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# 翻译

TRANSLATIONS



**Volume 1, Issue 5**

**Strategic (Power) Projection and Operational Sustainment:  
Perspectives on Naval Support Systems**



中国海事研究所  
China Maritime Studies Institute



U.S. NAVAL WAR COLLEGE  
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NEWPORT, RHODE ISLAND

## **Strategic (Power) Projection and Operational Sustainment: Perspectives on Naval Support Systems**

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## ABOUT THIS SERIES

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This series presents a curated collection of open-source Chinese-language journal and newspaper articles that were originally published in the People's Republic of China (PRC). Hand-selected for their relevance to PRC military maritime affairs and translated by the China Maritime Studies Institute (CMSI) researchers over the past thirteen years, these materials were previously only available for limited distribution. CMSI is now pleased to open access to these translations and offer them to a broader community of defense professionals and scholars seeking deeper insights into evolving PRC military maritime developments.

Each volume in the series is loosely organized by theme, featuring articles that address strategic, operational, and tactical dimensions of the PRC's maritime military affairs. Selection of articles for inclusion in this volume was guided by operational or policy relevance at the time of translation, with some articles anticipating key shifts in Chinese policy or doctrine, and others offering rare glimpses into both official narratives and unofficial discourse.

Though historical in origin, many of these sources remain timely. Readers may uncover enduring patterns, early indicators of current trends, or fresh perspectives on the PRC's long-term military maritime ambitions. CMSI will continue publishing volumes in this series until its archive of previously translated materials is fully released.

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## FROM THE DIRECTOR

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*Strategic (Power) Projection and Operational Sustainment: Perspectives on Naval Support Systems* presents a curated collection of open-source Chinese-language journal and newspaper articles originally published in the People's Republic of China (PRC). Translated by the China Maritime Studies Institute (CMSI) over the last thirteen years, the 16 articles contained in this volume examine the functional and technical foundations of the People's Liberation Army Navy (PLAN), with particular emphasis on the operational systems required to sustain a high-tech fleet.

These articles offer practical insights into the tangible obstacles that affect naval operations, including the challenges of far-seas fuel replenishment and damage control. By analyzing Chinese assessments of their own abilities—ranging from perceived deficiencies in countering sea mines to the complexities of over-the-shore logistics—readers gain visibility into several of the technical milestones the PLAN believes it must achieve to fulfill its near- and far-seas security objectives.

The volume is organized into four sections, each focused on a key component of maritime power development.

- **Part I: Equipment Support and Fleet Survivability** details the technical and psychological pillars of fleet readiness, showcasing an integrated maintenance approach that pairs physical repairs with crew competence and morale.
- **Part II: Strategic Power Projection and Amphibious Logistics** examines the mechanics of force transport, outlining the need for a civilian resource base for military use, and commercial assets to move power in support of island landing campaigns as well as overseas operations.
- **Part III: Sustaining Far-Seas Presence** investigates the supply chains and scientific data required for enduring missions, including the use of multi-crew rotation schemes and forward maritime hubs to ensure ships and submarines remain in theater for longer periods.
- **Part IV: Specialized Support for Undersea Warfare** covers the technical requirements of mine and torpedo operations, illustrating how merging military and civilian resources—such as utilizing non-military helicopters for clearing mines or

streamlining ordnance maintenance by sharing technical facilities—can significantly enhance mission capacity.

The articles in this volume highlight the often underexamined foundations of naval power: the support systems that enable fleets to operate, endure, and recover in complex environments. Together, they reflect a PLAN that is both advancing its capabilities and confronting its own perceived shortcomings. Through these translations, the volume offers a more granular understanding of how the PLAN approaches sustaining operations at distance—and provides a basis for assessing both the progress achieved and constraints that shape its development.



C.H. SHARMAN

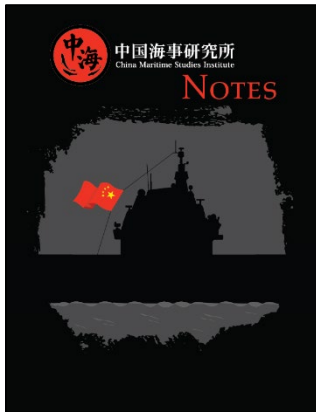
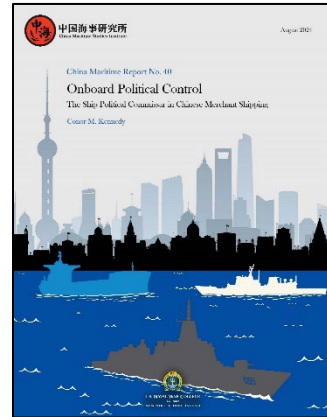
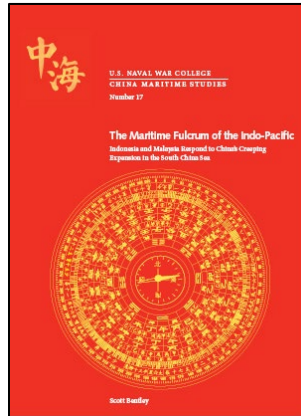
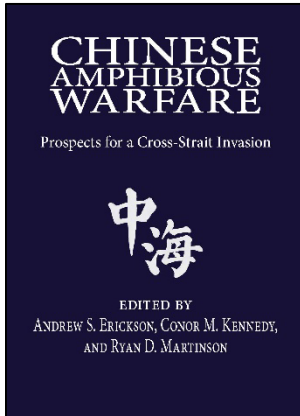
Director

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## Part I: Equipment Support and Warship Survivability

This section focuses on the foundational systems and training required to keep PLAN assets operational and resilient.



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## Sharpening Their Sword, On Course for Victory: An Account of the Armament Department of the East Sea Fleet Leveraging the Advantages of the New System in Order to Improve Equipment Support Abilities<sup>1</sup>

CHEN Xiong, CHI Zumin, LIU Yuexiang, WANG Chunfeng, DAI Zongfeng and YIN Fei

*In order to adapt to developments in the world revolution in military affairs and meet the needs of continuously expanding missions of the Chinese Navy, at the end of 2011 fleet armament departments were set up at each of the PLA Navy's three fleets. Since the East Sea Fleet (ESF) created its Armament Department, it has effectively leveraged the strengths of the new system. It has pioneered a new support model, streamlined resource allocation, built specialist teams, and deepened civil-military integration, thus enhancing management, use, repair, and validation of equipment and achieving a qualitative leap in equipment support capabilities. These reforms have done much to assist the building and development of fleet warfighting capabilities.*

### **Pioneering a Support Model: Using Various Means to Cope With Constantly Changing Mission Requirements**

At the beginning of 2013, when leaders from the ESF Armament Department made an inspection of a certain [unnamed] submarine force, they discovered that, because they lacked deep understanding of the performance capabilities of their equipment and had concerns over whether or not equipment was capable of performing a given function, some submariners lacked a sense of security and confidence when using equipment.

The Armament Department leaders felt that the problem was quite serious. They believed that not only was it necessary to ensure the “hard support” of fleet equipment; it was also important to ensure that submariners were able to safely use and manage equipment (i.e., provide “soft support”) This is the only way to resolve submariner anxieties about the safe performance of their equipment, and enable them to have peace of mind while on distant deployments.

Very quickly the ESF's Armament Department included strengthening confidence in using equipment into the submariners' training regimens. They invited experts from research institutes to visit submarine bases to launch training programs on safe use and repair of equipment, providing detailed instruction on

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<sup>1</sup> *Jiefangjun Huabao* (English name: *PLA Pictorial* - A twice monthly magazine published by the PLA Press.); 2013, issue 7b, pp 6-17.

topics ranging from overall submarine design, and equipment reliability, viability, and emergency operation to matters like dressing around pipes and valve repair. They also met with submariners to discuss and analyze methods for dealing with sudden malfunctions. Not only did these initiatives raise submariners' maintenance abilities; it also removed their confusion on these issues.

As the fleet takes on more varied missions, and areas of operations expand from the Near Seas to the Far Seas, and naval forces (*biandui*) more frequently cross areas to conduct war fighting operations and military operations other than war (MOOTW), requirements for equipment support increase. The Party Committee of the ESF Armament Department feels that given their responsibility for equipment support, they must maintain the equipment in top technical condition, regardless of how situations develop or change, what type of operations are conducted or forces used, or the intensity of the operation. At the same time they must leverage each piece of equipment's maximum support potential, and maintain maximum war fighting effectiveness. The Department needs to be able to cope with constantly changing mission needs while simultaneously maintaining a constant standard for equipment support.

In practice, their basic approach was to generate a new equipment support model. They would focus on changing equipment support from pure hardware support to comprehensive hardware and "software" support [meaning both the physical and human aspect of equipment support]. They would change from pure shore-based support to a combination of shore-based support and underway support, and from personnel-intensive support to a leaner and more efficient support approach.

Last year's Sino-Russian joint naval exercise was the first trans-regional support operation following the creation of the new fleet armament departments. PLA Navy forces used integrated shored-based support/underway support, self-support and technical self-assistance, equipment inspection and monitoring and proactive equipment inspection and repair, and both dispersed and concentrated use of technical personnel, providing multi-dimensional equipment support and ensuring that Chinese participants experienced zero malfunctions during the exercises.

The record achieved by equipment support cannot be assessed merely on the basis of how many pieces of equipment were repaired or how many tasks were completed. Rather, regular efforts must be made to reduce the need for repair, moving away from emergency support toward preventive support. Ensuring the ships are able to fight at any time is the overarching aim. For this purpose, the ESF created three expert groups: surface vessel and submarine equipment technical support groups and a ship equipment repair advisory group. They invited more than 30 experts to serve as technical consultants, to serve as advisors for personnel dealing with major technical problems. Beginning in February 2013, the ESF created six system technology units, comprising a total of more than 180 experts and technicians, to perform inspection and appraisal work on the condition of weapon systems on the vessels under their purview. Within the span of a few months, they resolved more than 100 malfunctions, and made over 30 advisory proposals on equipment use.

### **Streamlining Resource Allocation: Using a Five Finger Approach to Remedy Support Weaknesses**

At the beginning of 2013, a pier at a certain [unnamed] shipyard was crowded with people, waiting

“in full battle array.” During the span of one tidal period, three submarines, representing 3 different classes, slowly entered their berths. On this day, a new precedent was set in which multiple submarines could enter for dock repairs during the course of a single tidal cycle. It created an example of success for submarine repairs.

“In the past, it would have been unimaginable for three submarines to berth at the same dock for simultaneous repairs. Not long after the ESF Armament Department was established, for the first time the Navy attempted equipment support conglomerate (*qiye jituan*) operations, turning the four formerly independent shipyards into a business conglomerate, resulting in savings due to economies of scale. This raised their comprehensive ability to support naval ships. During this particular event [i.e., the abovementioned three submarines coming in for maintenance at the same time], we leveraged the strengths of both the Shanghai and Ningbo plants, adopting measures such as concentrating support resources, improving project management and simultaneously performing maintenance work. Maintenance expected to take three months was completed one month ahead of schedule,” Xu Changhong, head of a certain [unnamed] shipbuilding plant, proudly tells the reporter.

Turning the impossible into the possible, turning the unimaginable into reality – this is a microcosm of what the ESF Armament Department has achieved since it began to deepen system reform.

Before the fleet Armament Department was established, each support unit just focused on its part. There was conspicuous duplication of effort. Some units’ allocation of tasks was not ideal; some support configurations were not effective enough; some resources were idle, their capabilities inadequate. How does the fleet use limited resources to realize their greatest possible utility? The Party Committee of the ESF Armament Department felt that what was needed was an effort to improve economy and efficiency, and enhance use of resources in order to improve support capabilities.

Given the characteristics and support needs of the new system, they focused on the overall arrangement, prioritizing the front line needs, the most important goals and the key areas. They gave priority to construction of support capabilities for newer, more important equipment, working on the most pressing issues first and expanding from there. Moreover, they sought to enable equipment support forces to make the transition from peacetime to wartime; strengthen top level design, make functional adjustments, and eliminate bureaucratic interest barriers between support units; rationally allocate support tasks, and adopt regional collaboration, plant/research institute cooperation, and plant/navy complementarity; consolidate strengths and remedy weaknesses; and use abundance to remedy scarcity, to ensure that each support organization operates more rationally.

Raising quality and efficiency, means raising the Navy’s support capabilities and fighting prowess. Using wartime reserves, front line installations and commonly used patterns, the ESF Armament Department proposed a new program to integrate supplies stored in warehouses along the routes to Zhejiang, Shanghai, and Fujian. They moved supplies in order to make support faster, more efficient and more convenient. They created a fleet factory management committee, established a factory conglomerate, forming a more efficient comprehensive support capability. They also integrated different support units, making equipment support services more nimble and flexible, and mutually reinforcing.

The enhanced integration of resources spawned a high efficiency fusion of support capabilities. In the large exercise that took place in the first half of 2013, the ESF Armament Department transferred a highly capable support force from each unit to comprise a unified deployment, and they smoothly completed their tasks. Compared with similar sized exercises in the past, they used 27 percent fewer personnel, with time required for support tasks decreasing by one-half.

### **Forging Specialist Teams: Leveraging Intellectual Strengths to Break Through Support Bottlenecks**

At the end of 2012, an equipment technical support drill under simulated wartime conditions was conducted in a certain [unnamed] section of the East China Sea. A large number of technical experts from the ESF Armament Department were active on the front line. Many of their innovations were employed in the drill, with marked improvement in the speed in which damaged equipment was repaired.

Since it was established, the ESF Armament Department has focused on the needs of winning the informatized naval battles of the future, recognized the importance of building human capital, and constructed a highly expert and omni-competent corps of talented technicians.

The ESF's Armament Department, responding to the demands of being able to "fight and win victories", has implemented more than 10 different measures, including "The Five Year Plan for Building a Corps of New Type Support Technicians," in order to create a pyramidal structure of expert personnel; scientifically create complementarity between on the job training and more focused training opportunities, linking practices at the fleet with military educational institutions, connecting large and important tasks with R & D efforts in research institutes, creating a new integrated training model involving military education and local civilian training; select outstanding technical cadres to take leadership posts, to set up a beneficial leadership system whereby "experts are in positions of leadership" and "those with knowledge of the subject manage affairs"; and require shipbuilding plants to set up training centers at locations along the routes to Shanghai, Zhejiang and Fujian, adopting a training model whereby "when the ship is being repaired/maintained, the crew are in the classroom," effectively strengthening the ability of crew members to engage in self-study and self-help.

The implementation of these measures made the Armament Department become a gathering place for high level technicians from throughout the fleet, spawning a new type of technical personnel with deep theoretical knowledge and advanced information capabilities and is technically adept and highly innovative. Dozens of personnel from the Department have received national and military-wide recognition for their achievements, including numerous awards for their innovations.

### **Deepening Civil-Military Integration: Leveraging Others' Capabilities to Solve Difficult Problems**

In the early summer, not long after the start of a large scale exercise, two of the new class of frigates from a certain [unnamed] detachment (*zhidui*) experienced a malfunction at the same time. They urgently requested help from the ESF Armament Department's "Civil-Military Combined Equipment Support Command Center." The Command Center ordered a mixed task force of 25 civilian experts, called a "ship equipment technical support group," to immediately board the frigates

and begin repairs. At once, eight trucks carrying specialty equipment began heading towards the pier.

The majority the people making up the 25-person task force of civilian experts had taken part in the design and R & D of related equipment, and they had a rich professional knowledge and maintenance experience. Under the unified command of the Armament Department, they resolved the malfunction well within the time required by regulation.

Failure is the mother of success. Once, during a combined exercise, a ship from a new [unnamed] class of ship suddenly experienced a malfunction with its shipborne radar. Because that ship had only recently entered the fleet, the Armament Department requested help from the shipbuilder. But because they lacked a mechanism for cooperation and had no established means of contact, by the time the civilian experts arrived on the scene they had long exceeded the time frame required by regulation. Therefore, the ship with the radar malfunction had no choice but withdraw from the exercise.

This incident led to deep reflection among the leaders of the Armament Department. During a Department standing committee meeting speech, the head of the Department, Zhang Jingle, said, “we need to grasp the trend, liberate our thinking, solve the difficult problems that impede integrated development, boldly establish both the status and effectiveness of civilian support forces within the fleet equipment support system, to maximize their potential contributions, create both a broad and deep civil-military support system, and realize a  $1 + 1 > 2$  development model.”

They began by setting up and perfecting a ship equipment support mobilization system, then created a combined leader small group including both military and civilian leaders. After that, they thoroughly acquainted themselves with 40 ship equipment repair and manufacturing companies, learned the capabilities of local ship repair and shipbuilding groups, and selected a number of capable firms able to quickly transition from peacetime to wartime activities to serve as a backup force for when emergencies arise.

On the basis of intensive investigation and repeated validation, they set up a new model for support for ships on deployment, which involved framework agreements, PLA factories, and other specialty units. In March 2012, the ESF Armament Department and 36 local support units signed a framework agreement on ship equipment technical support, signifying the normalization and regularization of fleet civil-military integration on equipment support. The ESF has also established a working relationship with over 100 local civilian industrial departments, thereby creating a corps of equipment support personnel.

The deepening of civil-military integration has gone a long way to shorten equipment support timelines and raise equipment support efficiency. At one drill, a certain [unnamed] ship was at sea when it dropped anchor and reported an emergency: the navigation compass had experienced a breakdown and the ship requested technical support. Three experts from the factory that manufactured the navigation compass arrived at the ship within three hours to begin repairs. Once, a certain [unnamed] type of missile experienced an instruction failure during a launch readiness transition operation. An ordnance technology group immediately organized experts to conduct an investigation. They located the malfunction in a certain [unnamed] manifold and immediately resolved the issue.

With respect to the true benefits that come from civil-military integration, Cheng Chongxi, Senior Engineer in the ESF, has a deep impression. A certain [unnamed] new radar was unable to collect data; this problem was a longstanding issue for the ESF and the equipment support department. With the support of the Party Committee of the Armament Department, Cheng Chongxi used a cooperative agreement signed with Tsinghua University (Beijing), to innovate a solution. Since then, a new model of radar detection equipment has already been successfully developed.

## CAPTIONS

Caption 1: Since it was set up, the ESF Armament Department has clearly demonstrated the superiority of the new system, leading to huge improvement in the fleet's ability to perform equipment support and providing a powerful aid to the development of the fleet's combat forces.

Caption 2: The Party Committee of the ESF's Armament Department in action commanding forces.

Caption 3: Calibration of accuracy of a ship guidance radar is performed.

Caption 4: Changing the model for delivering supplies, by direct delivery onto vessels. Caption 5: Using advanced monitoring instruments to monitor operation of the main engine.

Caption 6: The start of an emergency repair exercise, to raise support capabilities in a real wartime environment.

Caption 7: Degaussing a warship that is about to embark on extended deployment, giving the warship "invisible wings."

Caption 8: Conducting testing of metal particle content of ship fuel.

Caption 9: Setting up digitized, three dimensional warehouse, raising the efficiency of warehouse management.

Caption 10: Transportation of supplies, realizing optimized integration of resources.

Caption 11: Integrating maintenance forces; multiple vessel types simultaneously entering the shipyard for maintenance, raising maintenance efficiency. Caption 12: The high-speed fluid injection device

(*kuaisu zhuanzhi zhuangzhi*) invented by NCO expert Chen Qinshi remedied a Chinese equipment gap; it has been widely adopted.

Caption 13: The establishment of a radar and ordnance support expert group has helped improve radar and ordnance support capabilities.

Caption 14: A cohort of expert, omnicompetent technicians is active on the front line.

Caption 15: A new-class guided missile fast attack craft undergoes maintenance.

Caption 16: Military and local civilian experts work together, pooling their forces to tackle problems.

Caption 17: Powerful equipment support has effectively raised fleet warfighting capabilities.



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## Attack of the “Iron Shark”—The Party Committee of an Eastern Theater Command Navy Submarine Flotilla Focuses on Actual Combat to Bolster Its Ability to Prevail in Combat<sup>1</sup>

Lian Wei and Zeng Ningning

Since it was established, this submarine flotilla (*zhidui*) has completed combat readiness patrols, extremely deep dives, exercises and drills, and other major tasks. It has set many iconic records such as traversing the first island chain for the first time and live firing (*shishe*) a certain type of weapon. On April 12, 2018, a submarine belonging to the flotilla gloriously received an inspection from Chairman Xi during the fleet review in the South China Sea. In recent years, the flotilla has devoted itself to the Party and valiantly carried out its mission, superbly completing a series of major military tasks, establishing many paradigms for the People’s Navy’s submarine force, and being recognized on multiple occasions by its superiors for being an advanced work unit. It has produced “the first operator of the AIP system for Chinese submarines,” Xiao Haisheng, the “most beautiful new era revolutionary soldier” in the military, Hu Xiaozhou, and other renowned members of the Navy. In June 2021, the flotilla’s Party Committee was recognized as “the Navy’s advanced Party Committee for the struggle in the new era.”

It is high summer at the naval harbor of an Eastern Theater Command Navy submarine flotilla. A sculpture inspired by the theme of “winning victory” is majestic and powerful under the sunlight, impressive to all who view it. The sculpture shows the sea bed with its peaks and valleys, a spectral submarine cruising through the water, and a torpedo leaving its tube...Every element in the statue is recounting a story of a powerful military in which the officers and enlisted in the flotilla are training and preparing for war and chasing victory.

In recent years, under the guidance of Xi Jinping’s thinking on building a powerful military, this flotilla’s Party Committee has persisted in viewing combat power (*zhandouli*) as the sole fundamental standard [of success]. It has energetically observed the spirit of the “iron shark” and led the officers and enlisted as they advanced to the deep blue and fiercely battled (*ao ’zhan*) the great oceans. It has satisfactorily completed live firing of multiple types of weapons, combat

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<sup>1</sup> 练伟, 曾宁宁 [Lian Wei and Zeng Ningning], “铁鲨”出击—东部战区海军某潜艇支队党委聚焦实战提升打赢能力 [“Attack of the ‘Iron Shark’—The Party Committee of an Eastern Theater Command Navy Submarine Flotilla Focuses on Actual Combat to Bolster Its Ability to Prevail in Combat”], 当代海军 [Navy Today], no. 10 (October 2021), pp. 21-24.

readiness patrols and long-distance [deployments], and other major exercises and training tasks. The flotilla's ability to fight and win has greatly improved.

### **Connecting with the Battlefield While Managing Training with a Heavy Hand**

It was an experience that AIP technician Liu Daohai would never forget. While his submarine was carrying out a major task, a valve suddenly began to give off smoke. If this was not handled quickly, it was highly likely that this piece of equipment would catch fire. Such an outcome would not only cause a huge economic loss; it would also impact the performance of the mission.

All the submariners were rattled! Liu Daohai did not have time to think too much about the situation. He quickly headed over to the point of failure. After carefully inspecting the equipment, he relied on his good professionalism (*zhuanye suzhi*) to carry out repairs on a key module without any spare parts or components, and the malfunction was successfully resolved.

“Only by engaging in rigorous training in normal times can one rise to the challenge without panicking during a critical moment.” Liu Daohai says, the future battlefield will have too many uncertainties, such as mechanical malfunctions, sudden dangers, etc. This [prospect] forces crew members to train in a focused and rigorous manner, continuously removing the uncertainties of the battlefield with the certainties of skills for victory.

----- p. 22-----

“If normal training is not real, if it is false, then one will certainly suffer huge setbacks and lose battles on the battlefield.” Throughout its ranks, the flotilla is unwavering in its commitment to strict and disciplined training (*congyan zhixun*), letting strict and disciplined training permeate every detail and rectifying every aspect [of training].

“Train and assess against the upper limits of the [training] outline, and train in a way that is close to real combat [conditions].” As submarine captain Yang Lu relates, when conducting daily training on a subject [such as] changing the submarine's depth (*bianshen*), the [training] outline stipulates several levels, but he and his crew always reference the highest indicator, demanding the strictest level of training.

Conscript sailor Zhang Hengrui adjusted the trim of the submarine (*dazongqing chuzhi*) in one fluid motion. It looked perfect. But he did not receive a “perfect score” from submarine captain Chen Lin. Subsequently, Chen Lin walked Zhang Hengrui through each step in the process, showing him the details of the operation, with repeated training on the simulator until finally Zhang Hengrui received an outstanding assessment. This year, due to his outstanding performance, Zhang Hengrui was easily approved to become an officer (*tigan*) and entered an academic institution for further studies.

A submarine stays hidden for several days in an unnamed location. The submarine begins to head home to base when it suddenly receives an order to “attack” (*chujì*). The challenge for submarine captain Lu Min is that information about the opponent is extremely sparse. Finding the opponent in the vast ocean would not be easy, but to attack covertly would be even more difficult. The boat's crew rises to the challenge, rapidly using limited information to conduct

analysis and make judgments to determine the ambush point. One day, then a second...time seems to pass very slowly on the submarine.

“Report, captain, I’ve discovered a suspicious target, bearing XX!” In a flash, the navigation, command and control, acoustic confrontation (*shengkang*), and other combat stations quickly entered a combat status...at this moment, the “enemy” ship is locked onto [by the submarine], becoming the submarine’s prey.

When submarines conduct maritime operations, it has become normal not to formulate plans (*yu’an*), not to set timing [for operations] (*bu ding shiji*), and not to delineate an area [for operations] (*bu hua fanwei*). Although the risks associated with training have risen as a result, commanders trust that the more rigorous the training the less likely there will be problems, that the greater the emphasis on passive security then the less security there is.

Rigorous training (*congyan zhixun*), raising a “hard bar” for assessment. “During a damage control drill, a power control box at a submarine pier catches fire, and it takes too long to provide water to the scene.” “During a damage control drill in unlit conditions, a submarine pipe is damaged and the pipe is not shut off properly.”...Flipping through the work reports, the flotilla’s pier joint inspection group carefully records these items from damage control drills into the file.

Today, the heavy-handed approach to training (*tiewan zhixun*) makes everyone feel an alarm bell in their hearts and a sword hanging over their heads.

### **Promoting Transformation While Innovating and Seeking Change**

A few years ago, submarine captain Lu Min experimented with an autonomous full-subject training mode, doing so without any references from predecessors and without any experience of his own. In recent years, the flotilla has carried out two instances of full-subject training reform innovation.

In that year, the winds were strong and the waves were high. An anti-submarine warfare (ASW) force comprising surface combatants and ASW aircraft had set up traps everywhere, waiting for the opportunity to “hunt sharks.” Submarine captain Zhang Aiping, however, drew from his at-sea experience and directed the crew to innovate their tactics. They superbly avoided being caught and successfully carried out a counter “hunt” against the surface combatants, winning great praise.

Studying war and knowing war is the only way to win in war. Standing in the great tide of the Navy’s transformational construction, they regard research into operational problems and tactical innovation as the most effective way to promote the generation of operational capability. They closely track the operational mission, operational opponent, and operational environment; vigorously engage in research on maximizing the performance of submarine weapons and equipment, tactical and warfighting innovation, etc.; actively adapt to changes in the pattern of warfare, combat styles, etc.; and continuously improve their capability to prevail in future wars.

During an exercise, one of the crew's teams studied and analyzed the force use patterns of the opponent to unearth weapons performance and innovatively apply the tactics of "pointing to the east but striking in the west" (*zhi dong da xi*).<sup>2</sup> Under the waves, just when the opponent believed they had a target lock, they were unaware that our torpedo was completing the fatal blow.

Innovation should focus on what is most needed in war. The flotilla always regards the improvement of combat effectiveness as the goal of innovation and strives to solve shortcomings and weaknesses in organizing training and equipment management to ensure that every result can connect to the future battlefield, and every breakthrough will serve in the construction of combat effectiveness.

—In response to the problem that mass training competitions are not closely related to actual combat, they have innovatively carried out "systematic" tactical operations competitions and "challenger" submarine attack and defense competitions. The crew was able to find problems, solve them, and improve their capabilities in a more realistic combat environment.

—In light of the fact that the level of crew practice is uneven and the efficiency of unit training is low, a team of crew members produced a set of teaching videos for basic submarine skills so that crew learning is more autonomous and convenient, and basic training more solid.

