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# Launch-On-Warning and China's Nuclear Posture


## Abstract

*China's deterrent is premised on the survivability and credibility of its nuclear forces. The policy of assured retaliation has allowed it to maintain a relatively small arsenal, stressing on second-strike capabilities for counter-value targeting. However, strides made by the US in precision strike, missile defence, and ISR systems threaten the credibility of China's deterrent as it stands today. China may seek to mitigate this threat by adopting a launch-on-warning posture, heralding a significant change in its nuclear doctrine. An overview of China's current nuclear posture and its vulnerabilities, along with the development of early warning systems indicate the CMC could seriously be considering launch-on-warning. When situated against the PLARF's warhead handling protocols and three-tier nuclear alert status, one can conclude it has already been retained as an option for wartime.*



**Keywords:** *Launch-on-Warning, China, PLARF, USA, Missile Defence, CPGS, Early Warning, Alert, Command and Control, SSBN, assured retaliation, Launch-under-Attack, Russia, CMC, Nuclear Posture, Negative Control, Positive Control, Escalation*


## Introduction

Much of the recent commentary relating to China's nuclear program has been in conjunction with the New START treaty, China's modernisation of its missile and submarine platforms, and US threats to its nuclear deterrent. Having pledged a No-First-Use (NFU) policy since its first nuclear test in 1964, China's nuclear forces have generally not evoked fears of a relatively aggressive/dangerous posture when considered against other nuclear weapon states. However, developments in the past two decades when situated with a growing US-China rivalry raise the worrying possibility of a less-defensive nuclear posture in the next few years, which this paper will explore.

The world has witnessed several close calls since the advent of nuclear weapons, like the Black Brant scare of 1995, or the NORAD system glitch in 1980 (NTI 2018). Unsurprisingly, most false alarms involving nuclear weapons are situated in the USA-USSR/Russia dyad, stemming in part from their respective nuclear postures. The two countries hold approximately 91% of all nuclear weapons today, with 5800 (USA) and 6372 (Russia) warheads in their inventories (Kristensen et al. 2020). These large arsenals are required for the nuclear warfighting both countries have worked into their military strategies. One aspect of such a posture is launch-on-warning, the reason behind near-nuclear war in the two incidents mentioned above, among others. Launch-on-warning (LoW) refers to a state of readiness where nuclear-tipped missiles are counter-launched on intelligence of an incoming attack, before enemy missiles have struck their targets. Such a posture is a consequence of strategies involving massive retaliation and nuclear warfighting that were conceived in the early days of the Cold War (Burr 2001). Rooted in fears of a decapitation strike rendering one's nuclear deterrent useless, it seeks to safeguard one's missiles by ensuring they are launched before enemy missiles can prevent their use (by targeting the launch systems themselves, or command and control nodes). This strategy originates from the desire to conduct pre-emptive strikes against 'strategic' enemy installations like nuclear command centres and missile & air bases. US Military commanders in the 1950s and 60s wanted the option of rapid-strike against 'time urgent' high-value targets once they received warning of an impending attack (National Security Archive 2019). This developed into a LoW posture that has endured till today, starting with the development of early warning systems in the 1960s. Individuals like Richard Garwin and Harold Brown noted such a strategy had a deterrent effect, such as making Soviet targeting of ICBM silos a "risky and unattractive proposition." (Blair 2011).

The three crucial components of employing such a strategy are nuclear weapons on alert, early warning systems, and excellent nuclear command, control, and communications (NC3). Alerted nuclear weapons are those that have warheads mated with the delivery vehicles, ready to be launched at a moment's notice. Under the terms of New START (valid till February 2021), Russia and the USA both have to cap their alerted (deployed) warheads under 1550. Possessing the most prolific nuclear arsenals, both countries have well-established NC3 systems honed over seven decades of possessing nuclear weapons.

Early warning systems in the form of satellite-based platforms and high-energy ground radars are required to promptly detect enemy launches and allow leaders sufficient decision-making time. For example, US early warning systems include three Upgraded Early Warning Radars (UEWR), and a network of six Space-Based Infrared System (SBIRS) satellites. The UEWR platforms are based in Greenland, Florida, and the United Kingdom, and are solid-state, phased-array radars (MDAA 2017). With a detection range of 4800 kilometres, they assist satellite platforms with classifying re-entry vehicles, mid-course coverage of long-range missiles, and coordinate with US National Command Authority to optimize the use of missile defence interceptors. Though they are an integral part of the US Early Warning network, their limited range is insufficient to allow adequate warning time in event of a missile launch. This is provided by the SBIRS satellites, which detect and track missiles in their initial boost phase (Sankaran 2019). Similarly, Russian early warning systems comprise of the Oko-1 and Kupol satellites, along with an extensive network of radars in Russia, Kazakhstan, and Belarus (Woolf 2020a). These systems provide almost instant detection of a launch, allowing a 15-30-minute window before the missiles strike their targets (Union of Concerned Scientists 2015).

