired as all brigades equipped with the system have upgraded to either the DF-31AG or DF-41.

[17] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

DF-31A (CSS-10 Mod 2)

4 DF-31A launchers at the 2009 National Day Parade. *China Central Television*.

Fuel	Solid
Stages	3
Range	~11,000 km+[18]
Length	14.8 m
Diameter	2.1 m
Number Deployed	24 Launchers
IOC	2007

The DF-31A is an upgraded version of the DF-31. This variant of the system fits a shroud over the warhead and has a different launcher. It also has a significantly upgraded range, and is capable of hitting targets on the western coast of the United States. While the ability to base the system deeper in China's interior improves the system's survivability, the system still lacks mobility, launch speed, and has a significant number of support vehicles. The number of brigades equipped with this version of the launcher has declined as brigades continue to be upgraded to the DF-31AG.

[18] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

DF-31AG (CSS-10 Mod Unknown)

12 DF-31AG launchers at the 2019 China National Day Parade. *China Military*.

Fuel	Solid
Stages	3
Range	~11,000 km[19]
Length	14.8 m
Diameter	2.1 m
Number Deployed	48 to 56 Launchers
IOC	2017

To increase mobility and modernize the support equipment for the missile, the PLARF unveiled the DF-31AG, which trades in the DF-31A's truck and trailer for a single eight-axle heavy vehicle, the HTF5980A. The DF-41 uses a version of the same chassis, the HTF5980B. It is unclear at this point what precisely the difference between the DF-31A and the DF-31AG is besides the change in transporter and support equipment. PLA military newspapers mention that the AG has upgraded cabling, reducing the number of necessary cables and allows for faster data transmission times. But what changes, if any, have been made to the missile itself is still unknown. Given the designation keeping the "A" designation and the fact that they do not appear to have upgraded the guidance system, it unlikely that the missile carried by the DF-31AG is significantly different from the DF-31A. There is also the fact that if the DF-31AG was significantly different, it should have been assigned a new designation by the US intelligence community (theoretically, CSS-10 Mod 3) but we have not seen any DoD report reference such a designation.

[19] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

DF-41 (CSS-20)

12 DF-31AG launchers at the 2019 China National Day Parade. *China Military*.

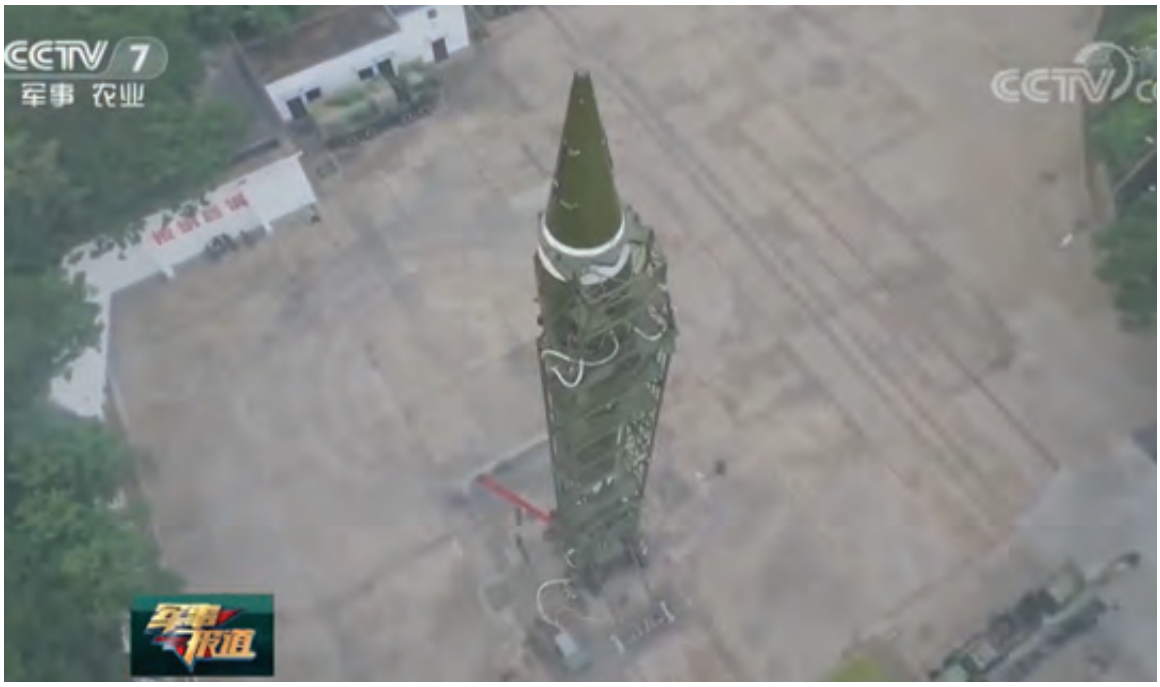
Fuel	Solid
Stages	3
Range	13,000 km+
Length	Unknown
Diameter	Unknown
Number Deployed	12 to 20 Launchers
IOC	Unknown

The DF-41 is the newest and the most advanced intercontinental ballistic missile in the PLARF's inventory. The DF-41 is capable of launching up to three warheads at targets beyond 13,000 km.[20] The system's range allows it to target on the United States' eastern coast. The PRC paraded sixteen launchers for this system in 2019 and claimed it comprised two brigades. The Department of Defense has revealed that the PRC is considering alternative basing modes for this system, including a silo basing mode and a rail basing mode.[21] However, the only launcher currently in use for this system is the road-mobile launcher.

[20] "2022 Report on Military and Security Developments Involving the People's Republic of China." United States Department of Defense, November 29th, 2022. Page 94.

[21] Ibid. Page 65.

DF-4 (CSS-3)



A DF-4 missile at a training facility in China. *China Central Television*.

Fuel	Liquid
Stages	2
Range	~5,000 km
Length	28.5 m
Diameter	2.25 m
Number Deployed	Retired
IOC	1975

The DF-4 is a two-stage, liquid-fuel intercontinental-range missile with a length of 28.2 m and a diameter of 2.25 m. The DF-4 has a range of around 6,000 kilometers and is capable of striking targets in the western Soviet Union like Moscow, and Guam. The system was introduced in 1975 and retired around 2015. The system was equipped with a 3 megaton warhead. Because the missile can only be fueled while in an erected upright position, firing a DF-4 requires time and a large number of support vehicles. The Second Artillery Corps decided to deploy the DF-4 in a "roll-out-to-launch" (ROTL) firing mode, in which the missile is stored horizontally in a hardened underground facility before being rolled out to a firing position immediately outside the blast door. This allowed the DF-4 to potentially survive a first strike during the Cold War period, but with the advent of extremely accurate ICBMs, the DF-4's basing mode became insufficient to guarantee or even moderately improve survivability. It is now only used as a training tool to introduce recruits to the maintenance and handling of liquid-fueled systems before they train on the larger DF-5 operational system.

DF-5 (CSS-4)

A DF-4 missile at a training facility in China. *China Central Television*.

Fuel	Liquid
Stages	3
Range	12,000 km+[22]
Length	DF-5A (CSS-4 Mod 2) = ~34.3 m DF-5B (CSS-4 Mod 3) = ~34.8 m
Diameter	3.35 m
Number Deployed	18 Silos
IOC	1983

Between the system's introduction into service in 1981 and the introduction into service of the DF-31A around 2006, the DF-5 was the only system available to the PRC with the range to strike targets in the contiguous United States, and until the deployment of the DF-41, the only system available to the PRC capable of striking targets on the East Coast of the United States from their deployment areas. Two variants of the DF-5 are currently deployed by the PLARF: the DF-5A, capable of delivering a single five megaton warhead, and the DF-5B, capable of delivering three warheads. A third variant, the DF-5C, that might be capable of delivering larger payloads, might be in development.[23]

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[22] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

[23] "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2022," Department of Defense, November 29th 2022. Page 65.

Structure of the Rocket Force

The People's Liberation Army Rocket Force can trace its lineage back over 50 years to July of 1966, when China established the Second Artillery Corps (SAC) to oversee China's land-based missile forces, which at that point were mostly aspirational.[24] During the Cold War the SAC deployed several large, liquid-fueled ballistic missiles in modest numbers equipped with nuclear weapons to deter both the Soviet Union and the United States. To preserve party control over China's nuclear weapons, units capable of delivering nuclear warheads and warhead handling units of the SAC reported directly to the Central Military Commission of the Communist Party of China. The SAC was expected to develop nuclear operation plans that were consistent with China's nuclear policies.[25] The SAC was upgraded to a full branch of the PLA and rechristened the People's Liberation Army Rocket Force (PLARF) in 2015.

The rapid expansion in the PRC's nuclear arsenal suggests a possible shift in China's thinking about the capabilities needed to deter the United States and confer regional military superiority, which translates into changes in their doctrine and force structure. Through the Cold War and into the 1990s and 2000s, PRC leaders were satisfied with keeping their modest force at an extremely low state of alert. The PRC deployed its nuclear missile forces in a minimum second-strike posture, planning to retaliate with a relatively small missile force against an aggressor only after that aggressor had completed its attack. During the Cold War, PRC leadership primarily thought of nuclear weapons as political and psychological tools in addition to having a positive effect on national prestige.[26] Limited emphasis was placed on warfighting with nuclear weapons. China made a public commitment to never be the first to use nuclear weapons in a conflict and never use nuclear weapons against non-nuclear states.[27] PRC nuclear strategy emphasized survivability over raw numbers, investing heavily in mobile ICBMs capable of evading an attack and camouflaging their existing DF-5 siloed ballistic missiles with vegetation.[28] Land-based mobile forces are kept at a very low state of alert in peacetime, with transporter-erector-launchers (TELs), warheads, and missiles all kept in separate locations.[29] In a crisis, the PLA would

[24] Lewis, Jeffrey G. *Paper Tigers : China's Nuclear Posture.* Abingdon, Oxon: Abingdon, Oxon : Routledge, 2014. Page 103.

[25] It should be noted that some nuclear weapon deployments made by the SAC are not in line with China's policy statements. For example, the SAC deployed the DF-21A nuclear missile to bases only capable of reaching Korea and Japan, despite the PRC publicly committing to refrain from striking non-nuclear weapon states with nuclear weapons.

[26] Lewis, Jeffrey G. *Paper Tigers : China's Nuclear Posture.* Abingdon, Oxon: Abingdon, Oxon: Routledge, 2014.

[27] The deployment of Chinese nuclear forces sometimes flies in the face of this commitment. For a number of years China deployed the DF-21A, a nuclear missile system, deployment areas targeting Japan.

[28] For examples of a camouflaged DF-5 silos, see appendix A. The camouflaging efforts would prove somewhat pointless as the United States intelligence community were able to spot the silos while they were still under construction. One Chinese former rocket scientist has claimed that China dug "shallow holes in the ground" as decoy DF-5 silos to bolster the survivability of its DF-5 force. I have seen no evidence that decoy DF-5 silos exist. Lewis, John Wilson, and Hua Di. "China's Ballistic Missile Programs: Technologies, Strategies, Goals." *International Security* 17, no. 2 (1992): 5–40.

[29] Stokes, Mark A. "China's Nuclear Warhead Storage and Handling System." Project 2049, 2010.

disperse these units to underground facilities hidden throughout the mountainous countryside where they could ride out an attack. If a launch order was given by political leadership, missile launchers would then disperse from their underground facilities to pre-surveyed launch points and retaliate. Military commanders did not have the authority to authorize the use of nuclear weapons. Only Chinese political leadership could authorize such a strike.[30]

Under this deployment strategy, the China's nuclear arsenal was extremely vulnerable to attack if an attack occurred before the dispersal of launchers could be completed. If an attack could destroy just one of the three storage locations for the missiles, launchers, or warheads, it would significantly disrupt the ability of the entire missile unit to complete its mission. The only units that could theoretically be ready to retaliate in a surprise attack scenario were the DF-5 silo brigades, and it is unknown how many, if any, of the DF-5 silos were kept on alert during this period and for how long. As the PRC did not have early warning assets during the Cold War period, even if these silos were ready to fire, it would be difficult to detect an incoming attack in time for a fire order to go out to the brigade commanders from political leadership. This would make it difficult, if not impossible, for the PRC to launch a retaliatory strike before the silos would be destroyed by US ICBMs and SLBMs.[31] China's options for nuclear strategies it could have adopted were not only restricted by political beliefs, but also by technological limitations. As far as can be observed, both the DF-5 and DF-31 series of ballistic missiles still use an antiquated system for missile alignment and guidance. This limits the potential accuracy of the systems and also injects a substantial amount of human error into the process of aiming the systems.[32] This, however, is almost certainly changing as China continues to modernize its nuclear missile forces. The PRC also began building and deploying conventional solid-fuel short-range missile systems like the DF-11 and DF-15. These systems have given China the ability to strike targets in regional wars even if China does not possess air superiority.