—To deal with the gaps in training of certain combat subjects, a team of crew members in cooperation with the training of brother units had the courage to innovate and took the initiative to set training precedents and enrich their style of combat.

Additionally, they paid attention to keeping with the PLA's fine tradition of military democracy (*junshi minzhu*) and actively advocating for the pioneering spirit by extensively carrying out activities such as mini-inventions, mini-creations, mini-innovations, and mini-improvements to continue stimulating vigorous innovation in the officers and enlisted and drive increases in unit combat effectiveness.

The "submarine charging generator multi-purpose control device," invented by diesel engine technician Wu Gang, can ensure the charging generator can still work reliably when its control equipment fails. It has been dubbed a "protective talisman" for the [submarine's] power system. A dedicated teaching circuit connection board designed and produced by electrical technician Pan Yuanping meets the crew's needs for skills training such as assembly and disassembly of electrical equipment, wiring practices, circuit analysis, and troubleshooting, which has proven popular with officers and enlisted.

"In the past, we have blazed a good path and achieved many gratifying achievements by relying on innovation. In the future, we will achieve more impressive results by also relying on innovation." In discussing innovation and transformation, flotilla political commissar Liu Hao was deeply touched.

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<sup>2</sup> **Translator's note:** The phrase "pointing to the east but striking to the west" means deceiving the enemy into believing one will attack a particular location while actually attacking another.

## Taking Responsibility for Risky Challenges

Open the main ballast valves (*zhushui xuancefa*), start the fast ascent automatic control device (*kuaipiao zikongyi*), open the top cover of the fast ascent tube (*kuaipiaotong shanggai*) ..... That year, crew team member Li Shilong took the initiative to participate in the finalization tests of a certain type of single-person fast ascent escape equipment (*kuaipiao tuoxian zhuangju*). During the action, he responded calmly, completed a series of actions in one go, and successfully “escaped” from underwater.

How can one dare to advance without courage and valor? Officers and enlisted admit that while navigating the deep sea every inch of sea ahead of the submariners is full of risk and challenges. But they always firmly believe one truth: submariners are not afraid of death and those that fear death are not submariners.

During one mission, a crew team quietly approached an “enemy” surface ship.

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Suddenly, the submarine encountered an ocean thermocline. Meter by meter ..... the speed of the submarine’s descent continued to increase.

Submariners all know that in this situation, if there is no emergency surfacing, the submarine may drop to the sea bottom and break apart under the immense pressure of the seawater and take on water, structurally disintegrating.

Pump out the water, increase speed ..... The crew worked closely and slowly stabilized the attitude of the submarine. But the greater challenge still lay ahead.

“Report captain, signal detected with bearing XXX.” At this time, surface ships were organizing anti-submarine searches. As the submarine continued its ascent, it would very likely expose itself.

The brave will always prevail in a face-to-face encounter. Then captain Hu Xiaozhou decisively ordered [the submarine] to enter below the thermocline to hide. The drastic changes in the density of sea water make submarines like small vessels tossed around by huge waves, making maneuver difficult and risky.

After hours of fighting, the crew overcame the thermocline layer and fought a fine battle. Hu Xiaozhou, named “the most beautiful revolutionary soldier in the new era” this year, told us: only by daring to face the test of life and death can we truly shoulder the burden of defending our country.

The longer peacetime is, the more it is necessary to mold the valor and courage of officers and enlisted. The flotilla’s Party Committee clearly realized that with the accelerated pace of military training and preparations, the use of forces and frequent live-firing of weaponry corresponds with a multiplied factor of risk. Only with strong professional skills and undaunted valor can we withstand [these] hazards.

“Those that work hard on the training ground will dare to charge [forth] on the naval battlefield.” Flotilla leader Fang Yuegang explained that they have long advocated the quality of being unafraid of hardship, willing to endure hardship, and able to endure hardship, even great hardships. [They] find ways to simulate the atmosphere of actual combat, create difficult settings for training, and constantly boost their spirits and temper true valor.

Night falls and the sea breeze blows. After a busy day, the crew strolls through the docks of the military port and the heart-warming battle song comes to their ears.

“Iron courage is blood, and fearlessness is devotion; the test of blood and fire is the glory of the soul of a soldier; the calmness of life and death forges a true hero with an indomitable spirit!”

The “Iron Shark” attacks and moves forward bravely. The blood of submarine officers and enlisted are rooted in the heroic spirit of “departing is to go into battle and to dive is to enter combat.” It has been internalized as a symbol and has become a nameplate and mark that will always be postured to charge [into battle] and overwhelm all enemies. In each attack, battle positions will be cast into “steel positions,” forging a strong maritime force that can attack and defeat [an enemy] and defend strongly. When the motherland and the people need it, they live up to their trust and mission.

Liu Hao (a submarine flotilla political commissar): Chairman Xi profoundly directed that the Party Committee should make war preparation and warfighting its first priority. As the Party Committee of a frontline unit, we must consciously assume our duties, earnestly grasp war affairs, and be ready to fight at any time. It is necessary that we instill a clear orientation for war and make real planning and research and real preparation a major political responsibility and a practical action done out of absolute loyalty to the Party. We must scientifically coordinate various work to ensure it is all focused on war preparation and warfighting. We should focus on the fundamental goal of winning wars and insist on taking the lead in researching military affairs and warfighting. We should take the lead in discussing training, implementing training, organizing training, and taking part in training. In real combat and actual preparation, we can continue to solve issues in warfighting and explore the mechanisms for winning. It is necessary we lead units in actual combat training and implement the requirements of integrating peace and war. This should be based on the most difficult and complex situations and focus on using combat to lead training, training troops systematically, and conducting confrontational testing. We should dare to train troops in complex and unfamiliar sea areas, dare to challenge them with difficult subjects, dare to use the enemy to train the troops (*nadi lianbing*), and fight against the powerful enemy (*qiang di*).<sup>3</sup> We should make great efforts to resolve the shortcomings, weaknesses, and tough problems that impair war preparations and warfighting, and effectively improve the hard power of units.

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<sup>3</sup> **Translator’s note:** The term “powerful enemy” (强敌) is a common euphemism for the United States.



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## Problems with Managing the Use of Warship Damage Control Equipment and Suggestions for Optimization<sup>1</sup>

Deng Kaiyong, Yin Hui, and Shu Xiong<sup>2</sup>

Damage control equipment (*sunguan qicai*) are effective tools for controlling the spread of dangerous conditions when a warship experiences a sudden situation. Currently, a warship's equipment for plugging leaks (*dulou qicai*) are mostly placed within the damage control locker in damage control locations (*buwei*) or placed against the wall, the fire hose reel is in the hose box, and the firefighting suits and other emergency use equipment are likewise stored in boxes and bags. Under emergency conditions, crew members cannot handle sudden incidents with the utmost speed, damage control is delayed, and the best opportunity for damage control may even be missed. The survivability (*shengmingli*) of a warship is affected by unseen safety hazards. In order to improve the efficiency of warship damage control and achieve the aim of rapid damage control, this article will first analyze the current situation with respect to management of the use of warship damage control equipment. On that foundation, it will then offer suggestions for optimizing the management style for the use of leak-plugging equipment, water hose boxes, firefighting suits, and special maintenance tools, clearly demonstrating the real effects of this optimization. This article provides a frame of reference for scientific optimization of warship damage control equipment on other warships.

### 1. Problems with the Current State of Warship Damage Control Equipment

For Chinese naval vessels, when engaging in daily management, conducting far seas training, and performing various tasks, the configuration and management of damage control equipment is extremely irrational. Getting and using the equipment is inconvenient, equipment configuration is unscientific, and the standards of configuration are not uniform, among other problems. This greatly impedes improvement of the damage control capabilities of the crew members and limits the ability of warships to deal with sudden damage.

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<sup>1</sup> 邓开勇, 尹辉, 舒雄 [Deng Kaiyong, Yin Hui, and Shu Xiong] 舰艇损管器材使用管理存在问题及优化建议 [“Problems with Managing the Use of Warship Damage Control Equipment and Suggestions for Optimization”] 中国修船 [China Ship Repair], no. 2 (April 2017), pp. 23-25.

<sup>2</sup> The authors work at the 6<sup>th</sup> Landing Ship *zhidui* of the Southern Theater Command Navy (i.e., PLA Unit 92692). First author, Deng Kaiyong, is an engineer who specializes in warship equipment maintenance and management.

### 1.1 Storage management of damage control equipment is irregular

- 1) There are limited lockers and baskets for damage control equipment throughout the ship, and the quantity of damage control equipment greatly exceeds the available space. Therefore, excess parts are placed at random, which is bad both for managing and using them.
- 2) Designs for the location of damage control equipment lockers (or baskets) are fairly ill-considered, and there is a lack of research into the form and size of the damage that the ship might receive, as well as the degree of impact this damage might have on the survivability of the ship, when configuring damage control equipment. For example, when seeking to use equipment in damage control boxes designed for the passageways, the corner of the compartment, or inside the compartment, one must spend lots of time in search of equipment suitable for the situation, which severely impacts the implementation of damage control.

### 1.2 Current damage control equipment is configured irrationally

- 1) Existing leak-plugging damage control equipment is old. Warships are chiefly

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- equipped with leak-plugging boxes, leak-plugging plates, rib supports, metal struts, wooden struts, wooden plugs, and leak-plugging equipment for wrapping pipes. With the continuous upgrading and advancements in warship equipment, existing damage control leak-plugging equipment increasingly seems old and antiquated. For example, some leak-plugging equipment cannot be used due to limitations caused by the location of the breach, while some damage control equipment is subject to strict limitations on the environmental conditions inside the damaged compartment. Existing damage control equipment normally requires the collaboration of multiple people in order to function. However, if a warship suffers damage, the atmosphere in its compartments is normally complex and confused, and the space is small and not conducive to multiple people working simultaneously.
- 2) New-type damage control equipment is not provided in a timely manner. With the growing recognition of the importance of warship damage control, research on damage control equipment is continuously deepening, so we have seen the introduction of some effective new-type damage control equipment, such as rapid leak-plugging tools, inflatable leak-plugging life-saving equipment, inflatable piping bandages, rapid repair agents, fast-drying adhesives, welding pens, quick-drying cement, and splice-able steel plates. These have greatly improved the efficiency of warship damage control, but currently only new warships are equipped with them, and their numbers are limited.
  - 3) Some firefighting equipment configurations are not conducive to efficient damage control. The key to warship damage control is speed and efficiency, but unlike

foreign warships our ships' water firefighting equipment is still in boxes, so damage control requires the cooperation of multiple people to perform a series of actions such as connecting to the fire hydrants and letting out the hoses. This severely impacts the efficiency of firefighting damage control.

### 1.3 The standards for damage control equipment are unscientific

- 1) The centralized management of damage control equipment is fairly fragmented. At present, the damage control equipment of naval forces is issued, supplemented, and replaced by navigation support departments (*hangbao bumen*), while equipment departments (*zhuangbei bumen*) are responsible for the servicing and management of damage control system equipment when it malfunctions. As a result, the departments that issue equipment are not adequately cognizant of the situation with respect to equipment use management, and they are unclear about the situation related to equipment use and suggestions for improvement.
- 2) The standards for damage control equipment are unscientific. When warships are fitted out, in many cases the damage control equipment standards are too simple, and they are not formulated according to the service life limit of the warship, the layout of the ship compartments, or the circumstances under which tasks must be carried out to conduct timely repair. This is not conducive to their use. After new-type damage control equipment is installed on a warship, obsolete equipment is not removed in a timely manner. As a result, there are large quantities of damage control equipment aboard the ship and management is fairly chaotic. When damage control occurs aboard the ship, damage control members must select the applicable damage control equipment from among the masses of equipment available and then go to the scene to conduct damage control, thereby delaying the rescue effort.
- 3) The specifications and model numbers of damage control equipment are inconsistent. When damage control equipment is due for replacement, problems with inconsistencies in model numbers render their corresponding fixed installations incompatible to their use. Modifications must be made through temporary ship repairs. For example, when one particular warship left the shipyard it was equipped with a CO<sub>2</sub> fire extinguisher (6 kg) manufactured by a factory in Zhejiang province, which was later replaced with a CO<sub>2</sub> fire extinguisher (6 kg) manufactured by a factory in Qingdao. The diameters of the two extinguishers were different and so were their heights. As a result, the fixed frame used for the original extinguisher could no longer be used and had to be completely replaced.

## 2. Recommendations for the Scientific Optimization of Ship Damage Control Equipment

### 2.1 Establish functional areas and standardize the management of damage control equipment in each area

Corresponding functional areas should be increased according to ship damage control zones. While setting up the damage control station, several compartments or areas should be created as various functional areas, such as firefighting team gear donning areas, leak-

plugging equipment areas, drainage equipment areas (*paishui qicaiqu*), and special tool areas. Allocating each functional area with the relevant equipment will improve ship damage control capabilities.

- 1) Firefighter gear donning areas (*miehuoyuan zhuozhuangqu*). Firefighting gear donning areas can be set up in positions at or near each of the ship's damage control stations. Gear donning space should be reserved, and it should be equipped with the corresponding equipment, such as turn-out gear, firefighting breathing apparatus, helmets, gloves, fire boots (selected according to size), demolition tools, and rescue rope. Various stowage locations such as racks for helmets, turn-out gear, and breathing apparatus should be set up so equipment can be hung on the wall or stowed in open cabinets for convenient access in emergencies and faster rescue, as shown in figure 1.



Figure 1: Schematic of firefighting gear donning area

- 2) Leak-plugging equipment areas. Shoring materials are primarily used for preventing the spread of flooding, and they are typically used in compartments below or close to the waterline. Damage to these compartments is mainly caused by blasts or collision. Shoring materials are largely placed in the main compartments below the waterline (including compartments spanning the waterline), adopting a distributed stowage method to make them easily accessible and manageable. They can be secured on walls by hooks and support racks during placement for easy access, as shown in figure 2.



Figure 2: Leak-plugging equipment placement areas

- 3) Drainage equipment areas. Drainage equipment areas set up in required compartments should principally be assembled according to similar functions and should concentrate placement of the necessary drainage equipment in dedicated lockers or on bulkheads for easy access.

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Equipment allocated to these areas should mainly include submersible pumps, hoses, connections, power cables, filters, wrenches, and other equipment to quickly establish drainage when water enters the compartment.

- 4) Special tools areas. Specialized compartments such as damage control stations and machine repair spaces can set up special tool lockers or functional areas. These special tools are mainly demolition and repair tools used in damage control, such as cutters, expanders, expanding impact devices, portable hydraulic pumps, multipurpose pipe fittings and other corresponding equipment. [There are also] emergency-use tools for ship damage control, such as emergency engine shutdown, heavy demolition, and percussion tools. Such tools can be arranged in fixed areas and secured on walls to improve efficiency in their management, prevent their loss from improper management, and enhance emergency response capabilities.

## 2.2 Optimize damage control equipment configuration and improve efficiency in various types of damage control.

- 1) Configure rapid damage control equipment. Ship rapid damage control equipment mainly refers to the materials and tools required for rapid damage control emergency repairs, such as cutting, welding, leak-plugging, cleaning, and mending. At present, most ships are not equipped with new types of rapid damage control equipment. Equipping easy-to-operate, fast and efficient damage control equipment such as quick repairing agents, fast-drying adhesives, and welding pens can greatly improve the ship's damage control capabilities.

- 2) Modify existing hose boxes. Water firefighting is an important part of ship firefighting. Using a water hose to extinguish a fire often requires the coordination of many personnel to connect hoses, nozzles, and hydrants, which involves a fair amount of time. During the process of modifying hose boxes, we should remove hose box covers, leave space for hose placement near hydrants, wall-mount hoses, and pre-connect hoses and nozzles. This reduces steps such as unrolling hoses, connecting nozzles, and connecting to pipelines. In an emergency, crew can directly pull the nozzle toward the area on fire while another crew member cooperates with the nozzleman to extinguish the fire immediately after opening the valve. This only requires a total of 10 seconds at the same levels of training, which is two-thirds shorter than the original way of stowing hoses in baskets.
- 3) Distribute damage control simulation training platforms. To effectively ensure the survivability of the ship during emergencies when it is disabled in combat or there is a fire, simulator training platforms for pipe damage, plugging leaks, and compartment fires can be created and issued to units. Crew emergency response in damage control starts with strengthening crew member training to handle various modes of damage and improve their ability to rescue themselves.

### 2.3 Rationally formulate damage control equipment standards to improve the system of regulations in ship damage control.

- 1) Improve central management of damage control equipment. Centralized management of damage control equipment should be further regulated and should try to centralize its supply, management, and modification to the same department to avoid problems such as unclear responsibilities and inter-departmental gaps. This can facilitate the management and improvement of damage control equipment.
- 2) Scientifically formulate standards in damage control equipment allocation. With thorough study of ship damage control requirements, we should eliminate unsuitable damage control equipment, simplify their configuration, and strengthen allocation of effective equipment. At the same time, relevant regulations should be drawn up and damage control equipment should be updated, and old equipment eliminated or recycled in a timely manner and in accordance with the actual conditions of the ship.
- 3) Unify specifications and standards in damage control equipment. We should formulate product standards for damage control equipment. These standards should include various requirements on equipment specifications, materials, strength, manufacturing, storage, and replacement. At the same time, damage control equipment procurement systems [should be] strictly regulated, feedback mechanisms on the state of equipment use [should be] improved, and situations where equipment is unusable or difficult to use [should be] reduced.

### **3. Conclusion**

Optimized configuration and scientific management of damage control equipment are important guarantees for the survivability of ships. Through analysis of the current situation in damage control equipment management, this article offers recommendations for their optimization and implementation aboard the ships of operational forces on the basis of those recommendations. A look at the results of their implementation shows that optimized and modified damage control equipment has received positive feedback in terms of their use and management. This provides ideas for optimizing and improving the use and management of damage control equipment aboard other ships.



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## Analysis of Problems with Warship Damage Control Plans and Methods for Preparing Damage Control Plans<sup>1</sup>

Jian Huajun and Zhu Haishi<sup>2</sup>

“Damage control” (*sunhai kongzhi*, or just *sunguan*) refers to measures and actions taken by a warship for the prevention, control, and elimination of damage in order to maintain or recover its vitality (*shengmingli*). If a warship suffers an accident, this could result in major casualties among the crew and cause damage to the ship’s equipment; it might also impact the ship’s vitality. The crew’s

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normal level of damage control training determines the success or failure of damage control. In order to fully leverage the active role of crew members in damage control and fully leverage the effectiveness of damage control, a scientific and rational damage control plan must be prepared. The damage control plan resolves questions related to the deployment and responsibilities of personnel during the damage control process, according to certain principals and requirements. It scientifically and rationally arranges for crew members at their individual combat posts (*zhanwei*) to use corresponding equipment and materials (*qicai*)<sup>3</sup> to implement the correct damage control actions to ensure the vitality of the ship. The ship’s commanding officer (CO) should prepare and periodically revise the damage control plan based on the kinds of damage that could occur. The preparing of the damage control plan must focus on the overall situation, highlight the key points, and be rooted in realistic combat situations. The damage control plan has important guiding, learning, training, and risk management functions in warship management, and it can improve warship safety management. But in practical work situations the emergency response plan often suffers from problems such as being incomplete, being disconnected from the scene [of the action], and crew members doing their own things (*gezi weizheng*). To a large extent, this is attributable to irregularities in the preparing of the damage control plan and poor quality control. As a result, the important functions of the damage control plan are not being fully leveraged.

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<sup>1</sup> 翦华军, 朱海仕 [Jian Huajun and Zhu Haishi], 舰艇损管预案问题分析与编制方法 [“Analysis of Problems with Warship Damage Control Plans and Methods for Preparing Damage Control Plans”], 安全 [Safety & Security], 43, no. 7 (July 2022), pp. 41-46.

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<sup>3</sup> The term *qicai* (器材), often translated as “materials,” refers to utensils, tools, parts, and components.

By conducting research into warship damage control plans and summarizing methods for preparing damage control plans and aspects that deserve attention, [this article] provides guidance for warships to effectively conduct damage control actions. [It seeks] to make it easier to organize rapid and orderly damage control operations, enable crew members to coordinate and cooperate from their individual battle stations and [damage control] zones (*quhua*) during the damage control process, employ various types of technologies and means, control the expansion of the damage, successfully implement damage control actions, and reduce damages and losses as much as possible, ultimately achieving a correct and highly efficient damage control effect in order to ensure the ship's vitality.

## **1. Analysis of the Current Situation with Damage Control Plans**

### *1.1 The Current Situation with Damage Control Plans*

In recent years, all warships have revised and improved their respective damage control plans based on requirements from above. During this process of revising and improving plans, it was discovered that the plans widely suffered from problems with damage configurations (*sunhai sheding*), handling [of damage control] on the scene (*xianchang chuzhi*), the dispatching of personnel (*renyuan diaodu*), equipment use, and organization and command. These mainly manifest in the following ways:

- (1) There is insufficient emphasis on damage control plans. Due to a low level of professional knowledge, inadequate work experience, and a weak sense of responsibility among the personnel responsible for preparing (*bianzhi*) damage control plans, some warships take plans from other ships, make a few minor modifications, and then adopt them as their own ship's plan in order to cope with inspections from their superiors. Personnel responsible for preparing the plans do not conduct on-site investigation or analysis at combat posts or in ship compartments. Instead, they "divorce themselves from reality" (*bimen zaoche*) in their offices. As a result, the contents of the plan are incongruent with the real circumstances of the ship, and in the case of an accident involving damage the plan cannot serve as the basis for overseeing or handling damage control.
- (2) Damage control plan risk analysis is inadequate. Risk assessment done by ship commanders for each compartment and combat post is inadequate, risk identification is unclear, the ability to control risk and handle issues is not comprehensive, and there are no targeted measures for managing risk assessment results. Moreover, analysis of the possible impact scope of the accident and the possible derivative accidents that it might cause is insufficient. As a result, damage control plans are poorly targeted (*zhenduixing bu qiang*). First, risk evaluation is incomplete. The ship CO does not convene the drafting team to study and research identified risks for equipment in each ship compartment and combat post. Instead, they just rely on personal impressions and knowledge to determine scenarios, so scenarios are too simplistic. Second, the scenarios do not match real combat [situations]. Scenarios are not determined based on the extent of weapon damage. If the scenario involves the vessel suffering a missile or torpedo attack, the size and location of the breach are artificially set, and not to the most difficult, most dangerous, and most complex possible [scenarios]. [These assumptions] are unsupported by data, and evaluations of effectiveness lack specificity.

- (3) Damage control decision making lacks theoretical basis. There has been no serious research or analysis into the patterns of the occurrence and development of damage, and actions to handle [damage] lack theoretical basis. Damage control commanders do not command and make decisions according to the development of the situation, and actions to handle [the situation] are fairly arbitrary. The emergency response behavior for each combat post, zone, and damage control team is disconnected. There is a lack of content such as analysis and assessment of the characteristics and extent of vessel damage; methods, requirements, and issues deserving special attention when conducting damage control; and damage control effectiveness assessments.
- (4) The damage control plan is not focused. First, the assignments and responsibilities of personnel are unclear. The actions for each combat post, zone, damage control team, and all other personnel on the ship are overly simplistic, there is little cooperation between them, and responsibilities are unclear. Second, when multiple different procedures are activated at the same time, there is no clear sequencing order, so there are overlapping procedures or overlapping responsibilities. After a certain part of the ship catches fire, or water enters, or equipment malfunctions, or casualties occur, questions such as who will go and rescue [the injured], should the fire be put out first or should the leak be plugged first, and who does what, are unclear, and cooperation between crew members is poor. Third, organizational structure is unsound. The damage control plan leaves out organizations such as fire fighting groups, groups responsible for preventing the ship from sinking (*kang chen zu*), equipment groups, rescue groups, and assessment groups. Some warships lack a leading group (*daodiao zu*). During the training process there is incomplete control over emergency situations. In every case, they complete training according to procedure, and they do not provide leadership (*daodiao*) for all elements and all systems related to the damage.
- (5) Drilling on the damage control plan is incomplete, and revisions are not meticulous. First, damage control plan drills are mere formalities (*liu yu xingshi*), organization is lacking, and comprehensive drills are not conducted. Thus, the results of damage control plan drills are suboptimal (*bujia*). Second, after the damage control plan is developed, it is seldom subject to testing under realistic conditions. Do the actions of personnel from each part of the ship make sense, and are they feasible? Are there any missing actions? Can methods for handling [the situation] eliminate the damage? These questions are never verified. Third, revisions to damage control plans are not meticulous enough. After the vessel develops a damage control plan, the plan must be continuously revised according to changes in the situation. For example, if there are changes to vessel personnel, or if equipment is modified, and as the warship ages, the damage control plan must be revised accordingly.

## 1.2 *Analysis of the Causes of These Problems*

- (1) The personnel charged with developing the damage control plan have low levels of theoretical understanding. Commanders at each level on the ship lack deep and solid theoretical knowledge of the ship's compartment structure, damage control devices, damage control regulations, and the destructive effects of weapons on ships, and there is an attitude of impulsivity. The approach to learning is not closely connected to reality,

there is a lack of comprehensive understanding, and the aim of studying while engaged in training and training while engaged in study cannot be achieved.

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- (2) There is insufficient understanding of the role of the damage control plan. First, there is inadequate understanding of the importance of damage control plans. Among personnel of all ranks on the ship, there is inadequate emphasis on the aim and function of damage control plans, with misalignment in thinking and understanding. The assessments of ship COs are inadequate with respect to the severe consequences that might be caused by an incident. There exists a luck mentality (*jiaoxing xinli*): they believe that the vessel could do without a damage control plan, so they are unwilling to expend lots of effort on the damage control plan. Second, damage control plans are developed by just a few people, their suitability for real combat situations is poor, and there exists a fairly pronounced problem with other crew members being unfamiliar with the contents of the damage control plan. The majority of vessel damage control plans are developed by the ship's chief mechanical/electrical officer (*jidianzhang*), without participation from commanders from other levels on the ship. As a direct result, the development of damage control plans is regarded as a mere formality. Third, risk assessment, the transfer (*diao Yong*) of damage control equipment for use, and the emergency use of equipment are all regarded as mere formalities. The description of complex risks is not well-focused, and there is no comprehensive scientific analysis of the severity of incidents, scope of impact, or secondary damage.
- (3) Development work for damage control plans is weak (*bu zhashi*). The organizer of the drafting of the damage control plan (i.e., the ship captain) does not form a damage control plan drafting group and does not conduct scientific planning or [establish a] division of labor for preparing the damage control plan, much less formulate corresponding work plans. After drafting of the damage control plan is complete, a simulation (*tuiyan*) or review (*shencha*) is not organized, the views or suggestions of commanders at different levels are not widely solicited, and the contents of the damage control plan are not further optimized.
- (4) The complexity of damage control training is not fully understood, and there is inadequate recognition of the [the importance of being] brief, flat, and rapid (*duan, ping, kuai*) in damage control plans. First, damage control is imagined in terms that are too simplistic. There is a belief that complex damage control involves a fire starting and water entering at the same time, with the addition of casualties. Crew members train according to assigned responsibilities, each combat post reports up the chain on how they are handling the situation, the commander sends down orders, and the damage is successfully dealt with. This [approach] ignores the complexity of the damage. Second, damage control training is overly simplistic. It is just a simple overlay of damage control skills training. It ignores the fact that the important characteristic of complex damage control is the total factor (*quan yaosu*) [aspect]. It does not conduct damage control training from [the perspectives of] individual crew member actions, combat post coordination, organization and command, and the damage situation. There is fairly little training on escaping from danger (*renyuan taosheng*) under complex conditions,

searching for missing crew members, emergency handling of equipment, and abandoning ship.

- (5) The guiding role of headquarters departments (*jiguan yewu bumen*) is not obvious. Headquarters departments do not carefully investigate issues related to the surface fleet's damage control plans. In their work, they have prioritized delegation and under-emphasized implementation (*zhong bushu qing luoshi*). They lack whole-of-process supervision, do not track results, and do not hold people accountable, and they are even less willing to take a hard line on these issues. Education and guidance on newly-emerging (*miaotouxing*) and tendentious (*qingxiangxing*) issues lack depth, and assistance is lacking (*bangdai baguan bu yan*). As a result, warship crews have inadequate understanding of damage control plans, with damage control plan corrections, guidance, and inspection not occurring in a timely manner. When contradictions occur, people just walk around them.

