Institute of Chinese Studies
ICS
中国研究所DELHI
50
1969 - 2019

OCCASIONAL PAPER

No. 33 June 2019

Understanding China's submarine capabilities: Undersea competition in the Indo-Pacific

Saurav Sarkar

ICS OCCASSIONAL PAPER NO. 33

Understanding China's submarine capabilities: Undersea competition in the Indo-Pacific

Author: Saurav Sarkar

First published in 2019

Institute of Chinese Studies
8/17 Sri Ram Road, Civil Lines
Delhi 110 054, INDIA
Ph.: +91-11-23938202; Fax: +91-11-23830728
Email: info@icsin.org
Website: www.icsin.org

ABOUT THE AUTHOR

Saurav Sarkar is a Research Associate at Centre for Air Power Studies, New Delhi. He has completed his MA in International Relations (2016-18) from Amity University Uttar Pradesh, Noida and done his BA (Honours) in English (2013-16) from the same university. He has received the Best Strategic Thinking Achiever's Award during his post-graduation from the university. He had interned at Pragyavataran Educational Society, Noida in May-June 2017 as a social work volunteer. His MA dissertation was on "Counter-terrorism policies of the Obama administration in Afghanistan-Pakistan". His areas of interest are China-Pakistan military and strategic cooperation, geopolitics of the South China Sea dispute and counter-terrorism.

Contact: srvsrkr11@gmail.com

Understanding China's submarine capabilities: Undersea competition in the Indo-Pacific

Abstract

The People's Liberation Army Navy's submarine fleet has, over the last few decades, undergone dynamic changes in operational capabilities as well as size. China still has a long way to go in counterforce capabilities vis-à-vis the US, which vehemently opposes its militarization of the South China Sea (SCS). With China's position as a strong military power in East Asia and an economic powerhouse, the PLAN's capabilities are instrumental in its power projection capabilities and in defence of its offshore interests. In this regard, its submarine fleet would play a big role in supplementing the PLA's capabilities in the SCS and would enable the PLAN to break through US defences along the First Island Chain and in its sea based nuclear deterrence role to ensure a second strike capability.

Keywords: *submarine warfare, nuclear deterrence, PLA Navy, submarines, ballistic missile, boomer, China, South China Sea, torpedoes, stealth, Indo-Pacific*

The People's Liberation Army Navy (PLAN) has since the 1990s, undertaken significant changes in operational capabilities, modernisation as well as size. The PLAN Submarine Force (PLANSF) currently operates four ballistic missile nuclear submarines (SSBN) that form part of its sea based nuclear triad, five nuclear powered attack submarines (SSN) and around 47 diesel-electric attack submarines. The PLAN is expected to have a total of around 69-78 submarines by 2020out of which 11 are expected to be nuclear powered (US Department of Defense[1] 2018: 29).However, others estimate the PLANSF in 2020 to have around 58 submarines, including ten nuclear powered(Boyd and Waldwyn 2017). As per a study by the US Congressional Research Service from 1995 to 2016 China was able to commission 57 submarines of all types, an average of 2.6 submarines a year (O'Rourke 2018: 16-17). China's submarine fleet is the largest in the world and the fastest growing, second only to North Korea. However, it should be kept in mind that the North Korean submarine fleet is mostly made up of vintage submarines from the 1950s and midget submarines capable of carrying out coastal defence in home waters. China still has a long way to go to be able to counter the United States, which vehemently opposes its militarization of the South China Sea (SCS) and has a well-established global presence. With China's position as a strong military power in East Asia and an economic powerhouse, the PLAN's capabilities are instrumental in its power projection capabilities and in defence of its offshore interests.

This paper will examine the PLAN's undersea operational capabilities in the Indo-Pacific region. The present progress in PLAN submarine capabilities would have severe security implications for countries like India, the US and Japan. In this regard its submarine fleet would play a big role in supplementing the PLA's capabilities in the SCS and would enable the PLAN to break through US defences along the First Island Chain and in its sea based nuclear deterrence role to ensure a second strike capability. China's port construction activities in the Indian Ocean Region and its island building and land reclamation activities in the SCS would also advance its advantages in submarine warfare to a large extent. China has not released any official document related to its submarine strategies but their

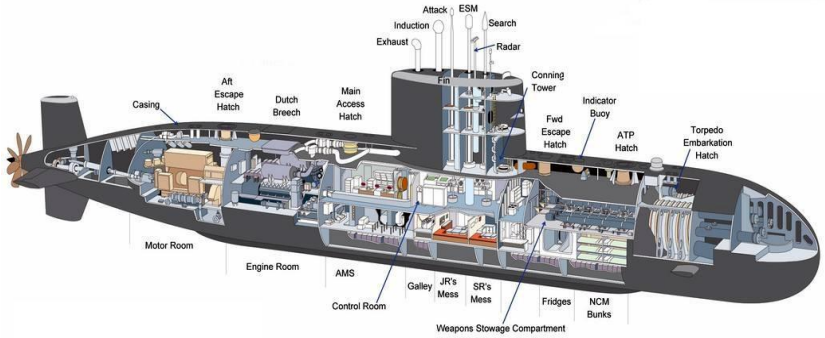
[1] Hereafter referred to as DOD

centrality and importance in advancing Chinese interests overseas and closer to home have been stressed in no uncertain terms by their political and military leadership, both past and present (Erickson and Goldstein 2007: 63; State Council Information Office of the People's Republic of China[2] 2015). China's submarine modernization effort has garnered enormous attention and justifiable concerns. The US Office of Naval Intelligence (ONI) states that 'China has long regarded its submarine force as a critical element of regional deterrence, particularly when conducting 'counter-intervention' against modern adversary. The large, but poorly equipped [submarine] force of the 1980s has given way to a more modern submarine force, optimized primarily for regional anti-surface warfare missions near major sea lines of communication'(Karotkin 2014)

Since there is a paucity of primary Chinese data on its submarine programme, most of the information used for this research has been sourced from Western military and intelligence reports and writings by arms control experts. The paper refers to the same sources for its assessment of the technical and military capabilities of China's, including existing photographic data. Attempt has been made to ascertain the probabilistic capabilities of Chinese submarines vis a vis Western submarines based on available open source information. The strategic dimension of Chinese submarines is analysed based on understanding the geographic and technical restrictions imposed on Chinese submarines and how they would logically transit and operate to ensure maximum stealth, survivability and striking capability.

Submarines have played an important role in naval warfare since the First and Second World Wars with the advent of German U-Boats that disrupted Allied shipping across the Atlantic. During the Cold War, submarines had changed the face of naval warfare with new developments in propulsion and weapons systems technologies. Submarines add another dimension to navies by expanding the battle zone below the ocean surface. Primarily, navies are supposed to be used as a country's power projection platform but submarines work contrary to this. Submarines ideally do not reveal their locations or movements to other countries like aircraft carriers and operate not just exclusively in international or territorial waters in peacetime. Also when it comes to command and control and operational concepts related to their movements and weapons systems, they are quite unorthodox and ambiguous compared to other military units, which leaves a lot of room for suspicion and miscalculations. Submarines come in various types depending on their propulsion systems, armaments and missions. They range from the large SSBNs capable of carrying enough firepower to destroy entire countries, to the stealthy and smaller SSNs and diesel-electric submarines to wage asymmetric undersea warfare on enemy assets.