Early warning systems have to communicate seamlessly with other elements of a country's nuclear launch authority, because of the timelines involved. Though a land-based missile's flight time between the US and Russia is 30 minutes, leaders actually have less than five minutes within which to make a decision to counter-launch, taking into account procedural checks and launch sequences (Lewis 2017). This is predicated on near-immediate, accurate, and verifiable intelligence from early warning systems, failing which a launch-on-warning posture is not possible.

These three factors work have to work together in order to operationalize LoW (referred to as launch under attack in the US). Due to the options of first-strike and strategies of massive retaliation envisaged by the US and Russia, the threat of a crippling strike remains a significant worry in both countries. Therefore, a large number of missiles (at most 1550) are kept 'alerted' for launch at a moment's notice. In the US, land-based Minuteman missiles can be launched within two minutes of the President giving the order, and the submarine-launched Trident missiles within 15 minutes (Woolf 2020b).

Critical to deterrence is positive control and negative control, also characterised as the 'always-never' criteria (Larsen 2019). Robust command & control implies a legitimate order to use nuclear weapons must always be carried out (positive control), while also ensuring they are never used accidentally/illegitimately (negative control). Keeping warheads on alert strengthens positive control, as the swift use of nuclear weapons weakens adversary efforts to nullify their use. At the same time, the 'ready-to-use' nature of alerted warheads also increases the risk of an accidental/illegitimate launch, calling for impeccable negative control mechanisms. LoW is perceived as a pressing need for the US and Russia only because of the nuclear strategies of the two countries, deemed necessary because of the existential threats the two countries faces from each other. If there was a conflict with any other nuclear-armed state, it is possible they would not risk LoW and the resulting dangers arising from false warnings and hasty decisions. This is because no other country has the capability to threaten their nuclear facilities to the same degree. As General Michael Hayden remarked, launch-on-warning "is designed for speed and decisiveness. It's not designed to debate the decision" (Woolf 2020b) Though the posture has its merits and demerits in the US-Russian context, it would be an incalculable danger were it to be replicated by other nuclear weapon states like China.

**China's Nuclear Posture**

The Chinese government and other scholars have long maintained that China's current force structure is sufficient in guaranteeing deterrence, with no shift to a more proactive posture required. Recently, the director general of the Arms Control department of the Chinese Ministry of Foreign Affairs even called on all nuclear weapons states to abandon launch-on-warning (Kulacki 2019). That said, developments in the US-China security dyad, when considered with a global trend of fraying arms control and growing Chinese assertiveness could precipitate a change in the current posture. Before exploring the rationale of a move towards launch-on-warning, one must discuss the present status of its nuclear forces to understand the vulnerabilities that would prompt China to do so.

China is estimated to have the third-largest nuclear arsenal in the world, with approximately 320 warheads (Kristensen et al. 2020). Significantly smaller than the US and Russian warhead inventories, China's nuclear strategy has been characterised as that of 'assured retaliation'. This entails China maintaining the least number of warheads capable of surviving a first strike, and still guaranteeing a retaliatory strike to cause unacceptable damage against an adversary (Cunningham et al. 2015). The defensive nature of China's current posture is reflected in its NFU pledge, the only country along with India to commit to the same. 'The Science of Military Strategy', published in 2013 by the Academy of Military Sciences encapsulates the main principle that influences Chinese nuclear strategy – nuclear weapon use shall only be triggered by a successful confirmation of a nuclear attack (Kulacki 2015).

As claimed in its 2006 Defence White Paper, China purports a 'self-defensive nuclear strategy' comprising of 'counter-attack in self-defence' and the limited development of nuclear weapons (Cunningham et al. 2015). Being a purely deterrent force, it is believed that Chinese nuclear forces are envisaged for limited counter-value targeting of civilian targets, rather than be used in a widespread, warfighting role against purely military targets (Heginbotham et al. 2017a). These proposed strikes are planned in multiple-waves of small/large scale retaliatory attacks.