## **2. Preparing the Damage Control Plan**

### *2.1 Overall Requirements*

- (1) The basis for preparing the damage control plan. Regarding the basis for preparing the damage control plan, there are mainly four aspects to consider. First, the damage control plan requirements as stipulated in the “Navy Military Training Outline”; second, the configuration of ship damage control equipment and materials and the personnel staffing situation; third, the ship's table of assignments (*bushu biao*); fourth, key parts of the vessel [related to] damage control and the damage that might be suffered.
- (2) Being clear about the role of the damage control plan. The ship CO should increase understanding of the importance of the damage control plan and clearly understand the role it plays in emergency response, fundamentally understanding that the damage control plan is used to handle emergencies. [The CO] must strengthen preparation and management of the damage control plan. [The CO] must strengthen the sense of responsibility among officers, must be forward thinking, must consider issues from the elevated perspective of science and development, and delegate responsibility in a reasonable manner. The damage control plan is not for show (*bu shi baishe*), and it is not just a means to cope with inspections. Rather, it should be continuously drilled during damage control training. Only by doing so will the crew not be panicked or perturbed and handle matters in an orderly way when an emergency occurs.

### *2.2 Issues that Deserve Attention*

- (1) Clear thought processes. A damage control plan must be prepared with a clear thought process. First, the damage situation must be ascertained, clearly determining primary and secondary [damage], followed by the resolve to handle the situation. Second, the importance of “limiting the spread” must be remembered at all times. [Ship crews] must adopt effective actions to control damage to the maximum extent possible, reduce or eliminate damage, and prevent the expansion or spread of damage to other compartments. Third, [crew members] must consider the impact that damage control actions will have on the equipment in the compartment [where damage occurred], in relevant compartments,

and on the combat post. Negative impacts must be eliminated, the combat power of the equipment must be preserved, and the ship's vitality must be recovered to the maximum extent possible. Fourth, the occurrence of secondary disasters must be prevented in a timely manner while handling the damage. Damage control cannot be treated in a narrow manner as simply preventing the ship from sinking and extinguishing fires. Rather, efforts to prevent sinking and extinguish fires should be closely integrated with the emergency handling of equipment. To the maximum extent possible, the supply of power and electricity to the whole warship should be maintained, the [ability to] use weapons and equipment systems should be ensured, and the ship's ability to maneuver should be ensured.

- (2) Emphasize “realistic” (*shizhanhua*) tabletop simulations (*zhuomian tuiyan*). Before preparing the [damage control] plan, the plan drafting group should take relevant scenarios and place them on a tabletop or aboard the ship. They should simulate the circumstances that might be encountered through every step of the process, discussing and determining the most reasonable and feasible measures. During the simulation, they must consider combat posts, zones, damage control teams, and support crew members from adjacent compartments. They must simulate the development of the damage situation, personnel coordination, and equipment use. After the tabletop simulation, they can then prepare the damage control plan.
- (3) Damage control data must be quantified. When preparing the damage control plan, relevant damage control data must be accurately calculated for different damage (fire) in each compartment. More calculations and comparisons must be done so that the data can be converted into intuitive phenomena and physical quantities, providing powerful bases for commanders to correctly judge the degree of damage and conduct scientific decision making. Every damage control action—the initial response by crew members at combat posts, initiation of the damage control response for the whole ship, resource allocation, emergency response, elevation of response, and the end of the response—should all be clearly described. For example, when the flow through a breach reaches a certain level the leak should be plugged and water removed first before dealing with the equipment, and when the volume of water entering the ship reaches a certain level the crew should abandon ship. The impact of the damage on the ship's floating stability should also be fully considered, and effective measures must be adopted in a timely manner in order to ensure the ship's vitality.
- (4) The setting for conducting drills related to the damage control plan should be realistic. On-the-scene drilling is a true simulation of a damage incident. The aim is to test (*jianyan*) and improve the

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damage control plan and make the plan more targeted. When simulating the accident, the damage control situation and course of events should be as realistic as possible, so that crew members feel that it is not an exercise and that a real ship accident has occurred. Equipment such as smoke generating devices, smoke canisters, and various types of leak-plugging simulation equipment should be used in order to increase the realism of the drill, so that those undergoing training can feel the battlefield and experience actual

combat, thereby strengthening their battlefield perception and real combat awareness. Those participating in training must be personnel assigned to that combat post or zone. The conduct of realistic drills can increase the ability of crew members to handle contingencies without surprise and [improve] their ability to adapt to the dynamic situations that occur during the course of a damage incident.

### 2.3 Drafting Process

The main work in the process of preparing the damage control plan includes the creation of a drafting group, research and collation of damage control materials, the drafting of a risk assessment report, analysis of damage control data, the drafting of the plan, revision and improvement [of the plan], and audit [of the plan]. The preparation of the damage control plan must prioritize the strengthening of realistic damage control capabilities under complex conditions, emphasize innovation in damage control training methods, deepen research on important and difficult points related to damage control, ensure the safety of the ship, and improve crew members' real damage control combat capabilities.

- (1) Establish a damage control drafting group. The damage control plan is an action plan implemented after personnel casualties, equipment damage, and fire and water damage occur. It involves each department and combat post on the ship. Drafting a damage control plan requires full cooperation from each department. A damage control plan drafting group should be formed with the ship captain as the group leader and participation from the executive officer and department heads. Moreover, the damage control team leaders, zone managers, compartment section leaders (team leaders), and rigging zone team leaders and combat post leaders and team leaders closely related to damage control should be included, with the group leader in charge of the whole drafting process.
- (2) Research and collate damage control materials. Damage control plan drafting must be created on a foundation of research on warships and damage. First, familiarity must be gained on the ship's overall performance, hull structure, the distribution of compartments and passageways, and the arrangement of systems, as this benefits the rapid analysis and judgment of a specific plan for the part of the ship that has suffered damaged (or is on fire). Determine the compartments and passageways fore and aft, port and starboard, and above and below [the damaged part of the ship]; what technical equipment is in the protection zone (*fanghu qu*); and how to safely enter the scene of the damage and what protective measures should be adopted by personnel. Second, information about the type, quantity, performance, function, distribution, and methods of use of the vessel's damage control equipment must be collated, and this information must be converted into a table indicating for each compartment what can be used and what damage control resources are available for support, such as firefighting checklist (*miehuoka*) and a checklist with items on the prevention of sinking (*kangchenka*). This is done so that when damage does occur personnel can rapidly know where damage control equipment is located, which parts of the ship to operate them, what equipment should be used and how much to use.
- (3) Draft a risk assessment report. First, before preparing the damage control plan the number and type of ship plans should be determined. [It must be determined] whether the plan is based on equipment (*zhuangbelei*) or based on common subject class (*gongtong*

*kemu lei*), whether it is comprehensive (*zonghelei*) or specialized (*zhuanxianglei*), and whether it is for the combat post, zone, or for the whole ship. The ship's plan for preventing sinking should take the ship's main watertight compartments as the smallest unit, and the type and number should cover all compartments below and across the waterline. The ship's firefighting plan should include main compartments such as the engine room, ammunition storage, the bridge, and the operations control room (*zuozhan zhihui shi*). Other compartments should prepare a combined plan encompassing the same watertight compartment and same deck. Second, risk analysis should be highlighted and the key parts of the plan and important sources of danger should be clarified. The primary task of the drafting group is to go deep into the combat posts and compartments to identify sources of hazard, summarize all of the danger points for each source of hazard, and propose control measures. On the foundation of comprehensive risk assessment, [the group] should analyze the possible types of hazards and the scope of impact posed to ship crew members and equipment. [They should] clarify matters such as the key parts [of the ship] for damage control, emergency response methods, supportive actions by crew members in nearby compartments, and matters that deserve special attention, forming a risk assessment report that can provide a basis for preparing the damage control plan.

- (4) Scientifically demonstrate and rationally allocate damage control forces. Ship damage control data analysis and accumulation should be strengthened. Accurate and detailed damage control data is an important basis for command decision making. This mainly entails blast effects of weapons on ships and data on resistance to sinking and fire extinguishing.

First, the blast effect of weapons on ships. Blast effects refer to the crushing and tearing effects of explosives and shock waves on a ship. The size of the effect is an extremely complex topic. It not only depends on factors such as the amount, type, packing density, packing methods of explosive material, and proximity to the explosion, it is also largely determined by ship structure, relative position, and hull strength. The damage radius of underwater weapons such as torpedoes, mines, and depth charges are generally no smaller than five meters. Guided missiles are generally composed of the seeker section, the forward section (*qianshe beicang*), the warhead section, the engine section, and the rear section (*houbei shecang*). Their damage radius against ships is typically no less than two meters.

Second, data on resistance to sinking. The flooding time of a damaged compartment is calculated according to formula (1) to obtain the time required for compartment flooding without any dewatering measures taken.

Formula 1:

$$t = \frac{klbz}{\mu s \sqrt{2gH}}$$

$k$  – permeability coefficient;

$l$  – vessel aft engine room length in meters;

$b$  – vessel aft engine room width in meters;

$z$  – vessel aft engine room depth in meters;

$\mu$  – flow coefficient;

$s$  – vessel aft engine room breach area in square meters;

$g$  – gravitational acceleration in meters per second;

$H$  – depth of aft engine room breach below water surface in meters.

For example, a ship's aft engine room has a length of  $l = 16$  meters, a width of  $b = 8.8$  meters, a depth of  $z = 3$  meters, a permeability coefficient of  $k = 0.85$ , and there is an underwater breach of  $H = 3$  meters. See Table 1 for the depth required for compartment flooding to reach one meter.

It can be seen from Table 1 that quickly plugging the breach can greatly prolong the time that important equipment is submerged. If timely dewatering measures are taken, the time that the equipment is submerged can be delayed and the initiative to plug the leak can be obtained. When flooding and fires occur simultaneously in compartments below the waterline of the ship, the commander, based on damage control data, must first make decisions on which type of damage control to carry out.

**Table 1: Breach Diameter and Flooding Time**

Breach diameter in centimeters	200	60	50	40	30	20	10
Breach area in square meters	3.14	0.283	0.196	0.126	0.07	0.03	0.008
Time in seconds	43	473	684	1063	1914	4467	16750

Third, fire extinguishing data. This mainly includes the capabilities, spray time, and working distance of various types of fire extinguishers, the burning time of each compartment after being sealed off, and the ventilation time of burned compartments after fires have been extinguished. This data provides the basis for commanders to organize command, study and make decisions, allocate damage control forces, and assess damage.

- (5) Determine the key points of damage control actions according to the flow chart (Figure 1). For the same type of damage in the same compartment, the least impact and the worst impact of damage should be considered comprehensively based on the most complex and difficult situation with all factors included. This compartment's damage control data can then be factored in to carry out corresponding emergency measures according to the specific situation. This allows various kinds of damage to be covered.

First, determine a flow chart for preparing the damage control plan. First determine the damage control scenario and explain the events taking place, their locations, nature, and extent. Scenarios should be closely related to actual combat so that the entire exercise is carried out in the context of actual combat. Then analyze the various elements involved in the scenario and prepare the damage control plan according to the results of this analysis. Finally, conduct an analysis and verification of the plan [to ensure] it is reasonable. If it is reasonable, further study the achievable objectives of the damage control plan, otherwise, modify the plan and verify it again. The process of damage control plan preparation is shown in Figure 1.

Second, clarify the division of labor and carry out deployment. When preparing the plan, it is necessary to

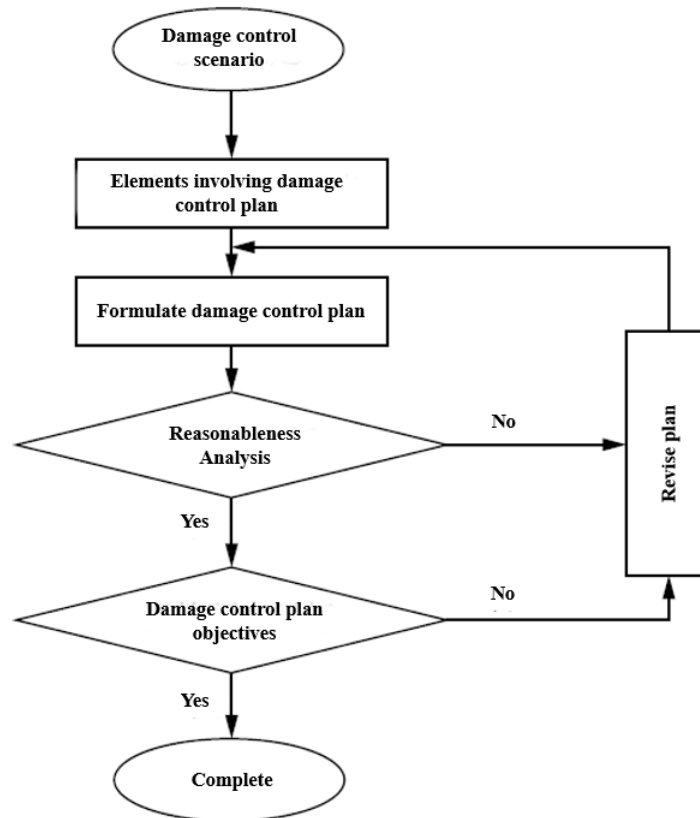


Figure 1: A flow chart for preparing the damage control plan.

pay attention to the characteristics of handling complex events (*fuhe shijian*). The plan should contain interfaces (*jielou*) to clarify the conditions for plan activation and response mechanisms to ensure the coordination of key tasks and links such as command authorities, materials dispatch, and team support. Organization of the command organization should be specified. Command methods (direct command or delegated command), who is in command, and various teams set up, such as the fire extinguishing teams, hole plugging teams, dewatering teams, shoring teams (*zhicheng jiagu zu*), evacuation teams, communication teams, safety support teams, rescue teams, fire search teams (*huoqing zhenchazu*), direction and coordination teams, and evaluation teams, should be specified. Deployment duties should be clarified, such as the corresponding responsibilities of personnel and their mutually coordinating actions in damage control at combat posts, zones, and the entire ship. Highlight relevant content in command organization, fire searches, personnel rescue, smoke prevention, smoke control, firefighting tactics, and preventing and stopping the [vessel] from sinking (*fangchen kangchen*). Command authorities should be transferrable. When the senior commander arrives on scene, the lower-level on-site commander will proactively report the damage situation and relinquish authority to the senior commander. When damage control personnel are supporting damage control, authority rests with the damage control team leader.

Third, strengthen work towards the “four goals” (*si hua*) in the damage control plan. For the damage control plan to work, it must not only be comprehensive and detailed, but also needs to be further optimized on the technical levels of its preparation. Augmenting “four goals” work in the damage control plan means it should be simple (*jianhua*), realistic (*shihua*), streamlined (*liuchenghua*), and illustrated (*tujiehua*). “Simple” refers to reduced descriptive content in the damage control plan and a focus on damage to important nodes. “Realistic” refers to putting the focus of plan preparation on the assigned responsibilities and tasks of ship personnel and the handling of damage control procedures. This highlights description of risk identification, risk analysis, evaluation of effects, and response measures. “Streamlined” means to standardize crew damage control response such as in activation timing, damage control response procedures, damage reporting, damage status analysis, and damage information plotting. It also means the process for handling damage control must be clear. “Illustrated” refers to the presentation of important combat posts and equipment, dangerous elements, response procedures, handling methods, and equipment changeout in the form of tables and flowcharts. Effort towards the “four goals” will make damage control plans understandable, digestible, and applicable, and will improve their operability, [allowing] for plans to play a real role [in damage control].

Fourth, pay attention to effective risk assessment. In accordance with the characteristics of different damage, [the plan should] identify existing hazard factors, analyze possible direct consequences and secondary and derivative consequences, evaluate the degree of harm and the scope of its impact, and put forward preventive and control measures to create a risk assessment report. This will provide a basis for the preparation of the plan. Linked to the tactical context, risk assessment should be conducted continuously and consider ship damage control in peacetime and wartime and the features of damage in actual combat environments. Risk assessment mainly applies qualitative and quantitative methods to conduct comprehensive analysis and conducts item by item assessment on identified damage risk results to determine the degree of risk tolerance and levels of risk. Targeted measures in the areas of safety technology and management can then be proposed according to the risk assessment results, thereby improving overall damage control capabilities and ensuring ship safety.

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- (6) Continuously verify and improve through simulation exercises. Ship damage control exercises are a fundamental task to test the plan and train the crew. The ship commander should organize the heads and relevant cadres of each department to discuss, analyze, and test the plan, so as to judge the soundness of the plan. Through exercises, problems are revealed and constant improvements and modifications made to the plan, thereby “guiding exercises with the plan and improving the plan through exercises.” The plan can be continuously improved in accordance with the closed-loop management [process] of “planning – drilling – revising the plan – drilling.” During exercises, commanders at all levels are expected to commit to their command positions and roles and convert the [damage control] plan into an exercise plan for damage control training. Attention should be paid to tactical coordination, close cooperation, and precise actions with a focus on complex disaster patterns and command training in damage control under actual combat conditions to strengthen teamwork in damage control teams. Damage control tasks should

be seamlessly used to lead operations, damage control training, and equipment use and management. Training should be organized closely around the damage control plan, constantly testing and improving the plan and enhancing its operability and practicability. Only by maintaining and making timely updates to the plan can it be continually improved and truly play a role when emergencies happen.

- (7) Review and solicit feedback. After the damage control plan is complete, it should be reviewed by the preparation team, focusing on whether there are omissions in risk assessment, improper calculation methods, and wrong calculation results. After the review is approved, opinions should be solicited from ship personnel at all levels, which should then be used by plan preparation team members to make necessary revisions. Linking problems arising from step-by-step training and comprehensive exercises, [the preparation team] should earnestly summarize and tackle key problems, learn from advanced experience and knowledge, and promptly apply findings to the improvement of the plan. Daily advancement and regular practice and updating will improve the scientific character of the plan. Headquarters departments review the hierarchy, content description, organization and command, countermeasures, and effects assessment of the damage control plan. With actual combat requirements as the evaluation standards, they will review the damage control plan's focus, practicability, objectivity (*kexuexing*), and operability and put forward relevant opinions.

### **3. Combat Effectiveness**

The damage control plan of a particular class of ship was revised and improved. After revisions, the damage control plan was accepted through inspection, evaluation, and assessment of damage control capabilities. It was found that the objectivity and practicability of the damage control plan improved by 80 percent, the plan's focus increased by 85 percent, and the scores of commanders at all levels on damage control theory were all above 95 points. Damage control drills became closer to actual combat, with standardized damage control actions. Combat posts, zones, and ship personnel at all levels were closely coordinating, and the command abilities of commanders at all levels reached 90 points or more. The overall damage control capability of the ship had risen to a higher level.

### **4. Conclusion**

Preparation of damage control plans is an important part of a ship's preparatory work for damage control training. It is a powerful tool for improving damage control capabilities. Taking a deep look at the characteristics of ship damage, this article expounds on the current status of damage control plans while also proposing specific methods and focus requirements for damage control plan preparation, so as to provide a basis for damage control command decision making.

Preparation of damage control plans must focus on the overall situation, highlight key points, and be based on the most difficult and complex damage situations. [Plan preparation should be] linked to specific compartments and specific equipment to convert abstract theory (*yuanli*) and doctrine (*yuanze*) into concrete measures and essential actions for ship personnel. In daily work, [we should] strengthen study of professional theoretical knowledge and place emphasis on the accumulation of damage control knowledge. Damage control skills and command capabilities should be improved, and plan maintenance, management, and updating should be strengthened.

Advanced technologies should be absorbed and drills carried out based on actual conditions. Continuous summary, revisions, and improvement will improve the objectivity, focus, and operability of damage control plan preparation, so that damage control plans can effectively serve the needs of damage control in actual combat.

## Part II: Strategic Power Projection and Amphibious Logistics

This section addresses the logistical challenges of moving forces across oceans and onto contested shores.



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## Construction of Carriers for Strategic Power Projection in Response to National Security Needs<sup>1</sup>

By Liu Jiasheng, Sun Datong, and Peng Fubing<sup>2</sup>

Strategic power projection<sup>3</sup> carriers are pillars of the military's long-range power projection and rapid deployment. They are important indicators of a country's comprehensive national power and scientific and technological capabilities. The number and quality of strategic power projection carriers have an extremely important impact on strategic power projection capabilities. With the leap in China's comprehensive national power and the continuous expansion of China's strategic interests, the threats to our national security are growing more diverse and the tasks that the military must assume are more varied. National security needs have created greater requirements for the construction of strategic power projection capabilities. In building a world-class military

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under the new historical conditions, we must draw lessons from the useful experience and common practice of world military powers, rely on the national transportation system to bolster construction of strategic power projection carriers, and create strategic power projection capabilities that are commensurate with China's status as a great power with a strong military.

### 1. Requirements for Strategic Projection Carriers for National Security

#### 1.1 Tasking Requirements

Relying on construction of the national transportation system, [we should] develop strategic power projection carriers of sensible scale and structure and with advanced technological levels.

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<sup>1</sup> 刘嘉生, 孙大同, 彭富兵 [Liu Jiasheng, Sun Datong, and Peng Fubing] 基于国家安全需求的战略投送载运工具建设 ["Construction of Carriers for Strategic Power Projection in Response to National Security Needs"] 军事交通学院学报 [*Journal of Military Transportation University*] vol. 21, no. 2 (February 2019), pp. 9-13.

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<sup>3</sup> **Translator's note:** According to the 2011 *PLA Dictionary of Military Terms* (p. 58), "strategic power projection" (战略投送) refers to "operations to comprehensively use various types of transportation forces to deliver battle force groups to an operational or crisis area."

[They] can show the national will and warfighting power to shock the adversary, control the situation, and seize the initiative; they can also effectively respond to an escalating situation and prepare for actual warfighting.

- 1) The task of safeguarding China's national security and development interests is growing heavier by the day, [so] we must emphasize construction of large, long-range strategic power projection carriers. On the one hand, future limited wars under informatized conditions in the maritime direction will be integrated joint operations at an extremely high level of informatization. The area of operations will be broad, the distance for maneuver will be great, and the consumption of equipment and materials will be large. Whether sending troops to the front, withdrawing casualties to the rear, or replenishing and shipping large quantities of equipment and material, all require large civilian carriers to provide effective support. On the other hand, with the continuous expansion of China's overseas interests, the political risks, financial risks, and transit risks China faces are growing by the day. Safeguarding the security of overseas strategic passages such as the Strait of Malacca, Strait of Hormuz, and the Suez Canal, providing support for national strategic resource security and economic security; protecting Chinese firms and property located abroad, safeguarding China's overseas investment interests; protecting the security of overseas Chinese, evacuating our personnel living abroad if and when necessary—all of these operations require leveraging the advantages of civilian carriers. [We should] widely use large, long-range carriers and improve cross-border, transoceanic, long-range power projection capabilities, in order to meet the strategic requirements of our military forces as they go out [into the world].
- 2) To effectively respond to various types of non-war military operations, we must emphasize construction of strategic power projection carriers that are mobile and efficient. With national economic and social reform entering a critical stage, deep social contradictions are growing more conspicuous by the day. China's peripheral environment and ethnic and religious problems are extremely complex. Various types of separatist forces are continuously creating incidents. Various types of security situations that we face remain severe. Our military has the dual mission of preventing foreign annexation and preventing internal separation. Effectively carrying out various types of tasks requires rapid projection of operational forces. In recent years, natural disasters and other types of emergency response incidents have become more frequent in China. Disaster relief is an important peacetime task for our military. It is a practical test of the military's ability to complete diversified military tasks. To effectively respond to natural disasters and other major sudden incidents, in an emergency situation we must rapidly project emergency rescue and relief forces and withdraw casualties. Additionally, we must rapidly deliver food, medicine, tents, construction equipment, and other rescue materials and equipment to the disaster zone. Force projection for various types of non-war military operations requires the country to emphasize construction of "expeditious" (*gaosuhua*) carriers that are fast, efficient, and flexible, in order to adapt to power projection requirements for forces to respond to emergencies rapidly and efficiently.

- 3) Integrated joint operational support is evolving towards greater precision, [so we] must emphasize construction of informatized strategic power projection carriers. In a limited war under informatized conditions, firepower (*huoli*), maneuver, and information constitute the three major pillars of modern military operational capabilities. Information capabilities have become important measures of a military's operational capabilities. Occurring in the context of rapidly developing information technology, so-called informatized limited wars are wars integrating multiple services occurring in all dimensions including on land, sea, air, space, and the electromagnetic [spectrum]. The chief operational forces on both sides are informatized. Its chief characteristics are multi-dimensionality of the information battlespace, automation of command, and intelligentization of armaments. The degree of intelligentization, informatization, and integration (*zonghehua*) of modern weapons is increasingly high. Informatized equipment—as represented by precision-guided weapons, unmanned vehicles, new-generation cruise missiles, and high technology reconnaissance and surveillance equipment—has achieved widespread use on the battlefield. This requires that strategic power projection carriers also develop in the direction of intelligentization and informatization, in order to improve precision support capabilities and levels of strategic power projection.

## 1.2 Capabilities Requirements

In order to adapt to the needs of the national security strategy and conduct military missions and tasks for the new era, strategic power projection carriers must adapt to the needs of systems confrontation and joint support involving multiple elements in local wars under informatized conditions. They must satisfy the support needs for major armaments to be rapidly loaded/unloaded and transported, and they must adapt to the development of power projection-type (*tousongxing*) logistics.

- 1) Multi-dimensional joint power projection capabilities. With the goal of improving three-dimensional—rail, road, water, and air—joint power projection capabilities, [we should] focus on efforts to organize state and military transport resources (*yunli ziyuan*), seek out shortcomings, optimize the structure of the equipment system, accelerate the construction and development of large strategic power projection carriers owned by the state and military, and improve the military's long-range, rapid power projection capabilities.
- 2) Containerized transport support capabilities. With the goal of creating a rapid and efficient containerized transport system, [we should] deepen research into circulation mechanisms for military use container equipment, intensify the research and development of containerized transport and support equipment, develop containerized loading/unloading and handling equipment for strategic power projection support bases and self-loading/unloading equipment for container materials in the field at the campaign level, establish a fused civil-military containerized transport equipment system, and boost the military's containerized transport support level.
- 3) Informatized and integrated joint support capabilities. Strive to bolster efforts to upgrade the degree of informatization of transport equipment. Relying on the

comprehensive military information network and the Beidou and Shentong satellite systems, [we should] construct a data link that connects operational, material, and medical service specialties. Relying on the military transport dynamic monitoring system, [we should]

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seamlessly connect the integrated logistics command platform and military logistics information system and integrate national transportation information. [We should] build a military transport command platform with connections between the Central Military Commission, theater commands (military services), and the operational forces (*budui*) with linkages between the military and the civilian government, and boost integrated joint support capabilities for strategic power projection.

- 4) Overseas strategic power projection support capabilities. In accordance with the strategic concept of the military force “going out” as proposed by Chairman Xi Jinping, [we should] focus on what is needed for military forces to project [power] overseas; conduct research into military transport support models and equipment technologies for overseas operations; focus on developing equipment for overseas force projection, base multimodal transport, rapid loading/unloading and handling and material tracking and identification; and satisfy the support needs of international peacekeeping, evacuating and protecting Chinese citizens, emergency response and rescue, and other overseas military operations.

## **2. Development Goals for Strategic Power Projection Carriers Based on National Security Requirements**

Taking into consideration multiple factors associated with civilian carriers—e.g., the rates of mobilization, military compatibility, average rates of operational readiness, transportation required for the civilian economy, and the rate of sharing of carriers by the military and civilian authorities—we should pursue the following goals when using national rail, road, waterway, and air carriers to conduct strategic power projection.

