



The Chinese Navy's Submarine Arm: Lynchpin of 'Active Defence'

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In broad pursuance of the goals of China's national defence in the new era, the People's Liberation Army Navy has been mainly tasked with the defence of its maritime rights, interests and security, safeguarding its economic development and serving its peaceful diplomacy. The Chinese submarines figure prominently in their military strategy of "Active Defence." The blistering pace of submarine modernisation, supporting infrastructure and intensive training regimen bear testimony to their centrality in the Chinese 'Offshore Defence' maritime thought process. With their nuclear attack submarines particularly capable of far-ranging missions of long durations, the United States as the predominantly present maritime power in the western and central Pacific Ocean will invariably stand to be affected. A real possibility of their deployment into the Indian Ocean in the medium to long term will also impact on the Indian maritime security scenario. Hence, it is prudent to carefully assess the Chinese nuclear submarine program.

"For the Chinese People's Liberation Army, in order to win local wars under the informationised conditions in future, it is imperative to establish the strategic idea of offensive-defense operation, and vigorously develop long-range

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strike weapons so that effectiveness of combined offense-defense operations can be maximized”.

– Official website of the Chinese Ministry of National Defense¹

In the maritime context, submarine launched ballistic missiles (SLBMs) would provide this long-range strike option for maximising the effectiveness of combined offense–defence operations, as envisaged in the above quote.

Introduction

The significance of the oceans to China’s economic development, if it must emerge as a maritime power has not been lost on the Chinese leadership. Therefore, it feels an urgent need to build a blue water navy capable of credible presence in global waterways. The overarching expectations from the People’s Liberation Army (PLA) Navy were aptly summed up by Chen Mingyi, member the National Committee of the Chinese People’s Political Consultative Conference, in March 2009 when he stated that “PLA Navy must move from coastal waters to oceans and shoulder the tasks of safeguarding territory, development of national economy and overseas interests”.² In fact, the Chinese Defense White Paper of 2004 indicated the course correction by articulating that the PLA has been seeking to shift focus from predominantly defensive position to one of calibrated power projection by strengthening the capabilities of PLA Navy and Air Force, so as to win command of the sea and air.³

The above pronouncements have not appeared suddenly in the public domain. Instead they emerge as a natural corollary from the 1980s thought processes of Chinese maritime visionaries and strategists like Admiral Liu Huaqing⁴ who persevered in charting out a definite direction for the PLA Navy’s modernisation plans. He also sought to redefine the Chinese strategic frontiers extending far out into the Pacific Ocean through a formulation of “Three Island Chains”.⁵

Accordingly, the PLA Navy currently adheres to the “offshore defence”⁶ strategy which is the naval component of the “active defence” strategic guidelines.⁷ In pursuit of this strategy, the PLA Navy has been endeavouring to enhance its capabilities of undertaking integrated operations, strategic deterrence and counterattacks, conduct campaigns in distant waters and counter non-traditional security threats.⁸

The critical role envisioned for submarines in China's overall defence strategy is quite apparent. Chairman Mao Zedong was once quoted as having said that "we should develop nuclear powered submarines even if it took 10,000 years to do so".⁹ Prerequisites for integrated operations, strategic deterrence and counterattacks in the maritime domain entail three dimensional – surface, sub-surface and air – control of the naval battle space. Deterrence in the context of China's "no first use" stated position, in particular, requires sea based nuclear second strike capability by ballistic missile carrying submarines (SSBNs). A large number of the PLA Navy's conventional submarines incorporating modern technologies of stealth, air independent propulsion and armed with long-range torpedoes and cruise missiles will look after the maritime interests and security off their coastline, in the South China Sea and in the Taiwan Strait.¹⁰

This paper attempts to analyse the historical, technological and operational aspects of Chinese submarines on the basis of information and data available in the open sources and then arrive at a realistic assessment of their role in furthering the PLA Navy's blue water capabilities, particularly in the Indian Ocean Region (IOR).

Evolution of PLA Navy's Submarine Arm

The submarine development programme of China from the very inception was closely linked to the Sino-Soviet relations. China incurred substantial expenses in purchasing a number of submarines and associated technology, in addition to the other naval hardware during the first plan period from 1953 to 1957. The PLA Navy set up its first flotilla of submarines in 1954 with four old boats purchased from Soviet Union and designated as numbers 11, 12, 21 and 22.¹¹ The licensed production of Golf (31) and Romeo (33) class submarines followed, under a 1958 agreement between China and the erstwhile USSR. However, the Chinese intentions to build their own submarines became clear when PLA Marshal Nie Rongzhen's proposal to build nuclear submarines was approved by the central leadership in 1958.¹²

After a decade-long hiatus on account of the Cultural Revolution and its after-effects, the navy-building task regained momentum.¹³ China launched its first self-designed conventional powered submarine in 1971. The first nuclear powered submarine named Project 09-1 was put into service in 1974. Appointment of the iconic and visionary Admiral Liu Huaqing as the Commander of the PLA Navy in

January 1982 further accelerated the process. Liu Huaqing was more than convinced that the considerations of offshore battles could only be met if “the main force was composed of submarines and airplanes”.¹⁴ For the submarine arm, it manifest in renewed focus being imparted to the underwater missile launch project, which was conceived well back in 1967. The end result was successful test launch of a missile from an underwater conventional submarine in October 1982. The PLA Navy’s first Xia-class nuclear ballistic missile submarine (Project 09-2) was commissioned soon after, in 1983. China succeeded in launching the SLBM from the Xia-class nuclear submarine in 1988 for the first time.¹⁵

A number of new conventionally-powered and nuclear submarines equipped with ultra-long wave communication system, tactical software, automated command systems and intelligent and precision-guided torpedoes were put into service since the beginning of the new century.¹⁶ The new submarines have lower noise levels and possess improved capabilities for underwater survival and penetration of enemy defences. While showcasing its strength during the International Fleet Review in April 2009, the PLA Navy displayed its Xia-class nuclear submarine in public for the first time.

Present Status of the Submarine Arm

Organisation

The PLA Navy’s submarine forces are organised under the three major fleets, viz., the North Sea Fleet, East Sea Fleet and the South Sea Fleet located respectively at Qingdao, Ningbo near Shanghai and Zhanjiang. There are two nuclear submarine bases – one at Jianggezhuang under the control of North Sea Fleet and the other newly built underground one at Hainan Island under the South Sea Fleet.

The organisational structure of the submarine force is shown in Figure 1.¹⁷ There are also two conventional submarine divisions (*Zhidui*), for each fleet.¹⁸ The submarine divisions are further subdivided into squadron-level organisations (*Dadui*). Nuclear-powered submarines each have two sets of crews as compared to one crew for each conventional boat.