To implement such a strategy, the People's Liberation Army Rocket Force (PLARF) has platforms across the land, air, and sea paradigms, though limited capabilities in the air and sea domains make it a fledgling triad. To ensure the survivability of its limited nuclear weapons, the past two decades have seen huge strides in developing mobile, solid-fuelled land missiles, as well as improving its undersea deterrent. While the new Jin-class submarines and their JL-2 missiles are crucial to ensure the survivability of China's nuclear option, the mainstay of the deterrent remains the land-based missiles, accounting for over 75% of the country's nuclear platforms (China Power 2019).

As a further commitment to its NFU policy and to strengthen negative control, the PLARF keeps its nuclear warheads separate from their launch platforms. An exception to this policy would be the sea leg of the nuclear triad. Because of the operating difficulties involved, the warhead and missile would have to be mated before the start of a deterrent patrol, breaking from decades-old Chinese nuclear policy (China Power 2020). Though negative control will be retained via technical means, it cannot be as robust as absolute de-alerting to prevent illegitimate use. This will involve a different command and control strategy for submarines, which is unclear at this time. On the other hand, the air and land legs of the triad are believed to have similar command and control mechanisms.

Taibai County in Central China houses Base 67, an underground tunnel complex responsible for the storage and upkeep of most of China's warhead stockpile (Stokes 2010). A regiment subordinate to Base 67 is responsible for the regular movement of warheads between Taibai County and the six missile bases spread across the country. Relying mostly on rail and road networks, the warheads are constantly circulated between the central storage and individual missile bases, with only a few at each base for an extended period of time. Five of the missile bases are estimated to command a mix of 3-5 conventional and nuclear missile brigades each. Base 61 is the exception, and hosts only conventional missiles brigades. Each brigade has subordinate launch battalions and/or launch companies that operate launch platforms, which can be silos, cave-based rollout launch sites, or transporter-erector-launchers (Logan 2019).

The most obvious indication of strict command and control can be noted in the demating of warheads and missiles at the missile bases. In China's three-tier alert system for missile forces, this is the first stage (peacetime alert status). In event of escalating hostilities, a second-tier alert would see the dispatching of warheads from Base 67 and other missile bases to individual brigades for preparations to carry out launch orders, with a third-tier alert implying PLARF battalions and companies are ready to launch missiles (Cunningham 2019). It is unclear what redlines in a conflict would render a second-tier alert, but the significant time involved in road and rail dispersion of warheads to missile brigades, battalions, and companies implies this alert may be sounded in the initial days of a conflict, especially against the US.

Even after a second-tier alert, the Central Military Commission (CMC) exerts absolute control over the PLARF. The four-tier chain of command runs from the CMC to the PLARF, to the missile bases and then the launch battalions/companies. The PLARF has operationalised a dedicated fibre-optic communications network, and also relies on radio and satellite communications. Combat communication units for missile battalions and companies rely on frequency-hopping and a combination of wireless, wired, and satellite communications, and can receive orders directly from the PLARF headquarters through a 'skip echelon' feature (Cunningham 2019). Due to the existence of a three-tier alert for missile forces and the growing role of mated warheads on ballistic missile submarines, one can assume the PLARF has developed competent Permissive Action Links (technical controls to prevent an unauthorised use of alerted warheads). Considering the CMC's compulsion for authoritative command and control, these technical controls are likely reliable, with even alerted weapons not in danger of being used without the requisite protocols.

China's 2015 Defence White Paper made a reference to improving strategic early warning in conjunction with other aspects of its nuclear forces (Cunningham et al. 2015). Currently, China does not operate any space-based early warning platforms, relying entirely on three long-range phased array radars in the Xinjiang, Fuijan, and Heilongjiang provinces, with an estimated detection range of 5500 kilometres (Defense World 2015). However, President Vladimir Putin made a public statement in October 2019 promising China assistance in further developing early warning systems. It is unclear exactly what expertise would be offered to China, with some believing it may involve the development of a satellite-based early warning platform.

Though the defensive nuclear posture mentioned earlier has served China well since its first nuclear test in 1964, various developments in the past two decades when set against the backdrop of US-China tensions may well threaten its self-defensive nuclear strategy. Though much of the nuclear force modernisation in the past few years has been within the bounds of Chinese credible minimum deterrence, a continuing perceived threat from US military strategy could prompt a more proactive posture.