### **2.1 Near-Term Goals**

Today, threats to national security chiefly come from our periphery and the maritime direction. Our military is focused on winning informatized local wars, mostly in the maritime direction. While prioritizing land-based power projection, the military should energetically develop strategic air lift and strategic sea lift. It should primarily develop large, high-speed rail, road, air, and sea carriers. It should prioritize resolving problems associated with improving, expanding, and ascending from the existing technological foundation of carrier equipment, including highly mobile integral self-loading/unloading vehicles, high-speed roll-on/roll-off (RO-RO) passenger ships, and large strategic transport aircraft technologies. [We should] use mature unmanned platform technologies and engage in research in areas such as military force projection and equipment and material transport, in order to resolve difficult power projection problems in special environments, and determine a system for building and developing unmanned projection technology and equipment. With a focus on improving existing precision projection technology

equipment, [we should] form a precision power projection technology system, chiefly including airdrop material packaging and pallet technology, low-altitude airdrop technology, and precision distribution technology.

## 2.2 Medium-Term Goals

Our preparation for military struggle [should] focus on countries and regions along the “Belt and Road” and areas around the globe that are related to China’s important interests. [We should] chiefly prioritize winning an informatized local war overseas or controlling a major crisis. With projecting power overseas as the priority, [we should] satisfy the transport projection capabilities needed to conduct an informatized local war or major crisis in key areas around the globe that are related to Chinese interests. [We should] primarily develop super high-speed trains, large high-speed RO-RO ships, and heavy transport aircraft. [We should] do more to boost projection speed and load quality of carriers. [We should] improve the unmanned projection equipment system and deepen comprehensive integration. [We should] actively engage in the development of technologies for an unmanned truck fleet, ship fleet, and aircraft fleet, and unmanned transport projection of military forces, unmanned transport of equipment and material, and casualty evacuation, as well as transport equipment environmental awareness, self-monitoring, self-diagnosis, self-repair, and other key technologies. [We should] pursue research on precise airdrop navigation control technology, precision airdrop technologies for poor weather, and airdrop material ground positioning search terminal technology. [We should] focus on resolving problems with accuracy and the impact of weather on airdrops.

## 2.3 Long-Term Goals

China’s economic interests will expand to every corner of the globe. [We] will establish systematized global strategic disposition. Our military will become a fully-established world-class military. With our strategic power projection efforts centered on global power projection, [we should] chiefly rely on our overseas base(s) and air and space multi-dimensional projection system, in order to satisfy the rapid response needs of transport projection capabilities for future conflict around the globe. [We should] chiefly develop advanced and ultra-high speed strategic power projection carriers such as rail lines for high speed freight trains, high efficiency marine shipping platforms, and hypersonic transport aircraft. [We should] conduct research on topics such as key technologies used by transportation robots and key technologies used by unmanned transportation system collaboration. [We should] focus on solving problems of system control of unmanned transportation systems, unmanned automatic dispatching systems and unmanned intelligent projection decision making systems, as well as problems associated with military applications of transport robots. [We should] pursue research on autonomous unmanned precision airdrop technologies, with a focus on solving problems of autonomy and intelligence in precision airdrops.

## **3. Guiding Principles in the Construction of Strategic Power Projection Carriers Based on National Security Requirements**

Strategic power projection carrier construction should be directed by the military strategic guidelines in the new era and adapt to the strategic requirement for military forces to “go out.” It should adhere to the development path of deep military-civilian integration and break with the

traditional mindset of separate construction for the state and the military. Construction should establish large systems development concepts to achieve coordinated development of civilian carriers and military transport equipment according to the principles of national development of general and common-use carriers and the military's construction of dedicated and special carriers. To provide strong support for the effective performance of the military's continuously expanding missions and tasks, we should accelerate the construction and formation of a strategic power projection carrier system that is primarily organic military transportation, supported by national transportation, and supplemented by societal transportation. This "triad" would be of an appropriate scale with a rational structure and advanced technology.

- 1) Based on the national situation and scientific development. Development of strategic power projection carriers should be guided by the requirements of national defense construction and national strategic power projection. It should be based on China's comprehensive national power and economic power, and should scientifically determine the construction goals, capability requirements, and development paths of military and civilian strategic power projection capabilities.

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- 2) Military-civilian fusion and coordinated development. Transportation has the outstanding feature and advantage of strong commonality in military and civilian use. Development of strategic power projection carriers must adhere to the path of military-civilian fusion, integrated construction, and synchronized development. While integrating the transportation capacity of the three services, national transportation forces should be fully relied upon, and civilian carriers that are dual-use and highly suited to military transportation should be developed.
- 3) Highlight sea and air and balanced development. In accordance with the needs of all-around, long-distance projection of operational forces, [we should] focus on the development of sea and air strategic power projection carriers while continuing to consolidate rail and roadway projection capabilities. [We should] achieve balanced development of rail, road, waterway, and aviation carriers, and strive to resolve the contradiction of China's strategic power projection forces being strong on land but weak on the sea and in the air.
- 4) Technology-driven innovative development. Development of strategic power projection carriers should focus on absorbing advanced information technology like the Internet of Things. [We should] attach importance to the development of new-type, large-scale, multifunctional carriers. [We should] improve their levels of intelligence and gradually build a strategic power projection carrier system with supporting systems and advanced technology.

#### **4. Strategies for Strategic Power Projection Carrier Development Based on National Security Requirements**

Reaching our goals for strategic power projection carrier construction will require the country to formulate an associated policy system and support and encourage transportation enterprises to

develop new-type, large-scale transportation equipment technologies while also implementing national defense requirements in those newly-built carriers. By constructing and maintaining a certain scale of large carriers and striving to maintain a scientific and rational structure proportional to the military's strategic power projection equipment, a strategic power projection carrier system that forms a complete set of large (heavy), medium, and small (light) carriers that combines short and long ranges can be gradually built. This system would feature joint military and civilian development and integrated utilization.

#### 4.1 Rationally Determine the Scale and Structure of Carriers

- 1) Develop heavy road transport vehicles. The United States, Russia, and other countries have sizeable heavy road transport units to ensure the rapid mobility of heavily equipped units. The current ratio of heavy equipment to heavy transport vehicles in the United States military is seven-to-one. Requisitioned capacity can decrease this to three-to-one during war. In terms of civilian transport capacity, the number of 40-ton-class or greater low flatbed trucks currently in China is small, their distribution is scattered, and they move around a lot, causing difficulties in their mobilization and requisition. Therefore, in addition to further allocations of heavy road transport vehicles, the military should also enact a planned increase in the number of civilian large low flatbed trucks in accordance with the development requirements of military-civilian fusion. This would meet the medium to long-range projection requirements of unit operations and exercises.
- 2) Build a certain number of RO-RO ships. After years of construction and development, China has many transport ships; however, most are suited to navigation in near-seas zones and are 20 years or older. There are relatively few RO-RO ships suited to the rapid projection of units' heavy equipment. In the future, further attention should be paid to the development of RO-RO ships with rapid loading and unloading, high utilization cycles, and suitability for shipping heavy equipment. We should increase inventory of these ships and improve their seaworthiness into the far seas through the implementation of national defense requirements.
- 3) Ensure an inventory of large civilian cargo aircraft. There are more than 6,000 aircraft of various types operated by American civil aviation, of which about 680 are freighters accounting for 11.3 percent of the total. The United States Civil Reserve Air Fleet has 554 aircraft of various types, of which 162 are freighters accounting for 29 percent of the total. The number of civilian cargo planes in China is obviously lower compared to developed countries. In recent years, China's large cargo aircraft have been impacted by the continued downturn in the international and domestic freight markets. Many civil aviation companies have grounded their large cargo aircraft and sold them on the international market. The number of aircraft are becoming fewer and fewer and strategic power projection resources are eroding day by day. Existing freighters only account for 4.7 percent of aircraft in service. According to strategic power projection requirements, the proportion of China's civilian large cargo aircraft should be around 8 percent. We should support and encourage civil aviation companies to increase their inventories by purchasing

domestically built large cargo aircraft and promote the sustained development of China's aviation industry.

#### 4.2 Encourage the Development of New-Type Large Carriers.

- 1) Railway cars: First, we should develop a special gondola car with sliding ends. In recent years, the railway's number of flatcars suitable for unit projection requirements has decreased. To change this situation, it is recommended that railway departments develop a new type of gondola car with sliding end wall panels that can enable rapid loading of wheeled vehicles and equipment through the sliding movement of the end panel. Secondly, we should produce freight cars for military and civilian use. China's existing specialized freight cars are clearly behind those of the United States and other developed countries. Specialized freight cars in the United States rank first in the world, accounting for more than 60 percent of its total freight cars. Russia's specialized freight cars occupy up to 40 percent, while China's only account for 5 percent [of its total freight cars]. According to structural adjustments and disposition of the national economy and industries, and accounting for the needs of markets and the battlefield, railway transportation companies should actively develop specialized freight cars for military and civilian use such as a new-type boxcar with moveable partitions or tanker trucks outfitted with room for escorts.
- 2) Road vehicles: We should develop large cargo trucks. Compared with medium-sized cargo trucks, large cargo trucks have two to four times more transportation efficiency at 80-85 percent of the cost. The country should focus on developing large flatbed trucks and heavy equipment trucks. In terms of functional requirements, corresponding auxiliary facilities can be added on the basis of existing vehicle technical performance while attending to the needs of containerized and special bulk material transports. New specialized vehicles should also be developed. In order to meet operational force requirements in heavy equipment and container transportation, the country should encourage companies to develop large flatbed trucks that can carry both heavy tracked equipment and containers.
- 3) Maritime transport ships: Ship types and structure should be optimized. In light of the current incompatibility of large tonnage transport ships for the military, shipping companies should be encouraged to develop moderate tonnage (5,000–20,000 ton), high-speed types of transport ships that can easily load and unload, such as multi-purpose ships and product tankers.

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At the same time, the military should accelerate construction of distant-ocean comprehensive replenishment ships, hospital ships, and life-saving ships to satisfy the requirements of maritime strategic power projection, transportation, and replenishment for organic units. RO-RO ships should also be vigorously developed. RO-RO ships facilitate the embarkation and debarkation of tracked and wheeled equipment rapidly under their own power, with high ship utilization rates. RO-RO

ships are therefore the preferred type of vessel for maritime projection of organic units.

- 4) Aviation carriers: Development should focus on large, heavy cargo aircraft. Whether it is an emergency air lift of a unit's special armaments, transportation of cutting edge secret equipment in national military scientific research or products of national defense scientific testing, or the rapid transport of heavy construction machinery such as excavators and bulldozers urgently needed in rescue and disaster relief, these all require the use of large, heavy cargo aircraft. Heavy transport helicopters should also be simultaneously developed. Heavy transport helicopters play a unique role in the transportation of emergency rescue materials and the lifting of large equipment. We should strengthen top-level planning and design and accelerate the introduction of existing foreign aircraft models. At the same time, we should launch joint research or independent research and development projects to fill in gaps in related fields as soon as possible.

#### 4.3 Fully Implement National Defense Requirements.

- 1) Research, develop, and implement a catalog system of national defense requirements. The implementation of national defense requirements in civilian carriers involves work across numerous departments, is highly technical, and requires a large investment. It is necessary to strengthen theoretical discussion and technological innovation and study the formulation of a catalog system for implementing national defense requirements that contains clear requirements, distinct elements, and logical hierarchies, and is functionally compatible. [We should] research and formulate a corresponding set of technical and industry standards that conform to the catalog management system and use these standards as the fundamental basis and technical standard for implementation of national defense requirements in civilian carrier design and construction. [These efforts] can achieve true military-civilian fusion in civilian carriers that balances peace and war and derives real cost benefits economically, socially, and militarily.
- 2) Focus on improving the national defense functions of sea and air carriers. Sea and air carriers are important platforms for operational force strategic power projection, as well as the focus of implementing national defense requirements. Carrier functions in military transportation should be enhanced by effectively implementing national defense requirements according to the overall requirements that they are suited to loading and unloading, transportation, and combat. For transport ships, the focus is on improving the ship's deck strength and lashing reinforcement methods to improve the shipping conditions for the heavy and large equipment of operational forces. The transportation conditions of dangerous items such as ammunition can be improved by taking measures in cargo hold fire prevention, mine protection, and electrostatic precautions. For civil aircraft, the focus is to reserve or install tethering devices for light portable weapons and equipment to meet the air transport requirements of units' portable armaments. Appropriately expanding cargo aircraft doors, strengthening the carrying capacity of cargo compartment floors, and installing cargo handling systems can improve the compatibility of civilian cargo aircraft for military transportation.

Disassembling seats, pre-installing stretcher lashing points, and leaving power connections provide the technical conditions for refitting aircraft for medical evacuation.

- 3) Give prominence to modification of large civilian road transportation vehicles. In light of the fact that there are few large flatbed trucks allocated to the military and they cannot satisfy the requirements of transporting tracked equipment, the following recommendations and requirements on development are proposed. This is in accordance with the national and local regulations and requirements on over-limit transportation and based on an overall analysis conducted on the technical characteristics of current large civilian transportation vehicles. For special low flatbed semi-trailers with body width close to 3 meters, their compatibility for transporting tracked equipment can be improved by laterally widening the vehicle and appropriately modifying the loading ramp and cargo platform. Special low flatbed semi-trailers with a body width over 3 meters can basically be directly used for transporting tracked military equipment after relatively little modification and outfitting with the corresponding auxiliary devices or equipment.

## **5. Conclusion**

The construction of strategic power projection carriers is a massive systems project with long construction periods, high technical requirements, large capital investment, and multiple facets. [We] must fully consider the expansion of our national strategic interests and the main threats that we face. [We must] firmly focus on the requirement of winning an informatized local war and tightly integrate the objective reality of economic and national defense construction. [We must] actively learn from the useful experiences of foreign military construction. [We must] establish concepts of systems, quality, and continuous construction using scientific evidence and overall planning. [We must] adhere to the development path of military-civilian fusion to gradually achieve a close connection and synchronized development of military and civilian strategic power projection forces. By comprehensively increasing our military's strategic power projection capabilities, [we can] provide a strong support for the PLA to effectively deal with various security threats and complete diversified military tasks.



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## Why Landing Operations Are Hard<sup>1</sup>

Wang Guo and Wang Xiang<sup>2</sup>

Amphibious operations are a form of war with a fairly high degree of difficulty. Due to the impact of weather, terrain, and other objective factors and factors such as organizational coordination and projection support, any large scale amphibious operation is full of uncertainty. From the perspective of past large-scale landing operations, once success is achieved, the gains are enormous. But the degree of difficulty is also large. So, what are the difficulties affecting landing operations?

**Seizing command of the sea and air.** The precondition for successful landing operations is gaining command of the sea and air. During World War II, the reason why the “Sea Lion” plan was aborted was that despite the best efforts of the Luftwaffe it was never able to seize air control over the English Channel. This meant that the German Navy, with its limited strength, was unable to seize command of the sea from the Royal Navy. Thus, the preconditions for a landing operation could not be met and the plan met a quiet end.

In modern war, with the increasing sophistication and gradually increasing price of combat aircraft, for countries and regions lacking independent production capabilities failure early on in the war means the loss of air power. But this certainly does not mean that the weaker country’s air power cannot adopt the “air force in being” approach, using hiding and sneak attack tactics to harass [the enemy], multiple military airfields to disperse aircraft, and highways as emergency takeoff and landing bases.

**The choice of time and place for the landing.** A successful amphibious landing must have a carefully chosen landing site. Choosing the landing site must take all aspects into consideration. One must consider both the weak spots in the enemy’s defense and the space needed by the landing force after it launches its attack and for the establishment of a logistics base. More importantly, for the sake of advancing after the landing is made, the landing location should be as close as possible to roads, in order to facilitate the rapid maneuver of the landing force.

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<sup>1</sup> 王果, 王翔 [Wang Guo and Wang Xiang], 登陆作战到底难在何处 [“Why Landing Operations Are Hard”], 人民海军 [People’s Navy], December 29, 2020, p. 4.

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The choice of timing for a landing involves multiple factors. One must consider the disposition of the [enemy] defense forces in the landing zone, the geography of the ocean zone, the climate and temperature, the rise and fall of tides, and visibility horizons. Moreover, the timing of the landing must conform to the overall preparations for the landing operations. The assembly of the different military services, the transport of supplies, and the advance of the landing vessels must all be considered. This leaves few appropriate landing times for the operational plan. During World War II, the allied army approved the “Overlord” plan in February 1944. But adjustment in the number of landing vessels meant that the timing of the landing had to be pushed back to the beginning of June. Then, considering the different operational requirements of the army, navy, air force, and airborne troops, a landing date of June 5<sup>th</sup> was eventually chosen after calculating and recalculating multiple times.

The strict requirements involved when choosing the location and timing of the landing can be exploited by the side defending against the landing. That is, by calculating the scale and numbers involved in the landing, one can narrow down the location and timing appropriate for the landing. The defending side often has more detailed information about the meteorology, hydrology, and topography of the coastline. As a result, in many cases when choosing the location and timing for the landing one must take various measures to conceal one’s intentions to attack.

**Sustained logistical support capabilities.** With landing operations, it is not enough just to deliver the landing force to the beach. In reality, the advance forces are under tremendous pressure as they attack a fortified position. They must rapidly seize communications strong points and expand the landing area, providing space for the follow on troops and supplies to get ashore. During World War II, the allied army’s hesitation on the beachhead of Anzio in Italy ultimately gave the German army time to concentrate their advantageous forces for a counterattack, and the allied army was almost driven back to the beach. Moreover, in certain respects amphibious landing operations are a case of landing forces engaging in combat without a rear. Injured soldiers can only be evacuated by air or sea to the hospital ships of the escort fleet. If the injured cannot be evacuated in a timely manner, morale on the front lines will be severely impacted.

The Gulf War was the first time after the end of the Cold War that the U.S. military conducted a large-scale, super-long-distance force and supply projection operation. Before the conflict, the U.S. military assembled more than 1900 military shipping vessels, comprising a total displacement of 46 million tons, and a large-scale air transport fleet, and it was able to conduct rapid transport of the Marine expeditionary brigade. On top of that, it requisitioned civilian vessels, thereby further bolstering the U.S. military’s capacity to ship supplies.



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## Countermeasures for Problems in Transport Service Support in Cross-Strait and Beach Landing<sup>1</sup>

Chen Xuanyu, Ren Cong, Wang Fengzhong<sup>2</sup>

### 1. Transport Service Support Requirements for Cross-Strait Island Landing

Transport service support in cross-strait island landings has the dual nature of combat and logistics support. In a broad sense, it is the organization of campaign transportation according to the overall intended objectives and missions of a landing operation to support the achievement of the campaign objective. In a narrow sense, it is the comprehensive employment of various transport means to complete forward delivery and retrieval of combat troops, logistics and equipment support forces, and various front-line support forces and materials. This is done in accordance with the various operational missions carried out by units participating in the landing campaign in order to meet the end demands of a cross-strait island landing operation. Transport service support must therefore grasp the dual nature of combat and logistics. It must meet the unique combat requirements of various engaged units while also paying close attention to the progress of a cross-strait island landing operation, integrating employment of various transportation means, and making overall plans to solve campaign transportation support issues.

The use of various informatized equipment in future cross-strait island landing operations during wartime will render the battlefield entirely transparent. The use of various precision weapons will cause unprecedented losses in personnel and equipment, and the battlefield environment will become extremely harsh with significantly increased difficulty in logistics support. These circumstances have imposed many requirements on transport service support for cross-strait island landing operations, chiefly including the following:

#### 1.1. Integrated joint command organization

When it comes to cross-strait landing and the implementation of joint operations involving various services and arms, there are numerous supported [elements] and the composition of

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<sup>1</sup> 陈炫宇, 任聪, 王凤忠诚 [Chen Xuanyu, Ren Cong, and Wang Fengzhong] 渡海登岛运输勤务保障面临的问题和对策 [“Countermeasures for Problems in Service Support in Cross-Strait and Beach Landing Transportation”], 物流技术 [Logistics Technology], No. 10, 2016, pp. 166-169.

<sup>2</sup> **Translator’s note:** Authors are affiliated with the PLA Military Transportation Academy in Tianjin. Chen Xuan’s research focuses on command of motorized units. Ren Cong researches military logistics. Wang Fengzhong is an associate professor who focuses on military logistics.

transport forces is complex. The use of various land, sea, and air conveyance should be integrated with numerous transportation links and frequent changes in transport modes. Transportation support must conduct forward transport and evacuation of personnel and materials, as well as organize embarkation and debarkation. It must also arrange the protection and emergency repair of transport routes. The onerous and complex transportation support mission cannot be completed without an authoritative joint transport command organization to implement centralized transport command.

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Early during the outbreak of World War II, the US military established the Joint Committee (Ground, Navy, and Air) and the Munitions Assignments Committees (Ground, Navy, and Air) in order to strengthen integrated support for multi-service joint operations. In October 1943, it then established the Joint Logistics Committee. Each military service established a dedicated supply service detachment in theater. A campaign commanding officer would be responsible for implementing unified command, coordination, and planning should an offensive campaign be conducted involving multiple arms, such as landing operations. For example, during the landing on Saipan, campaign commanders specifically entrusted an important officer to command and lead the Navy, Army, and Marine Corps' shore logistics units. The specific division of labor was as follows. Naval shore logistics units were responsible for transporting offloaded supplies from ships to shore. Marine Corps and Army shore logistics units were responsible for handling transportation ashore as well as managing materials received on shore and their distribution to subordinate units. Special units under a division had dedicated supply logistics units. This enabled the integration of logistic support for all three services in the landing operation. During the landing operation on Okinawa, a dedicated "port logistics command headquarters" was established under the campaign commander that was responsible for unified command of the various logistic resupply units of each service. Each landing division was also provided one to four transportation companies.

## 1.2. Flexible and efficient mobile support forces

Cross-strait island landing operations take many forms. For example, vertical landing is a very flexible combat method. It includes large-scale blitzkrieg landings (*denglu shanji*), assault landings in depth, "surgical" landing raids, and shifting guerilla landings (*bianhua duoyang de denglu youji*). Different scales of operations and combat styles require timely and appropriate adjustments to logistic support, adopting flexible and diverse support methods to meet the operational requirements of units. Moreover, future landing operations will be affected by operational concepts, conveyance, and support capabilities. They will conduct landings in all areas, at all times, and all airspace from different directions, different areas, and using different landing modes. Compared to the traditional sea surface-only landing method, unconventional landings have greater concealment and can surpass enemy anti-landing obstacles at greater speeds. They will greatly improve the effectiveness of landing operations by landing in numerous directions throughout the depth of enemy defensive areas at times, sites, and under weather conditions unforeseen by the opposition. This leads to unconventional assault formations that are relatively small-scale but have strong long-range rapid maneuver and independent land attack capabilities. This requires scientific rationality and flexible maneuverability in the

organization of logistic support, facilitating command coordination and the implementation of group support and zone support to ensure landing units can conduct three-dimensional landings.

### 1.3. Continuous and enduring transport support capability

Transport service support occurs throughout the entire preparation and execution process of island landing campaigns, requiring extremely high levels of support continuity. The entire process of a cross-strait island landing operation includes the troop assembly phase, the at-sea transport phase, and the island landing combat phase.

The primary task of transport service support during the troop assembly phase is the build-up of forces and their accompanying materials and equipment from multiple services and arms into various coastal embarkation areas via trans-theater, long-range rail, highway, waterway, and air transport modes.

The at-sea transport phase is the focus and hard part of support. It is timed for our military's effective control of enemy forces, effective suppression of enemy ground and air firepower, and clearance of the enemy's offshore and shoal obstacles. Transport service support is responsible for the large-scale forward transportation of personnel, materials, and equipment of follow-on units across the sea as well as the evacuation of sick and wounded. Chiefly it must be able to "load up, get across, and unload."

## **2. Analysis of Issues Present in Transport Service Support for Cross-Strait Island Landing Operations**

There are many issues in transport service support for cross-strait island landing operations under high technological conditions. These include issues such as fighting with our backs to the water and the heavy transport burden, difficulties in execution when blocked off by the sea, exposed rear area targets vulnerable to enemy strikes, and complex organization and command of logistics and transportation in joint ground, sea, and air operations. These issues are specifically expressed in the following ways.

### 2.1. The battlefield geographical environment is unusual and transport support operations are severely restricted

The ocean is a natural barrier to conducting logistic support for landing operations in a cross-strait island landing. Firstly, the battlefield's natural geographic conditions of "a sea wedged between Taiwan and the mainland" severely restricts transport across the sea. With transportation at its core, the logistics support of the entire battlefield is then affected.

Transportation across the sea not only requires large numbers of transport ships; it also requires a large number of suitable embarkation and debarkation facilities. In particular, situations could arise where materials arriving may have difficulty going ashore without certain debarkation conditions. More importantly, the long transportation cycles and numerous links in cross-sea transport are seriously impacted by marine meteorological and hydrological conditions. To organize transport support across the sea, various logistics forces must assemble in China's relatively exposed coastal areas, transit a wide ocean, and launch in narrow landing sites. The

density of manpower and materials [in these areas] will be high, and concealment will be difficult and vulnerable to enemy strikes. Organizing logistic support will be very difficult.

## 2.2. The battlefield is integrated, transparent, and logistic targets are easily exposed

During a cross-strait island landing operation, the enemy can use integrated battlefield reconnaissance, surveillance, and aerial early warning systems to conduct comprehensive, all-weather reconnaissance, surveillance, tracking, and searches of the strategic and operational rear areas, coastal regions, and throughout the depth of the landing force. [The enemy can do this] by using a variety of means and channels or drawing support from other countries' strategic reconnaissance capabilities, in combination with their own established high and low altitude campaign reconnaissance networks and low-altitude and ground tactical reconnaissance networks. Transport service support must not only ensure that all units of the services and arms can covertly carry out preparations for combat and launch sudden and rapid strikes; it must also covertly complete various support tasks. Therefore, the requirements for implementing various aspects of logistics missions will also be significantly increased.

## 2.3. The enemy has a variety of attack methods and logistics is vulnerable to multiple attacks

The enemy's long-range guided weapons have large lethal radii. There are various forms of "preemptive" and "countermeasure" operations and the damage wrought by sea and air blockade and land-attack strikes is severe. Logistics will encounter enemy attacks throughout the entire process.

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In past landing operations, threats to logistics chiefly came from enemy aircraft and long-range artillery. These threats had little impact on the movement of logistics support and organizing their defense was relatively easy. In future cross-strait island landing operations, the enemy will concentrate on the use of various advanced combat methods, especially long-range guided weapons with even greater lethal radii. Using various forms, they will carry out air strikes to damage and prevent our landing operations. Various logistical fixed targets and logistics forces, such as airports, ports, logistics bases, transportation hubs, and hospitals will be under constant enemy surprise attack from all directions, causing grave losses and damage. There is even the threat of logistics support systems being paralyzed.

### **3. Countermeasures for Transport Service Support in Cross-Strait Island Landing**

Landing and transportation equipment are the main means and fundamental conditions for conducting a landing operation. They constitute the key material foundation for landing operational capabilities. Therefore, understanding the features of current advanced landing and transportation equipment in the world and strengthening the construction of hardware systems such as landing craft and shipborne transport helicopters are useful for improving the level of transport service support in the PLA.

### 3.1. Strengthen development in air-cushion landing craft to improve surface landing capabilities

Air-cushion landing craft are extremely adaptive to landing zones. As an ideal tool for landing transport, they can deliver landing units directly from sea onto the beach. They can achieve tactical surprise with their combat ability to “get up and over” and “breakout.” They can rapidly seize beaches with their ability to cross the water barrier and unexpectedly occupy beachhead positions. They are capable of traveling across areas difficult for other vehicles, such as swamps, sand, and ice. They can stop to provide units logistics replenishment without pier facilities, ensuring that supply lines for units ashore can “stand up,” “hold firm,” and be able to develop inland.

### 3.2. Strengthen the construction of shipborne transport helicopters to enhance vertical landing capabilities

“Vertical landing” is a theory widely used by foreign militaries in landing operations. It often uses shipborne helicopters carrying landing units to seize important terrain in landing zones, such as transportation arteries, bridges, and mountain passes. This supports the land assault of the main landing units or cooperates with the actions of follow-on landing units to create conditions for consolidating and expanding landing sites by seizing key points and preventing the forward movement of enemy second echelon and reserve forces. The successful execution of this theory largely depends upon strong airborne transport service support forces.