Figure 1: A sample submarine outline



Source: Engineer Insider

[2] Hereafter referred to as SCIO

China's submarine force in a wider context

The significance of submarine operations is such that since they are difficult to track and enemy fleets would have to devote quite a lot of resources to look for a single submarine in a certain area even though they might not be a 100 percent sure of its presence. Submarines have become such a problem that fleets do not leave home ports without anti-submarine warfare (ASW) assets alongside. In the present day, six countries – the US, Russia, China, France, UK and India –operate submarines armed with nuclear weapons and it is nearly impossible to say with certainty whether or not one is within striking range of an enemy SSBN or if the submarine in question possesses a nuclear strike capability or not. Also the secretive nature of submarines also ensures they have an advantage when it comes to survivability in times of war for a nuclear strike. This is one reason why the United Kingdom has deployed all of its nuclear weapons on its submarines while France keeps almost 80 percent of its nuclear warheads on submarines and the US keeps about half. The four Type 094 (*Jin*-class) SSBNs that China operates at present can each carry 12 JL-2(CSS-NX-14) submarine launched ballistic missiles (SLBM) capable of carrying around 1-3 nuclear warheads each thus putting roughly 48-144 nukes at sea (Missile Defense Project 2018).

China's five SSNs and about 47 electric submarines are also no less, if not more, lethal. They might not possess the firepower of SSBNs but can sink or strike other important targets like aircraft carriers and land based assets. Diesel-electric submarines have a smaller profile and a smaller acoustic signature than their nuclear counterparts thus making them harder to detect. This is due to nuclear submarines requiring water pumps to run constantly to cool their nuclear reactors. However, diesel-electric submarines prefer and are compelled to keep shallow waters due to operational and technical limitations in their design. SSNs and SSBNs on the other hand have a much longer endurance than diesel-electric submarines as they do not have to refuel for an extended period of time and can stay submerged for months on end while diesel-electric designs have to return to port regularly despite advances in air-independent propulsion (AIP) technologies. However, diesel-electric submarines are quite cheap and the price of one nuclear submarine can buy several diesel ones, this is why navies with less resources invest in them. Nuclear submarines, however, keep deep waters due to their higher risk of detection.

China's submarine fleet though quite large is still relatively less sophisticated than the West. It is a mix and match of Chinese and Russian designs. Furthermore its nuclear submarine force is quite small and is yet to conduct deterrence patrols in waters outside its territory due to inferior capabilities than their Western counterparts. President Xi Jinping's military modernization goals have allocated more resources to the PLAN which had until now been the least funded of the PLA's three services and with this China has been making great strides in its attempt to move from 'offshore waters defence' to a mix of 'offshore waters defence' and 'open seas protection' (SCIO 2015).

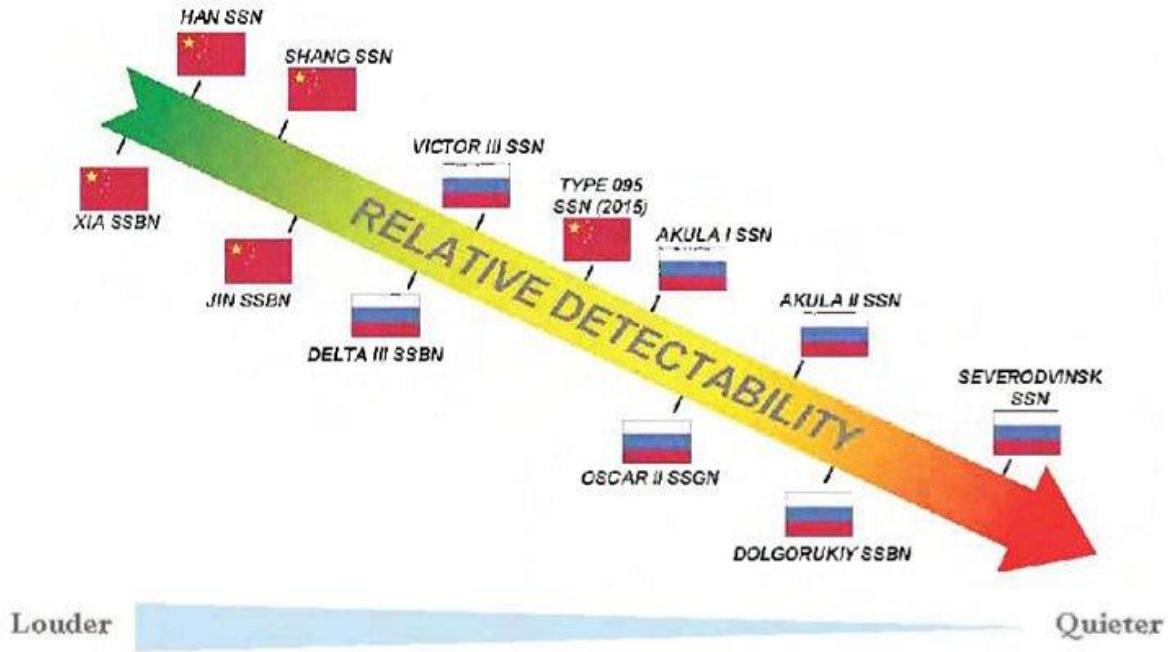
The number of primary combat vessels has stayed relatively constant, but their combat effectiveness has greatly increased as vintage vessels are replaced by bigger, multi-mission versions. China's submarine fleet is quite distinct from that of the US Navy, but its features are compatible with its specific mission parameters. Most of China's submarine force is diesel-electric, armed with anti-

ship cruise missiles (ASCM), but without towed array sonar (TAS). TAS does not reveal the location or identity of the vessel using it, unlike active sonars, because of its passive nature. TAS consists of a several miles long cable system to which hydrophones are fitted. The acoustic signals detected by these hydrophones are sent back to the towing vessel where they are analysed. These submarines are optimized for its near seas missions that focus on surface warfare near core sea lines of communications. The PLAN's small nuclear attack submarine force is more effective in operating away from the Chinese mainland and for undertaking intelligence, surveillance and reconnaissance (ISR), and anti-ship missions. However, China's submarines are not currently effective for two of the primary US Navy submarine missions —ASW and land attack (ONI 2015: 16). The next section will deal with understanding the capabilities and technical shortcomings of Chinese submarines split into two sections – SSBNs and nuclear powered attack submarines armed with ASCMs and guided missiles (SSNs/SSGNs). For the purposes and limitations of this research diesel-electric submarines will not be included.

PLA Navy Submarine Force capabilities

The PLANSF is made up of an assortment of indigenous and foreign designs with nuclear and conventional propulsion systems and armaments. A large majority of the PLANSF is conventionally powered and armed with nuclear submarines being just nine in number with another improved *Jin*-class SSBN, the Type 094A, and an improved *Shang II*-class SSGN, the Type 093G, undergoing trials. ONI assesses that China will likely field five SSBNs as required for an effective peacetime presence before commissioning its next generation Type 096 SSBN sometime after 2020 (China Power 2017). Nuclear submarines are among the most classified Chinese military programs – it is a rare opportunity to have even a photo of a 40-year-old Type 091 (*Han*-class) SSN, or the Type 092 (*Xia*-class) SSBN. The Chinese leadership believes that to safeguard the country's nuclear capability 'at the minimum level required for maintaining its national security' requires a survivable sea-based capability alongside their land and air based nuclear arsenal (SCIO 2015).