During the 1990s and early 2000s, China's minimum deterrence approach came under pressure from multiple sources. Operation Desert Storm showed China that their current military equipment and doctrine was ill-suited for fighting modern

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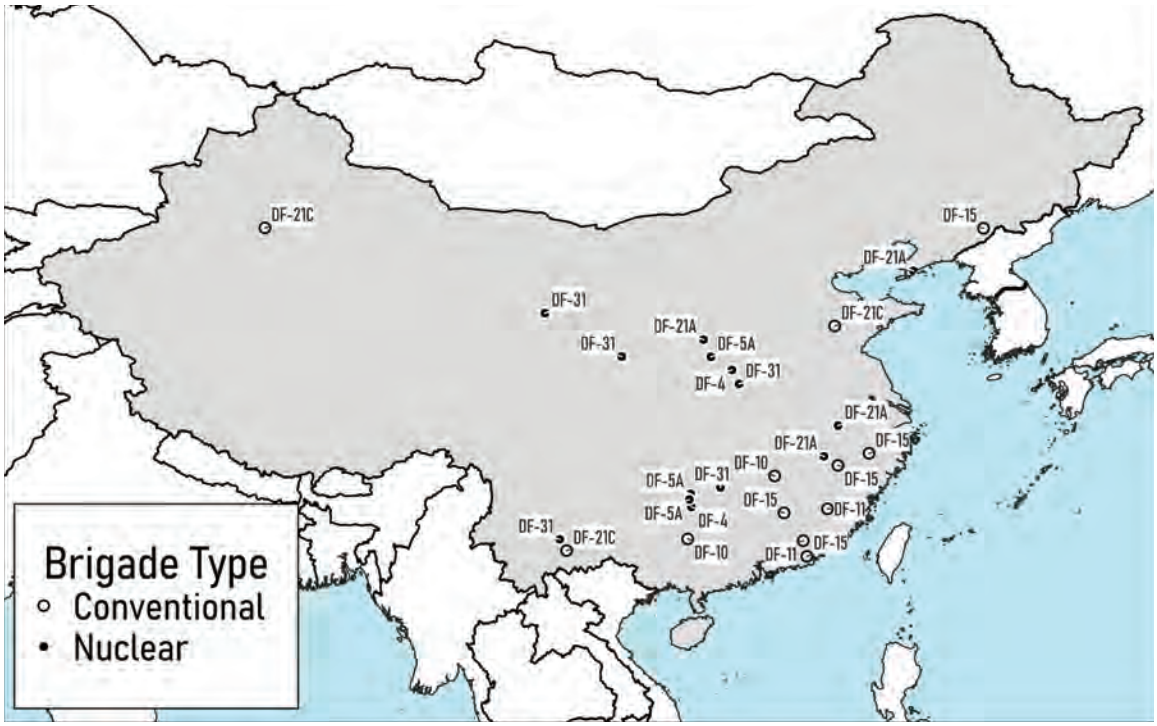
30 Lewis, Jeffrey G. *Paper Tigers : China's Nuclear Posture.* Abingdon, Oxon: Abingdon, Oxon : Routledge, 2014.

31 This was well known to Chinese strategists. DF-5 silos were referred to internally as "tombs."

32 The PLARF appears to use a system, standard across the DF-11, DF-15, DF-5, and DF-31 series of missiles, where the missile's position on the earth is communicated to the missile by aligning a mirror on the side of the missile with an azimuth angle taken by a theodolite. This system was used on older versions of the American Minuteman III and the Titan II. This system is not only time consuming but relies on the missile technician being extremely precise in their measurements. The possibility for human error to ruin the accuracy of a system was a major concern among the United States Air Force during the period when this system was used on American silo-based missiles. United States Air Force Major General John Hepfer summarized the problem: "I wouldn't argue too much that it [operational accuracy] might not be quite as good as the theoretical capacity…aligning a Minuteman missile to accomplish its intended mission is like threading a needle 400 feet away. They had a tube that went down into the silo, and then they had a mirror, and they would have these guys go out into sub-zero weather, minus 30 degrees…sighting on the stars and transferring…an azimuth alignment…you're talking of arc seconds to align to…I had some of the young fellows work for me and they would say, 'well, we got kind of cold, and your only desire was to get out of the cold, you didn't really care if it was 10 arc seconds or 30 arc seconds,' and that would really negate the accuracy of the system." MacKenzie, Donald. *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance.* Cambridge, MA: MIT Press, 1993. Page 366-367.

PEOPLE'S REPUBLIC OF CHINA
SECOND ARTILLERY CORPS BRIGADES 2010



wars where success partly depended on advanced technology and reconnaissance assets.[33] The 1999 US bombing of the Chinese embassy in Belgrade further convinced China to expand and modernize their military forces. In addition, the US withdrawal from the ABM Treaty and the continued development of the United States' missile defense forces may have motivated China to modernize their arsenal of nuclear missiles to further the survivability of their launcher systems and the penetration capabilities of the missiles themselves. These changes seemed to accelerate after the political ascension of Xi Jinping and the dramatic changes to China's political system that have occurred since then.

By 2015, rapid changes in China's missile forces were evident. Older ballistic missile systems like the DF-4 and DF-21A began to be replaced with more capable systems like the DF-26. Less mobile and less accurate nuclear systems like the DF-31 and DF-5 have been modernized with the unveiling of the DF-31AG and the DF-5B. The PLARF has also unveiled the DF-41, a completely new mobile ICBM capable of carrying up to three nuclear warheads.[34] The Rocket Force's total nuclear force is also rapidly changing. At three locations in northern China, the PLARF is building fields of missile silos that are of a similar size to US silo fields. When completed these silo

[33] Fravel, Taylor M. *Active Defense: China's Military Strategy* Since 1949. Princeton University Press, Princeton, New Jersey, 2019. Page 187-191.

[34] "2022 Report on Military and Security Developments Involving the People's Republic of China." United States Department of Defense, November 29th, 2022. Page 94.

fields will add 334 ICBM launchers to the PLARF's order of battle.[35] This is in addition to a relatively modest increase in the number of DF-5 ICBM silos, of which China will have at least 48 of by 2028. The number of mobile launchers is also growing as the PLARF deploys the DF-41 MIRV capable mobile ICBM and increases the number of DF-31A and DF-31AG launchers deployed to a single brigade.

Currently, the PLARF operates forty-one combat missile brigades across six "bases." Each base is effectively a corps level organization. These bases are numbered 61, 62, 63, 64, 65, and 66. Bases operate six to eight missile brigades with a large variety of missile types. Each brigade operates a single missile type. Mobile launcher brigades generally have their headquarters, barracks, and vehicle garages all at a single location, but do not store rocket fuel or warheads in the same garrison. PLARF units operating conventional missiles closely cooperate with the PLA's regional theatre command system, but do not appear to be directly subordinate to them.[36]

Individual PLA units can be identified by their five-digit military unit cover designator or MUCD. The first two digits identify the unit's branch – in our case, PLARF units begin with the numbers "96." The third digit indicates the size of the unit. Units that report directly to PLARF headquarters in Beijing like base command units are numbered 966XX, while brigades are numbered 967XX and regiments are numbered 968XX. The fourth digit in the MUCD will identify the particular base, and the fifth will identify the specific brigade. For example, a PLARF combat missile brigade with the MUCD 96754 will be the fourth brigade assigned to Base 65.

Three additional bases support the PLARF's operations. Base 67, headquartered in Baoji, Shaanxi, oversees the storage and handling of China's nuclear warheads. Warhead storage and handling units, including units responsible for delivering warheads to the combat missile brigades, report directly to the Central Military Commission of the Communist Party of China to preserve party control over the arsenal. China's primary warhead storage facility is thought to be a series of underground facilities built along the Taibai river valley, 60 km south of the city of Baoji.[37] In the event of a crisis, this base would transfer the warheads, first by truck, and then by rail, to the combat missile units. Given recent infrastructure changes among China's nuclear missile brigades, it is probable that the PLARF will begin storing nuclear warheads much closer to the launch brigades or silos. At the new solid-fuel silo fields being built across northern China, the PLARF is building new underground facilities, some of which might be used to store nuclear warheads. Similarly, large underground facilities are also being constructed near new liquid-fuel silos. Combined with the news that China may already have or will soon acquire an early warning capability, it is possible that China will posture their silo forces to be on higher alert to facilitate a launch-on-warning capability, with missiles prepped to

35 This includes 14 training silos.

36 Logan, David C. "PLA Reforms and China's Nuclear Forces." *Joint Forces Quarterly,* National Defense University, October 1st, 2016.

37 Stokes, Mark A. "China's Nuclear Warhead Storage and Handling System." Project 2049, 2010.

launch with live warheads on a rotating basis.[38] It is unknown how this change will affect the PLARF's party oversight structures.

Base 68 operates a number of engineering brigades and is responsible for the construction and maintenance of sensitive PLARF installations, like missile tunnels, missile test facilities, and storage sites. This base is headquartered in Luoyang, Henan, but engineering brigades are found across China.

The last base, Base 69, is responsible for maintaining testing and training facilities used by the PLARF. Importantly, this base is not responsible for the training of raw recruits. Instead, that task is given to the individual bases, each of which has a training regiment to conduct training on the systems specific to that base. For example, Base 66's training regiment maintains specialized equipment to train personnel on large liquid-fueled systems. Base 69 maintains specialized training facilities brigades can use for live-fire drills, including both the launch sites and the missile test ranges with a variety of targets. The PLARF commonly uses mockups of ships, airfields, bunkers, and aircraft as targets on their ranges.[39]

The PLARF maintains several facilities responsible for military education. The Rocket Force Engineering University in Xi'an, Shaanxi is a four-year undergraduate institution that trains the majority of the PLARF's new officers. The PLARF also has the Rocket Force Command College in Wuhan, Henan which seems to offer professional military education to PLARF commanders. Lastly, the PLA maintains a non-commissioned officer training facility in Qingzhou, Shandong.

38 "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2021," Department of Defense, Sept 1, 2021, Page 93.

39 For examples, see Sutton, H. I. "Great Wall of Naval Targets Discovered in Chinese Desert." United States Naval Institute, May 11, 2022.

Order of Battle and Estimates[40]

The following estimates the number of ballistic and cruise missile launchers within what I refer to as the PLARF's "active force." The active force counts all missile launchers that have been officially commissioned and are currently operated by a regular PLARF combat missile brigade. A great number of factors need to be considered when attempting to compile an estimate of the number of launchers in service. We must identify the system operated by each brigade, estimate the number of launchers in operation at each brigade individually, estimate what portion of the brigade's heavy vehicle fleet is dedicated to enabling reloads, account for the existence of reserve forces, and estimate the current pace of the PLARF's expansion. The number of launchers at each brigade varies by missile type and physical space. In general, the smaller the missile, the more launchers a brigade will have. Short-range ballistic missile brigades equipped with the DF-11A or DF-15B will typically have around 27 to 36 launchers per brigade, while medium and intermediate range systems may have between 24 and 36 depending on the unit in question.[41] Brigades also have significant numbers of vehicles for missile reloads. A typical SRBM brigade will have one combination crane and missile carrier and one to two additional missile carriers per launcher, giving a fully loaded brigade the ability to fire 108 missiles before needing to fully resupply. Fixed and mobile ICBM units operate between six and twelve launchers, depending on the system and the individual brigade in question. DF-31A and DF-31AG units generally operate twelve launchers per brigade, while older DF-5 silo units have six silos per brigade. The DF-5 units under construction appear to be building thirteen silos, with one silo at each unit probably intended to serve a training role. PLARF units operating the new DF-41 mobile ICBM operate eight launchers per brigade. While not counted in the active force, we also have to consider launchers that are not assigned to a brigade, but are kept in reserve. Chinese state media rarely mentions it, but the PLARF does have a reserve personnel program so those personnel can be mobilized in the event that the PLARF needs to add additional launchers to its combat power. Chinese state media has shown a DF-11A brigade training such reserve launch crews. During a major conflict, the PLARF could call up such reserves to operate DF-11A and DF-15 short-range ballistic missiles previously removed from the active force to bolster their combat power. We have seen in recent years the construction of battalion-level facilities across Fujian province that appear to be intended for DF-11A launchers or similarly sized systems, and DF-11A launchers have been sighted at several of these facilities. These facilities could be used to support active or reserve SRBM unit operations. The National Air and Space Intelligence Center also reports that the PLARF still has some number of DF-4 launchers, but as no brigade is currently assessed to operate the system, these systems are not counted in the active force.[42]

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[40] Many of these site coordinates were originally pulled from O'Connor, Sean, "PLA Second Artillery Corps." *Air Power Australia,* 2009. Last updated April 2012.

[41] There is some remaining uncertainty about the precise breakdown between the MRBM/IRBM launchers and their reload vehicles.

[42] "2020 Ballistic and Cruise Missile Threat." National Air and Space Intelligence Center, July 2020.