### 3.3. Establish maritime transport service support forces for both peacetime and wartime

Cross-strait island landing operations under high-technology conditions have placed even higher requirements on logistics replenishment. Army and naval ship transportation alone are no longer sufficient. Therefore, some countries have strengthened the construction of maritime transport forces that integrate peacetime and wartime [functions], mainly comprising merchant ships. Compared with other modern means of transport, merchant shipping has the advantages of large capacity, long range, and low costs. They have great potential in military transportation. In a cross-strait landing operation, they can carry out military logistics missions in transportation, replenishment, and first-aid treatment and evacuation of wounded [personnel]. During the 1982 Falklands War, the British Military not only requisitioned cargo ships such as oil tankers, RO-RO general cargo ships, and container ships, but also passenger ships, tugboats, fishing vessels and other ships. These ships were appropriately modified according to their own features. For example, with a little modification, RO-RO ships could serve as a simple landing ships and passenger ships could become troop transports or hospital ships.

## **4. Implementation of Countermeasures for Transport Service Support in Cross-Strait Island Landing Operations**

In addition to possessing advanced conveyance, support equipment, and facilities, countermeasures should also be taken to conduct transport service support in cross-strait island

landing operations under high-technological conditions. In doing so, the following five aspects should be considered.

#### 4.1. Establishing an elite effective command organization for the whole situation

There are numerous supported elements involving numerous units and coordinating relationships for maritime transport in a cross-strait island landing operation. Specifically, it is necessary to support unit maneuver and combat materials delivery, in addition to conducting protection and rush repair of traffic lines. This results in complex organization and command. Accomplishing transport service support tasks in a landing campaign under high-technology conditions will be difficult without a transportation command organization with strong authority to implement centralized and uninterrupted organizational command.

On the basis of national and military conditions, we should establish a joint command system for operational transportation based on the principles of end-to-end (*quancheng*), high-efficiency, concentration, and unity while adhering to the guidance of People's War doctrine to fully leverage the might of military and civilian support. Theater commands [should] establish joint transportation command headquarters (*yunshu lianhezhihuibu*) to be personally led by the commanding officer of each Theater Command. It would be based on the Military Region Transportation War Readiness Leading Small Groups and its main body [would] comprise the departments responsible for relevant functions in the Military Regions and Theater Command Navy and Air Force. It would also involve participation by local governments and railway, highway, shipping, aviation, and post and telecommunications departments. This [joint transportation command headquarters] would be fully authorized and responsible for the organization and command of operational transport service support. At the same time, various levels of transport support departments at the local level should also establish corresponding command organizations to support the smooth and efficient command of transportation in mainland rear areas. Under the unified command of the operational joint transportation command headquarters, coordination across the military and localities, and the three services of the army, navy, and air force can accomplish the transportation support mission for a landing operation.

#### 4.2. Make thoroughly meticulous pre-war preparations

Full preparation is the prerequisite for victory. A future cross-strait island landing operation must be guided by operational requirements with overall planning for all preparatory work in combat transport service support. Transport service support will focus its preparation on what is most urgently required for the landing operation. The formulation of transport service support plans must focus on operational requirements and the rational allocation of lift capacity and achieve a high degree of uniformity between the strategic level and operational plans, thereby ensuring the achievement of operational objectives. The various preparatory work of transport service support should be based on dealing with the most difficult and complicated situations for optimal preparations.

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All work must have an advance plan that is detailed for every segment, addressing the various emergencies that may occur during the support process. Prepare multiple plans and formulate a

variety of scientific and reasonable support response plans to ensure that the best choices are made for each situation during wartime. Prior to war, training exercises for transport service support should be strengthened and familiarization with the combat transportation support plan and the battlefield environment increased to effectively improve transportation support capabilities for landing operations.

#### 4.3. Organize flexible joint transport defenses

Firstly, an “integrated” defense concept should be established. When faced with a unified battlefield and strikes throughout [our] depth, we must adopt new ways of thinking to study new theories in transportation defense. The one-sided understanding of “fighting alone” should be abandoned and a new theory of “integrated” defense established. We should establish a concept of “information protection first” by enhancing information connectivity and interoperability and forming a Theater Command integrated transportation defense network to strengthen the overall effectiveness of defense. Secondly, make flexible use of defensive methods in response to changes in the way strikes are conducted. To enhance the effectiveness of transportation defense, transport service support units should combine changes in transportation methods, defense objectives, and defensive operations with the integration of all elements and processes into the Theater Command’s joint defense operations. This would highlight key goals and times and rely on unified deployments under the Theater Command.

### **5. Conclusion**

Cross-strait island landing operations are one of the most complex forms of joint operations. Targeted research into transport service support issues in cross-strait island landing operations under high-technology conditions have great significance for completing the great cause of national reunification. On the basis of in-depth analysis of issues in transport service support for cross-strait island landing operations, the proposed measures in this paper on hardware construction provide scientific reference for operational models in future cross-strait island landings. The next step is thorough study of new technologies and experiences of transport service support methods and techniques in foreign militaries. This can comprehensively improve the PLA’s transport service support capabilities for cross-strait island landing operations.



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## Approaches to Improving Support Capabilities for Dock-Less Unloading<sup>1</sup>

Liu Baoxin and Dong Nan<sup>2</sup>

During wartime, piers at enemy ports might be damaged and difficult to restore for use within a short period of time, causing increased difficulty in the unloading of equipment and material on enemy shores. Although our military's support capabilities for dock-less unloading<sup>3</sup> have improved after many years of development, there still exists a significant gap compared with the strategic requirements of absolute victory in war (*juezhhan juecheng*). There is an urgent need to strengthen research, tackle key problems, and develop corresponding measures to address prominent contradictions and problems related to building support capabilities for dock-less unloading, and to accelerate the resolution of difficult problems related to support for dock-less unloading during landing operations.

### 1. Accelerate the Construction of Support Forces for Dock-Less Unloading

Support forces are an important buttress for organizing and implementing support for dock-less unloading. The level of construction [of these forces] is an important gauge of the strength of support capabilities for dock-less unloading. Possessing a large and powerful support force for dock-less unloading is the key

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factor for ensuring victory in landing operations, with an important influence on the course and outcome of the war.

- 1) Accelerate the military's creation of organic support forces for dock-less unloading.

Organic support forces possess significant advantages such as a high degree of readiness training, rapid response times, and strong support capabilities. They are the main forces

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<sup>1</sup> 刘宝新, 董楠 [Liu Baoxin and Dong Nan], 提高无码头卸载保障能力的对策 [“Approaches to Improving Support Capabilities for Dock-Less Unloading”], *军事交通学报* [*Journal of Military Transportation*], vol. 1, no. 5 (May 2022), pp. 26-29.

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<sup>3</sup> **Translator's note:** The Chinese term “dock-less unloading” (无码头卸载) is similar to what the U.S. Department of Defense calls “logistics over-the-shore” operations.

[responsible] for organizing and implementing support for dock-less unloading in wartime. [Organic support forces] are the common practice of developed militaries like the U.S. military. The U.S. Army and U.S. Navy have respectively established specialized transport terminal units and engineering units equipped with corresponding support equipment and responsible for terminal operations in domestic and overseas ports and the construction of temporary piers. In order to robustly promote the preparation for military struggle in the maritime direction and effectively resolve the difficult issue of unloading on enemy shores, [we] should learn from the beneficial experience of the U.S. military and rely on the [PLA] Army's existing pontoon bridge units (*zhouqiao budui*) or the [PLA] Navy's Engineering Force to accelerate the creation of organic support forces for dock-less unloading. In peacetime, [these forces] would be responsible for managing and using support equipment for dock-less unloading. In wartime, they would be specifically responsible for constructing temporary piers, ensuring the unloading of personnel, equipment, material from the landing force, and [conducting] shallow depth (*qianjin zongshen*) material trans-shipment tasks.

2) Build a reserve unloading support force of a certain scale.

In wartime, the environment for dock-less unloading will be complex and the support tasks will be heavy. Just relying on the military's organic support forces for dock-less unloading would be difficult, so [we] must accelerate the creation of a reserve unloading support force of a certain scale. It can be created by relying on large port engineering firms and marine rescue and salvage corps as the main body, with active duty soldiers [with expertise in] dock-less unloading as the core, and officers and non-commissioned officers that have been transferred to civilian work or left the military as the backbone. Port engineering firms have complete sets of large engineering equipment such as tugboats, engineering barges, and semi-submersible barges. If the military can equip them with special dock-less loading/unloading support equipment, they can form a backbone equipment system for dock-less unloading support, basically possessing the ability to conduct dock-less unloading of people, equipment, and material. The marine rescue and salvage corps is equipped with various types of rescue and salvage ships and rescue helicopters, including 7,000t class high-powered rescue vessels and salvage engineering vessels with lift capacity of 5,000t. In wartime, one rescue corps and one salvage corps responsible for dock-less unloading marine service support functions can be assigned to each landing direction, providing support services such as salvaging sunken ships, rescuing people in distress, and cleaning up oil spills. Meanwhile, relevant engineering and technical personnel from port engineering firms and rescue and salvage corps can be classified as reserve personnel. In peacetime, [they can] organize and conduct training and drills and support the military's exercises and training activities in line with reserve

force construction standards. In wartime, [they can] integrate with the dock-less unloading support force corps according to plan.

- 3) Explore the construction of an unmanned dock-less unloading support force.

With the advance of science and technology, unmanned equipment like unmanned aerial vehicles has achieved rapid development in foreign militaries and has been applied in actual combat, becoming important offensive and defensive forces on the informatized battlefield. Unmanned surface vehicles that possess autonomous navigation and autonomous planning capabilities are playing increasingly important roles in domains such as intelligence collection, surveillance and reconnaissance, alert and patrol, mine countermeasures, anti-submarine warfare, fleet protection, search and rescue, and coastal mapping. Unmanned equipment has pronounced advantages such as strong adaptability to harsh sea states, no human casualties, low construction cost, and stable operational efficiency. It is extremely suitable for carrying out dock-less unloading support work such as security alert, channel marking, dismantling beach obstacles, and near-shore barge transport. As a result, accelerating the research/development of unmanned dock-less unloading support equipment such as unmanned obstacle clearing ships, unmanned transport platforms, and unmanned set-up piers (*dashe matou*) and exploring the creation of unmanned unloading support forces of a certain scale can improve operational efficiency and significantly lower casualties among dock-less unloading support personnel during landing operations.

## **2. Robustly Build and Develop Dock-Less Unloading Support Equipment**

- 1) Robustly conduct top-down design (*dingceng sheji*) of equipment systems.

Top-down design involves the use of engineering theory from the strategic perspective to conduct overall planning and [provide] impetus for the construction of dock-less unloading support equipment systems. It is an important method for rapidly improving the construction of dock-less unloading support capabilities. The top-down design of dock-less unloading support equipment systems includes design goals, strategic priorities, and plans. Top-down design of dock-less unloading support equipment must be “demand-driven and innovation-driven.” It must conduct in-depth analysis of the unloading support requirements for landing operations, understand the units that will be supported and means of support in future landing operations, and scientifically determine the equipment system [that will be used]. It must rationally classify the types, models, missions, allocations, and interchangeability of dock-less unloading support equipment, precisely aligning the construction and development targets for dock-less support equipment systems with operational support requirements and ensuring that construction of dock-less unloading support equipment does not duplicate [efforts], achieves full functional coverage, and has no performance dead ends. Driven by the goal of achieving the

national strategic intent, we must formulate a long-term plan for equipment development, clarifying the expected goals for the construction of dock-less unloading support equipment system over a fairly long time period. Prioritizing absolute victory in the main strategic direction, [we must] formulate a mid-term plan for equipment development, clarifying the framework for dock-less unloading support equipment systems and milestones along the way. With the goal of prioritizing the development of key support equipment for dock-less unloading that would have a definitive impact on victory in war, [we must] formulate a short-term plan for equipment development and clarify important matters such as funding arrangements. [We must] take a step-by-step approach, constantly adjusting the construction goals for the dock-less unloading support equipment system and revising the development path, to ensure the effective achievement of top-down design goals.

2) Comprehensively promote research/development and production of key equipment.

Closely focusing on the fundamental goal of [building] combat power, [we must] concentrate on resolving prominent contradictions and problems such as slow lightering of equipment (*zhuangbei guobo xiezai man*), poor support capabilities in heavy sea states, and the lack of unloading support equipment. Moreover, to effectively improve dock-less unloading support capabilities, [we] must prioritize the development of advanced roll-on/roll-off (Ro-Ro) lighters (*guobo*), elevated causeways (*gaojia zhanqiao*), and coastal unloading support equipment. [We must] accelerate the research/development of Ro-Ro lighter platforms in response to the problems of existing hoisted [cargo] lighter platforms such as slow maneuvering speed,

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excessive number of lightering steps, and low lighter efficiency. In order to improve the offshore lighter and unloading efficiency of units, [we must] prioritize research/development and production of Ro-Ro lighterage platforms that launch faster, have fewer operational steps, and boast higher unloading efficiency. [We] must accelerate the research/development of new-type causeway ferries (*zhanqiao duchuan*). Existing landing craft are unable to directly receive equipment lifted by the offshore hoisted [cargo] platform (*haishang diaozhuang guobo pingtai*). An intermediate platform must be set up to conduct Ro-Ro transfer, greatly impacting the efficiency of dock-less unloading support. [To remedy this problem, we] must accelerate the research/development of a causeway ferry with a wider deck, greater carrying capacity, and faster speed, enhancing near-shore lighter support capacity. [We] must accelerate the research/development of unloading support equipment for high sea states. Existing core unloading equipment with connections to the shore such as assembled causeway docks (*pinzhuangshi zhanqiao matou*), submersible Ro-Ro docks, and pontoon piers all have

floating structures, so their operational efficiency is highly subject to the impact of wind and waves. Therefore, in order to strengthen all-weather shore unloading support capabilities, [we] must accelerate the research/development of elevated causeway systems and flexible wave attenuating equipment. [We must] accelerate the research/development of new-type platform and raised beach unloading equipment. The enemy coast has lots of raised beaches, and it would be difficult to employ existing equipment in these complex circumstances. Therefore, [we] must concentrate on tackling key problems, accelerate the research/development of new-type coastal unloading equipment, and conduct coastal unloading over coastal sea walls, steep cliffs, and fishing harbors, taking sections [of the coast] traditionally unsuitable for landing and turning them into sections suitable for landing and unloading, thereby effectively expanding dock-less unloading support capabilities under complex terrain conditions.

- 3) Plan overall and promote the transformation and development of equipment reserves (*zhuangbei chubei*).

First, the scale of support equipment reserves should be rationally determined. The scale of equipment reserves for supporting dock-less offload is affected by various factors such as the military strategic guidelines, national fiscal resources, and the military's structure and organization. While fully integrating the requirements for dock-less unloading support equipment, [we] should rationally determine the scale and quantity of support equipment reserves in accordance with the characteristics of landing operations and operational standards. Second, flexible support equipment reserve methods should be adopted. Dock-less unloading support equipment combines both general and specialized equipment, quickly becomes technologically outdated, and consumes a lot of funds. When actual work is being performed, military reserves can be integrated with local reserves, whereby tangible, technical, and financial reserves are combined. Some dock-less unloading support equipment commonly used by the military and civilians can be increased in local reserves and reduced in military reserves. For equipment that obsolesces quickly and takes up significant funds, tangible reserves can be reduced, and technical and financial reserves increased. During wartime, direct purchases can be combined with emergency research and production to satisfy requirements for dock-less unloading support equipment. Third, adjustments to the structure of support equipment reserves should be accelerated. For dock-less unloading support equipment that takes a long time to produce, is difficult to store and transport, and is solely used by the military, current widespread methods of static physical storage have led to long-term occupation of significant stocks. Large numbers of reserve equipment are being phased out with new updated replacement equipment. In order to continuously improve the quality of dock-less unloading support equipment reserves, static reserves should be appropriately reduced. A dynamic conversion mechanism between combat readiness reserves and

rotational reserves should be improved to eliminate scrapped equipment, circulate usable equipment, and store completely new equipment, always ensuring that dock-less unloading support equipment reserves are at good states of readiness.

### **3. Attach Great Importance to the Emergency Repair and Construction of Ports and Terminals**

Compared to setting up temporary docks, restoring ports [so they can] conduct equipment and materials unloading [provides] outstanding speed, safety, and ease. It is an important means of organizing and implementing unloading on enemy shores in wartime. Advance preparations should be made in peace time according to the potential forms of damage port docks will receive, and the emergency repair and construction of port terminals should be done with care.

#### 1) Accelerate the emergency repair and construction of port handling machinery.

Port handling machinery is an indispensable and important tool for organizing and implementing the unloading of equipment and materials. After units capture and occupy a port, the level of damage to port handling machinery should be rapidly ascertained, and personnel should be quickly organized to conduct emergency repair on salvageable machinery. In cases where [machinery] is badly damaged or difficult to repair quickly, large civilian crane trucks or pontoons can be mobilized and requisitioned to carry out loading and unloading support. It is also possible to transport combined quayside cranes to enemy port terminals for rapid on-site assembly or organize large port machinery manufacturers to produce in advance a part of the port machinery, load it onto vessels, and install it directly after we seize and control a large port, thereby speeding up restoration of a port's handling capacity.

#### 2) Do a good job in dredging the waterways of ports and terminals and ensure the supply of fuel, water, and power.

Using sunken ships to block the waterway of port terminals and cutting off the supply of fuel and water is a low-cost, simple operation that is easily implemented. It is a common method used by an enemy to destroy port terminals during wartime. When an approach channel is obstructed by a sunken ship and vessels are unable to pass through, large civil port engineering machinery can be mobilized to salvage the sunken ship. This can make full use of the professional advantages of the local navigation engineering departments (*hangwu gongcheng bumen*) to rapidly clear sunken ship obstacles in channels. When [supplies of] power, fuel, and fresh water to a port terminal are destroyed, [we] could consider using power supply vessels or vehicle-borne generators to supply electricity to a port. Mobilized and requisitioned oil tankers and water ships can conduct emergency support for fuel and fresh water to meet the supply needs of a port terminal.

- 3) Accelerate the development of shoreside damaged terminal roll-off platforms (*bang'anshi shousun matou gunxie pingtai*).

Among civilian vessels, Ro-Ro vessels are the most ideal vessel-type for unit cross-sea delivery. Current civilian Ro-Ro vessels largely use straight stern ramps, placing higher requirements on port terminals by requiring special use sloped terminals at which to load and unload. Most port terminals adopt a vertical dock structure, which is difficult to satisfy the berthing requirements of Ro-Ro vessels. This urgently requires accelerated development of shoreside damaged terminal roll-off platforms and their inclusion into combat readiness reserve materials so as to form this support capability as soon as possible. The shoreside damaged terminal roll-off platform is composed of self-propelled flat barges and transfer causeways. It berths at the shoreline of a blocked or damaged port for Ro-Ro vessels to lay up against (*dingkao*) and connects to the surface of the terminal. It adapts to tidal changes and can ensure that heavy equipment can be directly rolled off, increasing the speed of debarkation.

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#### **4. Carry Out In-Depth Dock-Less Unloading Training Drills and Evaluations**

Dock-less unloading support operations are complicated, with a multiplicity of equipment systems and harsh operating environments, which places high requirements on the operating skills and the level of organization and command of support personnel. Therefore, [we] must make great efforts to do a good job in dock-less unloading support drills and exercises.

- 1) Greatly strengthen combat realism in joint training.

Cross-sea landing operations under informatized conditions are integrated joint operations with participation by multiple services and arms and local support-the-front forces.<sup>4</sup> Joint operations call for joint training and give rise to joint support. In order to speed up the formation of dock-less unloading support capabilities, professional military and civilian dock-less unloading support forces should regularly be organized to participate in the large-scale maritime projection exercise activities of operational units. Realistic support capabilities should be vigorously promoted by having [dock-less unloading support forces] and operational units train directly with each other (*huwei tiaojian tongchang xunlian*), focusing on drills under enemy threat conditions on subjects such as opening debarkation lines, equipment lighterage at sea, repairing damaged ports, and command coordination training.

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<sup>4</sup> **Translator's Note:** "Support the front" (支援前线) refers to activities by government and societal resources mobilized to support the military's front line operations.

2) Actively carry out dock-less unloading support simulation training.

Dock-less unloading support training requires significant materials and manpower, has complex organizing processes, and is heavily impacted by marine hydrometeorological factors. On top of that, there is a lack of training equipment. [These circumstances] have created a serious phenomenon where units “have no means or money to train.” Thus, [we] should accelerate and promote the construction of dock-less unloading support simulation training methods. Emphasis should be placed on development of dock-less unloading training simulators for single-unit operation, coordinated work, and joint games. They should target key operational links in lighterage at sea, near-shore lighterage, and beach offloading, as well as basic subjects such as pontoon assembly, hoisting operations, Ro-Ro operations, and barge lighter operations. A combination of single-device self-training and multi-device group training should be adopted to provide troops with an immersive computer virtual training method with comprehensive content, intuitive scenes, and human-machine interaction. This will enable participating officers and enlisted to quickly master the basic operational skills of dock-less unloading support, laying a solid foundation for actual joint exercises.

3) Emphasize training evaluations.

Evaluations are the “touchstone” for testing the effects of military training and the “booster” for in-depth development of training realism. In practice, [we] must pay attention to the driving and guiding role of evaluations in military training and incorporate dock-less unloading support training into the overall military training system as soon as possible. [We] should step up the formulation of the training outline and evaluation standards in dock-less unloading support training, so that there are laws and rules to follow in the training and assessment of dock-less unloading support force training. It is necessary to establish and improve incentive and punitive mechanisms in the evaluation of dock-less unloading support training, incorporating training evaluation results into a unit’s assessment and individual’s inspection conditions. Making reasonable use of the evaluation “baton” to enhance the enthusiasm, initiative, and creativity of dock-less unloading support force training work, can improve the quality and level of realism in training, and bring dock-less unloading support training closer toward actual combat.

4) Plan the construction of a talented dock-less unloading support force.

“It is better for personnel to wait for equipment than for equipment to wait for personnel.” [We] should fully leverage the advantages found in watercraft support and maritime transport and projection disciplines by relying on the existing training of watercraft specialists and development of dock-less unloading technologies at relevant professional colleges and scientific research institutions. [We] should adjust the

allocation of forces and build a professional discipline for dock-less unloading. It should highlight the special requirements of dock-less unloading including subjects such as lightering, platform operation, and assembly and construction. Efforts should be made to build a talent training system that combines college education with military and enterprise training [programs] to provide the human and intellectual support for the construction of dock-less unloading capabilities.

## **5. Conclusion**

The construction of dock-less unloading support capabilities for landing operations involves a wide range of areas, is highly technical, and requires large amounts of funding. It is very complicated systems engineering. This article is guided by our military's current requirements for military struggle in the maritime direction. In light of the current situation in the construction of dock-less unloading support capabilities, this article proposes relevant measures in order to serve as a useful reference and speed up solutions to the problem of equipment and materials being "unable to offload."

## Part III: Sustaining Far-Seas Presence

This section covers the lifelines required to maintain a fleet far from home ports for extended durations.



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## Deployment of Petroleum, Oil, and Lubricant (POL) Support Forces for Warship Formations Conducting Distant Ocean Operations<sup>1</sup>

Wei Zhenkun, Liao Xiaowu, Zhao Suli, Guo Zhan<sup>2</sup>

The deployment of petroleum, oil, and lubricant (POL) support forces for warship formations conducting distant ocean (*yuanyang*) operations takes place in deep-sea ocean environments far from the mainland. To support warship formations, POL support personnel, equipment, and material are arranged and deployed according to the combat mission deployment and POL support mission. It is an important task of the logistics department during wartime and chiefly includes organization, differentiation, and allocation of POL support forces.

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The correct deployment of POL support forces for warship formations in distant ocean operations is to effectively organize POL support at sea and make full use of manpower, material, and financial resources to improve the ability of POL support to respond to contingencies during war. It is an important measure in the completion of distant ocean combat logistics and equipment support missions.

### 1. Characteristics of POL Support

#### A) A diversity of supported forces

The distant ocean operations of the future will be combat operations to annihilate (*jianmie*) and expel (*quzhu*) an adversary's mobile forces mainly carried out by naval combat forces supported by air, conventional missile, information operations, and special operations forces. Distant ocean operations will be joint operations involving multiple services and arms and distant ocean operations POL support will be joint POL support across various support tasks. During distant ocean operations, only warship formations can perform multiple combat missions in almost any operational space and operational phase (*huanjie*). For example, warship formations integrate sea, air, and land operations in distant ocean naval blockade operations and destruction of sea lines of communication. Warship formations include a core force of surface warships comprising

<sup>1</sup> 魏振堃, 廖孝武, 赵素丽, 郭湛 [Wei Zhenkun, Liao Xiaowu, Zhao Suli, and Guo Zhan], 舰艇编队远洋作战油料保障力量部署 [“Deployment of Petroleum, Oil, and Lubricant (POL) Support Forces for Warship Formations Conducting Distant Ocean Operations”], 军事交通学院学报 [*Journal of Military Transportation University*], vol. 22, no. 4 (April 2020), pp. 53-56.

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guided missile destroyers, guided missile frigates, and guided missile fast attack craft. It includes submarine forces that move deep behind the enemy. It also includes coordinated maritime operations by shipborne aviation forces to guard the sea and air. There are many services taking part in combat in a relatively scattered operating space, creating complex and diverse demands on POL support and increasing its difficulty.

#### B) Vast ocean space in which to maneuver

The need for POL mobility stems from operating in distant oceans and the mobility of operating forces. Maneuver is an organized and purposeful movement of forces and weaponry carried out by the combat forces of warship formations throughout the battlefield space for particular strategic or tactical objectives. Warship operating areas are continuously extending and expanding, especially due to the high maneuverability and large operating range of aircraft carrier formations. Their strong maneuverability enables them to navigate 600 nautical miles in 24-hours and conduct reconnaissance, search, and attack over an area of one million square kilometers each day and night. The operating sea area of the U.S. Navy's Seventh Fleet extends from the Central Pacific to the east coast of Africa, covers an area of approximately 181.3 [million] square kilometers, and accounts for 72 percent of the total area of the two great oceans (*liang dayang*).<sup>3</sup> Taking the South China Sea as an example, it covers 3.5 million square kilometers of ocean space. When executing missions in the South China Sea, the [Chinese] navy's operational space or support space will be much larger than 3.5 million square kilometers, which requires robust far seas mobility in naval POL support to conduct forward support (*qianshen baozhang*).

#### C) Deeply integrated combat and support

Modern maritime operations require the simultaneous conduct of support and combat. Mobile POL support needs to be carried out while warship formations perform combat missions at sea. First, mobile support formations should be organized according to the combat formation's size, operational depth, and duration of the mission, as well as the situation within the theater. Second, the POL requirements of combat forces and weaponry should be met through accompanying (*bansui*), cyclic (*huihe*), and on-demand (*yingzhao*) support methods. General procedures: warship formations top off POL and then leave their berths. When they approach the operational sea area, oilers first refuel screening ships (*jingjie jianting*) while large warships also refuel escorting ships. The oilers then refuel the large warships, thereby reducing the duration of POL replenishment prior to combat. When the formation heads to the operational sea area for combat missions, the oiler sails to a pre-determined area to stand by for the formation to complete its mission or when it requires replenishment, whereupon it conducts rendezvous or on-demand support. This method of integrating POL support with combat missions not only enhances the combat capabilities of formations, but also improves POL support efficiency in the support formation.

#### D) Difficult security and defense

The focus of striking logistics in modern warfare is to hit the POL support lifeline. In distant ocean operations, the POL supply line will inevitably become a primary target of enemy attack

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<sup>3</sup> **Translator's Note:** The term "two great oceans" (两大洋) likely refers to the Pacific and Indian oceans.

and long-range precision-guided weapons will constantly pose a serious threat to its survival in war. First, security and defense of POL support bases is difficult. POL support facilities for warship formations are typically quite large, such as oil depots and docks, making them obvious targets and hard to conceal. Second, security and defense during the POL replenishment process at sea are difficult. There are a great quantity and variety of materials in warship replenishment at sea and replenishment equipment is complex and difficult to operate. There are many steps in conducting replenishment and the process takes a long time. This insecurity is also not conducive to the concealment and tactical maneuvering of warships and makes them extremely vulnerable to attack.