Inventory

The PLA Navy has 57 submarines of all types. The inventory can be broadly categorised into nuclear and conventional submarines. The nuclear submarines can be

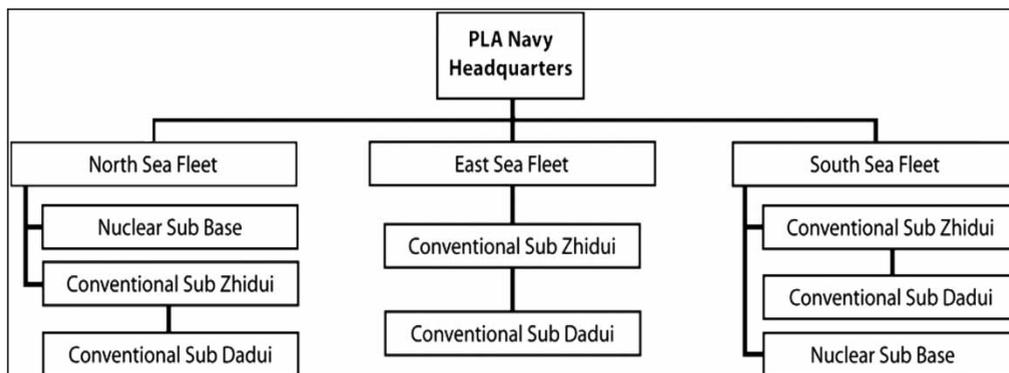


Fig. 1. The organisational structure of the submarine force.

further grouped into the ‘ballistic missile carrying nuclear powered submarines’ (SSBNs) and the ‘nuclear powered attack submarines’ (SSNs). The class-wise breakdown¹⁹ is shown at Table 1. Each of these categories will be discussed in detail in succeeding paragraphs.²⁰

Nuclear Submarines

China’s nuclear submarine program code named project 09, commenced in 1956 as part of the 12-year science and technology development plan. Project 09 comprises of the following programs.

Han (091) Class: The first Han-class nuclear propelled attack submarine, although completed in 1974, was not fully operational until the 1980s. The first

Table 1. PLA Navy submarine fleet.

Jin Type 094	SSBN	2	3 under construction
Xia Type 092	SSBN	1	
Golf Type 031	SSB	1	Test platform for JL-2 SLBM launch
Shang Type 093	SSN	2	
Han Type 091	SSN	3	
Kilo Class (636/877)	SSG	12	4x old 877 & 8x new 636 Submarines
Yuan Type 039A/041	SSG	4	3 under construction
Song Type 039	SSG	13	
Ming Type 035	SS	19	
	Total	57	8 nuclear and 49 diesel submarines

two of the class viz. hull numbers 401 and 402 were decommissioned in 2003 and 2007 respectively. From 404 onwards the hull has been extended by about 5 meters. Torpedoes are a combination of older straight running and more modern Russian homing types. Anti-ship cruise missiles may also be fired from the torpedo tubes. Two submarines are based in the North Sea Fleet at Jianggezhuang and one at Yalong bay on Hainan Island. All three submarines have undergone a mid-life refit wherein French Electronic Support Measure (ESM) equipment and intercept sonar have been fitted.

Xia (092) Class: Even before the completion of the first 091, China had commenced work on transforming the design of the 091 SSN into a SSBN. This project code named 09-2 comprised two distinct phases, first involving the designing of submarine and the second, development SLBM launch system. The submarine was eventually launched in 1981 and was commissioned with the pennant number 406, in 1983. The first successful launch of *Julang* (JL-1) SLBM was conducted on September 27, 1988. Besides the JL-1, the submarine is equipped with Yu-3 anti-submarine and C-34 wire guided anti-ship torpedoes. The submarine has been beset with power plant problems, radio-active leakage and SLBM launch mechanism inconsistency and has therefore remained operationally under-exploited. Further construction of this class was not undertaken and the only submarine is based at Jianggezhuang.

Shang (093) Class: This follow-on of 091 class attack submarines bears a strong resemblance to the Russian Victor III design. The prefabrication started in late 1994 and the first launch took place in late 2002. Two boats entered service in 2006 and 2007 respectively. These are far superior to the 091 Han-class attack submarines, with improvements reported in the reactor type and power rating; better weapons package including two types of torpedo tubes to launch Yu-3 and Yu4/6 torpedoes; and the capability to carry YJ-12 anti-ship cruise missiles. Both submarines are based at Yalong bay on Hainan Island.

Jin (094) Class: The 094 Jin-class SSBN is believed to be a derivative of the Russian Delta-class SSBN. Two boats of this class were reportedly launched in 2004 and 2006. The first became operational in mid-2007 followed by the second in 2009. However, they are yet to integrate the *Julang-2* (JL-2) SLBM onboard. Missile launch trials from “Golf”-class submarines have been in progress for about six years and the system could become operational on board the 094 submarine by 2013. Each

submarine will carry 12 SLBMs in addition to the heavy-duty torpedoes and advanced sensor package. The submarine is also credited with a lesser radiated noise level as compared to its predecessor, the Xia-class. The first two boats are based at Yalong bay on Hainan Island.

Conventional Submarines

Golf-Class: This submarine is powered by diesel engines and is used as a trial platform for launching the SLBMs. It was initially used for test-launching the JL-1 SLBM and a successful launch was conducted in October 1982. The submarine underwent a modernisation refit in 1995 to take one JL-2 missile. It is based in the North Sea Fleet and has been carrying out phased test launches of the JL-2 SLBMs.

Ming (035) Class: These are the oldest submarines in the PLA Navy inventory after the decommissioning of the older Romeo (033) class. The first three submarines were completed between 1971 and 1979. Commencing 1987, these submarines were built to three specific design modifications, at the rate of one per year till 2002. The weapons package includes only torpedoes. One Ming submarine, number 361, suffered an unexplained accident at sea in May 2003 wherein all 70 personnel onboard perished. The submarine was retrieved, repaired and again became operational in 2004. These submarines are known to be based in the North and South Sea Fleet areas of responsibility (AOR).

Song (039) Class: Construction of the first Song-class submarine commenced in 1995 and was completed in 1999. The second and third were commissioned in

Table 2. Nuclear submarines – comparison of broad technical parameters.

Parameters	091 Han SSN	092 Xia SSBN	093 Shang SSN	094 Jin SSBN
Length (meters)	106	120	107	137
Length/diameter ratio	10.6	12	9.72	12.72
Displacement dived (tonnes)	5639	6604	6096	8000
Power plant type and capacity	1 PWR#, 90 MW	1 PWR 90 MW	2 PWR* 150 MW	2 PWR* 150 MW
Speed dived (knots)	25	22	30	>33

Notes: # PWR – pressurised water reactor. *The PWR may have been upgraded to high temperature gas cooled reactor (HTGR).

2001 with substantial modifications. Ten submarines were built and commissioned between 2002 and 2006 by concurrent construction in the Wuchang and the Jiangnan Shanghai Shipyards. Song-class submarines are expected to be the workhorses of the PLA Navy though further units of this class are not being built. They are based in all three Fleet AORs.

Kilo-Class: The first four boats of project 877 were ordered in mid-1993. Two boats arrived in 1995 followed by the third and fourth in 1998 and 1999 respectively. A contract for eight more 636 M submarines armed with Klub (SS-N-27) anti-ship cruise missiles was signed in May 2002 and they were delivered between 2004 and 2006. The four older submarines are to also be upgraded and equipped with the “Klub” missile in Russia. The latest Kilo submarines have better weapons control systems and improved habitability. They can normally dive up to 240 meters. They are armed with the wire-guided torpedoes and an SA-N-8 SAM launcher may be fitted on top of the fin. Eight submarines are based under the AOR of the East Sea Fleet and the rest are with the South Sea Fleet.