Figure 2: Acoustic detection levels of Chinese and Russian nuclear submarines



Source: ONI 2009: 22

Ballistic missile nuclear submarines (SSBN)

The current PLAN SSBN fleet comprising of four Type 094 (*Jin*-class) submarines is China's first credible sea based nuclear deterrent as assessed by the US DOD. The Type 094 is the successor to the Type 092 (*Xia*-class) SSBN which hardly left port due to a heavy noise signature and limited striking range of its SLBMs. The Type 092 was China's first SSBN but it its detection probability was higher than even the vintage Soviet *Delta III*-class SSBN from the late 1970s plus its JL-1 SLBM had a range of just around 2000km and it is probably inactive as of present. The Type 092 never left port with nuclear weapons on board as a result (Thomas-Noone and Medcalf 2015: 6). The Type 094 is definitely an improvement, although a marginal one, over the Type 092 in this regard. It is less noisy and can carry a larger payload and has a bigger strike radius. However, its acoustic levels are still a cause for concern as it is still more detectable than the Soviet *Delta III*-class. The first Type 094 was commissioned in 2007 and the fourth and latest in 2015.It was China's first foray into the SSBN arena in two decades after the Type 092 was commissioned back in 1987. *IHS Jane's Fighting Ships 2017-2018* estimates that a total of five Type 094s are expected, with the last four SSBNs to incorporate the Type 093G SSGN quieting design (O'Rourke 2018: 13-17).

Available satellite images of the Type 094 let analysts estimate its length to be around 135m, a bit smaller than the French *Triomphant*-class SSBN (138m). For this reason it can be inferred that the submerged displacement of the Type 094 would also be around 14000 tons, close to the *Triomphant*-class (14335 tons) (Kristensen 2007).The submarine's general profile is common with a tubular hull with a tapered, finned tail section. The sail is well-ahead of the middle section with a raised platform just aft housing the vertical launch system (VLS) design.VLS is a type of universal, modular system able to carry and launch multiple types of missiles, providing a more versatile armament for different mission types. It is also believed by some observers that the Type 094 uses propellers similar to the advanced seven-blade design with cruciform vortex dissipaters that it already uses in its on its indigenous Song-class and imported Kilo-class diesel submarines to reduce noise (Erickson and Goldstein 2007: 67). Vortex dissipaters compress air/water sucked-in from a nozzle into an area where vortices are likely to form. Vortex dissipaters destroy the vortices that would otherwise suck debris from the ground into the engine. The reactor design propulsion system is a one-shaft drive arrangement. Its submerged speed can be expected to be around 20 knots if the Type 094 is assumed to be sub-par to the French *Triomphant*, however, to keep a low profile it would have to maintain a speed of about 10 knots. However, the Type 094 design has a significant design flaw that causes the large missile section at the rear of the submarine and the flood openings below the missile silos to produce a detectable acoustic signature (Conroy 2013).

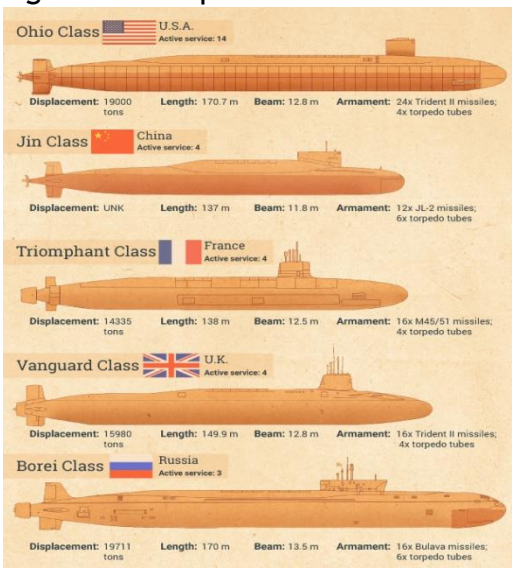
Figure 3: PLAN *Jin*-class Type 094/094A SSBN

Source: Lin and Singer 2017

The Type 094 can carry up to 12 JL-2 SLBMs with 1-3 nuclear warheads each for a total of 12-36 warheads per submarine. However, China's traditional security protocol of keeping the nukes and the missiles de-mated has implications for its nuclear deterrence (China Power 2017).Such a protocol ensures greater safety for the nukes and reduces the likelihood of accidents and their inadvertent use. The JL-2 has a range of about 7400km limiting its striking range to small parts of Alaska [when it comes to striking the continental US (CONUS)]at the maximum from the SCS (O'Rourke 2018: 18). However, its range well encompasses South Asia, including the Indian subcontinent. It has a potential payload of 1-2.8 tons and has a three-stage solid propellant engine with a launch weight of 42 tons. It can carry a one megaton warhead or multiple independent reentry vehicles of 20-150 kilotons each. The missile may be outfitted with penetration aids and decoys to overwhelm ballistic missile defences (BMD) systems. The missile uses an inertial guidance system and a GPS system. It may also use the Bei Dou navigational satellite system. These missiles will likely have an accuracy of 150-300m circular error probability (Missile Defense Project 2018).The submarine also has six torpedo launch tubes of 533mm each at its bow.

Going by this available unclassified information and conjecture on the Type 094's capabilities and dimensions it is way behind American, Russian, French and British SSBN designs. However relatively cheaper at $750 million, compared to the French *Triomphant* which costs $3.6 billion or the British *Vanguard*-class costing $1.9 billion (Till and Chan 2014: 23). When it comes to size, it is considerably smaller than the 170m long Russian Borei-class and the American *Ohio*-class whose submerged displacements are 18750 and 24000 tons respectively (O'Halloran 2013: 17). When it comes to striking range, its SLBM is decent enough comparatively but its ability to strike the CONUS would be severely restricted due to its high noise and detection levels as it would have to sail halfway across the Pacific to strike the American West Coast. However, the entire Indian subcontinent is comfortably in range from its current bastion at the Yulin Naval Base on Hainan Island. It is fourth on the detection scale released by ONI with the *Xia* being the most detectable followed by the *Han*-class and *Shang I*-class SSNs (ONI 2009: 22). It can be observed that present Chinese nuclear submarine designs are the noisiest followed by some vintage Russian designs.