## **2. Requirements in the Deployment of POL Support Forces**

The deployment of POL support forces for warship formations engaged in distant ocean operations is restricted by factors such as combat missions, the disposition of combatants, support equipment performance, battlefield geographic conditions, and the level of local threats. When deploying POL support forces, the military commander's operational intent and the support determined by the head of logistics must be correctly understood and the sea, terrain, and transportation conditions must be known. We should deploy POL support forces correctly and rationally according to their actual situation while avoiding disadvantages. The overall requirements for POL support for warship formations engaged in distant ocean operations is to meet the needs of distant ocean operations and to facilitate support, concealment, and safety, and have stable, continuous, and mobile support capabilities.

### **A) Rational differentiation conducive to replenishment.**

The differentiation of POL support forces refers to establishing a division of labor between support tasks and supporting forces according to operational decisions. This mainly includes determining the support system, clarifying the tasks and relationship of each supporting organization, and determining the support tasks undertaken by support departments at those corresponding levels. In POL support for warship formations engaged in distant ocean operations, it is necessary to clarify the division of responsibilities between leadership organs and support units, fully understand the role of each unit level in combat missions, and rationally differentiate organic support forces, higher-level reinforcing support forces, and local support forces. This will create POL support forces conducive to replenishment and improve the effectiveness of command in POL support.

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### **B) Ease of maneuver through scientific organization**

The organization of POL support forces refers to the differentiation of current POL support forces into several parts based on operational decisions, support tasks, and support capabilities. Support forces such as personnel, equipment, and materials are temporarily allocated and combined in certain ways to form support units based on the support tasks they will undertake. In POL support for warship formations engaged in distant ocean operations, the methods of specialized division of labor, building block assembly, and modular groupings should be adopted to quickly and rationally allocate the required support personnel, equipment, and materials based on different support tasking and requirements. This will create POL support forces for distant

ocean operations that are scientifically organized and maneuverable, enhancing rapid mobility in POL support.

#### C) Efficient allocation that aligns combat and support

The allocation of POL support forces refers to their placement in suitable positions based on factors such as POL support tasks, enemy conditions, and terrain. POL support forces for warship units are divided into two parts, ashore and afloat. They are based out of POL facilities on land equipped for refueling at ship docks, on shorelines or beaches, and afloat refueling equipment and oil tankers.<sup>4</sup> They carry out refueling of warships at docks, over shorelines and beaches, and while underway. To configure their positions correctly during allocation, it is necessary to analyze the composition of various POL support forces, the nature of their tasks, and their mutual relationships based on the battlefield situation and friendly and enemy support capabilities. This can establish an efficient allocation of POL support forces for distant ocean operations that aligns combat and support, strengthening the emergency response capabilities of POL support.

#### D) Protection and security are paramount

Supply ports and support ships are the source of life for our warship formations engaged in distant ocean operations. They are the focus of enemy targeting, with threats coming from multiple directions in the air, surface, and underwater. To ensure the security of offshore POL support bases, transport lines, points of embarkation and debarkation, and at-sea replenishment areas, support ships must have some anti-missile and anti-torpedo capabilities. They must also be able to rescue themselves with some ability to stop attacks and boarding by small bands of pirates and perform damage control in the distant oceans. Support bases must establish early warning equipment and facilities, especially sea and air reconnaissance, electromagnetic confrontation, and network attack and defense measures for timely warning of the enemy situation and risk aversion during the course of POL port replenishment (*youliao gangkou buji*). When necessary, warships should be dispatched as escorts or conduct early warning screening to form concentrated defense and security of POL support forces, enhancing the security and defense of POL support.

### 3. Methods for the Deployment of POL Support Forces

According to the characteristics of POL support for warship formations engaged in distant ocean operations and the requirements for the deployment of support forces, POL support forces for warship formations [should] use a combination of fixed and mobile and shore-based and sea-based deployments. Depending on the deployment area, there are three types of POL support forces for distant ocean operations conducted by warship formations: rear shore-based (*houfang anji*) POL support forces, forward base (*qianjin jidi*) POL support forces, and maritime mobile (*haishang jidong*) POL support forces.

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<sup>4</sup> **Translator's Note:** This sentence includes the phrase “岸滩” which in this context refers to refueling without access to dock facilities. See: Academy of Military Sciences [军事科学院], *PLA Directory of Military Terminology* [中国人民解放军军语] (Beijing: Military Sciences Press, 2011), 948.

A) Methods for the deployment of rear shore-based POL support forces

Rear shore-based POL support forces generally rely on naval near-coast defense bases, comprehensive support bases, and regional joint logistics support centers. They are located along shore-based harbors. Shore-based POL support organizations, shore-based mobile support detachments (*fendui*), and shore-based long range technical support detachments can be set up as needed. Shore-based POL support organizations comprise shore-based fuel depots and field (*vezhan*) petroleum pipeline teams; they are responsible for POL reserves, transfer, and supply in wartime. Shore-based mobile support detachments comprise personnel and mobile support equipment drawn from relevant POL support forces in order to meet changes in POL support requirements for distant ocean operations conducted by warship formations and boost shore-based mobile support capabilities. Their main task is to standby in the created unit and obey orders to organize and implement mobile accompanying support and forward (*qianchu*) support. Shore-based long-range technical support detachments are organizations that use information network technology methods to provide remote POL equipment repair information and technical support by military representative bureaus, educational institutions, scientific research institutions, and repair facilities. Their main task is to follow orders to organize and implement remote technical support for the POL support force.

B) Methods for the deployment of forward base POL support forces

Forward bases are generally established on remote islands/reefs and floating ships far from rear shore-based [bases]. They include a combination of remote fixed and mobile POL support forces such as overseas POL support bases and marine floating POL supply bases. With the continuous support of rear shore-based POL support forces and afloat mobile POL support forces, they form POL support organizations with comprehensive support capabilities such as storage, transport, and filling (*jiazhu*). They are the key force for constructing a POL support system for distant ocean operations. Remote overseas POL support bases are fixed POL support forces prepositioned on islands in important waters. They possess favorable harbors and equipment facilities for the entire sequence including POL receiving, testing, storage, delivery, and replenishment. They are primarily responsible for tasks such as receiving, storage, release, and quality control of POL; the loading onto ships and transport of bulk liquid oil and lubricants; the servicing of POL equipment and systems, and personnel and equipment support for dock-side fueling, tanker trucks, oil pipelines, and oil recovery. The term “marine floating support bases” refers to POL support forces prepositioned on large moveable comprehensive support platforms comprised of a certain number of specialized (*gongnengxing*) warships. They have robust equipment facilities for stockpiling, transporting, and filling (*jiazhu*) POL. They can perform mobile POL replenishment. Their primary tasks include POL stockpiling, transfer, and mobile refueling in sea areas where mobile operations are conducted. Forward bases can be set up in advance or set up right when they are needed. Their main task is to provide POL support within the organizational area before ships put to sea and after they return, to preserve and restore combat capabilities.

#### C) Methods for the deployment of maritime mobile POL support forces

Maritime mobile POL support forces are chiefly comprised of maritime mobile replenishment [ship] formations and maritime mobile transport [ship] formations. Maritime mobile replenishment formations are POL support forces comprising comprehensive supply ships and fast combat support ships that form organizations with sustained maritime support capabilities. They are the direct support forces enabling warships to conduct maritime mobile supply. Their main task is to travel between resupply areas and the forward base, providing maritime mobile supply for warships engaged in combat operations at preset supply areas. Maritime mobile transport formations are organizations comprising support forces including oil tankers, high speed transport ships, etc. drawn from both military and civilian groups that provide POL support for forward bases. Their primary task is to travel back and forth between shore-based POL support organizations and forward bases, providing POL for forward bases.

#### 4. Issues of Concern in the Deployment of POL Support Forces

##### A) Unified deployment of support forces, focus on overall effectiveness

In order to better leverage the overall support effectiveness of POL support forces during distant ocean operations, various types of on-shore and at-sea POL support forces should be integrated and employed in a centralized and unified way, thereby creating overall synergy. First, different operational styles should adopt different deployment forms. For example, in joint attack operations in island/reef areas a combination of fixed land-based deployments and mobile maritime deployments should generally be adopted, with land-based POL support forces as the foundation and maritime mobile support as the focal point. It is a deployment method that extends from shore to sea, is interconnected, and complementary. Joint landing operations must adapt to the requirements of across the water (*kuahai*) strike operations, so they must adopt a deployment method linking sea bases, maritime [operations], and the enemy coast. Second, they must pay attention to maintaining connections with other support forces. Logistical support for the distant ocean operations of the future will be joint support and not singular material support or singular support from one armed service. They cannot just be limited to organizing POL support forces, and task differentiation and configuration. They must also consider the issue of interfacing with other material support force deployments.

##### B) Develop prepositioned support forces, prepare to establish sea bases (*haishang jidi*)

Sea bases are supported by floating specialized support ships. Various types of POL support personnel, supplies, equipment, and materials need to be pre-positioned. While reducing requirements for shore-based oil reserves and air/sea transport to the maximum extent, they provide multiple levels of POL support and multiple ways for operational support for operational forces. To build and develop maritime POL support bases, it is first necessary to conduct planning in a scientific manner and take a gradual approach. The establishment of sea bases is politically sensitive. To do so requires a comprehensive consideration of the domestic and foreign situation and scientific planning when developing the approach to building them. We must start with small POL supply depots, progressively expanding supply point functionality, moving from points to lines, and from lines to networks, transitioning from "strategic

management of the two oceans" (*jinglue liangyang*) to "worldwide distribution" (*buju quanqiu*). Second, it is necessary to control the scale and module integration. The construction of maritime POL support bases is done overseas. The geographic space is limited. Scale must be controlled, striving for small, lean, and flexible. With respect to the allocation of equipment and gear, the three sub-modules of "storage, transport, and filling (*jia*)" should be integrated into one POL support module. Different storage methods, transport methods, and filling methods can be freely matched, forming modularized free combinations and achieving functional integration.

### C) Allocate civilian support forces, promote civil-military integration

The distant ocean operations of the future will inevitably be comprehensive operations integrating total national power, military power, and civilian power (*minli*). Therefore, widespread and deep mobilization of and reliance on the vigorous support of the masses is the guarantee for winning victory in war. In particular, our country's civil oil transportation equipment and oil storage facilities have a high degree of modernization. China's private oil transport equipment and oil storage facilities are fairly modernized, and its marine oil transport fleet is strong. Its oil storage capacity is getting larger and larger. For this reason, the civilian petroleum system will be a significant support force for maritime POL support for distant ocean operations. When requisitioning civilian oil system forces for distant ocean operations, the first [thing that civilian entities can do] is help access (*choucuo*) oil. Petro China and Sinopec possess overseas oil fields and may directly supply oil to our military. COSCO (China Ocean Shipping Company) can sign contracts with other countries to purchase oil and provide an indirect supply of oil to the military. The second [thing that civilian entities can do] is to provide technical support. Technical output can be provided in many ways, involving aspects such as oil storage, transport, filling, development, and production of oil equipment, use and maintenance, and even oil management and the training of oil technical personnel. Third, [civilian entities can] take part in operational support. The transfer of POL between rear bases and forward bases can generally be carried out by civilian oil tankers, achieving a relay connection with the military's POL support forces in waters that are fairly safe.

## 5. Conclusion

Becoming strong at sea is an important mission given to the navy in the new era. Oil is the source of power for warships. How far the navy can go will chiefly depend on whether or not POL can be supplied. The distant ocean operations of the future will be very far away from the [Chinese] mainland and the supply lines will be long. This places new challenges on POL support force deployments. Rational differentiation, scientific formation, and efficient allocation of POL support forces is an important part of guaranteeing that we can win the distant ocean combat of the future.



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## Lessons from Foreign Submarine Rotation \*

Li Jianlin, Wang Ruichen, and Xu Liming<sup>†</sup>

### 1. Introduction

The sea-based nuclear force is the primary force for far seas defense operations. Its chief operational tasks are maritime nuclear deterrence and nuclear counterstrike operations. In order to improve the effectiveness of their sea-based nuclear force's nuclear deterrence and counterstrike, states with nuclear weapons generally adopt a duty system for armed strategic missile nuclear submarines (SSBNs). That is, they deploy nuclear powered submarines armed with ballistic missiles to nuclear operating waters to covertly conduct combat readiness patrols, where they can be ordered at any time to carry out a nuclear strike. This type of at-sea presence of a sea-based nuclear force has real and credible deterrent power against potential opponents. Therefore, the ability of the sea-based nuclear force to be present at sea has become an important standard for assessing nuclear states' strategic nuclear strike capabilities and nuclear deterrent capabilities.

### 2. Current Capabilities and Ways of Improving At-Sea Presence

The sea-based nuclear force's rate of at-sea presence can be used to assess sea-based strategic nuclear force at-sea presence capability.

#### 2.1 Rate of At-Sea Presence for the Sea-based Nuclear Force

The rate of at-sea presence for the sea-based nuclear force refers to the time ratio for SSBNs to maintain combat duty at a given scale. For countries with comparatively limited numbers of SSBNs, this metric highlights the minimal amount of at-sea presence in order to maintain a corresponding minimal maritime nuclear counterattack and deterrence capability. The minimal rate of at-sea presence refers to the time ratio for maintaining one SSBN at sea on armed combat duty over the course of the year. Duty time is not equal to days at sea. It refers to the days after

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\* 李建林, 王瑞臣, 徐利明 [Li Jianlin, Wang Ruichen, and Xu Liming], 外军潜艇轮换及启示 [“Lessons from Foreign Submarine Rotation”], 舰船电子工程 [*Ship Electronic Engineering*], No. 9 (2019), pp. 4-7.

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the submarine has transited to its nuclear operating area, during which it conducts combat patrol. It is also called its effective duty time. From total days at sea, one must subtract the time spent going to and from the operating area.

## 2.2 Ways to Improve the Rate of At-Sea Presence of Sea-based Nuclear Force

Given the definition of at-sea presence of sea-based nuclear forces,

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there are two ways to increase the rate of at-sea presence: increase the number of SSBNs on duty and increase the effective duty time for each submarine deployment.

### 2.2.1 Increasing the Numbers of SSBNs on Duty

To increase the number of SSBNs on duty, [navies] can expand their numbers of SSBNs and increase the number of deployments.

The first approach is fairly direct, but SSBNs require a long construction period, are costly to operate, and would place a fairly large burden on the national economy. Moreover, given the current international climate [favoring] nuclear arms reductions, this approach would cause a negative political impact for the country. Thus, this is very difficult to achieve in the short term.

The second approach is to increase time underway for individual submarines, increasing yearly deployments by changing crews. This approach would greatly increase the intensity of equipment use, and it would increase the rate of equipment malfunction and the difficulty of equipment support. Reductions in time for boat crew training and rest/reorganization would affect combat power to a certain extent.

### 2.2.2 Increase Effective Duty Time for Each Submarine Deployment

SSBN numbers, equipment and technological conditions, and personnel matters will limit the overall number of submarines that can deploy each year. To raise the rate of at-sea presence for the sea-based nuclear force, [one] must fully leverage the potential of increasing the number of days of each submarine's effective combat readiness duty.

First, increase the total deployment time for each individual submarine to the maximum extent possible. To do this, [one] must improve the submarines' technical state and the submariners' physical and mental state during the preparation work prior to each submarine putting to sea, so that the crew and equipment can reach the submarine's highest level of self-sufficiency. But even if the equipment does not encounter problems, when going to sea for long periods of time submariners will face all kinds of troubles and even have to deal with severe physiological and psychological problems due to cramped space and abysmal conditions aboard the boat. These problems will impact the continuous execution of the tasking. Therefore, this approach has high risk, has many potential hidden problems, and would be difficult to implement.

Second, reduce transit time to/from operating areas to the maximum extent possible. To achieve this aim, [one] can increase missile range in order to expand the choices for operating areas and

reduce the time needed to get to these areas. Or, one could increase the capabilities and range of [one's] air control and sea control, thereby making it easier to penetrate enemy antisubmarine warfare zones while transiting to/from operating areas and reducing the time needed to penetrate [these zones]. Or, one could build overseas bases close to operating areas. Increasing missile range is a major systems project and will be difficult to achieve in a short period of time. Strengthening sea control and air control capabilities also requires the coordinated development of various forces and resources and cannot be achieved in one stroke. Building overseas bases requires even more national economic, political, and diplomatic involvement and activism. Seizing the right strategic opportunity to construct [overseas bases] will be difficult and time-consuming; this cannot be achieved in a single day.

### **3. Ideas for Improving At-Sea Presence Capabilities**

Given that increasing SSBN numbers is not feasible and expanding individual submarine effective duty time is very difficult under current circumstances, [we] must actively explore new and more effective ways that are in line with the situation of naval development. Today, states like the U.S. and Russia use a rotation approach whereby a single boat uses multiple crews in order to boost submarine use rates. [We should] look into using accompanying support and mobile support approaches to conduct distant ocean ship replenishment and maintenance in order to expand ship range of operations. [We] can explore SSBN far seas rotation by integrating submarine rotation and distant ocean support.

#### **3.1 SSBN Base Rotation**

In order to maximally increase the amount of time SSBNs spend performing tasks, the U.S. Navy sea-based nuclear force employs a “one boat, two groups” duty model. That is, one submarine has two crews. They rotate aboard the boat to perform the tasking and take turns on shore for training and rest/reorganization. Moreover, the U.S. Navy is currently validating a “two boat, three group” model. In the future, it could be widely employed. This approach of using multiple crews who take turns to serve aboard SSBNs is called SSBN rotation. Today, this type of rotation is used at submarine bases and is called base rotation. SSBN rotation can greatly increase the time SSBNs spend at sea performing combat readiness tasks. At the same time, [this approach] can ensure that submariners have ample time to rest and train. It is also beneficial for the recovery of submariners' psychological and physiological functions and [maintaining] stable training levels.

#### **3.2 SSBN Far Seas Rotation**

Foreign military SSBN rotation relies on submarine bases. When a submarine reaches the limits of endurance for its duty time, it must return to base. During the period of transit to and from its operating area, this submarine does not in fact possess strategic nuclear deterrent power. For states with limited numbers of SSBNs, this is undoubtedly a tremendous waste. If submarine rotation can take place in the nuclear operating area, this would reduce waste and remedy deficiencies.

Nuclear missile submarine rotation in nuclear operating areas is called SSBN far seas rotation. Relying on large support ships, SSBNs conduct equipment maintenance, logistics support, and

personnel rotation near their nuclear operating areas. This obviates nuclear submarines from having to return to base for rotation; they can instead immediately begin their next armed combat readiness duty. This will greatly increase combat readiness duty time for individual submarines, thereby increasing the rate of at-sea presence for the sea-based strategic nuclear force.

### 3.3 The Impact of Far Seas Rotation on the Rate of At-Sea Presence

For states that maintain the minimal at-sea presence, the sea-based nuclear force rate of at-sea presence  $K$  can be shown by the following formula:

$$K = \frac{1}{T} \sum_{i=1}^n t_i$$

Where  $t_i$  depicts the  $i^{th}$  SSBN's days of armed duty,  $T$  is one year. Take  $T=365$  days, let the total deployment time for the  $i^{th}$  SSBN be  $t_{i0}$ , and the time to get from the base to the operating area be  $t_{i1}$ . After completing its patrol task, the time to return from the operating area to base is  $t_{i2}$ . Then:

$$t_i = t_{i0} - t_{i1} - t_{i2}$$

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The first calculation is for two submarines over the course of one year. Each submarine alternates one time, and each deployment is 70 days (the endurance of an *Ohio*-class submarine). Let the time going to and from the operating area be the same ( $t_{i1}=t_{i2}$ ). For the sea-based nuclear force under the traditional base rotation model the relationship between the rate of at-sea presence and transit time to and from the operating area ( $t_{i1}$ ) is as follows:

Table 1. Rate of at-sea presence with base rotation

Time to/from operating area (days)	Rate of at-sea presence (%)
3	70.14
5	65.75
7	61.37
9	56.99
11	52.60
13	48.22
15	43.84
17	39.45

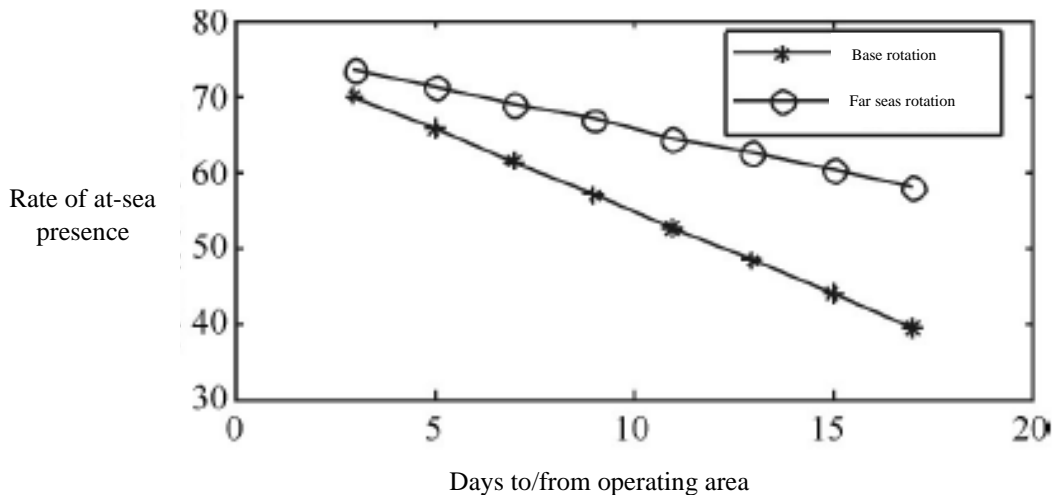
Using the far seas rotation model for the same two submarines over a one-year period of time, each alternating once, under the same conditions regarding time at sea and going to and from operating areas means one less trip to/from base. As a result, the rate of at-sea presence and time going to/from base have the following relationship for the sea-based nuclear force.

Table 2. Rate of at-sea presence with far seas rotation

Time to/from operating area (days)	Rate of at-sea presence (%)
3	73.42
5	71.23
7	69.04
9	66.85
11	64.66
13	62.47
15	60.27
17	58.08

These two tables show that implementing far seas rotation for SSBNs results in a clear improvement for the rate of at-sea presence for sea-based nuclear forces. A graphical comparison between these two rotation models under the same conditions shows that as the time of transit to/from the operating area increases the effect of far seas rotation on the rate of at-sea presence becomes clearer. The below figure depicts this comparison between the rate of at-sea presence for the two models.

Figure 1. The rate of at-sea presence for the two rotation models.



#### 4. SSBN Far Seas Rotation

Sources show that nuclear powers such as the U.S. and Russia keep a certain number of armed nuclear submarines deployed at sea at all times for combat duty in order to maintain absolute nuclear superiority and powerful nuclear deterrence. Upon receiving orders to fire, they can immediately conduct nuclear missile strikes. These countries have large numbers of SSBNs, which spend 1/3 of their time in each of three states: readiness (*beizhan*), training, and maintenance. They can ensure a 100 percent rate of at-sea presence for a certain scale of sea-based nuclear force. Moreover, the U.S. has large numbers of overseas military bases, its geographic position is excellent, and its equipment is advanced, with complete functionality. Moreover, it operates in all the major ocean areas around the world. This is extremely beneficial for the resupply, maintenance, and crew rotation for armed nuclear submarines. It can greatly increase submarine readiness. It can also reduce personnel duty time and ensure the good state of equipment and personnel for armed submarines

##### 4.1 The Necessity of Far Seas Rotation

To a large extent, choices regarding operating areas for the sea-based nuclear force are determined by the range of the missiles carried. If missile range is limited, then the submarine must approach the target in order to place it within its maximum range. To do so, the submarine must go very far from its base, and this will increase transit time to/from the operating area. Also, one must add the fact that the channels and straits that must be transited have very high concentrations of enemy submarine detection installations and anti-submarine forces. As a result, the difficulty and time required to transit to/from the nuclear operating area is greatly increased. In order to covertly pass through the enemy's submarine detection zone and anti-submarine force patrol areas, submarines must often spend significant effort and time engaged in maneuver. As a result, the effective armed patrol time for any deployment is severely reduced. If an SSBN conducts just one far seas rotation, it can reduce one trip to/from base. This can not only reduce the probability of being detected by the enemy and increase the submarine's stealth. It can also use the time spent going to/from base to conduct armed duty, thereby greatly increasing the rate of at-sea presence for the sea-based nuclear force.

##### 4.2 The Feasibility of Far Seas Rotation

For far seas rotation, SSBNs must rely on large support vessels and advanced support technologies. The large distant ocean support force can conduct accompanying support and mobile support for the oceanic fleet (*yuanhang jiandui*), providing petroleum products, material supplies, equipment service, and battlefield damage repairs, as well as serving the needs of the crews. In order to improve submarine distant ocean operational capabilities, submarine mobile support capabilities can be constructed, to include upgrading distant ocean support ships, refitting amphibious transport docks, and building submarine support ships. These support forces can provide petroleum products, water, power, reserve parts, weapons, and other supplies to submarines at anchor or alongside. They can also conduct the majority of base-grade maintenance and provide health and personal support for the submariners. [Doing] these things would establish a foundation for far seas rotation for SSBNs.

Far seas escort operations have enabled the distant ocean fleet to accumulate lots of experience with respect to logistics support. Gains have been made in the construction of support models and support systems, and the conditions for providing support have improved. Drawing from the advanced distant ocean submarine support experience and technologies of foreign [navies], while keeping [our] feet planted in the current state of support equipment, [we should] conduct research, validation, and practice; continuously innovate far seas support models; develop a far seas submarine support force; and conduct trials on and make improvements to far seas submarine rotation. [If we do these things,] SSBN far seas rotation can be achieved.

#### 4.3 Work to Be Done for Far Seas Rotation

SSBN far seas rotation involves the following different types of work:

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##### 4.3.1 Equipment Care and Maintenance

When it alternates in the far seas, a nuclear submarine has already conducted a fairly long armed patrol. After a long period of use, the equipment will start to suffer from malfunctions or develop the potential for future malfunctions. Thoroughly and meticulously servicing and caring for and examining the equipment for potential future malfunctions and resolving any existing malfunctions are important to ensuring the next duty task can be completed. [Submarines] must rely on the maintenance and repair capabilities of the support ship, which completes its work at sea with the assistance of the submarine crew.

##### 4.3.2 Crew Rotation

After servicing, maintenance, and repair, equipment can be continuously operated for a long period of time. But when a submarine goes to sea for a long period of time, the crew's bodies and minds face huge challenges. Therefore, the focus of far seas rotation is on alternating the crews. The submariners who have spent a long time on duty at sea are replaced by a second crew aboard the far seas support ship. They also exchange information about their respective posts, the tasking situation, the enemy situation, our own situation, and the conditions of the ocean. Moreover, major posts should have a period of settling in, so that the new crew can grasp the situation as quickly as possible and smoothly enter a state of combat duty.

##### 4.3.3 Turning Over Equipment

The turning over of equipment involves the person in charge at a given post turning over equipment to a successor. It includes [information related to] using the equipment, changes to the equipment performance, malfunctions and maintenance, spare parts and equipment logs, ignition apparatus such as weapon fuses, and various passwords and control keys. Equipment turnover should be standardized and meticulous. The two parties involved in the turnover should turn on and use equipment to ensure it is in [good] condition. If necessary, they can do a training exercise together, enabling the relieving crew to become as familiar as possible with the performance of the equipment and get fully up to speed.

#### 4.3.4 Material Supply

Material supply chiefly means replenishing used up materials. After a period of time operating at sea, a submarine on duty basically uses up all of its materials such as petroleum products and food. This requires that a support ship conduct a resupply. Material supply includes fuel, lubricant, maintenance materials and equipment, food, fresh water, office supplies, and equipment parts. Supplying these materials is a basic requirement for equipment and crew to work normally after a far seas rotation.