Yuan (041) Class: This new class of submarines was launched in May 2004 and completed in 2006. Two more boats were built in 2009, after which series production seems to have begun with one, two and one boats being built in 2010, 2011 and 2012 respectively. Up to 20 boats of this class are likely to be built. They may replace the older Ming-class submarines which will be phased out in stages. A second building line may be opened at Jiangnan shipyard to speed up the construction. The boat appears to be of indigenous Chinese design though it has certain similarities to the Russian Kilo-class with a teardrop hull, distinctive hump and large fin. Although shorter and broader than the Song-class, the stern section resembles that class, prompting speculation that the submarine is a modified version of Song-class, hence it is called Project 039A. The submarine is known to incorporate air-independent propulsion and is covered with anechoic tiles to increase acoustic stealth. The submarines are reportedly based in the South Sea Fleet AOR.

Submarine Weapons

The basic details of major weapon systems²¹ on the PLA Navy submarines are shown in Table 3.

Submarine Modernisation in Line with the PLA Navy's Growth

The submarine force modernisation forms a major element of the PLA Navy's growth effort. The early impetus to submarine modernisation was accorded by Admiral Liu Huaqing himself. He urged the PLA General Staff in March 1987 to seriously consider two key issues of core naval build-up viz. the development of SSBNs and aircraft carriers, if the PLA Navy was to be a credible combat-worthy force in wartime and become capable of exercising sufficient deterrence in peacetime.²²

Table 3. Submarine weapon systems.

Role	Weapon/ System	Country of origin	Range (km)	Other Details	Remarks
SLBM	JL-1	Indigenous IRBM derivative	2150	Single nuclear warhead 250 KT	Xia class SSBN
	JL-2	Indigenous derivative of DF 31 ICBM	8000	Single Nuclear Warhead 1MT or three MIRVs of lesser yield	To be fitted Jin class SSBN. Presently being test fired from Golf class submarine
Anti-ship cruise missiles	Klub SS N 27	Russian	180	<u>Speed</u> – 0.7 Mach (Cruise) – 2.5 Mach (Attack)	Kilo class submarine
	YJ8-2	Indigenous	120	Speed 0.9 Mach	Han class SSN and Song class
	YJ8-3 ⁱ	Indigenous	200	Speed 0.9 Mach	Possibly fitted on Shang class SSN and Yuan class
Torpedoes	Yu – 3/4	Similar to Russian CET-65E	15	Active/ passive homing Speed 40 knots	All submarines
	Yu-6	Indigenous		Wake homing	Shang and Yuan
	TEST 71/96	Russian	15	Wire guided Speed 40 knots	Kilo class
	CET 53–65	Russian	19	Speed 45 knots	Kilo class

ⁱMalcolm Fuller, *Jane's Naval Weapon Systems*, no. 53 (Surrey: IHS Global Limited, 2010), pp. 265–6.

Hardware

The indigenous production includes 093 Shang-class SSNs, 094 Jin-class SSBNs, Yuan and Song-class conventional submarines, while the acquisitions include eight kilo 636-class diesel submarines.²³ Currently, the PLA Navy has 31 modern submarines in its inventory. The pace of Chinese submarine modernisation can be gauged from the fact that the percentage of modern units in the force increased from less than 10% in 2004 to more than 50% in 2010, as compared to that of surface combatants, which increased by just about 25% in the same time period. The PLA Navy added 25 submarines from 2004 till 2010. China has commissioned a total of 42 submarines since 1995, at an average of 2.6 submarines per year.²⁴

Seen in terms of numbers, the submarine strength has been decreasing from nearly 120 in the mid-1980s, to 57 submarines currently. However, taking the imminent phasing out of older Ming-class submarines as the new Yuan-class boats enter service, there is not likely to be any accretion in the submarine numbers till 2020. It would therefore not be incorrect to say that although China is modernising its submarine force, it is not expanding it. The US Navy estimates that the force will stabilise at around 40 boats in the next decade.²⁵ The modernisation also concurrently applies to the advanced weapon systems which include SLBMs, anti-ship cruise missiles (ASCMs), torpedoes, mines and the supporting sensor and communication package. For instance, the latest anti-ship cruise missile being fitted on the newer submarines is the YJ 83 — the longer and faster versions of the older YJ 81 and YJ 82.²⁶

Infrastructure – Bases, Shipyards, Other Support

The infrastructure development specific to the submarine force includes the completion of the Yalong Bay nuclear submarine base on Hainan Island, capacity-building of the submarine construction yards, advances in the submarine communication set up and induction of latest submarine support, rescue and salvage assets.

Reports based on satellite imagery have revealed that after 10 years of construction and phased expansion, the new underground nuclear submarine base on Hainan Island was completed in 2011. The facility now has four submarine berthing jetties, possibly to accommodate at least two of each Shang-class SSNs and Jin-class SSBNs.²⁷ The ammunition depot at the base is reportedly a gigantic facility which will cater for all kinds of ordnance like the naval gun ammunitions, torpedoes, underwater mines,

anti-ship missiles, ship-to-air missiles, submarine-to-ship missiles for the nuclear submarines as well as the future aircraft carrier strike group. The underground cave-based depot has three entrances on the water and at least eight entrances on land, of which at least four are motorable with paved roads. The scale of construction suggests that this could be the largest ammunition facility of the PLA Navy.²⁸

China, having initiated major reforms in shipbuilding sector since 1982, has become the commercial shipbuilding global leader, overtaking South Korea in 2010.²⁹ The Chinese shipyards are well diversified with good infrastructure and are also involved in upstream activities like metallurgy, chemical engineering and diesel machinery, which indirectly support shipbuilding. Since they generally construct warships and commercial ships simultaneously and at the same location, they are effortlessly able to support cross transfer of technology. Further, two or more shipyards are awarded the contract for constructing submarines and warships at a time, so as to facilitate faster rate of production as also generate healthy technological and financial competitiveness. The Bohai and Dalian shipyards are building the nuclear submarines while the river-based Wuchang shipyard in inland Hubei Province and the Jiangnan in Shanghai are constructing the conventional submarines.³⁰

As the PLA Navy submarines become more potent and are likely to be deployed far from their shores, reliability, accuracy and timely communication becomes vital. The requirement becomes all the more crucial when strategic missile submarines are deployed as part of the “nuclear second strike” option. Admiral Liu Huaqing was cognisant of this requirement and strived to build such a communication linkage in parallel with the progress of nuclear submarine program in the 1970s. He was justifiably jubilant when the Xia-class SSBN successfully conducted its first two-way communication trial via the Chinese communication satellite in April 1984 and remarked that he was “glad to see the success of the nuclear-powered submarine’s experiment on instantaneous transmission of messages via the satellite. This success [had] pushed China’s submarine communications to a new level”.³¹ Ever since, the submarine communication system in the PLA Navy is being tried out across a range of options extending from land-based “extremely low frequency” (ELF) broadcast to air and satellite based connectivity.³² Some maritime strategists from the US Naval War College surmise that China may have raised a dedicated maritime aircraft squadron for maintaining communication links with its submarines, akin to the

American TACAMO (take charge and move out) air units which support US SSBN operations.³³

As the number of modern submarines in the PLA Navy is increasing, the concern of submarine safety and rescue is being appropriately addressed. The PLA Navy reinforced submarine rescue hardware by commissioning the first Dalao (Type 926) class submarine rescue mother ship with a displacement of 9500 tons in 2010.³⁴ The ship is equipped with the most advanced LR7 deep submarine rescue vessel (DSRV) imported from Britain in 2008. The LR7 is capable of conducting rescue up to a depth of 300 meters below sea level and can transfer 18 submarine personnel at a time.³⁵ The second follow-on ship was launched at Guangzhou shipyard in August 2011³⁶ and should be operationally available in the near future.