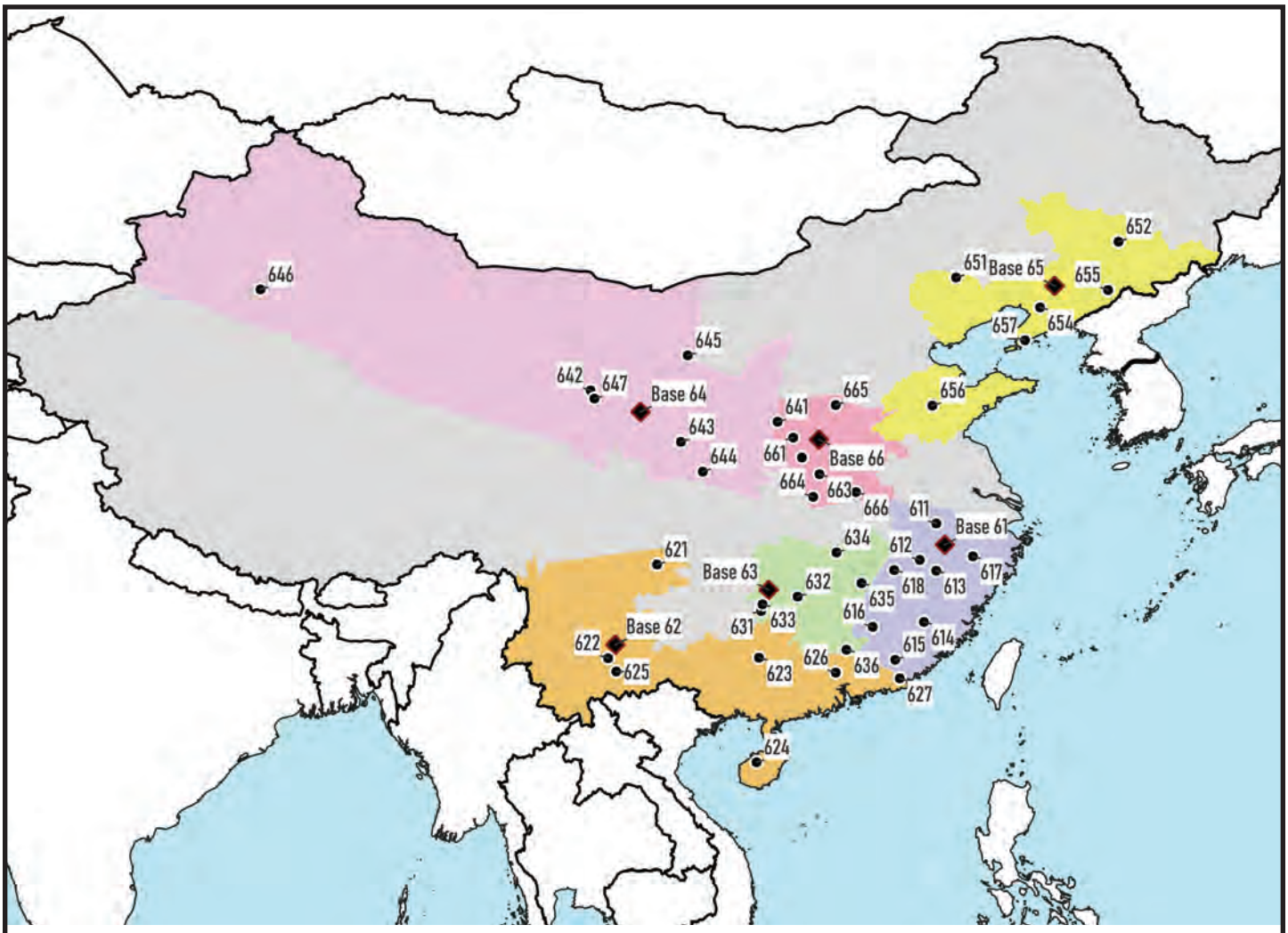
Much of my estimate differs significantly from the estimates provided by the United States Department of Defense, and there are clear reasons for that departure. United States government sources count *produced* launchers, not just deployed launchers. For example, the Department of Defense's recent 2022 Report on Military and Security Developments Involving the People's Republic of China has begun counting some of the new solid-fueled ICBM silos in their count of PLARF launchers, even though those silos are not currently operational.[43] As a result, their published data on the force strength of the PLARF is significantly higher than my estimates in several categories, as I am only counting forces that are operational.

Because the estimates include a projection on the future state of the arsenal, a discussion of how the PLARF introduces new systems into service is in order. New missile systems first go through testing with the Equipment Development Department of the Central Military Commission (EDD).[44] The new missile system will then be assigned a PLARF brigade and goes into operational testing and evaluation (OT&E) during which time the assigned PLARF brigade will train on the missile system while developing concepts of operations through field testing. In general, the time between a PLARF brigade receiving a missile for OT&E and the missile commissioning into active service is over two years. Missiles are officially unveiled during parades while they are still in OT&E. This means that missiles that have just been paraded are not necessarily within the "active" PLARF force. PLARF also assigns new missiles to OT&E brigades before those OT&E brigades have modernized their garrisons to accommodate the new system. The DF-41 OT&E brigade's garrison was not finished until a year after the system was paraded. The DF-17 OT&E brigade's garrison did not have enough garages large enough to accommodate the system when it was first paraded, and those facilities would not be finished until two years later. Sightings of new missiles before they are officially unveiled therefore do not give us any indication of the scale or shape of its deployment as those missiles will not be officially introduced into service for a number of years.

[43] "2022 Report on Military and Security Developments Involving the People's Republic of China." United States Department of Defense, November 29th, 2022. Page 167. The report's count of ICBM launchers only makes sense when taking the fixed ICBM construction into account.

[44] This organization replaced the General Armaments Department in 2016.

PLARF MISSILE BRIGADES 2023



Base 61

Brigade 96711	Chizhou	DF-26
Brigade 96712	Leping	DF-21A
Brigade 96713	Shangrao	DF-15
Brigade 96714	Yong'an	DF-17
Brigade 96715	Meizhou	DF-11
Brigade 96716	Gangzhou	DF-17*
Brigade 96717	Jinhua	DF-16
Brigade 96718	Nancheng	Unknown

Base 62

Brigade 96721	Yibin	DF-31AG
Brigade 96722	Yuxi	DF-31A
Brigade 96723	Luorong	DF-10A
Brigade 96724	Danzhou	DF-21D
Brigade 96725	Jianshui	DF-26
Brigade 96726	Qingyan	DF-26
Brigade 96727	Puning	DF-17

Base 63

Brigade 96731	Jingzhou	DF-5
Brigade 96732	Shaoyang	DF-31AG
Brigade 96733	Huitong	DF-5
Brigade 96734	Yueyang	DF-5*
Brigade 96735	Yichun	DF-10
Brigade 96736	Shaoguan	DF-16A

Base 64

Brigade 96741	Hancheng	DF-21A
Brigade 96742	Datong	DF-31AG
Brigade 96743	Tianshui	DF-31AG
Brigade 96744	Hanzhong	DF-41
Brigade 96745	Yinchuan	DF-41*
Brigade 96746	Korla	DF-26
Brigade 96747	Xining	DF-26

Base 65

Brigade 96751	Chifeng	DF-41*
Brigade 96752	Jilin City	DF-41*
Brigade 96753	Unknown	DF-21D
Brigade 96754	Haicheng	DF-26*
Brigade 96755	Tonghua	DF-17*
Brigade 96756	Jinan	DF-100
Brigade 96757	Jinzhou	Unknown

Base 66

Brigade 96761	Lushi	DF-5
Brigade 96762	Luanchuan	DF-5*
Brigade 96763	Nanyang	DF-31A
Brigade 96764	Xiangyang	DF-31AG
Brigade 96765	Changzhi	DF-26
Brigade 96766	Xinyang	DF-26

*Under Construction

BRIGADE	MUCD	CITY	PROVINCE	COORDINATES	EQUIPMENT	LAUNCHERS
Base 61	96601	Huangshan	Anhui	29.693670°, 118.300750°	N/A	N/A
611	96711	Chizhou	Anhui	30.693722°, 117.899460°	DF-26	36
612	96712	Leping	Jiangxi	28.980699°, 117.120333°	DF-21A[45]	12
613	96713	Shangrao	Jiangxi	28.473698°, 117.892180°	DF-15	~27-36
614	96714	Yong'an	Fujian	26.061420°, 117.314914°	DF-11[46]	~27-36
615	96715	Meizhou	Guangdong	24.284673°, 115.970660°	DF-11	~27-36
616	96716	Ganzhou	Guangdong	25.901627°, 114.960340°	DF-15[47]	~27-36
617	96717	Jinhua	Zhejiang	29.149513°, 119.615749°	DF-16B	~27-36
618	96718	Nanchang	Jiangxi	28.500880°, 115.922039°	Unknown[48]	Unknown

[45] It is possible that Brigade 96712 has upgraded to a new system. The brigade has modernized its support facilities extensively. In addition, a HTF5980 vehicle was spotted on the brigade's campus during a recent CCTV report, first spotted by Roderick Lee. This vehicle did not have a canister for a missile, nor did it have consoles in the vehicle cab that would support the launching of a ballistic missile.

[46] Brigade 96714 is currently in the process of transitioning from the DF-11A to the DF-17.

[47] Brigade 96716 is currently in the process of transitioning from the DF-15 to the DF-17.

[48] Brigade 96718 is now confirmed to be at this garrison, but the location does not have any of the necessary support facilities to support a combat missile brigade. It is possible that 618 is only temporary at this location while a more permanent purpose built facility is being constructed elsewhere.

BRIGADE	MUCD	CITY	PROVINCE	COORDINATES	EQUIPMENT	LAUNCHERS
Base 62	96602	Kunming	Yunnan	24.990880°, 102.834324°	N/A	N/A
621	96721	Yibin	Sichuan	28.761295°, 104.789930°	DF-31AG	12
622	96722	Yuxi	Yunnan	24.360227°, 102.492667°	DF-31A	12
623	96723	Luorong	Sichuan	24.386782°, 109.571921°	DF-10A	~27-36
624	96724	Danzhou	Hainan	19.472163°, 109.461026°	DF-21D[49]	~24
625	96725	Jianshui	Yunnan	23.734899°, 102.871884°	DF-26	36
626	96726	Qingyuan	Guangdong	23.684396°, 113.177081°	DF-26	36
627	96727	Puning	Guangdong	23.418995°, 116.177730°	DF-17[50]	~27-36

[49] It is possible that this brigade is equipped with a variety of DF-21 missile variants, but we have not seen confirmation of this yet.

[50] Brigade 96727 is the DF-17 OT&E Brigade. Roderick Lee was first to positively geolocate imagery of the DF-17 to this location.

BRIGADE	MUCD	CITY	PROVINCE	COORDINATES	EQUIPMENT	LAUNCHERS
Base 63	96603	Huaihua	Hunan	27.575323°, 110.025527°	N/A	N/A
631	96731	Jingzhou	Liaoning	26.579157°, 109.670782°	DF-5	6 (Silos)
632	96732	Shaoyang	Hunan	27.254009°, 111.388961°	DF-31AG	12
633	96733	Huitong	Hunan	26.893910°, 109.739592°	DF-5	6 (Silos)
634	96734	Yueyang	Hunan	29.333373°, 113.215396°	Fixed Liquid ICBM Probable DF-5	14 Under Construction (Silos)
635	96735	Yichun	Jiangxi	27.888072°, 114.387228°	DF-10[51]	~27-36
636	96736	Shaoguan	Guangdong	24.756827°, 113.680600°	DF-16A	~27-36

[51] Brigade 635 is almost certainly in the process of upgrading to a new missile system, possibly the DF-17. What are possibly DF-17 transporter-reloader vehicles have been spotted in Yichun city. Brigade 635 has also constructed a new set of garages that implies it intends to house a system with a launcher that is significantly longer than their existing DF-10s.

BRIGADE	MUCD	CITY	PROVINCE	COORDINATES	EQUIPMENT	LAUNCHERS
Base 64	96604	Lanzhou	Gansu	35.938060°, 104.012017°	N/A	N/A
641	96741	Hancheng[52]	Shaanxi	35.474651°, 110.446750°[53]	Future Mobile ICBM Probable DF-41	8 Launcher Garages Under Construction
642	96742	Datong	Qinghai	36.948337°, 101.666042°	DF-31AG	12
643	96743	Tianshui	Gansu	34.531120°, 105.913829°	DF-31AG[54]	12
644	96744	Hanzhong	Shaanxi	33.132149°, 106.935515°	DF-41[55]	12
645	96745	Yinchuan	Ningxia	38.594228°, 106.227469°	Future Mobile ICBM Probable DF-41	8 Launcher Garages Under Construction
646	96746	Korla	Xinjiang	41.691469°, 86.172619°	DF-26	36
647	96747	Xining	Qinghai	36.566253°, 101.848503°	Unknown[56]	Unknown

[52] A previously published version of this order of battle placed Brigade 96741's new garrison at a facility outside Sanmenxia, Henan. However, new information suggests that that facility actually belongs to Brigade 661. Credit to Ise Midori for pointing this out to me.

[53] Brigade 96741 is building a new brigade complex at 35.391098°, 110.375328°. The new garrison area is being constructed with ICBM garages.

[54] DF-31AG OT&E brigade.

[55] In addition to the presence of several ICBM-specific infrastructure signatures, Brigade 644 was awarded the honorific title "New Generation 1st Dongfeng Brigade," suggesting that this unit is equipped with the DF-41. In addition, Ma Xiu noticed that this brigade conducted launches of an unknown missile at the same time as reported DF-41 test launches.
Ma Xiu. "PLA Rocket Force Organization." *China Aerospace Studies Institute,* October 22nd 2022.

[56] According to research done by Ma Xiu, 96747 is reported by Chinese state media to be equipped with a new missile type. The brigade and its large support garrisons – of which this unit has several, each with its own large high-bay – do not have any infrastructure signatures unique to a known missile type.