**Threat Environment**

Due to the focus on China's nuclear posture, this paper will only explore threats to the country's nuclear forces, and not conventional conflict scenarios. The primary threat and competitor with respect to the PLARF remains the US. Though the 20th century saw periods of time when Russia (then USSR) was also considered a nuclear threat to China, the two countries now enjoy what has been described as 'security-enhancing relations' (Heginbotham et al. 2017). Though leaders still monitor nuclear developments in Russia, this is more because of its influence as a global nuclear power and the implications of its actions.

China's relationship with its western neighbour, India, is tempered with a long-standing border dispute, and a rivalry for predominance in South Asia. The only full-scale war in 1962 has been followed by a series of localised incidents, culminating in the Doklam crisis of 2017 and ongoing tensions starting May 2020. Both are nuclear weapons states with conflicting national interests that may lead to wide-scale hostilities. A complicating factor is the India-Pakistan-China dynamic, with military developments in one sparking a cascading effect on the other two (Narang 2013). However, the two countries are the only nuclear weapons states with avowed NFU policies. Some analysts claim China has vast military superiority vis-à-vis India, while others suggest India's military is not as threatened by China's conventional forces as commonly believed (O'Donnell 2020). Even if the two NFU pledges are not taken at face value, India's ability to mount a reasonable defence to Chinese aggression dispels the notion of it escalating to a nuclear first strike for military gains. Though China boasts a nuclear arsenal twice the size of India's and has markedly better missile platforms, it does not possess the technology to nullify India's nuclear deterrent. Recent statements by retired and serving Indian government officials raise the possibility of caveats in India's NFU pledge (Clary et al. 2019), but there have been no significant changes in force structure and technology that could threaten the effectiveness of China's deterrent. Both countries have developed nuclear forces focussed on assured, counter-value second strike capabilities, and therefore neither pose an existential threat to each other's nuclear deterrent. Consequently, Indian nuclear forces are unlikely to force China's hand in conducting a major overhaul of its declaratory nuclear doctrine, despite frequent hostilities during border incidents.

Also of note in the threat environment are South Korea and Japan. Though not nuclear weapon states themselves, both countries benefit from US extended deterrence in East Asia. China has independent security concerns and issues with both countries, which are exacerbated by their close alliance with the US. China's concerns extend to US forces and military technology in the region, such as Japan-US cooperation in missile defence, and the THAAD missile defence system in South Korea. Additionally, though both countries remain secure under the nuclear umbrella, a withdrawal of US support from the region could possibly lead to weaponisation of their low-breakout times into nuclear warheads (Roehrig 2017). Destabilising as such developments would be, they would not present an unassailable threat to Chinese nuclear forces and prompt a nuclear posture review. However, an escalating deployment of US military technology in the two countries and Guam is very likely to cause a less-defensive, potentially offensive Chinese nuclear posture.

A conflict between the US and China is most likely to be triggered by US support of Taiwan, which China considers an unacceptable infringement of its 'internal affairs.' The merits of this argument aside, Taiwan's sovereignty is indisputably a major trip wire for both countries. Though efforts will be made to keep the conflict below the nuclear threshold, fears of superior US military capabilities combined with resultant signalling of Chinese missile forces could lead to inadvertent escalation, perhaps even into the nuclear domain (Cunningham et al. 2019).

China's nuclear weapons were developed in part to deter nuclear coercion by other countries, in this example against nuclear warfighting by the US. To mitigate the use or threat of nuclear weapons, Chinese missiles have to 'assure' nuclear retaliation after surviving an initial nuclear attack. Among the various military capabilities that worry China, most significant would be the US's headway in ballistic missile defence and precision strike.

China's deterrent is especially premised on an adversary viewing a retaliatory counter-value strike as a credible threat, despite its relatively small nuclear arsenal. Since US withdrawal from the Anti-Ballistic Missile treaty in 2002, projects like the GMD systems in Alaska and THAAD systems in Guam and South Korea are particularly viewed as weakening Chinese 'assured retaliation' (Twomey et al. 2015). Not only the missiles themselves, but ground-based radars in Japan, South Korea, and Guam instil fears of burgeoning ISR capabilities that erode China's nuclear deterrent. For instance, the forward-based X radars in Japan can assist interceptor bases in Alaska and California with better targeting of incoming Chinese missiles by distinguishing decoys and other penetration aids from actual warheads (Heginbotham et al. 2017:64). Additionally, the US Navy has an estimated 33 ships with ballistic missile defence capabilities, with more than 60% deployed to East Asia (O'Rourke 2020). The Aegis systems on these systems are considered the gold standard in radar detection and tracking solutions, and can feed into ship-launched interceptors, or interface with air defence units in the continental USA. These examples are but a few of the developments in missile defence that induce feelings of constriction among Chinese leaders, because of which it is considered the primary threat to the country's nuclear deterrent (Kulacki 2014).