Figure 4: Comparison of various SSBN designs

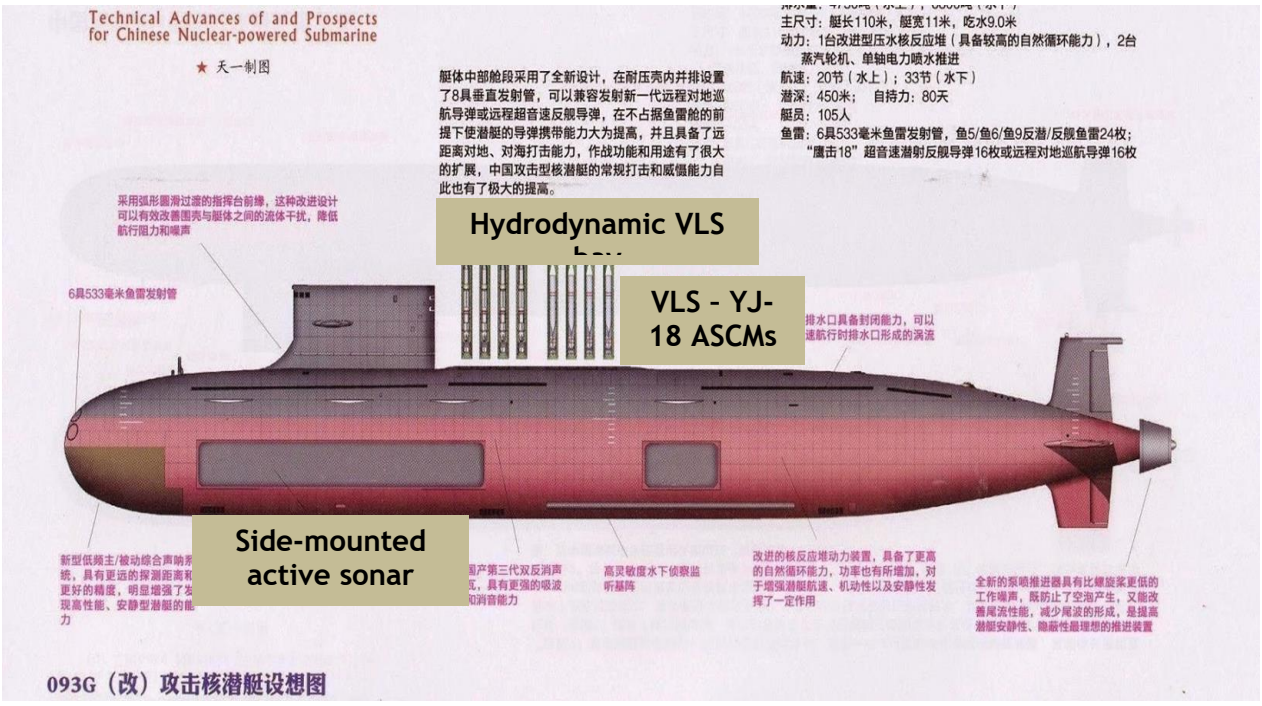


Source: China Power 2017

A new improved design of the Type 094 called the Type 094A was photographed sometime back in November 2016. This new design is presumed to be the first of the enhanced Type 094 designs incorporating quieting technologies from the Type 093G SSGN (a nuclear attack submarine armed with guided cruise missiles). The Type 094A seems to have a more raised 'hump' towards the rear of the sail (or fin). The Type 094A differs from the previous four Type 094s, due to its curved conning tower and front base that is blended into the submarine hull, possibly to minimize hydrodynamic drag. The Type 094A's conning tower is also windowless. Furthermore, the Type 094A has a retractable towed array sonar mounted on the top of its upper tailfin, which would make it easier for the submarine to 'listen' for dangers and avoid them. The Type 094A carries a new SLBM (expected to be the JL-2A), which has an 11200km range – a significant improvement over the JL-2 (Lin and Singer 2017). If the JL-2A has such a range, the new missile could theoretically strike the US mainland, without leaving the heavily fortified Yulin Naval Base (complete with hardened underground shelters and docks for submarines) in Hainan Island. This would bring it close to the capabilities of the Russian *Borei* and the American *Ohio*-class. A newer Type 096 SSBN is likely to be constructed after 2020 once these new Type 094As are sea-borne.

Figure 5: Nuclear-powered attack submarines and nuclear-powered guided missile submarines

PLAN Type 093G SSGN



Source: Coates 2015

China seems to be operating two Type 093 (*Shang I*-class) and up to four Type 093B/G[3] (*Shang II*-class) SSNs, which have slowly replaced the three Type 091 (*Han*-class) on a one by one basis (Boyd and Waldwyn 2017). It is difficult to say with certainty as to exactly how many SSNs the PLAN currently operates as some of them are undergoing sea trials, constructions and patrols concurrently. The US DOD assesses that the PLANSF currently has five operational SSNs of the *Shang I* and

[3] For the purpose of this research the improved version (Shang II-class) of the Type 093 will be referred to as 093B and the cruise missile variant as 093G (called 093A by Western analysts).

Shang II-classes. Over the past 15 years, the PLAN has constructed six nuclear attack submarines – two *Shang I*-class and four *Shang II*-class SSNs (DOD 2018: 29). The *Shang I*-class (Type 093) is noisier than even the *Jin*-class SSBN, it is third on the 2009 ONI detection list after the *Xia* and *Han* classes. The *Shang*-class' initial production run stopped after only two hulls that were launched in 2002 and 2003. After almost ten years, China continued production with four additional hulls of an improved version, the first of which was launched in 2012(ONI 2015: 30-4).The Type 093 was designed during the late 1980s/early 1990s. Only two Type 093s were ever constructed, as they are thought to be noisy and expensive, though a big improvement over the 1960s era Type 091. The Type 093B is assumed to be stealthier than the Type 093, building on decades of Chinese advances in metallurgy and reactor/propulsion fine-tuning.

The original two Type 093s were hampered by noisy reactors and propulsion systems, especially at high speeds, which limited their combat effectiveness. PLAN Admiral Liu Huaqing wrote in his memoirs that 093 production began in 1994 following President Jiang Zemin's continued support for nuclear submarine development after the launch of the final Type 091 in 1990. Others suggest that the Yinhe incident in 1993[4], and tensions with Taiwan, also drove approval of the program. The Type 093 is estimated to have a roughly 7000 tons displacement when submerged at 110m long. The submarine may also use a seven-blade asymmetric propeller. In 2002, Chinese sources claimed that the Type 093 was powered by a high-temperature gas-cooled reactor - which would mean a smaller, quieter and powerful reactor - but the under-development of this technology makes this improbable. The Type 093 is armed with six 650mm torpedo firing tubes. The Type 093 has been said to be armed with the YJ-18 anti-ship missiles. In 2002, Chinese sources claimed that the Type 093's acoustic level was similar to the improved US Navy's *Los Angeles*-class SSN. In 2004, Chinese sources said the Type 093 was on par with the Russian *Akula*-class at 110 decibels (Erickson and Goldstein 2007: 58-68). In 2009, ONI claimed the Type 093 was louder than the Soviet *Victor III*-class (ONI 2009: 22).

The Type 093B SSN is stealthy, fast and the first Chinese attack submarine to be able to fire vertically launched cruise missiles. The DOD assesses that three Type 093B SSNs were launched in 2015, and commissioned sometime in 2016-17 (DOD 2018: 29). Analysts locate its acoustic levels somewhere between the US Navy's *Los Angeles Flight I* and *Flight III* SSNs. The installation of a VLS firing slot behind the conning tower can be observed in a hydrodynamic hump blended into the hull. The VLS cell gives the Type 093B an advantage over previous PLAN attack submarines as instead of firing cruise missiles from the torpedo tubes, it can fire missiles from the VLS much faster. The bigger size of VLS cells also makes them a logical place to launch future underwater unmanned submersibles and unmanned aerial vehicles. The Type 093B can still carry torpedo tube-fired cruise missiles. The torpedoes on the Type 093B consist of canisters that surface and break open to fire their missiles. This orthodox system though, imposes size restrictions on the missile and is a slower launch process. The Type 093B's conning tower has a flared base, akin to modern attack submarines like the Type 39C diesel-electric submarine, and the American Virginia-class SSN. The flared base could have sensors, plus minimizing hydrodynamic drag and noise at certain speeds. There are also huge installation mounts on the hull sides for side-mounted active sonar that will listen

[4] A false claim was made by the US government that the China-registered container ship Yinhe was transporting chemical weapons supplies to Iran. The US Navy made the ship halt in international waters for a month.

for both surface ships and submarines (Lin and Singer 2016).