BRIGADE	MUCD	CITY	PROVINCE	COORDINATES	EQUIPMENT	LAUNCHERS
Base 65	96605	Shenyang	Liaoning	41.857919°, 123.451444°[57]	N/A	N/A
651	96751	Chifeng	Inner Mongolia	42.258124°, 118.825075°	DF-41[58]	6 Launcher Garages Under Construction[59]
652	96752	Jilin City	Jiangxi	43.938500°, 126.449443°	Future Mobile ICBM Probable DF-41	8 Launcher Garages Under Construction
653	96753	Unknown	Unknown	Unknown	DF-21D[60]	~24
654	96754	Haicheng	Liaoning	40.845255°, 122.768522°	DF-26	36
655	96755	Tonghua	Jilin	41.667404°, 125.957184°	DF-17[61]	Under Construction
656	96756	Jinan	Shandong	36.234871°, 117.715607°	DF-100[62]	~24
657	96757	Jinzhou	Liaoning	39.302431°, 122.064301°	Unknown	Unknown

[57] Ma Xiu. "PLA Rocket Force Organization." *China Aerospace Studies Institute,* October 22nd 2022.

[58] Individuals who participated in the 2019 China National Day Parade in the DF-41 section of the parade have been traced to this brigade. In addition, the brigade's garrison area is utilizing a launcher garage layout that we only see at ICBM class system garrisons.

[59] For reasons unknown the PLARF abandoned construction on one set of launcher garages, bringing the number of launchers the brigade is capable of housing down from eight to six.

[60] Brigade 653 is reported to have moved out of their old garrison in Jinan, Shandong, but their new garrison is currently unknown.

[61] Brigade 655 has taken over the Tonghua garrison from 652. The garrison area is still under construction but DF-17 launchers are visible on satellite imagery. Ma Xiu. "PLA Rocket Force Organization." *China Aerospace Studies Institute,* October 22nd 2022.

[62] The presence of DF-100 launchers in the area was first reported by the *China Aerospace Studies Institute.*

BRIGADE	MUCD	CITY	PROVINCE	COORDINATES	EQUIPMENT	LAUNCHERS
Base 66	96606	Luoyang	Henan	34.640071°, 112.381550°	N/A	N/A
661	96761	Lushi	Henan	34.516723°, 110.861740°	DF-5	6
662	96762	Launchuan	Henan	33.792418°, 111.588338°	Fixed Liquid ICBM Probable DF-5	13 Under Construction (Silos)
663	96763	Nanyang	Henan	33.010779°, 112.414978°	DF-31A	12
664	96764	Xiangyang	Henan	31.945292°, 112.120759°	Mobile ICBM Probable DF-41[63]	8
665	96765	Changzhi	Shanxi	36.258955°, 113.177970°	Unknown[64]	Unknown
666	96766	Xinyang	Henan	32.168528°, 114.127922°	DF-26	36

[63] Before Brigade 664's new garrison in Xiangyang was finished, they were temporarily based at Base 66's training regiment facility in Luoyang. During their stay there, CCTV released extensive imagery of the brigade training on several DF-31AGs. However, the garrison at Xiangyang closely matches other garrisons intended for the DF-41, so it is possible that this brigade is actually equipped with that system instead. Ma Xiu. "PLA Rocket Force Organization." *China Aerospace Studies Institute,* October 22nd 2022.

[64] The garrison at Changzhi does not match known garrison layouts. Tentatively, it appears to be intended for a MRBM or IRBM class system, possible the DF-26.

SYSTEM	CLASS	LAUNCHERS PER BRIGADE	LAUNCHERS TOTAL (2022)	2028 ESTIMATE
DF-4[65]	ICBM	4+	0	0
DF-5	ICBM	6 to 12[66]	18	At least 48
DF-11	SRBM	27 to 36	54 to 72	27 to 36
DF-15	SRBM	27 to 36	54 to 72	27 to 36
DF-16	SRBM	27 to 36	54 to 72	54 to 72
DF-17	MRBM	27 to 36	27 to 36	108 to 144
CJ-10	GLCM	27 to 36	27 to 36	0 to 36
DF-10A	GLCM	27 to 36	27 to 36	27 to 36
DF-100	GLCM	~24	~24	~24 to 48
DF-21A	MRBM	12	12	0 to 24
DF-21C	MRBM	12	0?[67]	0?
DF-21D[68]	MRBM	~24	~48	~48
DF-26	IRBM	36	216	At least 252
DF-31	ICBM	0	0	0
DF-31A	ICBM	12	24	0 to 24
DF-31AG	ICBM	12	48 to 56	48 to 80
DF-41 (mobile)	ICBM	6 to 12	12 to 20	34 to 50
Jilantai Silos	ICBM	N/A	0	14[69]
Yumen Silos	ICBM	N/A	0	120
Hami Silos	ICBM	N/A	0	110
Hanggin Banner Silos	ICBM	N/A	0	90

[65] All remaining DF-4 roll-out-to-launch sites have either been retired or are in the process of being converted into DF-5 pattern silos.

[66] Older DF-5 silo missile brigades had six silo launchers per brigade, each operated by a battalion sized unit. Several new silo brigade currently under construction appear to be building at least 12 silos at each silo area. It is unknown whether or not the PLARF plans to modernize older DF-5 brigades to this new quantity.

[67] No dedicated DF-21C brigades currently exist, but it is possible that the two DF-21D brigades are actually equipped with both DF-21C and DF-21D type missiles.

[68] It is possible that the brigades identified as DF-21D brigades are also equipped with a new nuclear variant of the system, the DF-21E, but this is unlikely due to geographic factors.

[69] This facility is a "concepts of operations" and is not used in combat operations.

CLASS	BRIGADES (ACTIVE)	TOTAL LAUNCHERS (2023)	TOTAL LAUNCHERS (2028)
SRBM	6	162 to 216	108 to 144
MRBM	4	87 to 96	156 to 192
GLCM	3	78 to 96	78 to 96
IRBM	6	216	252
ICBM (Mobile)	8	92	124
ICBM (Fixed)	3	18	383+
ICBM (Total)	11	110	507+
Nuclear (Total)	12	122	507+
Conventional (Total)	12	315 to 396	342-432
Dual (Total)[70]	6	216	252

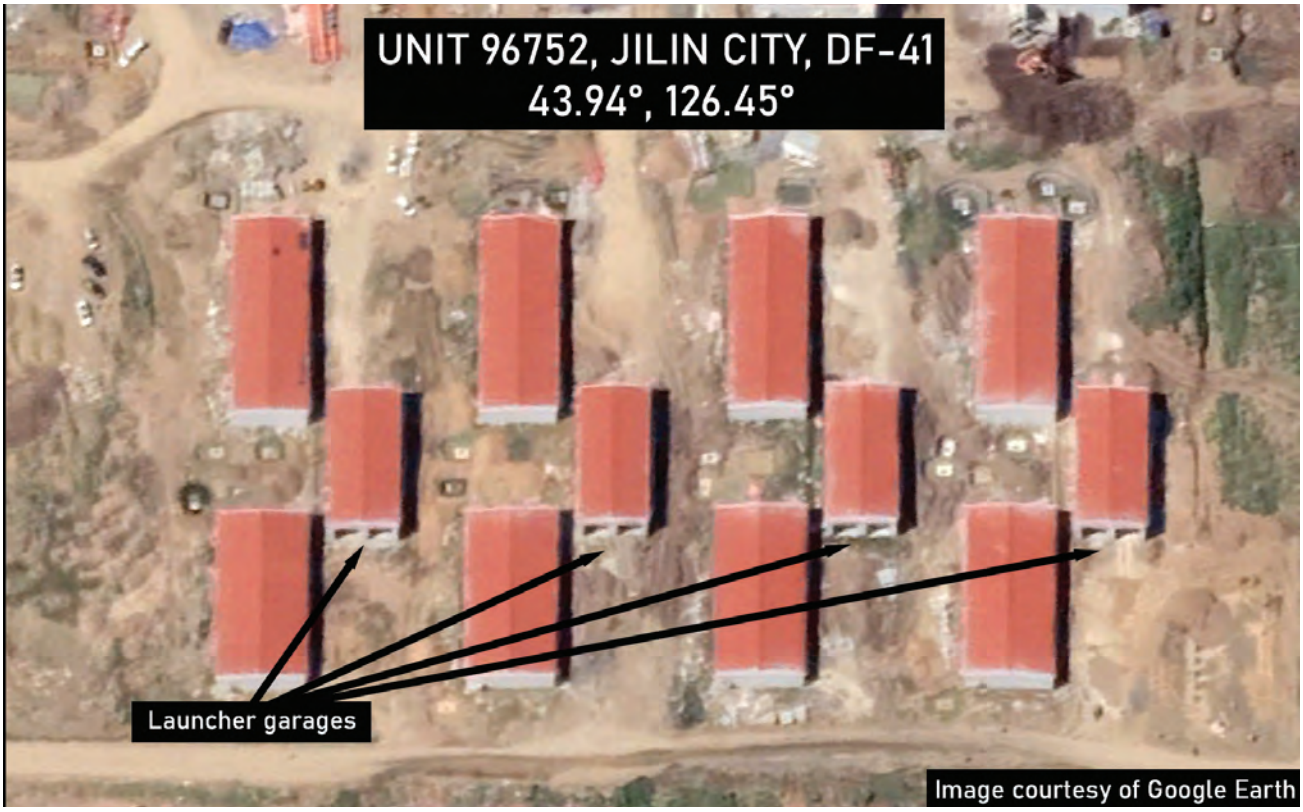
[70] The "dual" category refers to DF-26 brigades that are capable of launching nuclear and conventional warheads. This category does not overlap with either the conventional or nuclear category.

PLARF Brigade 96755, Tonghua, Jilin. *Google Earth*.

At time of publication, it is estimated that the PLARF has 162 to 216 SRBM launchers, 87 to 96 MRBM launchers, 78 to 96 GLCM launchers, 216 IRBM launchers, and 110 ICBM launchers within its active force. By 2028 this force will grow to at least 108 to 144 SRBM launchers, at least 156 to 192 MRBM launchers, at least 78 to 96 or more GLCM launchers, at least 252 IRBM launchers, and 507 or more ICBM launchers. It is worth emphasizing that everything in the current estimate is counting something that the PRC has already built or is in the process of building. While there are some cases where I cannot confirm precisely which system will be garrisoned at some brigades under construction, I am not conjuring the estimates from any hypothetical future expansion.

The PLARF currently operates six SRBM brigades equipped with the DF-11, DF-15, and DF-16 systems. These systems are intended to allow the PLA to strike critical time-sensitive targets like command and control nodes, weapon stockpiles, and airbases in the opening stages of a regional conflict, and these systems are capable of carrying a variety of warhead types that enable them to destroy each of these types of targets. SRBM brigades are structured with large numbers of vehicles dedicated to carrying missile reloads, allowing SRBM units in the field to continually reload by dispatching missile transporters to stockpiles spread across Fujian province.

The total number of SRBMs in PLARF inventory has decreased recently as the PLARF replaces DF-11As and DF-15s with DF-17s. At one former DF-11A brigade, Brigade 96714, the PLARF has built new garages that are slightly deeper than garages



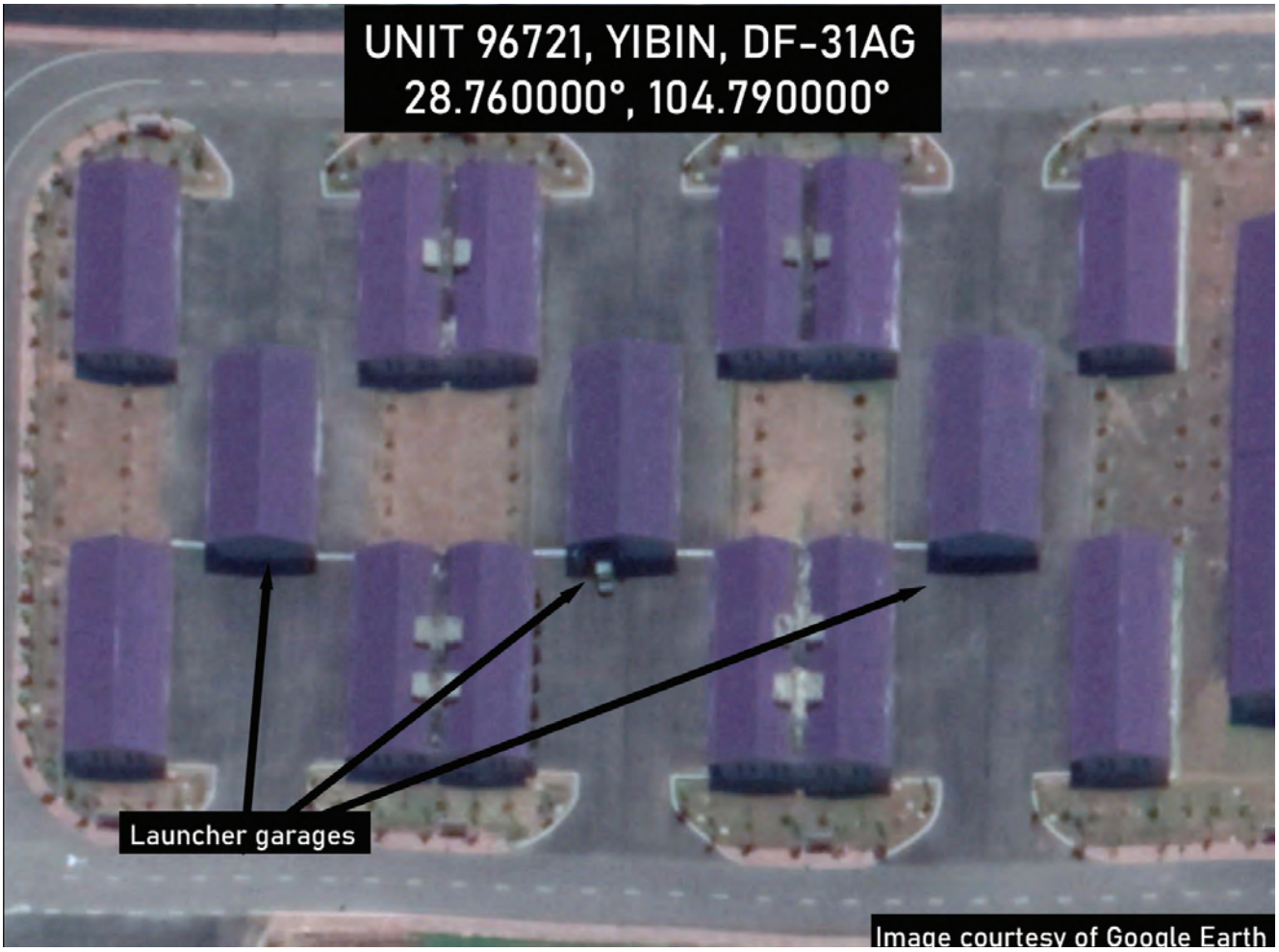
PLARF Brigade 96755, Tonghua, Jilin. *Google Earth*.