Also cause for concern in China is the US's offensive precision strike ability, specifically the Conventional Prompt Global Strike (CPGS) program, still under development. The Prompt Global Strike envisaged by the US Department of Defense (DOD) in 2003 sought to develop an ability to strike targets anywhere with conventional weapons in as little as an hour. The program's targets include air defence platforms, WMD stockpiles, or an adversary's command and control nodes. The DOD has argued this program is ideal for "high-value/fleeting targets" that may only be vulnerable to strikes at the beginning of a conflict (Woolf 2020b). CPGS differs from other strike options in that it seeks to use bombers, cruise and ballistic missiles, hypersonic glide vehicles, among others (platforms traditionally associated with nuclear weapons) to deliver conventional munitions against 'strategic' targets.

When considered with US C4ISR superiority, the networked set of radars, missile defence, and offensive weapons in China's neighbourhood and beyond pose a far greater threat to Chinese 'credible minimum deterrence' than many in the US might believe. To reiterate the points raised earlier, China's nuclear deterrence is premised on the arsenal's survivability after a first strike, safeguarding enough resources to ensure a retaliatory nuclear attack. This posture is the reason China has maintained a relatively small warhead stockpile, as it believes the thought of absorbing even a limited retaliatory counter-value strike is sufficient to deter an enemy from first-use of nuclear weapons. Offensive capabilities like CPGS threaten the 'survivability' aspect of the deterrent, with defensive capabilities like BMD putting the strike abilities of any remaining missiles in question.

While opinion appears to be divided about the degree of CPGS's threat to the PLARF's capabilities, US BMD is unequivocally regarded as a severe concern (Cunningham et al. 2015). The emphasis on developing CPGS does not concur with criticism of its effectiveness, for example the US Navy's appropriation for one CPGS-linked program alone was over $ 1 billion for FY2021 (Woolf 2020b: 34). Some of the "high-value/fleeting targets" the DOD referenced would certainly be China's missile brigades, early warning systems, PLARF transportation assets, command and control nodes, and warhead storage facilities. Were CPGS ever threatened/used to credibly neutralise several strategic targets at once, China's options for a retaliatory strike would be vastly reduced. The few assets that remain face the likelihood of being negated by BMD systems in East Asia and the continental US.

If both CPGS and BMD are inducted and found to function flawlessly, the US would not even need nuclear weapons to change the tide of a war. Having rendered much of their opponent's deterrent useless, they would have far more room for posturing/threatening, regardless of the status of ongoing conventional hostilities. It would force upon China a situation last seen between the Korean War and the 1964 nuclear test – an adversary with conflicting national interests at its doorstep, with superior conventional capabilities and an option to employ nuclear coercion. To guard against this threat, serious credence should be given to Chinese leaders adopting launch-on-warning to bolster the country's nuclear deterrent.

**Launch-on-Warning**

A launch-on-warning posture primarily addresses problems of survivability for China's nuclear arsenal, and consequently the credibility of its deterrent. Recent interest in developing early warning systems, protocols for storing and dispersing warheads, and the PLARF's three-tier alert status together indicate a possible interest in launch-on-warning. When considered with the technological and geographical challenges China's submarines face, launch-on-warning becomes an attractive solution to address concerns of credibility. This section details these factors, and suggests that China may already reserve the option of launch-on-warning for wartime.

There have been indications that the possibility of LOW has been discussed within policy circles. For instance, *The Science of Military Strategy* of 2013 by the Academy of Military Sciences suggested – "When conditions are prepared and when necessary, we can, under conditions confirming the enemy has launched nuclear missiles against us, before the enemy nuclear warheads have reached their targets and effectively exploded, before they have caused us actual nuclear damage, quickly launch a nuclear missile retaliatory strike" (Kulacki 2014). It also stated launch-on-warning would be "in accordance with China's long-standing no-first-use policy, and may effectively protect China's nuclear forces from sustaining even greater losses, improving the survivable nuclear counterstrike capability of China's nuclear missile forces" (Cunningham 2015). Though published work by the Academy of Military Sciences is not indicative of a shift in the country's nuclear posture, it does speak of discussions within the country where launch-on-warning is a viable option. Consequently, one must also look at other indications of a shift to launch-on-warning being considered.