Yet another initiative towards indirect but valuable rescue and salvage efforts in the submarines' context is the commissioning of the largest diving support vessel named *Shenqianhao*, under the PLA Navy's North Sea Fleet in August 2012. The 125-meter-long ship with 13,000-ton displacement is equipped with the deep sea saturation diving chamber which can accommodate up to 12 divers in the pressurised environment and a diving bell which takes three divers at a time up to the depth 300 meters.³⁷ The Type 926 submarine rescue ship with the LR7 DSRV when operating in tandem with the *Shenqianhao* diving support vessel with its saturation diving equipment would qualitatively enhance the PLA Navy's submarine rescue capabilities.

Training – Sea Sorties and Patrols

The submarine training, both ashore and at sea, has historically been a cause for concern in the PLA Navy. Admiral Liu Huaqing noted the very poor rate of submarine sailings — particularly so of the nuclear submarines — with exasperation in 1980, when he was the Deputy Chief of the General Staff. He found that the first Han-class boat, though commissioned in 1974, had rarely sailed and remained in port for some reason or the other. He demanded that the relevant submarine base step up the training of the crew with a view to sail it at the earliest, resulting in the maiden month-long training sortie in November–December 1981.³⁸ He thereafter continued to pay special attention to this weak area and strived to achieve maximum sailing rate for the submarines.

The current submarine training, as part of the overall PLA Navy training, is generally governed by the “Outline of Military Training and Evaluation” (OMTE) document, issued by the General Staff Department of the PLA. The first major revision incorporating substantial changes from previous training patterns was issued in June 2001. Based on this, the PLA Navy promulgated its force specific OMTE in January 2002 which was again revised in 2009 to include combined arms joint training and operations in complex electromagnetic environment. The submarine training under the revised OMTE was totally reformed to reflect the changed doctrinal thinking in the new century. While the previous tactics emphasised on attack with scant regard to defence prior to or post attack, the new concept sought to train the submarines in attack, survivability and re-attack.³⁹ The revised OMTE accordingly directs the PLA Navy submarines to undertake following activities:

- conduct training in intermediate and far sea area over many days to raise the endurance threshold of the submarines and their crew,⁴⁰ unlike single day, sunrise-to-sunset sorties;
- mission-oriented training as opposed to basic independent unit-level training;
- training on a number of themes simultaneously by multiple submarines in a combined forces environment as against single theme for every boat per sortie;
- fleet-level training for submarine damage contingencies and rescue; and
- simulator training for basic, technical and tactical training.

The submarines are accordingly being increasingly tasked to carry out long-range navigation training in unfamiliar areas. They regularly participate in the integrated PLA Navy's anti-submarine warfare (ASW) exercises wherein they practice approach, attack and evasion tactics. The Chinese submarines are regularly venturing into the Philippines Sea and western Pacific, particularly through the waterway between the Japanese Okinawa and Miyako islands. The submarines are believed to have accompanied the PLA Navy ships for naval exercises in the said area during April and June 2010 and again in June 2011.⁴¹ The submarines have also participated in major joint maritime exercises with the ships and ASW aircraft of the North and East Sea Fleets in September 2012. The exercises in the North Sea Fleet involved tracking and prosecution of submarine by destroyers and frigates and evasion tactics by a Song-class submarine (323).⁴² The East Sea Fleet ships, submarines and aircraft

also conducted live ammunition and missile-firing exercise in the East China Sea.⁴³ Submarine-specific training like the reconnaissance of hostile area, stealth landing of Special Forces ashore and mine laying is also being conducted regularly.

The training of submarine support services and staff has also progressed concurrently. For instance, a UK-based submarine rescue service company, M/S James Fisher, trained the PLA Navy sailors on the operation of LR7 DSRV in 2010–11.⁴⁴ The company also provided the software and simulation operating technologies in addition. In order to enable the personnel to cope with the rigours of the submarine life and intense pressure during operations and exercises, the psychological service system has been tasked with ensuring their physical and mental health.⁴⁵

Notwithstanding, the persistence of Admiral Liu Huaqing on long-duration far-sea submarine patrols, the patrolling rate of Chinese submarines has been pretty low. A graph depicting the details of Chinese submarines patrols conducted since 1981 was published by the Federation of American Scientists, ostensibly from the confidential data declassified by the US Navy.⁴⁶ This also explains the non-availability of such sensitive data for last three years. In the absence of authentic data, conclusions drawn may at best, be indicative only.

Nevertheless, the most obvious inferences that emerge from the graph are that during 2008, Chinese submarines conducted 12 patrols, double the number in 2007. The US Office of Naval Intelligence report of 2009 avers that the Chinese submarine patrol rate had more than tripled, when compared to that of last two decades.⁴⁷ Only two patrols were conducted in 2006 and none in 2005. Chinese SSBNs do not appear to have ever conducted “deterrent patrols”. Preliminary analysis of this data also suggests that the modernisation of the submarines had not resulted in any increase in the number of submarine patrols. The total operational experience for the entire Chinese submarine force is only 67 patrols in 28 years, averaging about 2.4 patrols per year. The submarine training reforms promulgated in the 2009 revised OMTE did suggest remedial measures to correct this shortcoming and it would definitely have affected the submarine patrol rate in the last three years.

Future Prospects

The stress on submarine building as a key area of Chinese naval modernisation is quite apparent with the pace of submarine constructions having picked up

substantially. Three more Jin-class SSBNs are under construction at the Huludao (Bohai) Shipyard, taking the projected total to five SSBNs.⁴⁸ Further, new conventional and nuclear submarine projects are either underway or are being planned. The prominent new submarine projects being discussed in the public domain are the *Qing* and upgraded Yuan-class conventional boats and the 095 SSNs and 096 SSBNs. Known details about them are mentioned below.