previously constructed to house DF-11A launchers. There is also ground-truth imagery of DF-17 launchers at Brigade 96714. That story is repeated at Brigade 96716, where an entirely new brigade complex is under construction with new garages that are carbon copies of the ones built at 96714. The replacement of DF-11A and DF-15 units with the new DF-17 is supported by changes in the CMPR's estimated number of SRBMs between 2021 and 2022. The number of SRBMs decreased from 250 to 200, supporting the satellite imagery evidence that multiple SRBM brigades are upgrading to an MRBM class system.[71]

Despite the fact that the DF-17 is an MRBM class system, the PLARF has decided to emplace them closest to Taiwan. Two confirmed operational and future DF-17 brigades in southern China, Brigade 96714 and Brigade 96727, are both placed roughly 400 kilometers from Taiwan. It is possible that this placement is to reduce the travel time of the DF-17 targets in Taiwan so that the PLARF gives the Taiwanese military as little warning time as possible as this system will certainly be used to strike Taiwanese air defense installations in order to enable strikes from other systems like the PLAAF's CJ-20 air-launched land attack cruise missile and the CH-AS-X-13 air-launched ballistic missile in the opening salvo of a conflict. It is also possible that this placement is simply the result of intra-organizational bureaucratic battles.

The number of MRBMs in PLARF service has risen as the PLARF reduces the number of DF-21s in service but adds significant numbers of DF-17s to their inventory.

[71] Huang, Kristin. "Exclusive: Chinese Military Fires 'Aircraft-Carrier Killer' Missiles Into South China Sea in 'Warning to the United States'" *South China Morning Post,* August 26th, 2020.
Brad, Lendon. "China Test Anti-Ship Missile in South China Sea, Pentagon Says." *Cable News Network* (CNN), July 3rd, 2019.



PLARF Brigade 96755, Tonghua, Jilin. *Google Earth*.

Currently the PLARF only has 12 DF-21A launchers still in the active force, but with the DF-21A's remaining brigade showing signs of imminent modernization, it is probable that those launchers will be retired and replaced shortly. The PLARF also still has two brigades of DF-21D launchers in inventory. It is possible that these units operate multiple variants of the DF-21 system.

The PLARF's active IRBM inventory entirely consists of the DF-26 IRBM. The DF-26 has now replaced the majority of DF-21A and DF-21C brigades. Currently the PLARF active force includes at least six DF-26 brigades. The exact number of DF-26s is difficult to estimate because of difficulties in distinguishing which heavy vehicles are launchers and which are reload vehicles and the fact that different brigades seem to have different amounts of garage space. The DF-26 IRBM can theoretically strike land and sea targets with either conventional or nuclear warheads. This allows it to support a variety of missions previously supported by different variants of the DF-21 system. The scale of the DF-26's deployment and the broad scope of its mission makes the DF-26 one of the most important missiles currently in the PLARF arsenal.

There is some doubt from open-source analysts about how capable the DF-21D and DF-26 systems are in reality in fulfilling their long-range anti-ship role. An effective long-range anti-ship capability requires both extreme accuracy and the effective

PLARF PROBABLE DF-41 LOCATIONS

PLARF Brigade 96755, Tonghua, Jilin. *Google Earth*.

deployment and use of ISR assets capable of fixing an enemy ship's position. It is unknown how capable the PLA's ISR systems are of either of those tasks, especially in a contested airspace. Reports suggest that the PLARF has successfully tested anti-ship ballistic missiles against moving targets in the South China Sea.[72]

SRBM, MRBM, and IRBM garrisons now increasingly rely on larger field garrison sites, especially for the SRBM and MRBM units stationed in Fujian Province directly across from Taiwan. Across the area, the PLARF has begun building numerous battalion-level garrisons. These garrisons can act as staging areas for units in the process of deployment, allowing ballistic missile launchers to be loaded with their warheads and missile before being sent out into the field. The large system of field garrisons also allows the PLARF to disperse their missile forces for long periods of time without putting too much stress on their forces.

The PLARF continues to modernize its ICBM range forces. These forces consist of the DF-4, DF-5, DF-31, and DF-41 systems. While government sources continue to claim that the PLARF continues to have some number of DF-4 missiles in service, no active PLARF brigades are currently assessed to be equipped with the system. The

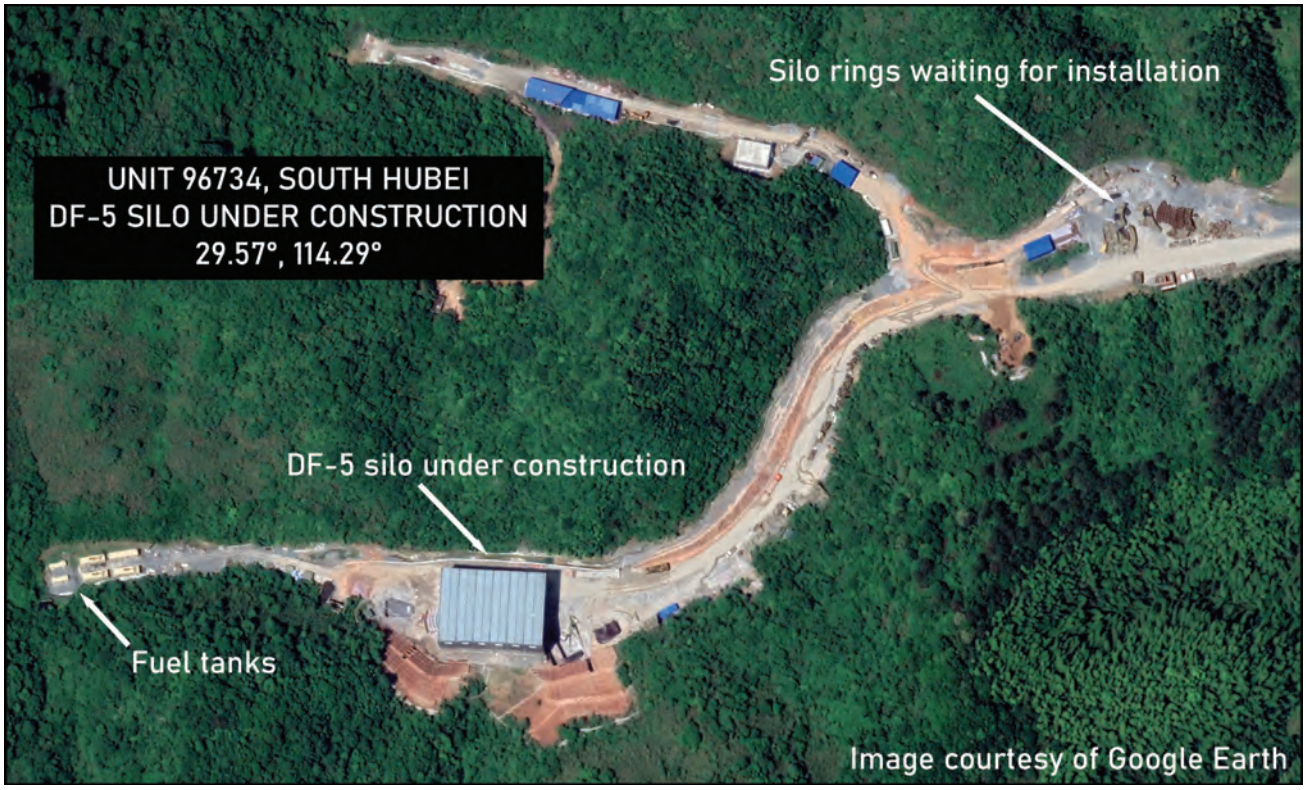
[72] Huang, Kristin. "Exclusive: Chinese Military Fires 'Aircraft-Carrier Killer' Missiles Into South China Sea in 'Warning to the United States'" *South China Morning Post,* August 26th, 2020.
Brad, Lendon. "China Test Anti-Ship Missile in South China Sea, Pentagon Says." *Cable News Network* (CNN), July 3rd, 2019.

DF-5 testing and operational silos. *Google Earth*.

original DF-31 missile is now retired, and the remaining DF-31A launchers are being replaced with the off-road mobile DF-31AG launchers. This not only allows the PLARF to launch from a larger number of positions, it also significantly shortens the launch preparation time of the system due to upgrades to the DF-31AG's support vehicles. The DF-41 MIRV-capable system is at this point close to exiting or already beyond the OT&E phase and is in the process of being deployed to additional brigades.

The PLARF has adopted a new garage layout for ICBM brigades in which the launchers are divided into company areas. Each mobile ICBM company has two launchers and their associated support vehicles. Evidence that we have so far from brigades with confirmed launcher equipment suggests that the DF-31AG will continue to have twelve launchers per brigade, while the newer brigades with only eight launchers per brigade are intended for the DF-41. It is also possible that the newer brigades reflect a general reorganization of ICBM launchers across the entire service, as the PLARF redistributes DF-31AG launchers over a wider number of brigades, but this is unlikely.

Notably, many of the new ICBM brigades are being constructed with significantly less room for support vehicles per launcher than in previous layouts. For example, Brigade 96721, a DF-31AG brigade, has twice as many garages for launcher support vehicles than Brigade 96751, a DF-41 brigade. It is probable this indicates a major difference between the two systems, with DF-41 launchers requiring significantly fewer support vehicles than the DF-31AG, partly due to the DF-41's new guidance system. This significantly lowers the logistical burden and footprint of a company of DF-41 mobile ICBM launchers compared to the DF-31AG.umber of fixed ICBM launchers from their previous inventory of 18 DF-5 silos to roughly 383 including training silos. Around 334 of these new launchers are flat-land silo



A DF-5 pattern silo under construction at PLARF Brigade 96734. *Google Earth*.

fields intended to house solid-fueled ICBMs like the DF-31 or DF-41. The remaining 30 new launchers are intended for the DF-5 liquid-fueled ICBM and are being constructed on mountainous terrain.

Three silo fields containing roughly 100 ICBM silos each are being constructed at three locations across northern China.[73] A fourth, much smaller set of silos at a place called Jilantai are intended for training and developing concepts of operations. The small size of these silos and lack of flame ducts suggests that these silos are intended for canisterized, cold-launched, solid-fueled ballistic missiles like the DF-31 or DF-41.

Launch control for these silos is handled by centralized command and control facilities, which each appear to control ten silos. Support facilities, including missile maintenance facilities, explosive storage facilities, and administrative facilities, are under construction at all three locations. Notable differences can be observed in the exact layout of each site and the support equipment present. While the silo fields at Yumen and Hami are very similar in design and construction, the field at Hanggin Banner does not appear to have the same pattern of command-and-control facilities and has pieces of supporting infrastructure whose purposes have not as of yet been identified. It is

[73] Yumen was detected first by the author. The Hami silo field was detected soon afterwards by Hans Kristensen and Matt Korda at the Federation of American Scientists. The last to be detected was the field at Hanggin Banner, detected by Roderick Lee over at the China Aerospace Studies Institute.
Warrick, Joby. "China is Building More than 100 New Missile Silos in its Western Desert, Analysts Say." *Washington Post,* June 30th 2021.
Korda, Matt, and Kristensen, Hans. "China is Building A Second Nuclear Missile Silo Field." *Federation of American Scientists,* July 26th, 2021.
Lee, Roderick. "PLA Likely Begins Construction of an Intercontinental Ballistic Missile Silos Site near Hanggin Banner." *China Aerospace Studies Institute*, August 12th, 2021.

An underground facility under construction at PLARF Brigade 96734. *Google Earth*.