Following the completed commissioning of the enhanced *Shang* Type 093B/G SSN/SSGN, the PLAN will likely begin development on the Type 095 SSN, which may provide a generational enhancement in many areas such as stealth and armament capacity. The Type 095, which may be deployed for sea trials around 2020, has been described by ONI as a SSGN meaning that it will carry a significant amount of cruise missiles, plus being a stealthy surface ship and submarine hunter-killer. The Type 095 is also likely to be stealthier than the Type 093B, as well having undersea network capability to work with other manned and unmanned platforms above and undersea, and enhanced passive and active sensors (ONI 2015: 19).

The Indo-Pacific – undersea competition and strategy

Submarines of all kinds have one priority – staying undetected to enemy forces – over all other mission parameters. Diesel-electric submarines due to their quietness and advances in AIP technology and low noise propulsion and hull designs are the best bet when it comes to survival and non-detection. They lack the firepower of SSBNs but they are fast, quiet and lethal and quite suitable for littoral combat in coastal waters or tracking and targeting enemy sea and land assets.

PLAN diesel-electric submarines have to a large extent become as stealthy as their Western counterparts with the induction of Russian *Kilo*-class (636) and *Yuan*-class (Type 039A/B) submarines. These submarines can also additionally escort PLAN SSBNs to waters closer to enemy positions due to their hunter-killer nature. SSNs and SSGNs on the other hand are also quiet but not as much as diesel submarines due to reactor design and function limitations. They can also perform missions similar to the aforementioned diesel submarines with an additional advantage of an indefinitely long submerged time and deep-water capability. For the purpose of this research the capability and probable strategy adopted by Chinese SSBNs will be elaborated upon. The following sections will be based on conjectures available in the public domain as to how and why China's SSBN's might adopt such a strategy.

Sea-borne deterrence

China's rise and its assertiveness have no doubt garnered it a lot of attention from concerned countries like the US, India and Japan. The situation is not as volatile as during the Cold War. True, the geopolitical competition in East Asia has heated up but it is nowhere near as relentless at least not at the moment. US Navy submarines during the Cold War had undertaken (and still do) 'continued at sea deterrence' (CASD) patrols against the Soviets who had chosen a 'bastion' strategy for their submarines by hiding under the Arctic ice away from the prying eyes of American ASW assets. The bastion strategy means basing submarines at particular fortified location(s) at home ports to safeguard their survivability. However, both sides' SLBMs were always within striking range of each other, irrespective of their positions. It is a double-edged sword, however, as a massive first strike could easily decapitate the bastion submarines. However, if the submarines were as noisy as the current Chinese Type 094s are, then it would seem like a logical thing to do considering their lesser numbers. Nuclear deterrence works on the assumption that nuclear attack can be prevented by a credible means of nuclear retaliation along with the political will to do so. A safe second-strike capability necessitates that some segments of a country's nuclear forces survive an enemy's first strike. By the advantage of being able to hide in the depths of the ocean, SSBNs have been a

necessary part of American, Russian, British and French nuclear doctrines. Their mobility is a big plus because it allows their missiles to be launched from platforms that can beat BMDs. Detection is a major vulnerability of submarines. If a country can successfully home in on and track an enemy SSBN, the SSBN's ability to survive a first strike is reduced drastically.

Coming to the present day, PLAN SSBNs seem to have adopted a bastion strategy considering their loud acoustic signature and small numbers. This is similar to what the Soviets did during the Cold War; however, the Soviets had better submarines than the Chinese do. PLANSF SSBNs are threatened by American ASW assets hence they do not move out of friendly waters. Since China does not have a first strike policy regarding nuclear weapons the survivability of its SSBNs is critical in case its land and air based nuclear delivery systems are decapitated to ensure a second strike capability. So far the four active Type 094 SSBNs are all docked at the Yulin Naval Base in Hainan province and have not gone further much into offshore waters. If it were to conduct a CASD policy then it not only would have to increase its fleet size but also would have to improve their stealth capabilities as well as make changes in the firing protocols and missile and warhead storage. The probable strategy that can be inferred is that China is looking to increase its SSBN force to at least six with two at port and two on armed patrol and two on standby for contingencies. This might as well include the improved Type 094A and the upcoming Type 096.

However, one thing remains certain - China's nuclear submarine fleet is not just cosmetic as what is commonly mistaken from its current capabilities – and its reasons for developing its naval underwater capabilities is to keep external powers like the US at bay while it pursues its regional goals and assertions by making foreign intervention too costly to contemplate. Its goals of re-unifying Taiwan with mainland China and consolidation of its position in the SCS and East China Sea can only be done if it could avoid another Taiwan Strait Crisis-like event. If PLAN submarines can keep US aircraft carriers at bay, it would not just be a propaganda win for China but would also be a major setback for the US. This can be seen as an alternate form of deterrence without nuclear weapons with hidden, asymmetric underwater capabilities.

Location and range

Submarine warfare is a lot like real estate – it is all about location. Countries like the US, UK, Russia, France, India etc. have a favourable naval geography with wide coastlines and less cluttered seas. Not to mention they have well established and defended piers and ports along with enjoying the benefit of distance away from their adversaries. For a country like China its immediate maritime geography is a crowded space in a limited body of water that has some of the busiest shipping routes as well as naval activity. Countries with which China has various disputes are all adjacent to it and share many overlapping maritime zones and hence are right up next to China's coast. Even far away countries with no direct stakes in the Indo-Pacific like the US also have a well-established maritime presence. China's littoral zones are shallow bodies of water that are not good for disguising submarine movements making it easier to track their already loud SSBNs. These shallow waters are, however, favourable for their diesel-electric submarines that can defend against and attack enemy targets closer to home. Also their large numbers would be an added advantage in defence against stretched out American or

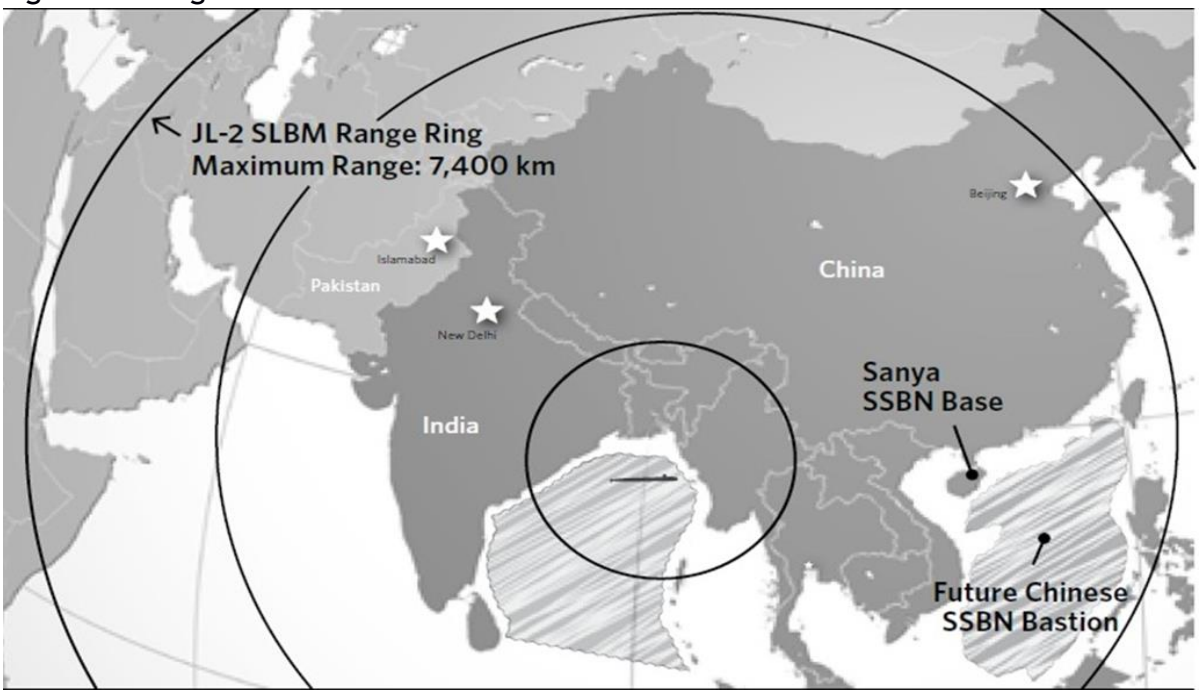
Japanese fleets.