Qing (039B) class: The Qing-class submarine is also described as type 039B-class. It is reportedly longer than the 041 Yuan-class, has a very high degree of automation and is fitted with the Stirling type⁴⁹ air independent propulsion (AIP) system. A sales brochure submitted by China Shipbuilding Offshore International Company (CSOC) — the trade arm of China Shipbuilding Industry Corporation (CSIC) — to the Thai naval authorities mentions that the export version of this submarine named S-20 is about 66-meter-long with 1850-tons surface and 2300-tons submerged displacement. Its can dive up to maximum depth of 300 meters, will possibly be equipped with the 1500 km range CJ10 (DH10) cruise missiles and is said to have an endurance of 60 days at sea.⁵⁰

Upgraded Yuan (041A) Class: Yet another version of the 041 Yuan-class, alternately called the 041A has been observed by China Navy watchers.⁵¹ The submarine's unusual overall length of about 87 meters and abnormally large sail size tends to give credence to the assumption that it will be fitted with either the long-range cruise missiles if it is to be used as a combat submarine or some kind of submarine launched ballistic missile, if it is to replace the aging Golf-class as an experimental SLBM launch platform.⁵²

095 SSN: China is likely to construct another type 095 nuclear attack submarine. The US Department of Defense estimates that “China will expand its nuclear-powered attack submarine force, with two second generation 093 SSNs being supplemented by as many as five third generation [095 SSNs] in the coming years. . . . the new class of SSNs will incorporate better quieting technology and improve China's capability to conduct missions ranging from surveillance to the interdiction of surface vessels with torpedoes and long range [CH-SS-NX-13] ASCMs”.⁵³ It is speculated that the 095 submarine could have displacement ranging from 7000 to 11,000 tons and have radiated noise level (RNL) of around 90 db. There is also a possibility of the submarine being powered by high-temperature gas cooled reactor (HTGR)⁵⁴ and fitted with vertical cruise missile launchers.

096 SSBN: It is believed that China is producing a new class of SSBN.⁵⁵ At present the SSBNs in service have displacement ranging from 13,250 tons for the Russian Delta III-class to 26,500 tons of the Typhoon-class. There is a possibility that 096 could have a length of 150 meters and a displacement of 12,000 tons or above. Modern SSBNs carry 16 to 24 missiles; hence 096 could carry more than 12 missiles. It is speculated that its RNL could be in the range of 95–100 db.

In so far as the new weapons are concerned, the most notable is the possible reconfiguration of CJ10/DH10 land attack cruise missiles (LACM) into the ASCM. China has developed and deployed the Donghai 10 (DH 10) LACM and also the air launched version of the same. These missiles are said to have a range of 1500 to 2000 km and are currently configured to attack static land targets. This missile is probably referred to as “*CH-SS-NX-13*” by the US Department of Defense and will possibly be fitted on Song, Yuan, new Qing, upgraded Yuan 041A conventional submarines and the 093 and future 095-class SSNs.⁵⁶

Role in Furthering the PLA Navy’s Blue Water Capabilities

Since the First World War when the submarine appeared as a means for inferior naval powers to dispute and deny the command of the sea exercised by superior powers,⁵⁷ China has still found this concept to be applicable, even a century later. A Western scholar in fact chooses to call “the submarine as the weapon of choice for the underdog”.⁵⁸ The absence of an integrated fleet air defence in the form of an operational aircraft carrier (with embarked air-wing) limits the PLA Navy’s blue water options. But the Chinese SSNs, capable of unassisted long-range deployment, make the blue water operations feasible. However, it would be prudent to place their limitations in context vis-à-vis the roles they are expected to perform.

Requirement versus Limitations

The PLA Navy’s strategy, including that of its submarine arm, generally corresponds to the Soviet model because of formative influence exerted by erstwhile USSR, since its inception.⁵⁹ The main objective of the Soviets in building, organising and deploying its submarine force was for countering the superiority of the American aircraft carrier battle groups. China also appears to have subscribed to the same logic

in planning its submarine force levels and operational philosophy, particularly after a US aircraft carrier group sailed through the Taiwan Strait with impunity during the 1996 Taiwan crisis.⁶⁰ It may therefore be considered that the main driving force for the persistence of this thought process in Beijing continues to be the need to keep US aircraft carriers as far away from the Chinese seaboard as possible.

In this endeavour, the PLA Navy will have to rely heavily on its submarine force to optimally exploit the under-sea space. This is perhaps the only option which may provide it enough leeway to counter the unquestionably strong control of sea surface and corresponding airspace by US maritime forces in the central and western Pacific. One of the biggest constraints to effective submarine operations in the region relates to its topography. One American analyst avers that “so long as the first island chain is in the hands of forces opposed to PRC; the PLA Navy will face a formidable obstacle in securing working control of the sea beyond that barrier, to permit Beijing to project power outside China’s littoral waters”.⁶¹ If these shackles have to be broken, the Chinese submarines have to leverage the available depths to their utmost advantage by laying greater emphasis on the stealth and corresponding reduction in the radiated noise level.

The US Office of Naval Intelligence published a graph depicting the comparative RNLs of the Chinese and Russian nuclear submarines without ascribing absolute values.⁶² The most obvious inference from the graph is that the RNL of the latest Chinese submarines is higher than the Russian submarines on whose design they are thought to be built upon — 093 SSN on Victor III and 094 SSBN on Delta. When these comparative trends are placed on a Displacement-RNL graph (see Figure 2) of Thomas Stefanick in his classic work on *Strategic Anti-submarine Warfare and Naval Strategy*, the estimated radiated noise of Chinese nuclear submarines falls in the range of 130–150 decibels (db).⁶³ This graph (Figure 2) also shows a pronounced RNL difference vis-à-vis the modern American submarines like the Sea Wolf, Los Angeles and the Virginia-class.⁶⁴ As there is a direct correlation between the RNL and the detection range, the Chinese submarines will find it very difficult to pass undetected through the relatively narrow waterways between the various land features of the first island chain. This should also be weighed against the robust submarine detection infrastructure that the US maritime forces — being the principle adversary for the Chinese — would be capable of establishing in such waterways.⁶⁵

There is also a considerable technological and professional differential between the Chinese intentions and the present status of the Chinese submarine force. The Chinese nuclear submarines are definitely inferior in terms of design and technology when compared to modern Western ones. They are noisier, slower and are not armed with the weapons of matching capabilities. The SLBMs have not yet crossed the trial stage. The strategic submarine operating infrastructure like the secure, reliable and long-distance communication system may not be in place.

Role of Conventional Submarines

According to a “PLA Navy Officers’ Manual”, the submarine arm is to be tasked with wiping out enemy transport vessels and large and medium-type attack craft; damaging/destroying enemy naval bases/harbours; attacking the enemy coasts; carrying out reconnaissance on seas; patrolling; and laying, clearing and protecting against mines.⁶⁶ The reconnaissance can be further expanded to intelligence collection, surveillance and special operations, if required. Such submarine special operations could involve landing of Special Forces on hostile shores for clandestine activities or pre-emptive localised