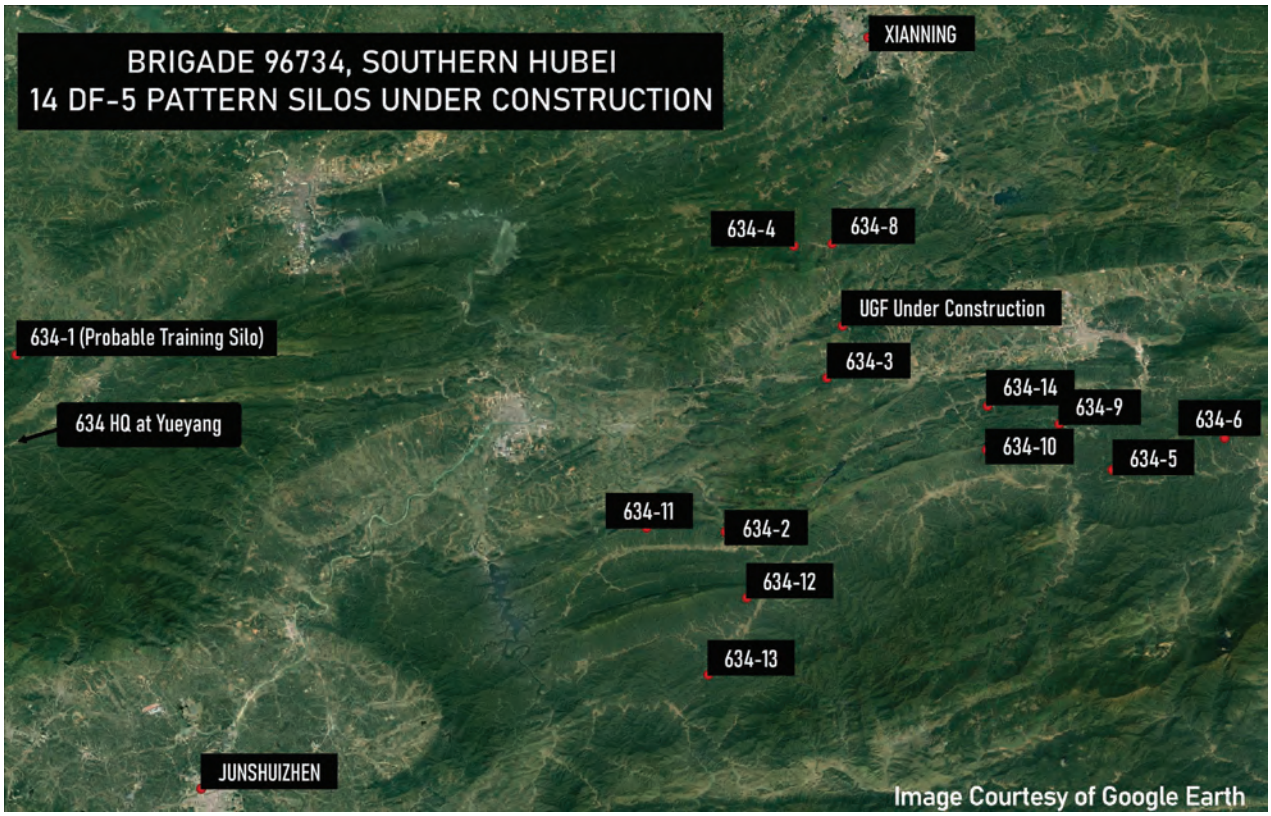
possible that this location is intended to host a different system. A notable feature of all the solid-fueled missile fields is what appear to be raised concrete emplacements consistent with existing Chinese radar facilities. It is likely that the PLARF will invest heavily in radar and possibly air defense launchers at each silo field in an effort to defend against American stealth cruise missiles and stealth bombers.

PLARF units probably involved in maintaining and operating China's new solid-fueled silos are placed in the nearest major city in compliance with standing PLARF policy that brigade level units are placed in or near large cities.[74] Infrastructure signatures unique to the Hanggin Banner silo field are also present at a PLARF facility in Yinchuan, 230 kilometers away. As these infrastructure signatures only appear at Hanggin Banner and at this PLARF facility, it is likely that this facility in Yinchuan will be involved in the operation of China's new solid-fueled missile silos.

It is unclear how long it will take for these silos to become operational. The 2022 Report on Military and Security Developments Involving the People's Republic of China appears to count some of these systems in their estimate of PLARF launchers, indicating that some of the silos themselves have finished construction.[75] However, it may take some time before the silo fields enter operation. Personnel will need to be trained, missiles and support equipment produced, and concepts of operation will continue to be developed.

[74] Lewis, John Wilson, and Hua Di. "China's Ballistic Missile Programs: Technologies, Strategies, Goals." *International Security* 17, no. 2 (1992): 5-40.

[75] "2022 Report on Military and Security Developments Involving the People's Republic of China." United States Department of Defense, November 29th, 2022. Page 167.



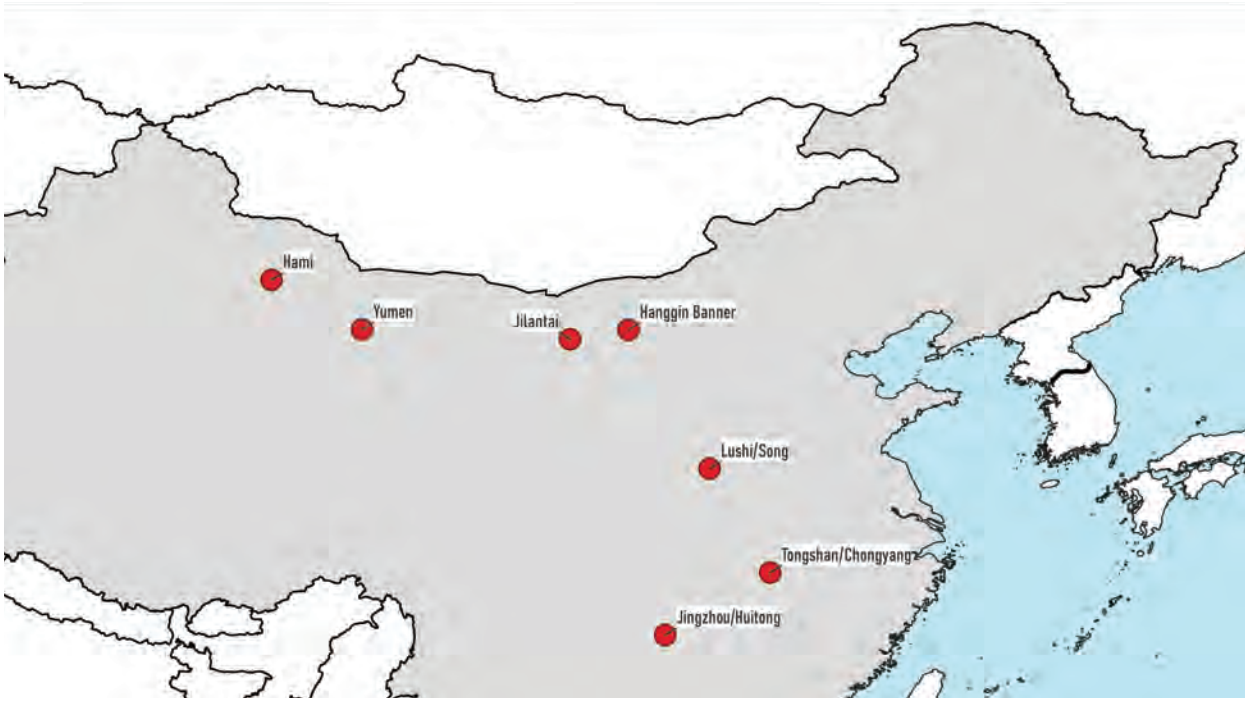
An underground facility under construction at PLARF Brigade 96734. *Google Earth*.

Analysts and academics have put forward predictions about the possible number of warheads the PLARF could deploy to the new solid-fuel silos that range from a couple dozen to over one thousand.[76] Lower estimates tend to theorize that China could deploy a limited number of missiles across a much larger number of silos, shifting them around periodically so that a potential adversary would not be able to tell which silos are armed and which are empty.[77] Such a strategy, referred to in the United States as "shell game," would force an adversary to dedicate a much larger number of missiles to destroy a handful of Chinese missiles. This argument partly rests on an assessment of China's lack of sufficient fissile material, an issue that is extremely difficult to accurately assess via open-source means. The shell game basing mode is both technically feasible given advances in PRC missile technology and arguably in line with historical PRC nuclear weapons doctrine. The biggest piece of evidence in favor of this hypothesis is the existence of Jilantai. At Jilantai, a known site the PLARF uses to develop concepts of operation for ballistic missile forces, the PRC is building a total of 14 missile silos, ten on flat land, and another four placed into the side of a hill. This number is more than either the United States or the Soviet Union ever built at a single site. It is possible that the PLARF has built the ten flat land silos to support training and developing deception operations under a shell game deployment plan.

[76] For an example of an estimate at the lower end, see Acton, James M. "Don't Panic About China's New Nuclear Capabilities." *The Washington Post,* July 27th 2021.

[77] The usual point of comparison here is the Multiple Protective Shelter basing mode that the United States Air Force planned on using to deploy the Peacekeeper missile. This system involved distributing 200 missile launchers across 4,600 hardened shelters.

PLARF SILO DEPLOYMENT AREAS



Locations of silos either under construction or currently operational in China.

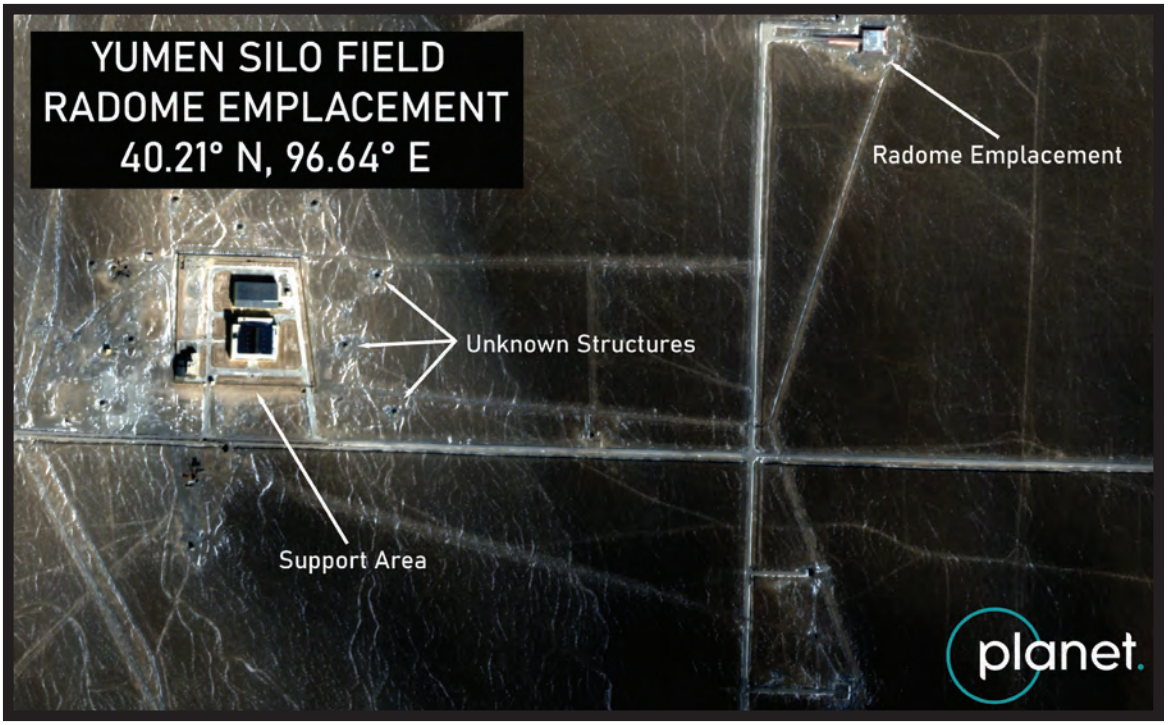
It would also be very difficult for any open-source analyst to verify whether or not the PLARF is implementing a shell game strategy. If done correctly, it should be close to impossible for an outsider to identify which silos are armed and which are empty.

This assumes the PLARF fakes maintenance patterns and maintains a number of dummy missile canisters to move around and confuse the adversary's analyst. This would be resource and personnel intensive, but this has not stopped the PRC in the past. At the present time, the United States government also appears unclear on what deployment strategy the PLARF will eventually adopt. Former STRATCOM head Admiral Charles Richard has previously stated that whether or not the PRC will put a missile in every silo is currently unknown.[78] It is also unknown precisely which solid-fueled ICBM would be deployed at these sites. Congressional testimony from STRATCOM head Admiral Charles Richards suggests that the PLARF might deploy DF-31A missiles inside the solid-fueled silos, not the DF-41.[79]

This would bring the number of possible deployed warheads down considerably considering the DF-31A is not thought to be capable of carrying multiple warheads and still keep the United States within range. If true, that deployment would significantly reduce the possible number of nuclear warheads the PLA is capable of

[78] Heinrichs, Rebeccah. "Transcript: A Conversation with Admiral Richard." The Hudson Institute, September 14, 2021.

[79] Statement of Charles A. Richard, Commander, United States Strategic Command, Before the House Appropriations Subcommittee on Defense. 117th Congress, April 5th 2022.



A probable radar facility under construction at the Yumen silo field. *Image courtesy of Planet Labs PBC.*

deploying among their land-based missile forces, as the DF-31A is not capable of carrying multiple warheads. The Department of Defense's 2022 Report on Military and Security Developments Involving the People's Republic of China is, however, tracking an increase in the number of ICBMs produced by China that seems to match the number of silos under construction.[80] This suggests that the PLARF will, at the very least, keep the option of deploying a missile in every silo open.