For China's Type 094 SSBN's credible nuclear deterrence role it is imperative that they are able to strike the CONUS. As mentioned previously, from their current bastions at Yulin in the SCS they can only strike parts of Alaska and Russia, Guam, Japan and the Indian subcontinent due to the limited range of the JL-2 SLBM. If the Type 094 could sail close to southern Japan then it could very well strike Hawaii and parts of Alaska and could target the western US from locations mid-west of Hawaii. The whole of the US can be targeted from locations mid-east of Hawaii. However, to be able to reach these striking positions the PLAN SSBNs will have to overcome US and allied defences and ASW assets along the First, Second and Third Island Chains. Not to mention that both the US and China have set up a wide surveillance network in the Western Pacific to detect each other's submarines. US Navy submarines, ships and aircraft already conduct freedom of navigation operations and overflight in the SCS and the Pacific to engage Chinese SSBNs if they ever leave port.

Now coming to question as to how China's land reclamation activities in the SCS and port construction activities in the SCS play into making its submarine strategies a success, it is both a combination of maritime geography and hard power. Within the last five years China has constructed and militarized four major islands in the South China Sea and is either already developing other islands or has plans to do so. The military fortifications at Fiery Cross Reef, Mischief Reef and Subi Reef in the Spratlys and Woody Island in the Paracels are strategically important to China's grander Indo-Pacific submarine strategy. Fiery Cross Reef is strategically positioned in the centre of the southern access zone into the SCS and has been strengthened with surface to air missiles and ASCMs. These act as anti-access/area denial (A2/AD) weapon systems designed to defend against incoming enemy aircraft and ships. Fiery Cross Reef also has docks and piers to station warships and submarines. In addition to Fiery Cross there are similar fortifications and infrastructure on Subi and Mischief Reef as well. There are also advanced radar and early warning system for electronic warfare and detection on these islands (Davidson 2018). The defences at Fiery Cross, Mischief and Subi Reef are also important as this arc of A2/AD systems is designed to protect the SSBNs at Yulin. The waters surrounding Fiery Cross are good for submarine operations as they plunge into great depths and thus make it easier to disguise the movements of China's SSBNs. Hence the need for a secondary logistical submarine base at Fiery Cross Reef which is approximately 1024km south from Yulin.

Another component of this is also a part of the Belt and Road Initiative. China's ports overseas in Gwadar, Pakistan and in Maldives are also in a way useful for submarine operations. Gwadar, a deep sea port in the north Arabian Sea, has conditions favourable to submarine operations due to because of the unique bathymetries in its adjacent waters making it easier to hide submarines among the noise and traffic of this region (Wueger 2017). The Arabian Sea has a hot water current and tropical waters are not favourable for ASW due to temperature profile. PLAN submarines have conducted patrols in this region for anti-piracy missions, officially. This gives the PLAN much needed information about operating conditions in the waters of the IOR.

Figure 6: Range of PLAN SLBMs in the Indo-Pacific

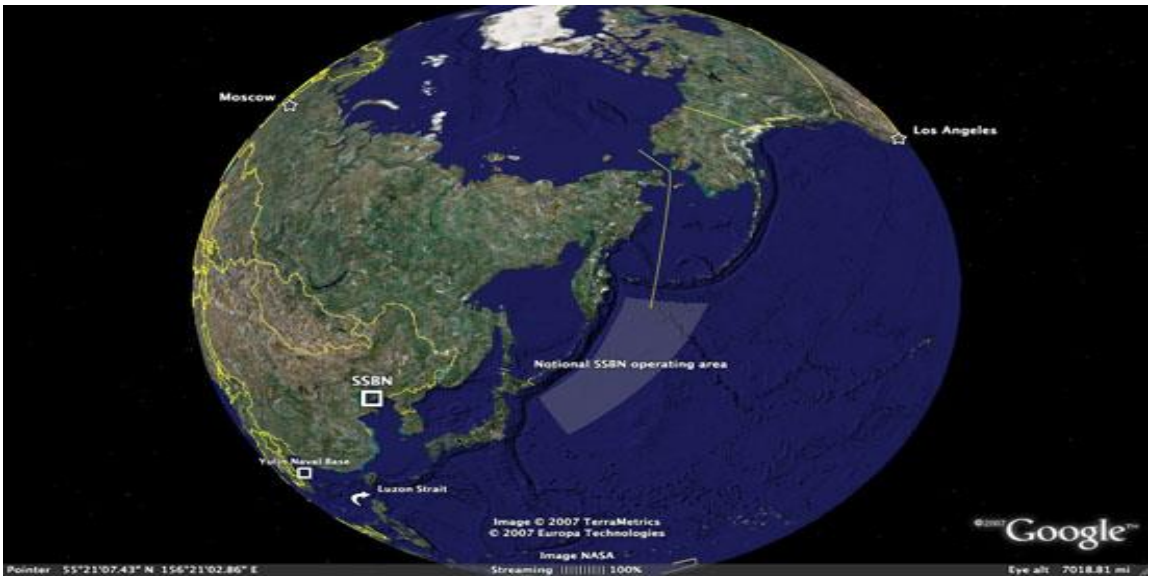


Source: Rehman 2015

It is no surprise then that the PLA Southern Theatre Navy based at Zhanjiang near Hainan has the most advanced PLANSF units including all four SSBNs, two SSNs and 16 diesel submarines for movements in and out of the SCS. The Eastern Theatre Navy has 16 diesel submarines based at Ningbo, just adjacent to the Japanese Ryukus from where American and Japanese naval fleets are expected to rush from in a Taiwan or Korean contingency. The diesel submarines at this place could harass enemy fleets and overwhelm those using large numbers and stealthy profiles similar to what the German U-Boats did in the Atlantic during the Second World War. The Northern Theatre Navy at Qingdao has 15 diesel submarines and three SSN's along with its only operational aircraft carrier the *Liaoning* (DOD 2018: 32).

ONI, however, apparently assess that the Type 094 will make the 9000km round-trip between Hainan Island and the region east-ward and between north-eastern Japan and the Kamchatka Peninsula in Russia. Assuming that the SSBN sails at about 10 knots, to avoid detection that would endanger the location of the submarine, the round trip from Hainan to the patrolling area takes about ten days either way (the distance about 4300km). If the Type 094 has an approximate80 day endurance, that leaves a 60 day patrol (Lewis 2007).Even if technical improvements are made to the Type 094 that allow the submarine to evade advanced ASW assets, American BMD systems will likely be able to intercept most JL-2 SLBMs capable of reaching the CONUS from the Type 094s assumed firing positions on the Bohai Gulf and SCS. Once a JL-2 SLBM is launched, Aegis BMD radars deployed on US Navy *Ticonderoga*-class cruisers and *Arleigh Burke*-class destroyers in the Pacific (16 out of 30 such ships are in the Pacific) will instantly detect the missile launch, which will launch SM-3 interceptors five seconds later. There are also ground-based interceptors in Alaska and California (Conroy 2013).