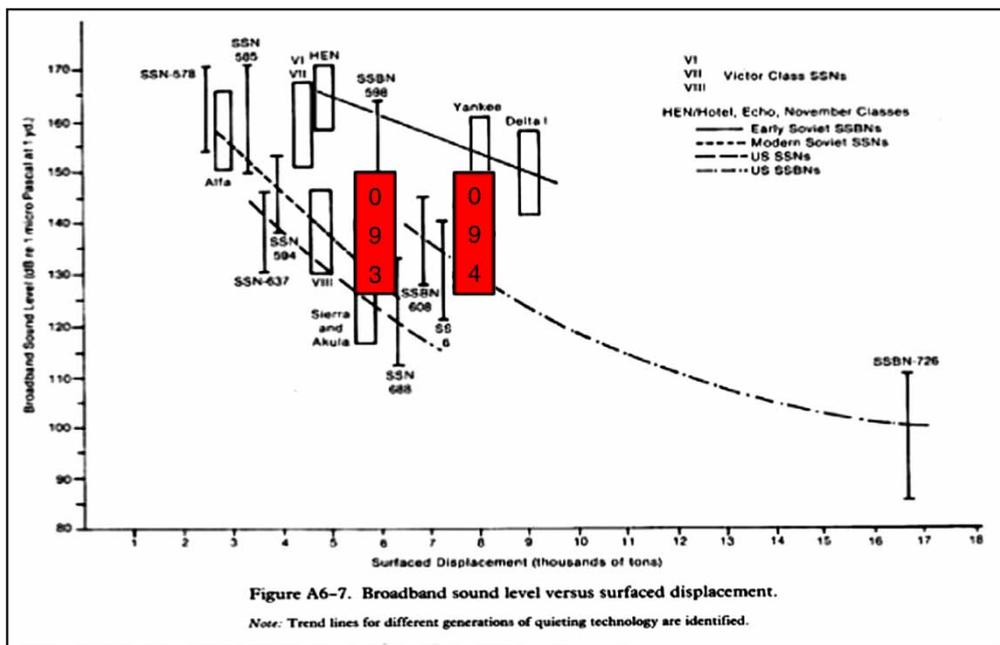


Fig. 2. Radiated Noise Level Versus Displacement Graph for Nuclear Submarines

operations and their recovery. The new submarines would also be employed in protecting the strategic SSBN bastions.⁶⁷ Moving at less than 4 knots, these submarines can maintain fairly quiet defensive barrier patrols across key choke points for days on end. Similar defensive barriers can also be set up at entry points to vital ports.⁶⁸

Role of Nuclear Submarines

Given China's declaratory policy of "no-first use of nuclear weapons at any time and in any circumstances",⁶⁹ it becomes incumbent to possess a swift, sure and survivable response capability. The 094 Jin-class SSBNs armed with JL 2 SLBMs are intended to provide this near continuous at-sea strategic deterrent.⁷⁰ These submarines operating from the "bastions" established possibly in the Bohai Bay or further east into the Yellow Sea would aim to target the adversary's mainland.⁷¹ These submarines will also form the "strategic reserve" after the nuclear umbrella goes up. The other underground nuclear submarine base on Hainan Island and 094 SSBNs operating from there probably indicates China's desire to ensure survivability of their "strategic reserves" by dispersing them.⁷²

The SSNs are said to have a larger operating radius, immense propulsive and electric power, theoretically unlimited endurance, high underwater speed, more diving depth and lesser noise level,⁷³ as compared to the conventional submarines. They also possess better capacity to withstand battle damage and a large weapon-carrying capability. These attributes make them ideal platforms for planning global attack strategies, providing an advance screen for carrier groups or tailing them (depending on which side the SSN belongs to) and also escorting and protecting the SSBNs on bastion patrol.⁷⁴ They can also independently undertake extended-duration long-range missions, either for sea denial, blockade, interdicting enemy sea lines of communication (SLOCs) or for protecting one's own. In this context, China apparently counts a lot on the utility of SSNs by suggesting that they are "PLA Navy's main long distance sea force".⁷⁵ Lastly, by attaching nationalistic symbolism to major technological breakthroughs and military achievements, the Chinese see their SSNs as representative of their march towards "great power" status.⁷⁶

Chinese Submarine Presence in the Indian Ocean Region?

The second nuclear submarine base at Hainan Island increases the sub-surface reach of the PLA Navy in the southern Pacific and possibly towards the Indian Ocean Region

(IOR) as well.⁷⁷ Considering the geographical proximity and the fact that China has a significantly large arsenal of land-based nuclear missiles, the possibility of Chinese SSBNs being deployed against India appears to be remote. With a clear role envisaged for the conventional submarines in the South China Sea, Taiwan and the immediate littoral, the SSNs are currently the only units capable of undertaking unassisted offensive deployments in the IOR.⁷⁸ These SSNs armed with anti-ship cruise missiles and modern torpedoes, will pose a credible threat to the IOR SLOCs. The unpredictability factor in their detection increases in the tropical waters where the sea conditions complicate the sound propagation profile, thus placing the submarines in an inherently advantageous position. In such an environment, they could achieve effective sea denial, while disproportionate ASW effort would be required to detect and prosecute them.

The Chinese SSNs are said to have an endurance of 60–90 days. Though the American submarines are said to transit to their patrol stations at about 16–18 knots⁷⁹, a prudent speed averaging 12–13 knots would amount to a 300 Nautical miles advance per day. It is considered that the SSNs would transit into the Indian Ocean through one of the following four routes if they have to maintain an acceptable degree of stealth:

- through the Sunda Strait – About 3200 Nautical miles (NM);
- through the Lombok Strait – About 4300 NM;
- from the northern coast of Australia – About 8500 NM; or
- around Australia – About 11200 NM⁸⁰

With an assumed endurance of 75 days for the purpose of calculation, the SSN operating from Hainan would be able to maintain an effective patrol of 1–45 days in the Arabian Sea and 5–50 days in the Bay of Bengal, depending on the choice of transit route. The patrol duration would also be affected by factors like the exact destination area, en route and nearby support infrastructure and the maritime domain awareness capability of the littoral states. If the Chinese acquire a base in the region, then the effectiveness of the nuclear submarines would increase manifold. Till such time, commencement of deployment could occur either after the Chinese SSN makes a routine port call or undertakes Operational Turn Round (OTR) at friendly ports in

the area. However, in times of hostility, the latter option may not be beneficial, either for the Chinese or the host countries. The fact of the Chinese SSN being known to be in the area itself will narrow their operational options, in addition to placing the host country in direct opposition to India. The SSNs would also be part of the Chinese aircraft carrier strike group in medium to long term, as and when they are ready to deploy them in the IOR.

Whether the Chinese SSNs operate alone or as part of the Carrier Group, their presence will definitely affect the operational pattern of the Indian Navy. The availability of maritime space for operations, exercises and training for Indian Navy could be severely constrained. Its intentions and movements would be open to monitoring and possible interdiction. In such a constricting environment, the policies, plans and procedures of the Indian Navy will have to be transformed accordingly. The proposed sale of Chinese submarines to Pakistan in addition to their wholesome maritime cooperation may lead to the Chinese maritime assets and expertise being progressively positioned in Pakistan. Such a presence may be under the pretext of training, but the Indian naval establishment will have to be cognisant of this fact when planning its maritime mission profiles, operational doctrines and tactical plans. In the period of heightened tensions, the possibility of active or tacit cooperation between the two forces will also have to be factored in.

Conclusion

The trajectory of the Chinese nuclear submarine program is the most significant indicator of its ambitions to emerge as an effective blue water navy. China has the capability to target the continental United States from the sea even though doubts persist on the actual range of the JL-2 SLBM.

Even a quantitative increase in the SSBN force levels not necessarily matched by qualitative improvements could ensure the availability of a Chinese survivable 'second strike' option against the US. The propensity of the Chinese technological establishment to glean advanced foreign technology and then innovate upon it, implies that qualitative improvements in submarine design, propulsion, weapons, sensors and stealth technology would also be well underway. The Western analysis of the relative technological inferiority of Chinese submarines should however not

influence India's preparedness. Chinese nuclear submarines have an overwhelming superiority in an Asian context. The Chinese SSNs are more lethal as opposed to the SSBNs since they represent an option to escalate while not crossing the nuclear threshold. Considering the timeframe required for assimilating new technology and imbibing operating philosophies, it is conservatively estimated that the Chinese SSNs would be capable of undertaking long-range offensive deployments in the IOR within five to seven years. The Chinese could use these SSNs in the eventuality of either a real or perceived threat to their shipping lanes in IOR. Further, these units afford them the option of undertaking covert yet deterrent actions as the deniability factor in case of international incidents involving submarines is very high.