In addition to the expansion in solid-fueled missiles, the PLARF is also expanding the number of liquid-fueled DF-5 pattern ballistic missile silos under construction. At three different locations, the PLARF is building new sets of silos with the exact same construction patterns as patterns spotted by the Central Intelligence Agency during the DF-5's initial deployment in the 1980s.[81] Satellite images also show several silo ring segments of a size appropriate for DF-5 pattern silos. At two brigades constructing new DF-5 pattern silos, Brigade 96734 in Yueyang and Brigade 96762 in Launchuan, the PLARF is building sets of DF-5 pattern silos in sets of around thirteen.[82] One silo at each brigade is likely intended to be a training facility. This is double the number of silos per brigade at older DF-5 silo brigades. At a third site, the PLARF is building four new DF-5 pattern silos over older DF-4 roll-out-to-launch sites, but one would expect this location to have a quantity of silos matching the other new

[80] "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2022," Department of Defense, November 29th 2022.

[81] For examples and a discussion of the timeline of DF-5 construction, see Lafoy, Scott, and Eveleth, Decker. "Possible ICBM Modernization Underway at Sundian." *Arms Control Wonk,* February 5th 2020.

[82] See appendix A for precise locations.

missile brigades. It is possible that these silos will be operated by a nearby existing DF-5 silo brigade, Brigade 96731.

In the older DF-5 brigades, the silos themselves are camouflaged, first with grass covers to obscure the sliding silo door, and then sometimes with fake greenhouses or other small buildings placed on top of the sliding door. However, no effort is made to obscure the nearby battalion-level administrative and support buildings. The entire silo garrison (1 launch battalion) lives and works in buildings usually within close proximity of the silo itself, with the administration and support facilities for the entire brigade situated in the nearest large town or city.[83] Newer DF-5 silos do not attempt any semblance of camouflage. Brigade 96762, the silo brigade at the furthest stage of construction, will probably enter service within the next two years.

Recent infrastructure changes also imply a change to how the PLARF deploys its nuclear warheads to combat missile brigades. At both new and old DF-5 silo brigades, the PLARF is building new large underground facilities and expanding their existing facilities, possibly indicating the placement of nuclear warheads closer to the silos themselves. In combination with United States government publications reporting that China is moving toward a launch-on-warning posture, it is likely that future silo-based nuclear forces will be kept on much higher states of alert than China has previously practiced.[84]

It is at this point effectively impossible to determine where the PRC will end their missile expansion but one notable detail about the possibility of future PLARF expansion is that the PLARF does attempt to distribute brigades somewhat evenly across their bases, possibly out of concern that putting too many brigades under a single base would put unacceptable stress on that base's organization. If organizational stress factors are a serious concern of the PLARF, then we should expect that the force organization that we currently see under its current base structure is likely close to where the PLARF will settle in the longer term unless we see the PLARF begin to stand up new bases. This also suggests that the solid-fueled silo units currently under construction, due to their probable manpower and organization demands, would be placed under a new base.

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83 The primary garrison of a PLARF brigade is almost always situated near or within a major city, apparently for morale reasons.
Lewis, John Wilson, and Hua Di. "China's Ballistic Missile Programs: Technologies, Strategies, Goals." *International Security* 17, no. 2 (1992): 5–40.

84 "2022 Report on Military and Security Developments Involving the People's Republic of China." United States Department of Defense, November 29th, 2022. Page 99.

Implications

The PLARF's missile expansion has serious implications for China's wartime capabilities and international behavior. At the sub-strategic nuclear level, the PLARF's expansion of MRBM and IRBM systems enables them to strike a variety of important time-sensitive targets in the opening stages of a conflict while preserving the magazine depth necessary to continue fighting as adversary reinforcements pour into the region. It is important to consider that this expansion does not exist in a vacuum, and that many of the conventional missile capabilities that the PLARF is pursuing exist to enable action from other arms of their military force. As already mentioned, an example of this is the DF-17's capability of evading and neutralizing adversary missile defense sites, enabling the PLA to use other less expensive systems to strike those now undefended areas. Continued investment in large numbers of long-range anti-ship missiles complicates the United States' ability to militarily respond to a Chinese invasion of Taiwan or other aggressive actions in the region. At the strategic nuclear level, China's rapid expansion of strategic ICBM launchers gives the Chinese nuclear deterrent a degree of survivability in the face of adversary missile defenses, conventional precision strike systems, and continued American superiority in fast-striking SLBMs. At the present time however, because the political drivers and thought processes behind China's nuclear build are very difficult to assess, we have limited ability to predict where China's nuclear expansion will stop, what basing concepts they will eventually adopt, and how they might utilize their nuclear forces in the event of a crisis or conflict.

Attempts to estimate the future size of the PRC's nuclear arsenal have been wrong in the past, partly because of an underemphasis on the political beliefs of China's leadership. A good example of this is a Defense Intelligence Agency National Intelligence Estimate from 1974 titled "PRC Strategic Nuclear Forces: How Much is Enough?" that projected that the size of China's nuclear arsenal would grow to 50-75 MRBM launchers, 15-30 IRBM launchers, 50-75 ICBM launchers, and 5-10 SLBM submarines within the next ten years.[85] This estimate was based not on what analysts knew about how Chinese leadership thought about the role of nuclear weapons, but was based on the assessment of what China would need to gain a survivable and credible deterrent according to American standards. As it did not take into account these factors, their estimates were wildly in excess of what China actually constructed during this time frame. It is important to keep this in mind and avoid mirror-imaging the Chinese expansion, especially while we have so little data on the beliefs of China's military and leadership. The various organizations with China's political and military apparatus today might not have the same outlook and assumptions about how to structure a missile force or what is required to be survivable or control escalation as the United States does. Systems and concepts that might seem like obvious compliments to their growing force to American analysts might not make sense to Chinese planners.

[85] See Eveleth, Decker, "On Projections," *A Boy and His Blog,* March 7th 2022, for a copy of this document.

The system is opaque even to Chinese academic experts, whose writing on Chinese nuclear thought was previously at least partly reflective of the thought processes of the Chinese government and military. Public academic sources have been increasingly disconnected from the actual state of the Chinese arsenal in the Xi Jinping era, and some Chinese academics report that their colleagues seem reluctant to even discuss the new solid-fueled silos or seriously believe Chinese state media's ludicrous suggestion that they are actually windfarms.[86] A recent example is the 2020 edition of The Science of Military Strategy, an academic text compiled by the People's Liberation Army National Defense University, that covers Chinese perspectives on the state of China's military strategy. Sometimes such texts could serve as an accurate depiction of Chinese strategic thought and give hints about the future direction of the PLA's military procurement. However, recent PLARF construction is contrary to the authors' viewpoints on Chinese nuclear strategy. In a section entitled "The Status of Mobile Combat Force Construction Will be More Prominent," the authors speak warmly of the utility of strategic mobile forces over fixed silo forces. "Taking into account China's national and military conditions, the combination of mobile operations and fixed operations, and more emphasis on the construction of mobile combat forces will be the direction of the construction and development of strategic missile forces."[87] The actual development of China nuclear forces does not match that suggestion. Instead, we see a relatively modest expansion of their mobile forces and a massive expansion of their fixed silo forces. Before the detection of the new silo fields at Yumen, Hami, and Hanggin Banner, Chinese academics had even expressed confusion as to why the PLARF was hanging on to even its modest collection of 18 DF-5 silos considering the advantages of mobile launchers.[88] Now we see the number of DF-5 silos ballooning to 48 or more.

Despite our lack of insight into political drivers and thought processes, security drivers are easier to see, as China has been particularly vocal about American capabilities either already deployed or under development that could seriously compromise their nuclear arsenal. Chinese military leaders, academics, and diplomatic personnel have repeatedly voiced concern that the United States is embracing a military strategy to ensure global hegemony and nuclear primacy over

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[86] Tong Zhao, "What's Driving China's Nuclear Buildup?" Carnegie Endowment for International Peace, August 5th, 2021.

[87] "The Science of Military Strategy." Xiao Tianliang, Lou Yaoliang, Kang Wuchao, and Cai Renzhao. *National Defense University Press,* Beijing, 2020. Page 382. Translated by the China Aerospace Studies Institute, January 2022.

[88] When Wu Riqiang, a Chinese scholar at Renmin University was questioned on why, if China could ensure deterrence entirely with their land mobile and submarine arsenal, the PLA was still maintaining the DF-5 silo force, he suggested that the force existed for technology demonstration.
"Why is China Modernizing its Nuclear Arsenal?" Transcript, Carnegie International Nuclear Policy Conference 2015." March 24, 2015.

China through conventional long-range firepower and missile defenses.[89] Regardless of the actual capability of the current American national missile defense system or stated American intent regarding the missile defense system, the PRC worries that the United States could in the future neutralize a large portion of incoming Chinese warheads, possibly after destroying a portion of Chinese nuclear launchers on the ground with long-range conventional strikes, negating the deterrent effect of the existing nuclear arsenal. A decade ago, when the PRC only had the capability to throw around 30 missiles at the contiguous United States, even a limited missile defense system like the one the United States has in operation was a major threat. In addition, the continued development of precise long-range conventional systems capable of striking strategic targets around the world under the Prompt Global Strike program could allow the United States to quickly destroy nuclear launcher systems in the PRC without using nuclear weapons. Both of these programs have been the source of anxiety in Beijing despite the immense technological challenges they present. There is also the idea that China's mobile missile arsenal was in the past vulnerable to American numerical superiority in nuclear weapons. Given the United States' superiority in numbers and its advanced intelligence capabilities, some Chinese academics have been concerned in the past that the United States could either locate launchers in the field or afford to dedicate a large number of warheads to the destruction of a single launcher, carpeting a large area to ensure its destruction.[90] The first generation of Chinese ICBM launcher's lack of mobility, large number of support vehicles, long launch preparation time, and locatable launch sites degraded their survivability even further. All of these concerns have probably contributed to China's decision to rapidly expand their nuclear missile arsenal. Others have argued that China should build a large arsenal to avoid seeming weak and show force to Western powers who might try to intimidate the country. Hu Xijin at the Global Times, a state media outlet that publishes in English, explicitly referenced the power of nuclear weapons to "shape the attitudes of US elites towards China."[91]

Some concerns may also be implied from what China is in the process of building and how they are building it. A massive expansion in solid-fueled silos could be a result of decreasing confidence in the survivability of their mobile forces and an attempt to create a "missile sponge" that would be large enough to absorb an American first strike and leave the United States with few missiles for targeting China's mobile forces. The expansion in liquid-fueled systems implies that China is also concerned about the amount of damage that their forces need to be capable of inflicting. Liquid-fueled

[89] This concern has generated much discussion and multiple technical studies about the survivability of the Chinese nuclear deterrent, especially after Keir A. Lieber and Daryl G. Press's much debated paper "The End of MAD? The Nuclear Dimension of U.S. Primacy." *International Security,* 30, no. 4 (2006): 7-44. Two notable works by Chinese academics discussing the survivability of the Chinese arsenal are Li Bin "Tracking Chinese Strategic Mobile Missiles." *Science and Global Security* 15 (2007):1-30 and Wu Riqiang "Living With Uncertainty: Modeling China's Nuclear Survivability." *International Security* 44, no. 4 (2020): 84-118.

[90] Li Bin "Tracking Chinese Strategic Mobile Missiles." *Science and Global Security* 15 (2007):1-30

[91] "China Needs to Increase its Nuclear Warheads to 1,000." Hu Xijin, *Global Times,* May 8th 2020.

missiles like the DF-5 are capable of carrying much heavier payloads than solid-fueled missiles, allowing the missile to carry a larger number of warheads and penetration aids. This allows even a small expansion of missiles to have a large impact on China's ability to penetrate American missile defenses and strike US cities. Another piece of evidence that China is concerned about their ability to penetrate American missile defenses is its investment in a fractional orbital bombardment system (FOBS). A FOBS system throws warhead effectively into orbit, allowing you to fire in directions that are not covered by an adversary's missile defense system. In August of 2021, the PRC tested a hypersonic-glide vehicle equipped ICBM that circumnavigated the globe before impacting one of China's missile testing ranges.[92] The missile missed the target by more than two dozen miles, but demonstrated a commitment to developing technologies in order to defeat advances in American missile defense technology.

Other developments suggest concerns over not just American national missile defenses, but also missile defense assets tied to conventional theatre missile defense networks deployed by the United States, Japan, and South Korea. It is increasingly difficult to differentiate the homeland and theatre rungs of American missile defense deployments. Radar systems like the AN/TPY-2 deployed with forward deployed theatre missile defense systems, many of which are intended to defend South Korea and Japan from North Korean missile attack, could be used to detect Chinese strategic ballistic missiles in the boost phase and relay trajectory data to strategic missile defense systems intended to defend against ICBMs. During the period when the United States first deployed the AN/TPY-2 missile defense radar systems to Japan, the PRC had a DF-31 ICBM brigade not 55 kilometers from the North Korean border, easily within the AN/TPY-2's detection range. The PLARF is continuing to deploy ICBMs to the region with the discovery of two probable DF-41 brigades being committed to areas within 500 kilometers of the North Korean border. China has been particularly vocal about the deployment of the AN/TPY-2 and its concerns over the effects on China's security, going so far as to sanction various South Korean companies.[93] It is notable that there is evidence that the PLARF brigade garrison that operated the DF-31 ICBMs close to the North Korean border is now transitioning to the DF-17, a missile designed for evading missile defenses. The DF-17 is now in the process of being widely deployed to both the area around Korea and the Taiwan Strait. The deployment of the DF-100, a supersonic cruise missile, to Shandong province is another indication that the PLARF is concerned about its ability to penetrate adversary missile defense systems.