#### 4.4 Issues to Pay Attention to with Respect to Far Seas Rotation

For SSBNs, far seas rotation is more complex than base rotation. There are greater challenges and difficulties. Therefore, there are several things to pay attention to when alternating. First, the difficulty of rotation is great. It requires a submarine to lay alongside a ship, so the conditions for receiving supplies are extremely limited. Therefore, [those involved] must make thorough plans and train for submarine at-sea maintenance, supply, and other support tasks. Second, the precondition for far seas rotation is the submarine cannot suffer a breakdown that cannot be dealt with at sea or that impacts the submarine's continuation of its duty. This requires that the submarine persist in performing maintenance and service [of equipment] and resolve any potential problems while at sea. The support force should conduct maintenance training and be fully prepared with all necessary maintenance equipment and materials. Third, rotation must occur in the vicinity of the nuclear operating area. It must consider both the ocean area and sea state and the enemy situation, ensuring security and the submarine's concealment. [Those involved] can enlist the help of a surface ship action group. Fourth, information support must be reliable and effective. In order to maintain the submarine's concealment, under normal circumstances submarines only receive communications and do not transmit. But when conducting a far seas rotation, a fairly large amount of communication is required. [We] should accelerate the adoption of concealing communications technologies such as blue-green lasers, neutrinos, and quantum communications.

### 5. Conclusion

SSBN far seas rotation is a new approach that integrates far seas support and crew rotation. There is no ready-made experience from which to draw. But [our] sea-based nuclear force faces an environment in which it is hemmed in by multiple layers of enemy forces. Moreover, due to the impact of factors such as limited missile range, there are limited options when selecting a nuclear operating area. Conducting far seas rotation for SSBNs can greatly increase the sea-based nuclear force's rate of at-sea presence, strengthen the effectiveness of nuclear deterrence, and boost the effects of nuclear counterstrike operations. By engaging in continuous practice, this will become one way of rapidly increasing the at-sea presence capabilities of sea-based nuclear forces.



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## The Biggest Obstacle to Chinese Nuclear Submarines Going Out Into The Indian Ocean\*

By Hei Jin (pseudonym)

In June 2016, India's New Delhi TV Network suddenly reported that a Chinese nuclear submarine had been operating in the Indian Ocean for three months. The report also said that a Chinese submarine support ship had appeared in the Indian Ocean at the same time. Not long afterward, China's official media formally reported that this nuclear submarine had been conducting counter-piracy escort operations in the Gulf of Aden. Meanwhile, the U.S. Navy offered a short supplement to these reports, saying that in 2015 it discovered that Chinese nuclear submarines had entered the Indian Ocean for operations. A few years later, with the Djibouti support base now complete and operational, is it feasible for Chinese nuclear submarines to head to the Indian Ocean to conduct operational deployments? What are the greatest obstacles to going out into the Indian Ocean?

### **It is Not Accurate to Say "Chinese Nuclear Submarines Challenge the Indian Navy"**

The news of Chinese nuclear submarines appearing in the Indian Ocean was exaggerated by certain Indian media, who claimed that "Chinese submarines have been deployed to the Indian Ocean." Reports also cited an Indian official who argued "the activities of China's nuclear submarines have touched India's red line, and this could give rise to an arms race between the two navies." Both the Indian media and Indian officials felt apprehensive about a Chinese nuclear submarine entering the Indian Ocean to perform a task for the first time. Former Commander of the Indian Navy's Southern Naval Command, Vice Admiral K.N. Sushil, said that China had clearly showed its capacity to exert control in India's "backyard." India's foreign intelligence agency and the Indian Navy's department of intelligence jointly drafted a secret intelligence assessment saying that the entry of Chinese nuclear submarines into the Indian Ocean seriously increased India's security concerns.

But these apprehensions and censures [stem from] facts that have been distorted and manipulated. At present, the Chinese Navy's dispatch of submarines to the Indian Ocean chiefly involves the conduct of long-distance training and necessary support tasks for [counter-piracy] escort [operations]. However, deployment (*bushu*) refers to a submarine or warship being stationed long-term in a target area or a certain location with an explicit task and organization

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\* 黑金 [Hei Jin], 中国和潜艇前出印度洋的最大障碍 ["The Biggest Obstacle to Chinese Nuclear Submarines Going Out Into The Indian Ocean"], 现代舰船 [Modern Ships], no. 11-12 (2020), pp. 71-76.

(*bianzu*), and at present our submarines operating in the Indian Ocean are definitely not doing this.

The purpose of Chinese submarines going to the Indian Ocean is very explicit: that is, to participate in [counter-piracy] escort missions and safeguard the security of maritime passages. When Chinese submarines carried out this task, [China] informed Singapore, India, Sri Lanka, and other neighboring states, as well as the United States. At the time, however, there were few media reports. Going forward, the Chinese military will send various types of vessels to relevant waters to conduct escort tasks, doing so according to changes with the escort situation and tasking needs. These are all normal activities and there is really no need to overinterpret them.

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To date, Chinese nuclear submarines have not entered India's territorial sea. They have just performed tasks in high seas areas of the Indian Ocean. India has no right to prevent China from using nuclear submarines. Moreover, although from the outside the Chinese and Indian navies look about the same, in reality there exists a huge gap in terms of weapons and equipment. Whether submarines or surface vessels, the Indian Navy is not in the same class as the Chinese Navy. There also exists a large gap between India and China in terms of capacity for research and development of naval equipment. If we must speak in terms of an arms race, then it is just a case of India trying to catch up with China.

According to a report on the Voice of Russia website, the first trip by a Chinese nuclear submarine to the Indian Ocean lasted for more than three months. The Chinese nuclear submarine transited the Strait of Malacca, and before it did the Chinese Ministry of Foreign Affairs formally told the military attaché of neighboring countries. It remained in the Indian Ocean for more than two months. On its way back to China after completing its task, China once again informed the military attaché of neighboring countries such as Singapore and Malaysia. In fact, after these states were informed they issued short news releases on their official websites— it was just that the media was insensitive to the news and did not grasp this information.

Today, Chinese nuclear submarines heading to the Indian Ocean cannot go there covertly, and they have no support points (*zhichengdian*) in the Indian Ocean. To go to the Gulf of Aden to conduct an escort task they must pass through the South China Sea, taking the Malacca Strait or Sunda Strait to enter the Indian Ocean. The Malacca Strait and the Sunda Strait are closely monitored and controlled by the U.S. and its allies. The Malacca/Sunda Straits are further away from Mainland China than the Balintang Channel or the various straits of the East China Sea. Therefore, China cannot use electromagnetic interference or other supportive means to ensure that nuclear submarines can covertly transit these two straits. Thus, in theory every time China sends a nuclear submarine to the Indian Ocean the US and its allies will know, and this often means that India also knows.

In peacetime, Chinese nuclear submarines can freely transit the Malacca/Sunda Straits to enter the Indian Ocean. In wartime, this kind of transit is not very realistic. In Singapore and Malaysia there are deployed large numbers of anti-submarine weapons including littoral combat ships, anti-submarine maritime patrol aircraft, and anti-submarine helicopters. Just taking off from an airfield and flying a short distance they can arrive over the Malacca Strait. Bahrain in the Persian

Gulf is the headquarters of the U.S. 5th Fleet. In Bahrain and in neighboring Saudi Arabia, Kuwait, and Iraq there are bases for air, sea, and ground forces. Therefore, China's current nuclear submarine activities in the Indian Ocean certainly cannot prove that India has lost anything in terms of command of the sea. India need not be excessively anxious.

### **The Expansion and Evolution of the Chinese Navy's Area of Operations**

On December 26, 2008, the Navy sent its first ship formation to the Gulf of Aden and Somali waters to conduct escort tasks, which have become normalized. This marked the start of the Chinese Navy leaving the near seas and engaging in far seas protection. From 2008 to present, our Navy has become a frequent visitor to the Indian Ocean. [With this], it took its most important step in expanding the operational navy.

Although it was only in the last 10+ years that "sailing to the far seas" became Chinese naval strategy and began to be implemented, as a strategic aspiration and strategic idea it very early on was the subject of detailed research in China and a preliminary theoretical framework had been created. As early as 1957, Navy Commander Admiral Xiao Jinguang proposed the strategic and tactical thought of "maritime sabotage-raid warfare,"

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arguing that the Chinese Navy's area of operations should expand outward. But given the circumstances of that time period, this [proposal] just referred to moving from the coast to the near seas.

For a long period of time the Chinese navy regarded the near seas as the geographic extent of its operations. This had to do with the fairly heavy pressure it faced at sea at the time. During the early and middle part of the Cold War, the U.S. and its allies formed a geostrategic blockade system in the waters facing China. This system's encirclement of China comprised three lines of defense. The first line of defense consisted of the three offensive bridgeheads of South Korea, Taiwan, and South Vietnam. The second line of defense was Japan, Okinawa, the Philippines, Thailand, and Malaysia. It was the focus of deployments for the whole system. The third line of defense included the Bonin Islands, Mariana Islands, Australia, and New Zealand. This was the advance rear of the strategic system, while Hawaii was the center of this defensive system.

This implied that China was unlike some coastal states who can leave harbor and be in the open ocean. Once Chinese ships left the near seas they faced the leading naval power, which was China's main opponent. Of course, the same is true today.

Consequently, during the Cold War the Chinese Navy had two primary areas of operations. One was areas adjacent to its coasts and islands, conducting counter landing operations along the coast. With respect to the second area of operations, in the 1970s China began opening up the enemy's proximate ocean areas, to conduct maritime sabotage raid warfare. At the time, this [strategy] still served coastal and near seas counter amphibious landing operations, using submarines and aviation forces to strike proactively, striking enemy supporting vessels and transport fleets located fairly far away (200nm or slightly more away from Chinese territory, but not exceeding 600nm) and indirectly reducing the pressure on coastal counter amphibious landing operations.

By the 1980s, this area of operations had achieved the significance of being an independent battlespace, and now the navy no longer just played a supporting role. In theory, the enemy's proximate ocean areas were the near and middle ocean areas within 600 nm of China's coastline. But as Admiral Xiao Jingong said, "although the submarine can operate in fairly remote waters, we've had no combat practice since they were built. Therefore, in general this light maritime force has not yet left near coastal waters. It should assist and support army operations, creating an overall defensive system in concert with defending forces."

In September 1975, Admiral Liu Huaqing proposed the idea that "submarines must go to the northeastern and central parts of the Pacific Ocean and the Indian Ocean to conduct activities." At the time, the Chinese Navy's concept of operations was still primarily about annihilating the enemy in the near seas, but Liu Huaqing proposed the idea that the navy must also "advance when the enemy advances," that it must be in the near seas but it also must definitely go to the rear of the enemy in the far seas to strike and annihilate the enemy. At the same time, Liu Huaqing proposed the idea that the Chinese Navy's near seas defense strategy was a dynamic and flexible strategy. After delimiting the scope of the near seas, [he] could not forget to add the point that "with the continuous strengthening of China's economic power and improvements in its scientific and technological levels, and growth in its naval forces, our area of operations will also gradually be extended, until it ultimately reaches the full extent needed for the country's maritime strategic defense."

After the 1990s, the People's Navy's most important area of operational expansion was the Spratly waters. This expansion began with the Johnson Reef naval battle of 1988. The iconic event for fighting into the Spratly waters was the 1994 construction on and control of Mischief Reef. Full expansion of its operational area in the Spratly waters did not occur until recent years with the completed construction of large artificial islands.

Aside from having massive exclusive economic zones and being rich in fish and mineral resources, the South China Sea—especially the Spratly waters—is also strategically important. Completely controlling the Spratly waters would allow our Navy's ships to threaten the southern part of America's first island chain, that is, the comparatively weak point that it somewhat neglected in the past. Moreover, having air and sea footholds (*lizudian*) in the Spratlys can impede (*zhiyue*) the U.S. and its allies stationed along the second island chain from providing support to the first island chain.

Aside from considerations of naval strategy, the Spratly waters have special significance with respect to nuclear strategy and national strategy. In terms of seabed geography, these waters chiefly include the Philippine Basin, Parece Vela Basin, and the Western Mariana Basin.<sup>†</sup> Their average depth is 5,000-6,000m, 4,500-5,000m, and about 5,000m, respectively. These waters are good for the covert operation and maneuver of ballistic missile nuclear submarines, and they are

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<sup>†</sup> **Translator's note:** These undersea features are actually located in the Philippine Sea. The author seems to be referring to the importance of the Spratlys for supporting Chinese SSBN operations in the Philippine Sea.

important ocean areas for achieving a nuclear counterstrike against the enemy's homeland. They are also good for nuclear attack submarines conducting patrols and blocking operations (*zujī*)<sup>‡</sup>.

The Chinese Navy's operational scope in the far seas is just directional and not regional. Heading east from Mainland China, past the two large island chains, is the Pacific Ocean. Heading west is the Indian Ocean. Therefore, when discussing areas of operation it is more often the case that we speak in terms of heading east or heading south, and heading west. An ocean area's strategic value is multi-dimensional. It chiefly includes three aspects: military, economic, and political. The strategic value of the far seas in the Pacific Ocean direction

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is more focused on the military aspect, while the strategic value of the far seas in the Indian Ocean direction is more focused on the economic aspect. Today we are in a period of peaceful development. Therefore, the strategic value of the Indian Ocean direction is temporarily greater than the depths [*sic*] of the Pacific Ocean.

With respect to the far seas in the Indian Ocean direction, some scholars of geopolitics call the Indian Ocean the “center of world sea power.” Its strategic value for contemporary China is as follows. First, it is the focal direction for the 21<sup>st</sup> Century Maritime Silk Road. Next, it is the chief trade channel between China and the countries of Europe, the Middle East, and Africa, and it is the chief channel for China's oil imports, with implications for the security of China's maritime communications lines during a crisis or war. Lastly, countries that are fairly close to China politically are mostly located along the coast of the Indian Ocean or nearby (such as Pakistan, Zimbabwe, Ethiopia, etc.) Therefore, the Indian Ocean is a channel for China to deepen its political and strategic relationships with these countries.

### **Entering the Indian Ocean is the Necessary Trend for Chinese Naval Development**

In the Indian Ocean, when we examine the chief maritime shipping lanes between China and Europe the first thing we notice is that the Indian subcontinent plunges abruptly into the Indian Ocean for 2,000+ km. This requires that sea lanes between the Malacca Strait and the Suez Canal and the Persian Gulf make a detour. Moreover, southwest of the Indian peninsula, roughly 2,000 km from Indian territory and right in the middle of the Indian Ocean, is America's large comprehensive air and naval base—Diego Garcia.

The Indian peninsula's natural geographic position enables India to disrupt communications (*pojiao*) [by attacking] merchant vessels on the chief maritime shipping lanes between China and Europe just by using tactical air (4<sup>th</sup> and 5<sup>th</sup> generation fighters and fighter bombers). And India's sea and air forces are not just limited to tactical air. India already possesses one medium-sized aircraft carrier, it is building another, and it plans to build one large aircraft carrier. The Indian Navy already has a third generation nuclear attack submarine that it leased from Russia and a nuclear powered ballistic missile submarine that it built on its own, advanced “Kalvari” class

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<sup>‡</sup> **Translator's note:** According to the *PLA Dictionary of Military Terms* (2011), “blocking” (阻击) refers to operations aimed at preventing the enemy from attacking or advancing.

conventional submarines, and a large fleet of destroyers. It is worth noting that India's destroyers are currently receiving rapid upgrades.

If the Indian Navy completes its planned expansion, in 2030 it will have three aircraft carriers and second generation ballistic missile submarines. It will have the ability to seize command of the air over the battlespace in the majority of the waters of the Indian Ocean. In the past, only Chinese surface ships entered the Indian Ocean. Due to the fact that they lack effective air and undersea cover, there is no reason to be optimistic about their ability to survive in wartime. If we were to just simply increase the numbers of surface ships we sent to the Indian Ocean and Djibouti and did not make any other major improvements in terms of quality and vessel type, then if a large-scale maritime conflict were to erupt the Chinese Navy would be unable to prevail in the Indian Ocean against an Indian Navy that has a diversified combined force that includes aircraft carriers, nuclear submarines, and conventional submarines.

Therefore, if the Chinese Navy's tasks in the Indian Ocean are not limited to counter-piracy escort operations, then the vessel of choice for stationing (*paizhu*) in the Indian Ocean is the nuclear submarine.

The precondition for the Chinese Navy's underseas forces to enter the Indian Ocean is the possession of submarine equipment that can enter the Indian Ocean. The new-generation nuclear attack submarines revealed at the 2018 and 2019 naval fleet reviews possess the endurance and operational capabilities to enter the Indian Ocean. Based on open source materials, that boat's quieting performance exhibits major improvements over the earlier class and already approaches the level of similar equipment used by the Indian Navy. With regards to operational systems and operational weapons, although they are not as good as the same type of equipment owned by the Indian Navy, [China's boats] can simultaneously carry torpedoes and anti-ship cruise missiles, giving them long-range precision strike capabilities.

Entering the Indian Ocean while submerged makes for a very long journey and the waters along the way are complex. To be able to covertly enter the Indian Ocean and safely return requires careful

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preparation. First, one must have ample mastery of the hydrological conditions, bathymetry, and other information about the planned course. Obviously, the U.S. will not sell China bathymetric charts and hydrological databases of the Indian Ocean or other ocean areas around the world. China has had to completely rely on gradual accumulation of the relevant data since 2008. That a Chinese nuclear submarine was able to enter the Indian Ocean in 2013 to conduct tasking shows that China already has a first set of reliable hydrographic data for the Indian Ocean. The Navy already has the ability to support submarines carrying out relevant tasks in the far seas of the Indian Ocean.

### **How to Enable Nuclear Submarines to Get a Foothold in the Indian Ocean?**

There is an enormous difference between a nuclear submarine operating far away in a time of peace and covertly striking during a time of war. The only feasible way for the submarine force to breach the island chain blockade and [avoid] interception and attack [while operating along]

international sea lanes and successfully enter the Indian Ocean in a wartime state is to give our Indian [Ocean] overseas support base the ability to support submarines.

In May 2018, overseas media took a photo of an improved Chinese “Song” class conventional submarine moored at China’s naval support base in Djibouti.<sup>§</sup> The formal name of China’s Djibouti support base is the “Chinese People’s Liberation Army Djibouti Support Base.” It formally opened on August 1, 2017. The base’s most obvious characteristics include an aircraft apron and a large military-use pier. Its largest berth is 400m long. In theory, all of China’s surface ships and submarines from the 056 light frigate to the 055 destroyer can moor there. Improved “Song” class conventional submarines naturally would be no problem. The question is whether or not the Djibouti base possesses the conditions to support the long-term Indian Ocean deployments of conventional submarines and nuclear submarines.



Purported Chinese *Song*-class submarine in Djibouti (May 2018)

The notion of “support” is not a simple matter of letting a submarine come to shore and letting submariners get off the boat for some fresh air. Rather, it refers to the material conditions needed for submarines to deploy long-term in the Indian Ocean. Conventional submarines are

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<sup>§</sup> **Translator’s note:** The photo in question actually shows a submarine moored in another section of the port of Djibouti.

comparatively simple. This is why in the last two years the frequency of China's deployments of nuclear submarines to the Indian Ocean has lessened and the number of conventional submarines has increased. A submarine is a complex underwater combat platform. To support the long-term deployment of submarines in the Indian Ocean, we must first ensure that the submarines can be resupplied with oil and munitions at the Indian Ocean base. For conventional submarines, we must first ensure that the base has stored enough torpedoes and missiles. Next is the oil specifically used by submarines. In the past, conventional submarines just used diesel fuel, so we just needed to install a diesel fuel tank with the grade of diesel used by submarines and the problem was solved. But to support the operation of conventional submarines with air-independent propulsion (AIP) a tank containing a special type of fuel must also be installed.

Aside from oil and munitions, submarines need to receive basic maintenance, repairs, and status checks at the support base. This involves installing a spare parts warehouse and creating an engineering team that can perform pier side maintenance on submarines, and installing maintenance and testing equipment, especially a platform that can be used to degauss submarines. The support base must also have the lubricants used by submarines and the provisions needed by the crew. This way, when a submarine departs China and enters the Indian Ocean in a public manner, after it arrives at Djibouti it can then operate in the Indian Ocean for 2-3 years with support from Djibouti, returning to China only when it must rotate out the whole submarine or make major repairs.

Supporting nuclear submarines is far more complex than supporting conventional submarines. On top of the munitions, oil (nuclear submarines also have emergency diesel engines), maintenance, repair, and support equipment needed by conventional submarines, they need another huge set of equipment related to supporting and maintaining nuclear reactors. There are not many examples of foreign navies having overseas

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bases with a full set of equipment for supporting nuclear submarines. Even in the case of the U.S. Navy, it only does this at the submarine base of its hardcore ally the United Kingdom. With such well-equipped support facilities, U.S. nuclear submarines can be deployed for several years at British bases. U.S. nuclear submarines only use America's other overseas bases, including its own bases at places like Guam, as short-term stopping points. After a six month deployment, nuclear attack submarines or ballistic missile submarines will return to U.S. territory.

Therefore, this author believes that if we want to build Djibouti into a base for Chinese nuclear submarines the technical difficulties are fairly great and the political and economic costs of doing so would be fairly high.

Aside from considering technical, political, and economic difficulties, we must also consider security issues for the Djibouti base itself. Rental services for foreign military bases have become a pillar industry for the Republic of Djibouti. On its territory, which is not large, are 10+ foreign bases located in very close proximity. They are not far apart from each other. For example, the closest U.S. military base is less than 10 km away from China's Djibouti support base. The two are practically right on top of each other.

India has not built a base in Djibouti. But it must be pointed out that in theory Djibouti would accept an Indian request to build a base, as long as India could afford it. India may believe that Djibouti is too crowded or the cost of land there is too high. Therefore, after the construction of China's Djibouti support base India quickly signed an agreement with the Republic of Seychelles to build a military base there, with support facilities including a barracks and airfield. But it was disappointing for India that the agreement explicitly provides that the military base be limited to peacetime use. Once a war breaks out, the Seychelles would take back India's military base.

The Djibouti support base also has another potential disadvantage for submarines and especially nuclear submarines: it is too close to hot spot regions. The first hot spot region is the Red Sea and Gulf of Aden. It is one of the world's busiest shipping lanes. Here, commercial vessels come and go in very close proximity, while warships from around the world frequently pass. The second hot spot region is the Middle East. The Yemen civil war is far from over. The Saudi-led coalition of Arab states periodically fights militarists in Yemen. If submarines want to operate covertly, the most fundamental requirement is the ability to covertly depart for a deployment. But in Djibouti foreign surveillance aircraft and ships can use optical observation methods to see submarines at pier. When a submarine departs, nearby P-3Cs can live-broadcast the entire voyage. So clearly we cannot even begin to discuss the idea of covert strikes.

Thus, for the submarine force to obtain an ideal stationing base in the Indian Ocean it perhaps needs a location somewhat distant from hot spot sea lanes, choosing instead a comparatively remote region. After all, even a conventional submarine is a vessel with a fairly impressive range, and nuclear submarines can sail for an unlimited distance. A stationing base that is somewhat more remote is acceptable. In the Indian Ocean, "second tier" areas such as Tanzania and Madagascar perhaps are more suitable for a base to station submarines.



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## Serve Readiness and Warfighting, Promote Marine Environmental Construction<sup>1</sup>

By Xu Quanjun and Xie Zhimin<sup>2</sup>

The Ming Dynasty explorer Zheng He once said, “If one desires to make the country rich and strong, then one cannot ignore the ocean. Wealth is taken from the sea; threats also come from the sea.” This was his lifelong realization, and it is a cautionary message for us, his descendants. In the new century and the new phase, our country’s security and development interests are expanding and it is facing new and more severe challenges in the maritime direction, requiring our military to improve its ability to complete diversified military tasks centered on winning local wars under informatized conditions. Having the military conduct diversified maritime tasks presents a series of new and greater requirements for marine environmental support.

The frontiers of national security are expanding. In the maritime direction, the battlespace is continuously expanding. Marine environmental support must extend to the deep sea and wide ocean. The Western Pacific and Indian Ocean waters, which are closely related to [China’s] national strategic interests, as well as important waterways such as the Malacca Strait, will be the normalized operating areas for [the navy’s] far seas combat forces. This calls for marine environmental support to extend to these important operating areas, to extend to the middle and far seas. In order to effectively expand and safeguard the country’s political, economic, and security interests in the Arctic Ocean, and in order to provide environmental information support for prepositioning (预置) in the Arctic Ocean, marine and meteorological surveys and monitoring and support research must extend to the Arctic Ocean. At the same time, it must also extend to the undersea [domain]. [We must] continuously optimize our global numerical forecast models, increase research into numerical forecasting of undersea militarily-sensitive elements

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<sup>1</sup> 徐全军, 谢志敏 [Xu Quanjun and Xie Zhimin], 服务备战打仗 推进海洋环境建设 [“Serve Readiness and Warfighting, Promote Marine Environmental Construction”], 人民海军 [*People’s Navy*], November 11, 2020, p. 14.

<sup>2</sup> Both authors work at the PLA Special Office on the Marine Environment (解放军海洋环境专项办公室), located in Beijing.

and ocean acoustic fields, and improve ocean support capabilities for underwater missile launches, submarine positioning, and underwater communications.

Diversified maritime military tasks take place far away from home. The difficulty of shore-based marine environmental support is increasing. There is an urgent need to improve warships' independent support capabilities. First, [we] must improve warships' ability to observe elements of the marine environment. [We must] increase the numbers of disposable ocean observation and detection equipment, and retrofit fixed temperature, salinity, and depth detection instruments, as well as portable meteorological observation and detection equipment. Second, [we] must improve [our] ability to receive marine environmental information. [We must] comprehensively use military communications satellites, short-wave communications, and other means to build independent shore-to-ship transmission systems for marine hydrological and meteorological information for the military. Third, [we must] research independent marine environmental forecasting support methods and means for main combat platforms.

The use of high technology weapons and equipment requires accelerating the development of exquisite (精细化) marine environmental support. First, [we] must have exquisite marine hydrological and meteorological monitoring capabilities. [We must] accelerate the development of marine environmental observation technology and improve the accuracy and reliability of Chinese manufactured marine hydrological and meteorological observation equipment. [We must] have the ability to observe marine hydrological and meteorological elements with high temporal and spatial resolution and high accuracy. Second, [we] must provide exquisite numerical forecasting products. [We must] carry out research into regional high-resolution oceanographic and meteorological numerical forecasting methods and technologies. [We must] provide highly accurate, time-sensitive regional numerical forecast products. Third, [we] must bolster research on forecasting elements that are militarily sensitive. [We must] bolster research on numerical forecasting for ocean fronts, thermoclines, mesoscale eddies, internal waves, sea fog, and other militarily-sensitive elements, the atmospheric duct phenomenon, as well as the ocean acoustic fields in waters within the Second Island Chain.

The struggle over maritime sovereign rights and interests is intensifying. The military environment we face at sea is deteriorating. To adapt to the requirements of effectively handling sudden incidents, [we] must build a marine environmental support system that [provides] efficient three-dimensional support. First, [we] must have a variety of means to rapidly obtain marine environmental information. [We must] strengthen construction of various means such as covert underwater observation, drift buoy monitoring, and radar remote sensing, as well as construction of ocean array observation and undersea observation networks. Second, [we] must

have the capability to rapidly transmit marine environmental information. [We must] build a terrestrial broadband network based on terrestrial wired links with greater bandwidth, smaller delay, and more secure and reliable transmission, and that is able to carry data collection and distribution, video conferencing, grid applications, and Web services. [We must] comprehensively use military communications satellites, short-wave communications, and other means to establish a shore-to-ship transmission channel that is reliable and efficient. Third, [we] must establish an integrated marine environment combat support system. [We must] integrate marine environment information into the integrated command and intelligence system, achieve a true fusion of marine environmental data and operational/intelligence data, and leverage its operational support effectiveness to the maximum extent.

At present, [our] marine environmental support capabilities for the military are relatively weak, and there is a fairly large gap [between our capabilities and] the expansion of [China's] national security and development interests, and [the support] needed [to conduct] diversified maritime military tasks. [We] must strengthen unified leadership and top-down planning for the construction of marine environmental support work for the military, augment the strength of training and recruitment of maritime personnel, make breakthroughs in key technologies such as observation and monitoring and numerical forecasting in the field of marine hydrology and meteorology, accelerate sharing of marine environmental information, and fully promote the development of marine environmental support for the military.