The only area of vulnerability for the Chinese nuclear submarines may lie at the points of entry into Indian Ocean and Bay of Bengal. Effective surveillance and other detection means could complicate the problem for the Chinese. The aim should be to have a mechanism to detect them at these vulnerable points and have the naval capability to track them thereafter. While it may take some time to build such ASW capabilities, there is an absolute need to monitor the Chinese SSN program more closely, considering their assessed threat potential.

Notes

1. Chen Long, "PLA Should Foster Offensive Thinking in Developing Long-range Strike - Weapons," Chinese Ministry of National Defense website, January 13, 2012, http://eng.mod.gov.cn/Opinion/2012-01/13/content_4337482.htm (accessed November 12, 2012).
2. China Internet Information Center, "Chinese Navy Urged to go from Coastal Waters to Oceans," March 7, 2009, <http://www.china.org.cn/e-white/20041227/III.htm#2> (accessed November 12, 2012).
3. White Paper on China's National Defense in 2004, Chapter III, <http://www.china.org.cn/e-white/20041227/III.htm#2>, (accessed November 12, 2012).
4. Admiral Liu Huaqing was the Commander of the PLA Navy from 1982 to 1988 and the Vice Chairman of the Central Military Commission (CMC) from 1989 to 1997.
5. The "Three Island Chain" formulation required the PLA Navy to establish blue water presence in the first island chain running from Japan, past Taiwan to Philippines, by 2010. The second island chain running south of Sakhalin to the islands in the south-west Pacific was

- the established goal by 2025. The third island chain extending from Aleutian Islands in the north to Antarctica in the south was to be the goal for 2050. See David Shambaugh, *Modernising China's Military: Progress, Problems and Prospects* (New Delhi: Book Mart Publishers under arrangement with University of California Press, 2005), p. 67.
6. Xinhua, "Chinese Navy to Stick to Defensive Strategy," April 23, 2009, http://news.xinhuanet.com/english/2009-04/23/content_11239423.htm (accessed August 13, 2012).
 7. This guideline aims at winning "local wars under conditions of informationization" by way of joint operations, training and support, optimising the force structure and composition, and building the capabilities suitable for such warfare. It professes close coordination between military actions and diplomatic, economic and legal efforts towards attainment of the same aim. See White Paper on "China's National Defense in 2008, Section II – National Defence Policy," http://www.china.org.cn/government/central_government/2009-01/20/content_17155577_4.htm (accessed November 12, 2012). Details of the active defence concept can also be found in Peng Guangqian and Yao Youzhi, ed., *The Science of Military Strategy* (Beijing: Military Science Publishing House [Jūnshì kēxué chūbǎn shè]: 2005), pp. 459–61.
 8. White Paper on 'China's National Defense in 2010', Section III – Modernization of the People's Liberation Army, http://www.china.org.cn/government/whitepaper/2011-03/31/content_22263445.htm, (accessed November 12, 2012).
 9. Liu Huaqing quoted Chairman Mao during a naval meeting in December 1989 which he attended as the Vice Chairman of the Central Military Commission (CMC). This has been taken from Chapter 17 of the Foreign Broadcast Information Service (FBIS) translated version of *Memoirs of Liu Huaqing*, (Beijing: PLA Publishing House (解放军出版社), (Jiefangjun Chubanshe, 2004). The author thanks the Centre for Naval Analysis, Washington, for sharing a portion of this translated text with the National Maritime Foundation.
 10. P.R. Franklin, *Submarine Operations* (New Delhi: Knowledge World Publishers for the National Maritime Foundation, 2010), p. 35.
 11. U.S. Office of Naval Intelligence, 'China's Navy 2007', p 31, <http://www.fas.org/irp/agency/oni/chinanavy2007.pdf>, (accessed November 12, 2012).
 12. John Wilson Lewis and Xue Litai, *China's Strategic Sea Power – The Politics of Force Modernisation* (California, CA: Stanford University Press, 1994), p. 6.
 13. *Ibid.*, p. 39.
 14. FBIS, *Memoirs of Liu Huaqing*, Chapter 17.
 15. Peoples' Daily online, "Backgrounder: Brief History of China's People's Liberation Army Navy," April 16, 2009, <http://english.peopledaily.com.cn/90001/90776/90786/6638073.html> (accessed August 16, 2012).
 16. *Ibid.*

17. The organisational chart appears in the US Office of Naval Intelligence publication, *China's Navy 2007*, p. 32. The nuclear submarine *Zhidui* shown in the chart under the South Sea Fleet has been upgraded by the author to the nuclear submarine base, after its construction on the Hainan Island was completed in 2011.
18. Stephen Saunders, *Jane's Fighting Ships 2011–12* (Surrey: IHS Global, 2012), p. 129.
19. *Ibid*, pp. 129–35. There is often great variation in inventory figures from source to source. For instance the IISS, *Military Balance 2012* (London: International Institute of Strategic Studies, March 2012), p. 235 cites 71 submarines in the PLA Navy inventory.
20. Unless otherwise mentioned, all the details about Chinese submarines, both nuclear and conventional, have been taken from Saunders, *Jane's Fighting Ships*.
21. Unless otherwise mentioned, all the details about Chinese submarine borne weapons have been taken from Saunders, *Jane's Fighting Ships*, pp. 115–33.
22. FBIS, *Memoirs of Liu Huaqing*, Chapter 17.
23. Ronald O'Rourke, "Force Structure: Submarines, Ships and Aircraft," in *The Chinese Navy: Expanding Capabilities, Evolving Roles*, ed. Phillip Saunders et al. (Washington, DC: National Defense University Press, 2011), p. 144.
24. Ronald O'Rourke, "China Naval Modernization: Implications for U.S. Navy Capabilities – Background and Issues for Congress," CRS Report for Congress, July 31, 2012, p. 15, <http://www.fas.org/sfp/crs/row/RL33153.pdf> (accessed August 12, 2012).
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32. Andrew Erickson and Lyle Goldstein, "China's Future Nuclear Submarine Force," *Naval War College Review*, 60, no. 1 (2007): 69–70.