China's current early warning system is inadequate in providing notification of an enemy launch in a manner timely enough for launch-on-warning. With a detection range of 5500 kilometres, the ground based radars can only provide warning of a launch in the advanced stages of boost phase, or maybe even only during mid-course flight. Taking into account procedural requirements for confirming an enemy launch, this allows almost no time to absorb information and process it for initiating an appropriate response. Some analysts have speculated that the SJ-11 series of satellites are China's attempt at a space-based early warning system, though the government maintains they are merely communication satellites (Nowakowski 2014). As mentioned earlier, Russia will be helping China in developing an early warning system, after several years of Chinese requests. Sources claim a $60 million contract has already been signed with the Vimpel and Kometa companies in Russia. This is thought to be related to software development, making use of Vimpel's expertise in the development of early warning systems, missile defence, and counter-space systems (Stefanovich 2019). Other support may extend to personnel training, developing independent verifiable intelligence platforms, selling radar components, and maybe even working together on artificial intelligence in early warning systems. It will be interesting to note the degree of collaboration on such 'strategic' systems; China acceding to Russian inputs for early warning reflects a hitherto unseen degree of trust between the two countries.

It is possible these developments are indicative of a desire to boost the country's nascent missile defence program, and improve their situational awareness in air and space. Nonetheless, China's current ground-based radars are already sufficient in providing operational intelligence for the S-400 and other missile defence systems in the country. With a 5500-kilometre range and covering three different approaches to the country, the three radars are adequate for competent missile defence. The added advantages with satellites would be more time for developing tracking solutions, better intelligence on tracking aids, trajectory estimates, among others (Gompert et al. 1999).

However, China does not appear to be pursuing its missile defence program with much alacrity. Why then, is emphasis being laid on improving early warning systems? If this collaboration with Russia results in satellite based platforms, the cost involved appears excessive merely to improve situational awareness. For perspective, the US's first four SBIRS platforms cost $ 1.7 billion per satellite, and this after decades of research and development in similar technologies (Erwin 2018). China will have to spend far more in developing a competent network of satellites even with Russian help, drawing funding away from the core projects like a blue-water navy. If China's missile defence program remains limited and Sino-Russian cooperation engenders a sizeable network of satellites, one can seriously attribute Chinese interest in early warning systems to a shift in PLARF operating doctrines.

China has also paid keen attention to expanding its ballistic missile submarine (SSBN) program in recent years. The threats to the survivability of one's nuclear deterrent are mitigated significantly with an intercontinental range submarine-launched platform, which in China's case are the Type 094 submarines armed with the JL-2 missiles (range of over 8000 km). There are four active Type 094 submarines as of May 2020, with two awaiting induction. One submarine can field 12 JL-2s, making the combined submarine force a hefty arm of the nuclear triad. Each missile is fitted with a single warhead and possible penetration aids, though some believe the option of a MIRVed JL-2 exists (Missile Threat 2019). Although four platforms fielding 48 missiles appears a daunting force, there are several issues with China's SSBN fleet.

Analysts have acknowledged the Type-094 is an extremely noisy submarine, only marginally better than its predecessors (Wu 2011). Easier to detect, it is likely the submarines will operate in a bastion strategy or coastal patrol model, with heavily-armed escorts. With the range of the JL-2, a coastal patrol will not allow strikes against the continental United States, requiring the submarine to travel further from friendly waters to be a credible deterrent. China perceives its maritime geography as tilted heavily in its adversaries' favour, as the literature about island chains has shown (Yoshihara 2012). With a detectable acoustic signature and hostile maritime assets in the area, it is highly unlikely that the submarine deterrent can be banked upon to guard against the threats of US decapitation strikes.

Enemy forces would not even have to neutralise the Type 094; an attack submarine with a rough operational location of Chinese SSBNs can possibly cue Aegis ships (an estimated 18 in East Asia) to 'kill' the SLBM during midcourse, given an appropriate range (Wu 2011). The several chokepoints around the East and South China Seas also make it easier for US and allied ships to track submarines, especially ones as noisy as the Type-094. Some feel that the expected Type-096 submarines will address issues of acoustic signatures, armed with the JL-3 missile (expected range of over 11000km). Even if this is true, the primary threat to the SSBN force will remain unchanged. US and allied forces will continue to field technologies like Aegis ships and advanced radar & missile systems, all the while aided by a series of chokepoints constricting the PLA Navy in its own backyard.