Figure 7: Possible PLAN SSBN operating areas



Source: Lewis 2007

In the US, there are already attempts to strengthen ASW capabilities, including drones scanning the oceans and sensor arrays that track the movement of marine wildlife to know when large numbers of animals are displaced by enemy submarines. Among these submarine detection programs, the Defense Advanced Research Projects Agency (DARPA) has what many assume to be the most efficient large-scale submarine detection system: a powerful light detection and ranging (LIDAR) system that when mounted on the nose of a reconnaissance plane can detect the presence of a submarine at depths of 200m. Common test depth for a typical US Navy nuclear submarine is 240m with a maximum crush depth of 720m and SLBM firing depth is typically 50m (Hollins 2018). Going by the available information on PLAN nuclear submarines it can be assumed that even they would be vulnerable to this kind of detection using LIDAR.

Operational concepts

Submarines compared to other branches of the military operate under entirely different parameters. The reason is for this is that they operate in isolation, often behind enemy lines and communication with them becomes next to impossible due to security and technical reasons. Submarines operate at great depths and it is difficult for radio or satellite signals to penetrate salt water in such cases. Often to receive signals submarines have to come close to the surface but this put them at risk of detection. For this reason communications with submarines, especially SSBNs are usually one-way. Their high command either give them their orders and operation protocols when they leave port or when they surface, the submarines cannot and do not communicate from their end once orders or any communication is received as their communications can be intercepted by enemy signals intelligence. This leads to ambiguity when it comes to submarine operations as non-friendly countries would be greatly alarmed by the presence of an unknown submarine in their waters or near their ships. It can be difficult to tell whether a submarine is conventionally or nuclear armed and this leads to high chances of miscalculation and escalation. There have been quite a few close calls and mishaps in history but fortunately those were contained by calm decision-makings.

Now the second thing is that when it comes to firing orders from SSBNs, unclear as to exactly how they are executed. A lot of information about American SSBNs come from popular culture as even their operational details remain highly classified so it is no surprise that there is next to no discourse when it comes to Chinese launch protocols. China is a relatively new player in the world of SSBNs and it still has to conduct a deterrence patrol with nuclear weapons on-board which it has not done yet. However, China would like its other two branches of its nuclear weapons – land and sea based – would probably follow the same chain of command for its SLBM. The Central Military Commission (CMC) led by the President is the primary launch authority for nuclear weapons and the nuclear arsenal is handled by the PLA Rocket Force (PLARF).

However, this presents a dilemma for its SSBNs and SLBMs as again unlike land and air based assets SSBNs have to be out at sea and away from prying eyes. A hybrid model might be used where the operational authority of the SSBNs might remain with the PLAN and the launch authority of the SLBMs remains with the PLANRF who might have officers on board SSBNs. In this dual command model, the PLAN would be responsible for armament provision, selecting deterrent patrol zones, and executing operational authority of SSBNs while on patrol. However, the SLBMs stored on these submarines could only be launched on an explicit order by the CMC delivered through the PLARF to the SSBNs. The PLARF would be responsible for warhead handling and storage, target selection and de-escalation, and the nuclear personnel reliability check. (Logan 2017). China's 2015 defence white paper states that with the increase in the number of China's nuclear ICBMs and the commencement of SSBN deterrence operations the PLA would have to undertake more advanced command and control protocols and methods that protect the integrity of nuclear strike authority for a bigger, more spread out arsenal (SCIO 2015). Again since the PLAN would be more experienced in operating submarines they might want to handle target selection as well but then again the PLANRF or the CMC might not be comfortable delegating so much authority to the navy (Logan 2017).

Conclusion and future prospects

In the realm of submarine technology, China is steadily progressing to be at a level that can challenge the US and its allies if push came to shove in East Asia. China's numerous maritime and territorial disputes with its neighbours have necessitated the development of its asymmetric capabilities in order to keep an established military superpower like the US at bay. Its large number of stealthy diesel electric submarines could cause a big inconvenience to American warships. Submarines, along with anti-ship ballistic missiles (ASBM), are a part of China's asymmetric strategy to gain an upper hand against US forces in the Pacific. China's primary objective at the present seems to be to defend its immediate interests against foreign intervention. To this end, China has been developing ASBMs to sink aircraft carriers, SSBNs to serve as a sea-based nuclear deterrent and conventional attack submarines to engage enemy fleets by enjoying a numerical superiority. Still, unless China has a credible and a quieter SSBN force, its sea-based nuclear triad would always be vulnerable and incomplete. However, once the Type 094A becomes operational and the new Type 096 starts sea trials, the equation would slowly start shifting in China's favour. It goes without saying that although the US Navy would always maintain supremacy in open combat, however, geography and resource utilization would play an equally important role (just as technology and

skill does) in the event of a conflict.

It will be sometime around 2025 that China's navy would be able to begin tackling the many problems plaguing it today. From personnel training and experience to sub-par ASW capabilities and long range precision strikes, the PLAN has a long way to go but is slowly playing catch up with its competitors with every new technological breakthrough. Its sea based nuclear assets are not any more or any less survivable than its land based ones but just provide an alternate delivery means at the present. Until China's SSBNs acquire better stealth mechanisms and longer range delivery systems, they will not be able to escape the trap the Soviet SSBNs found themselves in during the Cold War – of being forced to strike from their home ports under hardened underwater shelters. Although its offshore island and port facilities can go some way in strengthening its position but they will not be able to totally compensate the current technical shortcomings and lack of experience if a crisis broke out.

REFERENCES

Boyd, Henry and Tom Waldwyn. 2017. 'China's submarine force: an overview' Institute of International and Strategic Studies. 4 October, https://www.iiss.org/blogs/military-balance/2017/10/china-submarine-force (accessed on 30 August 2018).

China Power. 2007. 'Does China have an effective sea-based nuclear deterrent?' Centre for Strategic and International Studies, 4 August, https://chinapower.csis.org/ssbn/ (accessed on 30 August 2018).

Coates, Peter. 2015. 'Chinese Type 093A or 093G SSN armed with YJ-18 Carrier Killer Missiles' Submarine Matters. 5 April, http://gentleseas.blogspot.com/2015/04/chinese-type-093a-or-093g-ssn-armed.html (accessed on 1 January 2019)

Conroy, Christian. 2013. 'China's Ballistic-Missile Submarines: How Dangerous?' National Interest. 18 November, https://nationalinterest.org/commentary/chinas-ballistic-missile-submarines-how-dangerous-9414 (accessed on 1 August 2018).

Davidson, Philip. 2018. 'Advance Policy Questions for Admiral Philip Davidson, USN Expected Nominee for Commander, U.S. Pacific Command' US Senate Committee on Armed Services. 17 April, https://www.armed-services.senate.gov/imo/media/doc/Davidson_APQs_04-17-18.pdf (accessed on 1 August 2018).

Engineer Insider. https://engineeringinsider.org/submarine-principles-design-working/ (accessed on 2 January 2019)

Erickson, Andrew and Lyle Goldstein. 2007. 'China's Future Nuclear Submarine Force. Insights from Chinese Writings' US Naval War College Review. http://www.dtic.mil/dtic/tr/fulltext/u2/a519346.pdf (accessed on 10 August 2018).