A simple numerical expansion of nuclear launchers while keeping the same constrained nuclear posture of second strike NFU should not be a cause of significant concern. It is even possible that China maintaining a much larger second strike NFU force would lower the risk of nuclear confrontation because China's arsenal would be

[92] Sevastopulo, Demetri, "China Tests New Space Capability with Hypersonic Missile." *Financial Times,* October 16th 2021.

[93] Kim, Victoria. "When China and U.S. Spar, It's South Korea That Gets Punched." *Los Angeles Times,* November 19th, 2020.

more survivable against an American nuclear attack and accidental destruction of some nuclear capable launchers during a conventional conflict would not significantly erode its retaliatory capability. Concern should be focused on how the nuclear expansion might either be the result of planned changes to China's nuclear posture, or could result in eventual changes to China's nuclear posture. Even if China is not currently planning to utilize its new nuclear assets more aggressively, the fact that those assets now exist and are capable of doing so makes a possible eventual shift to a more aggressive posture much easier to achieve.

The most concerning change to China's nuclear forces is not actually the numerical expansion in launchers, but their apparent shift from a retaliation plan that imagined firing a salvo of nuclear missiles after an adversary had already completed an attack against the Chinese homeland to a posture of launch of warning (LOW). Under launch on warning, an incoming nuclear attack is detected in flight with satellites and ground-based radar, allowing a state to retaliate before the incoming missiles have struck their targets. China's developing launch on warning capability, combined with solid-fueled missile silos, means that they can quickly launch a nuclear attack at a moment's notice. A LOW posture presents new challenges in ensuring conventional conflicts stay conventional. Unlike the United States, any future war China will be involved in will include the large-scale use of long-range conventional munitions against targets within the Chinese homeland. LOW relies at least in part on ground-based radar that is also capable of detecting regional conventional munitions and aircraft. As such, it is probable that at least some of these systems and their support systems will be struck by American munitions during a conventional conflict. Given that China now appears to be investing in protection for its fixed ICBM force, it is probable that Chinese planners are concerned about American stealth cruise missile and bomber attacks that will preclude any large-scale attack on Chinese strategic forces. Striking radar used for strategic early warning could be misinterpreted as a prelude to a larger damage limitation strike.

How these modernizations will affect escalation during a crisis or conflict with the United States is also a source of concern. In the past, the risk of a conventional conflict escalating to nuclear use was very low due to China's strong normative commitment to NFU and the lack of entanglement of nuclear and conventional launchers. During a major conventional conflict between the United States and China, the United States strategy calls for the destruction of Chinese military sites in the Chinese interior like command-and-control nodes, airfields, and missile facilities.[94] Ten years ago, the risk of a facility related to China's strategic nuclear deterrent being misidentified as a conventional military facility was very low due to the uniqueness of infrastructure signatures at Chinese nuclear sites and the fact that facilities like missile tunnels for nuclear assets were mostly geographically separate from conventional ones. The only exception to this was China's arsenal of nuclear DF-21A nuclear MRBM missiles, the majority of which were aimed at Okinawa and mainland Japan. However, the uniqueness of their launchers and launch sites made it unlikely that the United States would accidentally strike them if looking for conventional targets.

[94] Talmadge, Caitlin. "Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States." *International Security* 41, no. 4 (2017): 50-92.

However, Chinese conventional and nuclear military assets are now being entangled in two important respects.[95] The first is geographic colocation. Recall that the PLARF uses hardened tunnels to both hide their launchers and enable them to survive strikes by an adversary after the launchers have been dispersed from their bases. Once conventional hostilities begin China might deploy their nuclear missile launchers to their tunnel facilities, either out of fear of an American first strike or as a way of signaling to the United States that it was prepared to strike as such deployments would be detectable via satellite imagery. It is unreasonable to assume that the United States intelligence community does not know where at least the majority of these tunnel facilities are. Excavation efforts are very difficult to hide because of both the size of the supporting infrastructure necessary for tunnel construction and the amount of earth that needs to be removed from the excavation. The DF-26 is also based in areas that also host mobile ICBM brigades. If the DF-26 is sheltered in tunnels similar to the ones used by mobile ICBM brigades, it would be difficult to distinguish whether or not any particular PLARF tunnel is hosting a conventional or nuclear asset. This risks the United States accidentally striking mobile ICBM assets during a conventional conflict, leading to escalation as the PRC believes that its nuclear deterrent is under deliberate attack.

The second way that conventional and nuclear military assets are being entangled is through an increasing reliance on launchers that are capable of firing either conventional or nuclear missiles like the DF-26. The PRC would utilize the DF-26 heavily in any conflict involving the United States or its allies in East Asia and the Pacific. The PLARF practices striking mock airfields and stationary ship-sized targets with live missiles on a regular basis and would use such capabilities to attempt to prevent the United States from coming to Taiwan's defense in the event of war. Nuclear warheads could be delivered to DF-26 brigades prior to the initiation of a conventional conflict, as DF-26 units practice rapidly switching from a conventional to a nuclear mission. The delivery of nuclear warheads to the brigades could be detected by United States intelligence means, forcing the United States to consider the possibility that any inbound DF-26 missiles could be nuclear in nature. This aspect of the DF-26 – which some have argued is a feature, not a bug, and others have argued is simply a cost saving measure – carries significant risk of inadvertent escalation as the United States would not be able to conclusively determine whether or not DF-26 operations are conventional or nuclear in nature.[96]

Lastly, the interaction between the PLARF's missile expansion and the United States' missile expansion should be carefully considered. Previous PRC nuclear strategy of simply riding out an attack by placing their ICBM in hardened tunnels had the positive effect that, if the PRC was confident in the survivability of those hardened tunnels, there was a smaller risk of the PRC striking first after misidentifying an incoming American munition. The silo fields have changed this. The PRC has presented an extremely

[95] Many of my thoughts on escalation relies on the previous work of James Acton.
James M. Acton; "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War." *International Security* 2018; 43 (1): 56–99.

[96] Panda, Ankit. "China's Dual-Capable Missiles: A Dangerous Feature, Not a Bug." *The Diplomat,* May 13th 2020.

obvious set of fixed targets they fully expect the US will attempt to neutralize with nuclear ballistic and cruise munitions. The establishment of PLARF air defense units and construction of what are probably air defense support facilities at the new solid-fueled silo fields suggest that the PLARF is very concerned about systems like LRSO being utilized against nuclear command and control nodes at the silo fields. It would be difficult for the PRC to determine the intended target of incoming cruise missiles if the United States attempts to strike targets in China's interior. If during a conventional conflict the PLARF receives reports about incoming American cruise missiles or intermediate-range ballistic missiles and believes those missiles are intended for the silo fields, they might have a strong incentive to "use it or lose it."

As evidenced by both writings from Chinese academics and strategies and by the infrastructure and systems China is currently in the process of emplacing, attacks by the United States on its allies against nuclear command and control and early warning systems utilizing long-range stealth systems are a source of serious concern. This concern, fueled in part by rhetoric from the United States, increases the risk that conventional military actions undertaken by the United States during a conventional conflict will be misinterpreted as preludes to a larger damage limiting strike on Chinese strategic systems. To ease this concern, an effort should be undertaken by the United States government to change its rhetoric and general attitude towards the Chinese strategic capability, first by explicitly acknowledging that the United States and China exist in a state of mutual vulnerability. This acknowledgement, supported by possible changes to United States nuclear policy, could be used to reassure the People's Republic of China that the United States is not posturing its forces with the intent to achieve a state of nuclear primacy over its adversaries. This could also open the door for possible dialogues between the United States and China on nuclear issues. Currently Chinese nuclear thinking is a black box – we can see the security drivers being fed into the box, and we can see the military infrastructure and deployed military systems that come out of that box, but as the Chinese military does not publicly talk about their thoughts concerning nuclear weapons and deterrence, their exact thinking eludes us. The United States should attempt to establish dialogue between the United States military and the Chinese military to ensure each side has a clear idea of how the other thinks about nuclear deterrence and escalation. These dialogues would help ensure that each side knows how the other might react to certain actions and deployments so as to avoid miscalculation.

Conclusion

The PLARF is transforming from a modest collection of outdated missile systems to a modern survivable force capable of executing a variety of missions. On the conventional side, the PLARF is now equipping itself with highly accurate systems capable of evading missile defenses for the destruction of targets in Taiwan, Japan, and the Korean peninsula. On the nuclear side, the PRC's massive and rapid expansion of their ICBM force from under 100 launchers to around 500 launchers dramatically increases the survivability of their force. Risks of nuclear conflict are not inherent to any given system however, nor does the risk necessarily increase as the number of nuclear missiles grows. Instead, the risk of nuclear war is a function of the deployment patterns, levels of alert, modes of thinking, and employment strategies China chooses to adopt, and, most importantly, the fact that we don't know how those things are changing. As we have little insight into many of these aspects, the amount of risk involved in a potential conflict between the United States and China increases as we have no clear ideas about what sort of military action or losses China would find acceptable and what it would find unacceptable. Several aspects of their arsenal are, justly, causes of extreme concern. But a simple numerical expansion of the number of nuclear weapons they have available should not concern us as much as the United States accidentally ticking off a checklist of things China believes would be precursors to an American first strike due to its ignorance of Chinese employment strategies.

As the launchers China is currently constructing become operational, China's deployed nuclear forces will increasingly be at odds with its public statements on their nuclear policy. The PRC has so far refused to acknowledge the scale of their nuclear force expansion, especially the solid-fueled missile silos under construction. As it would be difficult for them to publicly discuss its nuclear posture without basically acknowledging the missile forces they have recently constructed, we will have to wait for China to first acknowledge what they are building before the United States can hope for them to begin speaking with China on how they plan to posture them. While the United States and China cannot even agree on even a basic picture of each other's arsenals there is little point in making specific suggestions about potential strategies for arms control negotiations. Instead, the first step towards avoiding an arms race and reducing the risk of conflict must begin with restarting communication between the militaries and policy communities of each country. Time will tell precisely which posture the PRC adopts for its new nuclear forces. The possible courses of action the United States and others could take in response to the PRC's nuclear expansion depends on what sort of paradigms Chinese political and military leaders have adopted when thinking about their own arsenal.

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Appendix A: Locations of DF-5 Pattern Silos[97]

661-1	34.360996°, 111.844502°	Operational
661-2	34.285075°, 111.627066°	Operational
661-3	34.199984°, 111.008438°	Operational
661-4	33.929888°, 111.043407°	Operational
661-5	33.863203°, 111.307279°	Operational
661-6	33.978170°, 111.254034°	Operational
662-1	33.786214°, 112.024075°	Under Construction
662-2	33.809708°, 111.942421°	Under Construction
662-3	33.760176°, 112.163625°	Under Construction
662-4	33.764653°, 112.207810°	Under Construction
662-5	33.909091°, 112.174327°	Under Construction
662-6	33.892992°, 111.873807°	Under Construction
662-7	33.910421°,111.902537°	Under Construction
662-8	33.938413°, 111.890494°	Under Construction
662-9	33.889641°, 112.219333°	Under Construction
662-10	33.934342°, 112.289509°	Under Construction
662-11	33.862991°, 112.233247°	Under Construction
662-12	33.922618°, 111.846142°	Under Construction
662-13	34.119758°, 111.832412°	Under Construction
633-1	26.813563°, 109.649910°	Operational
633-2	26.862612°, 109.926385°	Operational
633-3	26.947774°, 109.710334°	Operational
633-4	27.031126°, 109.787864°	Operational
633-5	27.034813°, 109.880123°	Operational
633-6	26.944392°, 109.946422°	Operational
631-1	26.430807°, 109.461770°	Operational
631-2	26.440251°, 109.563333°	Operational
631-3	26.474686°, 109.628713°	Operational
631-4	26.484534°, 109.912996°	Operational
631-5	26.561295°, 109.845390°	Operational
631-6	26.647122°, 109.823929°	Operational
631-7	26.312695°, 109.950076°	Under Construction
631-8	26.268510°, 109.924854°	Under Construction
631-9	26.228579°,109.901905°	Under Construction
631-10	26.187640°, 109.893310°	Under Construction
634-1	29.587878°, 113.663187°	Under Construction
634-2	29.451151°, 114.210927°	Under Construction
634-3	29.570014°, 114.289402°	Under Construction

[97] Several of the locations in this list were first published by Ben Reuter.

SILO	COORDINATES	STATUS
634-4	29.671949°,114.263895°	Under Construction
634-5	29.498568°, 114.510974°	Under Construction
634-6	29.523660°, 114.596433°	Under Construction
634-7	29.591893°, 114.660436°	Under Construction
634-8	29.673740°,114.293365°	Under Construction
634-9	29.534310°,114.468723°	Under Construction
634-10	29.514527°, 114.412744°	Under Construction
634-11	29.454190°, 114.150093°	Under Construction
634-12	29.400185°, 114.227494°	Under Construction
634-13	29.343784°, 114.195723°	Under Construction
634-14	29.550094°, 114.407798°	Under Construction

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