Hence, even though the sea-leg of the nuclear triad is important for the arsenal's survivability, geographical and technological constraints burden the SSBN force too much to rely on it alone. The air-leg is in a very nascent stage, with very limited information about how it would be structured and deployed. Up to a certain degree, we can expect warhead storage and transportation for air-launched and land-based missiles to be similar. This brings us to the mainstay of China's deterrent, the land-based systems. Forming 75% of the country's arsenal, they range from liquid-fuelled silo missiles to mobile solid-fuelled missiles. Because of their importance within the triad, it is likely the threat to land-based missiles is what could finally push China towards launch-on-warning. Even despite technologies and tactics involving the dispersal of mobile solid-fuelled missiles to huge tunnel complexes, US ISR and precision strikes still put deterrence in doubt. As remarked earlier, launch-on-warning stems from a fear of losing one's ability to retaliate. The centrality of land-based systems to the Chinese deterrent will likely induce a 'use it or lose it' mindset, especially in a conflict with the USA. Chinese leaders studying US military strategy are aware the US may exercise the option of a first-strike crippling either the missile systems or the PLARF communications network to attack Chinese command and control. This would completely shift the balance of power between the two countries, leaving China no room to negotiate.

If China were to adopt launch-on-warning, it would be the land-based systems themselves that will be used for an immediate counter-strike. The reasons are twofold – as Chinese leaders fear the loss of the land-leg of the triad disproportionately, the 'use it or lose it' mindset will see the very systems that are threatened being used in retaliation. Secondly, the SSBN systems currently operational are not ideal for a launch-on-warning posture. Taking the example of the US, land-based missiles can be fired within two minutes of a launch order, while submarine-based missiles can take as long as 15 minutes. This is because timely communications with deployed submarines can only be done using Very Low Frequencies (VLF), when submarines are at a depth of 20 metres. Extremely Low Frequency (ELF) communications will be required for submarines at operational depths, where SSBNs usually will be during a conflict (China Power 2020). ELF communications take several minutes just to transmit a handful of words, which are usually orders to come to VLF depth.

Considering the time-sensitive nature of launch-on-warning, such uncertainty in communicating orders for an immediate counterstrike does not inspire confidence in SSBNs as a platform. Additionally, it makes no sense to launch missiles from a platform that is not threatened by incoming missiles, while allowing the backbone of one's deterrent to be neutralised. China's SSBNs are therefore likely to be kept in reserve for a second strike capability, with the land-based systems being used for a launch-on-warning posture. However, command and control with regard to the SSBN force needs careful study while considering the possibility of LOW. Depending on how it is structured, SSBNs could see pre-delegation of launch authority to a mix of officers on board, or something akin to the UK's letters of last resort. These developments could grow to have relevance for the PLARF's mobile missile brigades as well, in terms of preparations the CMC has made to delegate launch authority in event of a decapitation strike.

Once operational, the air-leg of the triad can allow leaders more flexible responses and a more stable triad, as missile-laden bombers can simply take to the air on confirmation of an incoming strike, with no irreversible courses of action being undertaken. However, most air-launched missiles/bombs have a limited range, and cannot easily threaten the continental USA with counter-value retaliatory strikes (as China's nuclear doctrine plans for). Until land-based systems occupy a disproportionate status in the triad, China will always be tempted to put them on alert for a rapid response.

Interestingly, China may be closer to launch-on-warning than people might think. As mentioned earlier, such a posture requires warheads be mated with their delivery vehicles. The PLARF keeps missiles and warheads separated in peacetime. In the second stage of the three-tier alert status, Chinese missile crews will be "preparing to carry out launch orders", with the third stage being "ready to launch" (Cunningham 2019). Chinese strategy also calls for the dispersal of mobile missile units in event of conflict (Heginbotham 2017). Preparing for worst case scenarios, it is likely that dispersion would occur only after launch battalions and companies possess the warhead and the delivery vehicle (Stokes 2010).

The bulk of the PLARF's warhead transport protocols revolve around road and rail networks. With all warheads housed in missile bases during peacetime (most warheads housed in a single base – Base 67), the transportation of warheads to individual battalions and companies remains the most vulnerable link of PLARF battle preparations. This stage of readying nuclear weapons represents the 'high-value fleeting targets' that the CPGS was developed for, making it unlikely that warhead dispersal to mobile brigades (and further down) would occur once hostilities have broken out, and not before. Losing a bulk of China's nuclear warheads would be too great a risk for the PLARF to allow transportation during an ongoing conflict. Therefore, one can assume that a second-tier alert is to be sounded in the initial to middle stages of an escalating crisis with the US, with mobile missile brigades to be dispersed/hidden in tunnel complexes to ensure survivability in event of further escalation. A second-tier alert includes activities such as transportation of warheads to missile bases and beyond, dispersion of individual launch battalions and companies, and mating of warheads with missiles. The third stage would consequently see alerted nuclear weapons.