33. *Ibid.*, p. 70. The authors cite an article in August 2003 edition of the Chinese periodical named 舰船知识 '*Jian Chuan Zhishi*' (Naval and Merchant Ships). It is published monthly by the Chinese Society of Naval Architecture and Marine Engineering.
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45. Chinese Ministry of National Defense, "Submarine Flotilla Establishes Psychological Service System," August 25, 2010, http://eng.mod.gov.cn/DefenseNews/2010-08/25/content_4187809.htm (accessed September 10, 2012).
46. For the Chinese submarines patrol graph, see Hans Kristensen, "Chinese Submarine Patrols Doubled in 2008," February 3, 2009, <http://www.fas.org/blog/ssp/2009/02/patrols.php> (accessed September 11, 2012).
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49. In the Stirling-cycle AIP, heat from an outside source is transferred to an enclosed quantity of working fluid – generally an inert gas – and drives it through a repeating sequence of thermodynamic changes. By expanding the gas against a piston and then drawing it into a separate cooling chamber for subsequent compression, the heat from external combustion can be converted to mechanical work and then, in turn, to electricity. This approach has an advantage over internal combustion systems, in that the combustion processes can be kept separate from those that actually convert heat to mechanical work. This provides significant flexibility in dealing with exhaust products and controlling acoustic radiation. The Stirling-cycle engine forms the basis of the first AIP system to enter naval service in recent times. The Swedish builders, Kockums Naval Systems, tested a prototype plant at sea in 1989, and today, three Swedish Gotland-class boats are each fitted with two adjunct, 75 kilowatt Stirling-cycle propulsion units that burn liquid oxygen and diesel fuel to generate electricity for either propulsion or charging batteries within a conventional diesel-electric plant. The resulting underwater endurance of the 1500-ton boats is reported to be up to 14 days at five knots, but significant burst speeds are possible when the batteries are topped up. For details on various existing AIP systems, see Edward C. Whitman, 'Air-Independent Propulsion Technology Creates a New Undersea Threat', http://www.navy.mil/navydata/cno/n87/usw/issue_13/propulsion.htm (accessed September 13, 2012).
50. Andrei Pinkov, "039B Submarine Being Exported," Kanwa Asian Defense online, May 24, 2012.
51. Ted Parsons, "China Launches New SSK," *Jane's Defence Weekly*, September 22, 2010, p. 16. A similar article was published by the same author, "Launch of Mystery Chinese SSK Fuels Submarine Race in Asia," *Jane's Navy International*, October 2010.
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53. US Department of Defense, *Military and Security Developments Involving the People's Republic of China, May 2012*, Annual Report to Congress (Washington, DC: US Department of Defense, 2012), p. 23. The words in the box brackets have been inserted on the basis of US DOD report of 2011 on the same subject, p. 4.
54. HTGR is used as an alternative to light water-cooled and moderated reactors. It uses graphite as a moderator and helium as the coolant. HTGR has been used for electric power generation for a long time. The helium coolant enters the reactor at 636F and exits at 1377F. It is possible to employ conventional superheat/reheat cycles found in high performance fossil-fuelled power plants because of these high temperatures. HTGR is reported to occupy a small volume, generate a large power at a relatively low noise level and is capable of giving very high

- speeds to the submarine. It is also believed to have an improved reactor safety. See Erickson and Goldstein, "China's Future Nuclear Submarine Force," p. 67.
55. US Department of Defense, *Military and Security Developments Involving the People's Republic of China, May 2012*, p. 23.
 56. US Department of Defense, *Military and Security Developments Involving the People's Republic of China, 2011*, Annual Report to Congress (Washington, DC: US Department of Defense, 2011) p. 4.
 57. The German submarine *U-21* sank the British cruiser *HMS Pathfinder* in the North Sea on September 3, 1914, providing the first practical evidence of its formidable qualities for weaker naval powers to challenge the domination of stronger naval powers. See M. Gilbert, *The First World War* (London: Harper Collins, 1994), p. 67.
 58. Peter Howarth, *China's Rising Sea Power: PLA Navy's Submarine Challenge* (New York: Routledge, 2006), p. 70.
 59. Shambaugh, *Modernising China's Military*, p. 109.
 60. Howarth, *China's Rising Sea Power*, pp. 117–8.
 61. *Ibid.*, p. 86.
 62. US Office of Naval Intelligence, *The People's Liberation Army Navy*, p. 22.
 63. Tom Stefanick, *Strategic Anti-submarine Warfare and Naval Strategy* (Lexington, MA: Lexington Books, 1987), p. 281. The graph has also been explained in an online article by Jeffrey Lewis titled "China's Noisy New Boomer," November 24, 2009, <http://lewis.armscontrolwonk.com/archive/2544/chinas-noisy-new-boomer> (accessed August 21, 2012). The rough placement of the Chinese submarines on the graph has been done by the author. It is not accurate, but only representative.
 64. Tom Stefanick, *Strategic Anti-submarine Warfare and Naval Strategy*, Note 63, *Ibid.*
 65. The US Navy has developed reasonably sound nuclear submarine detection and tracking capabilities borne out of the sizeable tracking effort mounted against Russian SSBNs during the Cold War period, particularly when the submarines were slated to cross the narrow sea passages. For instance, the United States laid the sound surveillance system (SOSUS) chain on the sea bed in Greenland–Iceland–UK (GIUK) gap and the Berring Strait.
 66. Srikanth Kondapally, *China's Naval Power* (New Delhi: Knowledge World, 2001), p. 48.
 67. The "Bastion" concept of SSBN operations is basically of Soviet origin. This entails the SSBN remaining within heavily defended waters or "Bastion", so that it can launch either a full-scale second strike without the fear of counter attack from opposing forces or limited nuclear attack with a view to retain the option to fire rest of the missiles at a later time. The "Bastion" is guarded by a combination of defensive minefield, conventional submarines on barrier patrol at strategic choke points and escorting nuclear attack submarine/s. The Chinese Navy could also be employing the same defensive strategy in their SSBN exploitation

- plans, since they draw heavily from the Soviet concept of submarine operations, as also the adversary and the threat from its attack submarines, remains the same. See Stefanick, *Strategic Anti-submarine Warfare and Naval Strategy*, p. 7.
68. *Ibid.*, p. 57.
69. White Paper on “China’s National Defense in 2010”, Section X – Arms Control and Disarmament.
70. US Department of Defense, *Military and Security Developments Involving the People’s Republic of China, 2012*, p. 7.
71. As of now, the threat envelop of JL2 SLBM with the known range of about “7400 km + ” extends only to Alaska on the American mainland and greater part of Canada. See US Department of Defense, *Military and Security Developments Involving the People’s Republic of China, 2012*, Figure 7, p. 43.
72. Kamlesh Kumar Agnihotri, “Strategic Direction of the PLA Navy: Capability and Intent Assessment,” *Maritime Affairs Journal of the National Maritime Foundation*, 6, no. 1 (2010): 75.
73. When compared to conventional submarines making equal speed.
74. Stefanick, *Strategic Anti-submarine Warfare and Naval Strategy*, p. 7.
75. The Chinese comments are attributed to the China Shipbuilding Industry Corporation (CSIC) publication *Xiandai Jian Chuan* (Modern Ships), no. 5 (2005), as cited in Erickson and Goldstein, “China’s Future Nuclear Submarine Force,” p. 64.
76. Erickson and Goldstein, “China’s Future Nuclear Submarine Force,” p. 63.
77. Agnihotri, “Strategic Direction of the PLA Navy,” p. 75.
78. *Ibid.*, p. 90.
79. The American SSNs prefer to transit at 18 knots when they proceed for “out of area” deployment/patrol. See Robert Harkavy, *Bases Abroad: The Global Foreign Military Presence* (New York: Oxford University Press, 1989), pp. 34–5.
80. The distances are measured from Sanya Naval base in Hainan Island till the central Bay of Bengal.