Hollins, Alex. 2018. 'China announces new sub detection system so advanced experts aren't sure it's even possible' Newsrep. 2 October, https://thenewsrep.com/108831/china-announces-a-new-sub-detection-system-so-advanced-experts-arent-sure-its-even-possible/ (accessed on 4 October 2018).

Karotkin, Jesse. 2014. 'Trends in China's Naval Modernization' testimony to US-China Economic and Security Review Commission. US Naval Institute News.3 February, https://news.usni.org/2014/02/03/document-chinas-naval-modernization (accessed on 3 August 2018).

Kristensen, Hans. 2007. 'New Chinese Ballistic Missile Submarine Spotted' Federation of American Scientists. 5 July, https://fas.org/blogs/security/2007/07/new_chinese_ballistic_missile/ (accessed on 18 August 2018).

Lewis, Jeffrey. 2007. 'How Capable is the 094?' Arms Control Wonk.31 July, https://www.armscontrolwonk.com/archive/201579/how-capable-is-the-094-23/ (accessed on 23 August 2018).

Lin, Jeffrey and P. W. Singer. 2016. 'First Picture Of China's Secretive New Submarine' Popular Science.23 June, https://www.popsci.com/first-picture-chinas-secretive-new-submarine-type-093b (accessed on 3 August 2018).

Lin, Jeffrey and P. W. Singer. 2017. 'China's New Ballistic Missile Submarine Could Change Its Prospects in Nuclear War' Popular Science. 10 January, https://www.popsci.com/china-ballistic-missile-submarine-type-094a-ssbn (accessed on 18 August 2018).

Logan, David. 2017. 'China´s Future SSBN Command and Control Structure' Institute for National Strategic Studies. 9 January, http://www.css.ethz.ch/en/services/digital-library/articles/article.html/384905e4-ee22-4b2c-9dd3-c3280c782687/pdf (accessed on 15 August 2018).

Missile Defense Project. 2018. 'Ju Lang-2 (JL-2/CSS-NX-14)' Missile Threat, Center for Strategic and International Studies. 15 June, https://missilethreat.csis.org/missile/jl-2/ (accessed on 24 August 2018).

O'Halloran, James. 2013. IHS Jane's Weapons: Strategic. UK: Jane's Information Group.

O'Rourke, Ronald. 2018. 'China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress' US Congressional Research Service. 21 May, https://fas.org/sgp/crs/row/RL33153.pdf (accessed on 15 August 2018).

Rehman, Iskander. 2015. 'Murky Waters: Naval Nuclear Dynamics in the Indian Ocean' Carnegie Endowment for International Peace. 9 March, https://carnegieendowment.org/2015/03/09/murky-waters-naval-nuclear-dynamics-in-indian-ocean-pub-59279 (accessed on 1 November 2018)

State Council Information Office of the People's Republic of China. 2015. 'China's Military Strategy', 26 May, http://eng.mod.gov.cn/Press/2015-05/26/content_4586805.htm (accessed on 4 August 2018).

Thomas-Noone, Brendan and Rory Medcalf. 2015. 'Nuclear armed submarines in Indo-Pacific Asia: Stabiliser or Menace?' Lowly Institute for International Policy.September, https://www.lowyinstitute.org/sites/default/files/nuclear-armed-submarines-in-indo-pacific-asia-stabiliser-or-menace_0_0.pdf (accessed on 20 August 2018).

Till, G., J. Chan (Eds.). 2014. Naval Modernisation in South-East Asia. London: Routledge.

US Department of Defense. 2018. Military and Security Developments Involving the People's Republic of China 2018: Annual Report to Congress. 16 May, https://media.defense.gov/2018/Aug/16/2001955282/-1/-1/1/2018-CHINA-MILITARY-POWER-REPORT.PDF (accessed on 29 August 2018).

US Office of Naval Intelligence. 2009. The People's Liberation Army Navy, A Modern Navy with Chinese Characteristics. August, https://fas.org/irp/agency/oni/pla-navy.pdf (accessed on 2 August 2018).

US Office of Naval Intelligence. 2015. The PLA Navy: New Capabilities and Missions for the 21st Century, http://www.oni.navy.mil/Portals/12/Intel%20agencies/China_Media/2015_PLA_NAVY_PUB_Print.pdf?ver=2015-12-02-081247-687 (accessed on 3 August 2018).

Wueger, Diane. 2017. 'Through a Periscope Darkly: The Nuclear Undersea Competition in Southern Asia is just Beginning' War on the Rocks. 18 October, https://warontherocks.com/2017/10/through-a-periscope-darkly-the-nuclear-undersea-competition-in-southern-asia-is-just-beginning/ (accessed on 1 August 2018).

ICS OCCASSIONAL PAPER *Back Issues*

ICS Occasional Papers showcase ongoing research of ICS faculty and associates on aspects of Chinese and East Asian politics, international relations, economy, society, history and culture.

Issue No/ Month	Title	Author
No: 32| Jun 2019	The Rising Tide of Technology Denial against China	Uday Khanapurkar
No: 31| May 2019	Growth of Shipbuilding in China: The Science, Technology, and Innovation Route	Nitin Agarwala and Rana Divyank Chaudhary
No: 30| Apr 2019	Land, People and Faith: Wang Meng's Narrative of Uyghur Life in *Zhe bian fengjing*	Debasish Chaudhuri
No: 29| Apr 2019	Materials related to Republican-era China in the National Archives of India	Madhavi Thampi
No: 28| Apr 2019	Science, Fiction and Politics: Chinese Science Fiction and its Socio-Political Engagements	Shruti Sonal

PRINCIPAL SUPPORTERS TO ICS RESEARCH FUND

TATA TRUSTS

MINISTRY OF EXTERNAL AFFAIRS
GOVERNMENT OF INDIA

INDIAN COUNCIL OF
SOCIAL SCIENCE RESEARCH

GARGI AND VIDYA
PRAKASH DUTT FOUNDATION

JAMNALAL BAJAJ FOUNDATION

PIROJSHA GODREJ FOUNDATION

ICS PUBLICATIONS

ICS ANALYSIS
A short brief on a topic of contemporary interest with policy-related inputs

ICS OCCASIONAL PAPER
Platform for ongoing research of the ICS faculty and associates

ICS MONOGRAPH
Authored by the faculty, also emerging from research projects and international conferences

ICS WORKING PAPER
Draft paper of ongoing research

ICS JOURNAL

In its 55th year, *China Report* is a refereed journal in the field of social sciences and international relations. It welcomes and offers a platform for original research from a multi-disciplinary perspective, in new and emerging areas, by scholars and research students. It seeks to promote analysis and vigorous debate on all aspects of Sino-Indian relations, India-China comparative studies and multilateral and bilateral initiatives and collaborations across Asia.

China Report is brought out by Sage Publications Ltd, New Delhi.

Editor	Sreemati Chakrabarti
Associate Editor	G. Balatchandirane
Assistant Editor	Rityusha Mani Tiwari
Book Review Editor	Vijay K Nambiar

INSTITUTE OF CHINESE STUDIES
8/17, Sri Ram Road, Civil Lines,
Delhi 110054, INDIA
T: +91 (0) 11 2393 8202
F: +91 (0) 11 2383 0728

http://www.icsin.org/
info@icsin.org

twitter.com/ics_delhi
facebook.com/icsin.delhi
In.linkedin.com/Icsdelhi
soundcloud.com.ICSIN
youtube.com/ICSWEB
instagram.com/icsdelhi