This tiered alert system does not appear to fit with other stated aspects of Chinese nuclear policy, such as confidence in security measures for missile bases and mobile brigades. The vulnerabilities highlighted above ensure a third-tier alert has to be sounded before a nuclear attack even occurs. The transportation and movement of warheads can be used to posture for the enemy's benefit, but also makes them vulnerable to pre-emptive strikes during a conflict. Is this risk outweighed by the benefit of moving towards a third-tier alert? If so, is moving to a third-tier alert only for signalling resolve to an enemy? The alternative is the CMC wanting the option of launching missiles at a moment's notice, in event of escalation beyond the nuclear threshold.

CMC leaders are aware that such posturing can hasten a first-strike from the US just as much as deterring one. This calls for us to seriously consider the possibility of China retaining the option of a launch-on-warning posture *only* during wartime. While a better solution than keeping nuclear weapons on hair-trigger alert during peacetime, the resultant signalling (second and third-tier alerts) during a conflict may pressure an adversary to order a pre-emptive strike, if such a policy is made publicly known. To mitigate this, the CMC and PLARF may publicly rubbish launch-on-warning, but develop the technologies required to employ such a posture during wartime. However, expecting an adversary to take public disavowals and NFU pledges at face value during the fog of war is a thin straw to bank upon. Chinese strategists should bear in mind that developing certain technologies and the deployment of PLARF forces speak far louder to doctrinal changes than MFA statements will, especially while moving closer to a nuclear threshold.

**Conclusion**

To confirm such a posture being in place, the coming years will require careful study of several factors. Development of space-based early warning system without resulting missile defence capabilities should not be attributed solely to increasing situational awareness, but studied alongside any changes in the PLARF's protocols for land-based systems. Any additional literature relating to the tripwires for China's three-tier alert will explain what circumstances would see the mating of warheads and delivery vehicles, and possibly substantiate launch-on-warning during wartime. Similarly, the deployment and command & control of China's SSBN force is noteworthy because of the insight provided into the CMC's negative control measures. Though it is unlikely Chinese submarine technology will mature exponentially to become the backbone of the nuclear deterrent, the nature of deterrent patrols will reflect how robust technical controls are perceived to be, with bearings on how land-based systems might be alerted during conflicts.

Contextualising such a shift in posture, China adopting launch-on-warning, even launch-on-warning in wartime, would be disastrous. The coming years are already slated to see increased missile deployments after the end of the INF treaty. This global arms race will be brought home to China, with intermediate-range missiles expected in places like Guam, or even Japan during heightened crises. The post-INF arms race between Russia and the US has the potential to increase exponentially, especially as the prospects of New START surviving its February 2021 deadline look increasingly bleak.

Reflective of a vicious cycle, post-INF and post-New START developments might be exactly what pushes China towards the edge and embrace launch-on-warning. Already facing US precision strike and missile defence technologies in East Asia, a build-up of intermediate range missiles would constitute significant escalation for China. If it begets launch-on-warning, the US and Russia will be further disinclined to discuss arms control. Regionally, one can also expect a spill-over in South Asia, with India perceiving the option of alerted warheads as escalatory. The measures India may take to balance this will further cause ripples in the Indo-Pak nuclear dyad, arguably the most incendiary in the world.

Unfortunately, one must take a dim view of any efforts to nip this issue in the bud. Possibly the only way forward is the ability of the US, Russia, and China to develop a multilateral arms control agreement. Not to be confused with the flawed reasoning behind US demands that China accede to a New START- like treaty, such an agreement would have to address the threats major nuclear powers face from each other. A treaty incorporating aspects of the Anti-Ballistic Missile and INF treaties would be appropriate. However, both the USA and Russia accuse each other of cheating on the terms of the INF treaty. China often lambasts the USA for an inability to honour agreements it is committed to. The USA now views missile defence as an integral part of its national security, similar to how China feels about intermediate range missiles tackling the threats it faces in the neighbourhood. Unless the countries involved are willing to concede space on programs and technologies considered central to their military strategy, Chinese launch-on-warning may only be the beginning of a more dangerous nuclear age.

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