## Part IV: Specialized Support for Undersea Warfare

This section addresses the logistical and technical support for specific mission sets: mine warfare and ordnance.



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## Mine Warfare Should Not Be Neglected<sup>1</sup>

Huang Fengzhi<sup>2</sup>

Mine warfare is a type of naval warfare prosecuted with sea mines and mine countermeasure (MCM) equipment that primarily involves either blockade or counter-blockade missions. As both an offensive and defensive weapon, sea mines are not only used to conduct campaign and tactical missions in wartime; they often have strategic utility. From World War II to the Korean War, from the Vietnam War to the Gulf War, in the maritime domain, especially in the countless wars taking place in the littorals, mines have served an irreplaceable function in countering amphibious landings, performing maritime blockades, and disrupting seaborne communications.

In World War I, a total of 310,000 mines were laid by all combatants, damaging or sinking a total of 800 vessels. In World War II, a total of 800,000 mines were laid, damaging or sinking a total of 2,700 vessels. During the period from March to August 1945, the U.S. laid more than 12,000 mines in the waters adjacent to Japan, resulting in the destruction of more than 670 Japanese ships, including the Japanese aircraft carrier *Kaiyo*. During this period, Japanese imports declined 90 percent; supplies of oil, coal, and the other materials of war were nearly cut off. The severing of shipping and supplies of grain played an important role in hastening Fascist Japan's destruction.

During the last 30 years, only five U.S. Navy ships have suffered damaged in conflicts. Three of these were the victims of sea mines: in 1988, the USS *Samuel B. Roberts* was severely damaged by an Iranian sea mine in the Persian Gulf; in 1991, the USS *Tripoli* was struck by an aged Iraqi sea mine, suffering serious damage; the cruiser *USS Princeton* was severely damaged when it struck two Italian-made mines. Fearing the threat of sea mines, U.S. amphibious assault forces gave up on a plan to land in Kuwait. These [examples] amply demonstrate the huge effect that these ancient weapons can have in modern warfare.

Looking back at past naval battles, sea mines have a stellar record in performing blockades and countering amphibious landings. Sea mines have five main advantages: 1) they are difficult to detect, and their attacks are invisible and sudden; 2) they are capable of autonomously biding time, waiting for the right opportunity to strike; they are a weapon of sea control; they can remain in place for long periods of time, presenting an enduring threat; 3) they are easy to deploy: naval ships, fishing vessels, merchant ships, aircraft, and submarines can all lay mines;

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<sup>1</sup> 黄凤志 [Huang Fengzhi], 水雷战不容忽视 [“Mine Warfare Should Not Be Neglected”], 当代海军 [Modern Navy], no. 6 (June 2013), p. 1.

*Modern Navy* (AKA *Navy Today*) is a monthly magazine sponsored by the Political Department of the PLA Navy.

<sup>2</sup> Huang Fengzhi is the commanding officer of an unnamed naval garrison (水警区) of the PLA Navy's South Sea Fleet

4) they possess comparatively strong offensive capabilities, and have the ability to serve both offensive and defensive functions; 5) they are difficult to remove/sweep; at present there is no MCM approach that can completely eliminate the threat of sea mines. It is commonly accepted among the world's navies that MCM, anti-submarine warfare (ASW), and anti-missile warfare are the three most important subjects in 21<sup>st</sup> century naval warfare. With advances in science and technology, there have been successful efforts towards resolving the second and third of these issues, but developing effective MCM remains an eternal difficulty for the navies of the world.

At present, many countries have invested heavily in research on sea mines. In particular, they have pursued breakthroughs in the variety and destructiveness of sea mines. These efforts have led to the development of neural network sea mines (*shenjing wangluo shuilei*), program controlled sea mines (*biancheng zikong shuilei*), hidden missile sea mines (*chenfu daodan shuilei*), intelligent self-guided mines (*zhineng zidao shuilei*), sound-magnetic induction mines (*shengci ganying shuilei*), sonobuoy mines (*shengna fubiao shuilei*), and other highly intelligent sea mines. Their performance, destructiveness, invisibility and resistance to MCM have all reached unprecedented levels.

With respect to the Chinese Navy, our MCM capabilities still have quite a ways to go. China's maritime domain is vast, and the waters near our shores are shallow, the [seabed] topography is flat, and our adversaries are very likely to conduct offensive mining against us. Therefore, MCM tasks are likely to be extremely arduous. Although our navy's MCM equipment has improved quite a bit – we have contact minesweeping equipment, electro-magnetic and acoustic minesweeping equipment, and other advanced minesweeping means and methods – but compared with the pace of global sea mine development, there remains a fairly large gap and the future MCM situation looks grave. Focusing on the naval battle spaces of the future, we need to place a high priority on researching modern mine warfare, and we need to energetically increase and maintain our navy's operational strength in this domain. This is the only way for the PLA Navy's drive for the blue waters to achieve a more robust pace.



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## Discussion of Capacity Building of China's Mine Countermeasure Support Ships\*

Ni Hua,<sup>†</sup> Zhao Zhiping, Guan Hong, and Ai Yanhui

### Abstract

The military's mine countermeasure (MCM) combat tasks have undergone change in line with the Chinese Navy's strategic transformation. In addition to the traditional near-coast/near-seas MCM tasks, the Navy has added MCM tasks for straits, sea lanes, and overseas bases. MCM support ships have strong comprehensive operational capabilities, with high levels of informatization and automation. During combat operations, they provide various types of support for MCM forces, including command, control, communications, and replenishment. They rapidly improve the levels of informatization, autonomy, and modularity of MCM systems. They enable MCM equipment to work in coordination, maximizing MCM combat effectiveness. They are an ideal equipment for improving the Navy's current MCM combat capabilities.

### Introduction

Sea mines are well-concealed, can strike suddenly, are easy to deploy and hard to remove, have a high ratio of effectiveness to expense, are very destructive, and able to pose long-term threats. They are a conventional naval weapon capable of exerting a strategic deterrence function. Historical cases of wars demonstrate that sea mines have exerted a tremendous effect in operations such as base defense, countering amphibious landings, and sea lane blockade. They can effectively deter and suppress the operations of enemy forces, causing paralysis in the enemy's maritime transport. They are a strong weapon used by powerful countries to blockade their enemies and weak countries to resist powerful enemies.

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\* 倪华, 赵治平, 官红, 艾艳辉 [Ni Hua, Zhao Zhiping, Guan Hong, and Ai Yanhui] 我国反水雷支援舰能力建设探讨 ["Discussion of Capacity Building of China's Mine Countermeasure Support Ships"] 数字海洋与水下攻防 [Digital Ocean & Underwater Warfare] No. 2 (2019), pp. 1-6.

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## 1) Mine Threats Faced by the “Maritime Silk Road”

The Third Plenary Session of the 18th Central Committee of the Chinese Communist Party fully enacted China’s new round of reform and opening. Chairman Xi Jinping personally planned and promoted the strategic layout for constructing the “Silk Road Economic Belt” and building the 21<sup>st</sup> century “Maritime Silk Road.” These will become new points of growth for China’s opening up. The “Belt and Road” is a commercial route connecting China with Eurasia. It is also an important energy import channel for China. In particular, Pakistan’s port of Gwadar is the maritime starting point of the China Pakistan Economic Corridor. It is a bridgehead by which China can alleviate strategic pressure caused by the Pacific Ocean island chains and overcome the Malacca Strait dilemma. The port of Gwadar and the Gulf of Aden port of Djibouti—which could serve as China’s future overseas supply base—will become important supports for China to ensure the security of transport for China’s foreign trade and energy.

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However, due to the complexity of Middle East issues and the problems of piracy caused by the backwardness of economic development in northeast Africa, this region has seen many years of conflict. Sea mines pose a real threat to the region.

Terror organizations and pirates could use sea mines to conduct harassing blockades along important routes and within important waters, with the hope of exerting international influence in order to achieve their political or economic aims. The mine-laying incident in the Red Sea in the 1980s—during which 19 ships from 15 countries including China suffered damage from sea mines—is a case in point.

## 2) The Mine Threat Faced by “Presence in the Two Oceans” (两洋存在)

In order to respond to the continuously expanding influence of the maritime domain on China’s national security and the overall situation of China’s development strategy, by 2030 the navy will—on the foundation of the strategy of near seas defense, far seas protection—do more to deepen preparations for military struggle and promote the construction and development of equipment according to the strategic requirements of “nears seas defense, far seas protection, presence in the two oceans, expansion into the two poles.” The U.S. military has made “deploying sea mines in strategically-significant straits and ports” a chief operational task in naval warfare. It calls mine warfare “a force multiplier with tremendous potential.” As early as 1986, the U.S. military declared that in a conflict it would control 16 maritime choke points around the world. Among these are the several key straits that Chinese forces must pass when transiting the island chains, as well as the Strait of Hormuz, Bab-el-Mandeb, and Suez Canal—straits that China relies on for foreign trade.

Once maritime shipping lanes suffer large-scale sea mine blockade by the powerful enemy, China’s maritime strategic space would be compressed and its operational

capabilities for maritime maneuver would be lost. This would not only cause major strategic threats to the operations of China's maritime forces; China's economic development would also suffer a major blow. It would directly impact China's political and social stability and the security of the overall strategic situation.

### 3) Limitations with Current Equipment

China's current mine countermeasure (MCM) equipment systems were built according to the guiding logic of "near-coast defense" from the early period after the founding of the republic. Professional MCM forces are arrayed in an important ocean area, forming MCM operational capabilities within a certain radius from the center. Therefore, current MCM capabilities and levels still cannot satisfy the operational requirements of near seas defense. Operational support capabilities for middle- and far-seas protection<sup>‡</sup> are even less adequate.

In order to improve its MCM capabilities, China needs to develop new-type MCM equipment and platforms. It must also urgently research/develop MCM support ships—the "force multipliers" that can effectively integrate and maximally leverage the comprehensive combat capabilities of MCM equipment. MCM support ships have large displacements and good endurance. They have strong comprehensive combat capabilities, high levels of informatization and automation, and good habitability. They are the ideal equipment for swiftly integrating and improving the navy's current MCM operational capabilities.

## I. On the Necessity of MCM Support Ships

MCM support ships chiefly provide information, equipment, personnel, supplies, and other types of support to MCM forces during the conduct of MCM operations. They themselves possess fairly powerful MCM operational capabilities and can directly conduct MCM combat tasks.

### 1.1 Informational Support Needs for MCM Operations

MCM operations suffer from a certain degree of blindness. The fundamental reason for this is that sea mines are concealed under the water, their numbers are hard to know, their locations are hard to determine, their capabilities are hard to measure, and their state is hard to ascertain. For MCM operations under informatized conditions, information collection in peacetime and intelligence processing during wartime are extremely important. These aspects are important for assuring success in MCM. Equipment aboard MCM support ships includes tactical support systems used to deal with the complex and changeable battlefield and marine environment. During peacetime, they can be used to build a database containing information about the marine environment in the primary operating area and a database containing information about target characteristics. Using these databases as a foundation, the navy can

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<sup>‡</sup> *Translator's note:* The authors use the terms "near seas," "middle seas," and "far seas." Although they do not define the terms, "near seas" likely refers to waters within the first island chain, "middle seas" likely refers to waters between the first and second island chains, and the "far seas" likely refer to all other ocean areas.

integrate the relevant conclusions of operational experience and operational simulations, providing real-time decision making support for fleet MCM operations.

## 1.2 Force Coordination Needs for MCM Operations

In future MCM operations, MCM forces operating alone have obvious limitations. It is imperative that we explore and discover the potential of current MCM equipment and forces; conduct joint MCM exercises involving multiple forces and multiple service branches, organic (建制式) MCM equipment, and civilian vessels; and improve comprehensive MCM capabilities given current conditions. MCM support ships rely on tactical support systems and advanced observation, communication, navigation, and positioning equipment. They excel at performing internal coordination within an MCM formation (编队中反水雷兵力内部的协同). They can also conduct coordination and communication with nearby friendly operational units, becoming flagships for operational tasks largely focused on MCM.

## 1.3 Needs for Leveraging MCM Equipment Capabilities

MCM operations are confrontations between equipment systems. They take place over long periods of time and are very dangerous; moreover, their operational effects cannot be seen at a glance. As a result, the leveraging of the operational potential of MCM equipment and correct judgments of MCM operational effectiveness are aspects that cannot be overlooked. Given current equipment conditions, there exist three weakness with MCM operations: 1) when remote-controlled mine sweeping boats conduct mine sweeping operations or training, we still cannot adequately support personnel transfers (人员换乘), rest for sailors, petroleum, oils, and lubricants and water supplies, and equipment maintenance; 2) helicopters used for MCM are not ideal; 3) we still lack means for reasonably configuring resources, scientifically formulating plans, comprehensively monitoring processes, and reliably assessing effectiveness, and as a result we have not yet joined forces for MCM equipment.

## II. The Current State and Trends of MCM Support Ships

### 2.1 Traditional MCM Support Ships

With the development of sea mines, MCM operations have become more difficult and dangerous. MCM equipment that lacks information support, equipment support, and logistics support can no longer adapt to the requirements of MCM operations under informatized conditions. MCM support ships meet these needs and have been embraced by naval powers. They have undergone development since the mid and late 1990s.

Outside China, early MCM support ships were chiefly used for resolving force projection and supply problems. Fairly representative examples include the U.S. *Inchon* MCM support ship of the *Iwo Jima* class and Japan's *Uraga* (浦贺)/*Funko* (丰后) minesweeper mother ship of the *Uraga* (浦贺) class.

The *Inchon* amphibious assault ship was converted into the *Inchon* MCM command and support ship, officially entering service in 1996. The primary mission of the *Inchon* was to

provide command, control, and support services for the mine warfare command department and its air, surface, and subsurface MCM forces, and mine detonation team.

In 1971, Japan built its first mine sweeper mother ship, the *Hase* (早瀬). That ship's standard displacement was 2,000t (3,000t full-load displacement). It embarked one V-107A mine sweeper helicopter. The *Uraga*-class was built to replace the *Hase* mine sweeper mother ship, which had come to the end of its service life. That ship's standard displacement was 5,650t. It was chiefly used to serve as the flag ship for the mine sweeping team. In fact, ships of that class had various functions. They could embark mine sweeping helicopters and carry out mine sweeping tasks from the air; they could also be used to supplement supplies and consumables for mine sweeping vessels. Each ship usually possessed the ability to replenish one mine sweeping team of roughly 15 mine sweeping vessels.

## 2.2 Planned MCM Support Ships

In order to improve usage rates of warships and save on military expenses, Western countries are planning to use common platforms as MCM support ships. Not only can they carry out MCM tasks; they can also conduct various other tasks including marine exploration, hydrographic surveys, and patrols. Each task has a corresponding weapon system mission packages. The mission packages can be installed on the common warships within short time frames. Aside from MCM combat tasks, MCM support ships can carry out other tasks during peacetime.

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In the future, the U.S. military's MCM capabilities will chiefly rely on the littoral combat ship (LCS). Aside from carrying out mine warfare operations, the LCS can perform antisubmarine warfare and surface warfare, and it can even be used to provide medical treatment, humanitarian assistance, force transport, and naval fire support, among other uses. MCM mission packages include one unmanned surface vessel (equipped with one unmanned surface mine sweeper system), two remote-controlled mine hunting systems, one organic airborne or shipborne non-contact mine sweeping system, one airborne laser mine detection system, three different mine hunter sonars, one airborne mine disposal system, one airborne rapid mine removal system, as well as other auxiliary equipment such as vertical take-off and landing drones, containers, standard interfaces, and hardware and software for the mission package computing environment. Each airborne system is carried aboard MH-60S shipborne helicopters.

The development philosophy behind Great Britain's new-type MCM ship is multi-functionality. Aside from MCM tasks, it possesses comprehensive capabilities to perform tasks such as hydrographic surveys and patrols. The new-type ship will gradually replace current specialized MCM ships, hydrographic monitoring ships, and fisheries enforcement vessels. The new ship will displace 2,700t, with a maximum speed of 23-24 knots. It will have a large flight deck for helicopters, mission bays and stern ramps with integrated deployment/recovery systems. It can be equipped with unmanned surface vessels and unmanned underwater vehicles with MCM functions.

France has developed its future mine countermeasures program (SLAM-F program). The objective of this program is to promote the universalization and modularization of equipment through capability-focused development, thereby enhancing the French Navy's capabilities in MCM operations. According to the program, the French Navy's future mine countermeasure force will rely on five large catamarans displacing 2,000 to 3,000 tons, and a total load of 11 modules capable of final operations (最终作战能力) and six portable modules. A module capable of final operations includes one Sterenn Du USV, one large AUV, one semi-submersible vehicle, one portable module for towed sonar, one Alister-100 AUV, and one K-Ster mine disposal vehicle. The mothership will be far from the mined area when carrying out MCM missions, relying on unmanned systems to complete MCM work.

The Royal Australian Navy decided to use a multipurpose offshore combat ship to replace its current patrol vessels, MCM ships, and hydrographic survey and marine survey ships. This ship displaces up to 2,000 tons. When executing MCM missions, its onboard weapon systems include its own small surface vessel and warship sensor systems, USVs, UUVs, and divers. These systems can carry out various missions in mine detection, neutralization, sweeping, and marine data collection.

Japan's Acquisition, Technology & Logistics Agency (ATLA) announced its high-speed trimaran concept design at the 2017 Maritime/Air Systems & Technologies Asia Exhibition in Tokyo. The high-speed trimaran is an all-aluminum ship with a displacement of 1,500 tons, a maximum speed of 35 knots, and a range of 6,482 kilometers at 15 knots. It can conduct MCM, disaster relief, maritime patrol, and special warfare support missions. In MCM missions, this ship can install two approximately 12-meter containers, two 11-meter MCM USVs, one vertical takeoff and landing UAV, and one mine-warfare helicopter. In addition, multi-purpose mission modules can also accommodate 16 MCM unmanned underwater vehicles.

### **III. Mission Requirement Analysis of China's MCM Support Ships**

Given the threat of mines against China and its currently inadequate MCM equipment system and considering the development trajectory of international CMC technology, [China's] future MCM equipment systems will chiefly include base MCM equipment, MCM support ship equipment, and organic MCM equipment.

Base MCM equipment is mainly based on our navy's current MCM equipment. It is used for near shore defensive MCM operations. Organic MCM equipment is mainly carried aboard surface warships such as destroyers and frigates. It is used as a rapid mine countermeasure by ship formations to handle low-level mine threats. MCM support ships are primarily used to support large-scale MCM operations, such as MCM operations during landings, large-scale MCM operations in middle and far seas, and in MCM operations at overseas bases.

While focusing on MCM operations, China's MCM support ships should also draw from the development trends of foreign support ships. They should possess the ability to conduct a variety of tasks including MCM, ocean exploration, hydrologic survey, and patrols. MCM support ship displacement should be approximately 3,000 tons and be able to patrol at 20 knots with a maximum speed no less than 25 knots.

When conducting MCM missions, MCM support ships should mainly have the following functions: 1) Provide command and control and information support capabilities to MCM combat forces as the MCM force flagship; 2) [Act as] the MCM mothership for delivering aerial, surface, and underwater MCM equipment; 3) [Provide] maintenance and support for MCM equipment; and 4) [Provide] petroleum, oil, and lubricant and water replenishment and replacements for consumable parts.

MCM support ships may operate in deep waters, shallow waters, very shallow waters, surf zones, and landing zones when carrying out operations such as MCM for landings and large-scale MCM in middle and far seas. Any type of foreign mine could be encountered. Not only could there be vast stores of old-type mines and mines capable of distinguishing traditional sweeping gear from warships; there are also new intelligent mines with highly-capable target discrimination and anti-sweeping counters, as well as special mines and networked mixed mine barriers.

-----P. 5-----

As a result, no single MCM method is sufficient to complete all MCM missions.

Therefore, the MCM mission package of MCM support ships should be based on the complementary use of multiple MCM methods in order to combat the various technical levels of mines. A contest between MCM and mine equipment systems should then take shape. A variety of MCM methods such as mine hunting and minesweeping should be established and improved to ensure the coordinated development of various air, surface, and underwater platforms, forming a MCM weapon system with stronger integrated MCM combat capabilities.

The makeup of the MCM weapon system is shown in the block diagram of figure four. It comprises MCM command and control systems, MCM information support systems, ship hull sonar, and aerial, surface, and underwater MCM systems. In it, aerial MCM systems include helicopter minesweeping systems, helicopter mine hunting systems, and coastal battlefield reconnaissance systems. Surface MCM systems include shipborne self-propelled mine hunting systems and large surface unmanned MCM systems. Underwater MCM systems include recon and disposal AUV systems.

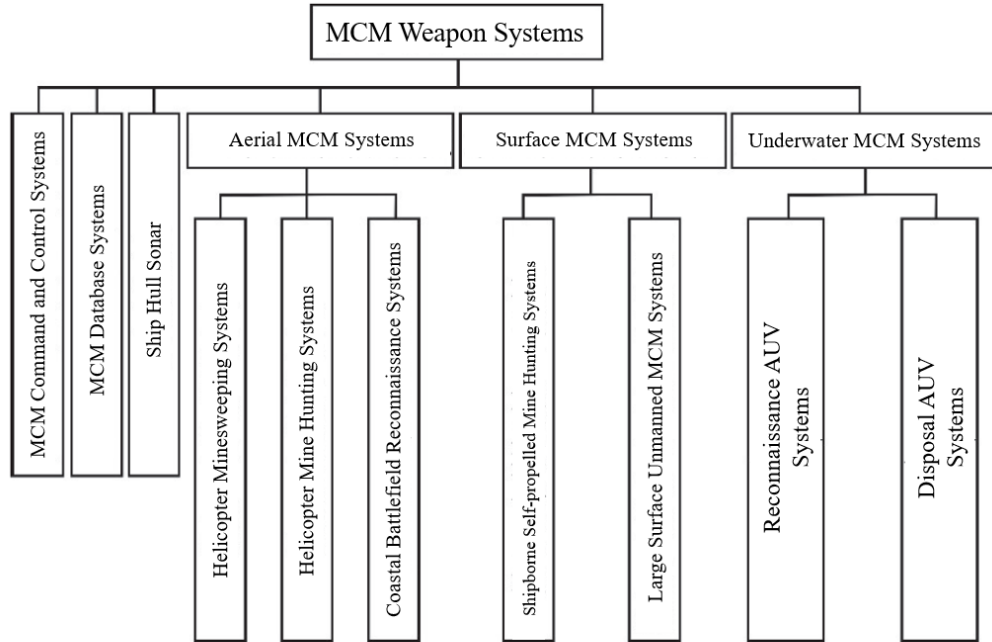


图 4 反水雷武器系统组成框图

Fig. 4 Constitution of MCM weapon system

#### IV. Weapon Configuration of MCM Support Ships

##### 4.1 MCM Command and Control Systems

MCM command and control systems are the core of MCM support ships. MCM support ship navigation and positioning, detection and identification of mine targets, display and discrimination of target imagery, and the remote control and guidance of mine disposal vehicles are all carried out by the command and control system during the course of MCM work. The main functions of MCM command and control systems are as follows:

- 1) Tactical decision support: This refers to the use of computer-aided methods in accordance with established tactics. MCM operational forces are rationally planned after comprehensively exploiting the relevant MCM information in the MCM information support database to make tactically-optimized decisions. This integrates real-time battlefield situation information and evaluations of mine threats, MCM operational effects, and weaponry performance. It produces dynamically calibrated decision making for operational forces in real-time, thereby achieving the technology for a comprehensive, complete, multi-method, rapid, and efficient MCM operational system that integrates MCM combat elements, shares battlefield situation information, and coordinates the command of numerous combat platforms.

2) Comprehensive operational situation display: A comprehensive operational picture is provided that displays the position, navigational information, planned operating routes, detected target information, and disposal information of MCM support ships and MCM weapon systems using electronic sea charts as a background.

3) Provide communications, navigation, and positioning information: Establish a high-speed wireless communications network between the MCM support ship and MCM weapon systems that features high-speed wireless data transmission. This will meet the requirements of high-speed data transmission and data exchange between MCM support ships and other combat ships and shore-based command centers.

4) Automatic ship-to-ship and ship-to-shore data exchange for MCM support ships.

5) Displays operating condition information of MCM support ships and MCM weapon systems.

#### 4.2 MCM Database Systems

MCM database systems include major foreign mine fuze databases, target characteristic databases of the PLAN's main warships, submarine topographical and landform databases, sonar imaging databases for major foreign mines, and marine environmental information databases. When MCM weapon systems are conducting operations, MCM database systems provide relevant information to minesweeping and mine detection equipment, thereby enhancing MCM effectiveness.

#### 4.3 Ship Hull Sonar

Hull sonar detects mines in a limited sector forward of the MCM support ship to ensure the safety of the support ship itself. Hull sonar not only can detect anchored mines, but it also can detect seabed mines and has advantages in convenience and long detection ranges.

#### 4.4 Aerial MCM Systems

##### 1) Helicopter Minesweeping Systems

Helicopter minesweeping systems are used in shallow waters, very shallow waters, surf zones, and in waterways for continuous and rapid clearance of high-sensitivity acoustic or magnetically-fuzed mines and combined acoustic-magnetic fuzed mines. During minesweeping, the MCM support ship will set simulated target information such as ship-type and speed, and transmit it via wireless communication systems to the helicopter. Minesweeping control software automatically selects acoustic or magnetic signals based on this as a simulation reference and generates control signals. Acoustic or magnetic minesweeping gear then operates according to the set mode to achieve a simulation of the ship's physical field characteristics.

## 2) Helicopter Mine Hunting Systems

Helicopter mine hunting systems are mainly used in rapid mine hunting missions in near shore seas and accompanying warship formations. They feature high security, maneuverability, and fast operating speed. Helicopter mine hunting systems include helicopter mine detection systems and helicopter mine disposal systems. Long-range remotely-controlled helicopters from MCM support ships can enter operating areas to conduct full-coverage detection using towed mine hunting sonar according to a planned route and speed. After a target is detected, the helicopter can hover at a suitable height near the mine and deploy a mine disposal vehicle to complete the mission.

## 3) Coastal Battlefield Mine Reconnaissance and Disposal Systems

Mine reconnaissance and disposal systems in coastal battlefields utilize miniaturized and modular magneto-optical combined detection modules on UAVs to carry out detection, identification, and location of exposed and sediment-covered mines in surf zones and very shallow waters.

### 4.5 Surface MCM systems

#### 1) Shipborne Self-propelled Mine Hunting Systems

Shipborne remote-controlled mine hunting systems effectively detect targets on the seabed and in the sea using diesel-powered semi-submersible craft towing a variety of portable sonar equipment underwater. Shipborne self-propelled mine hunting systems are a type of organic MCM equipment carried aboard surface warfare ships that, once deployed, can autonomously navigate and carry out mine detection missions ahead of the ship. When necessary, single-use mine disposal vehicles can neutralize mines, providing a basic MCM capability for combat formations in middle and far seas.

#### 2) Large USV Mine Hunting and Sweeping Systems

Displacing 10-25 tons, large USV mine hunting and sweeping systems are mainly carried aboard MCM support ships. They are similar in shape to the German ARCIMS or French swordfish-class unmanned boats, with the ability to tow and retract deep-water minesweeping and detection equipment, AUVs, small USVs, and ROVs.

### 4.6 Underwater MCM Systems

Underwater MCM systems include recon and disposal-type AUV systems. Recon AUV systems chiefly carry out autonomous missions in mine detection, identification, and location. They have the ability to covertly enter specified areas submerged at long-ranges to carry out reconnaissance of mine deployments and the undersea battlefield environment, thereby opening up safe channels. The disposal AUV system enables mine disposal capabilities through cooperation with existing disposal/hunting vehicles or by autonomously releasing mine-disposal charges.

MCM mission modules under the unified command and control of the MCM support ship can form a relatively improved surface, underwater, and aerial MCM combat system. They can rapidly, efficiently, and safely complete MCM operations and protect the security of aircraft carrier formations.

## **V. Conclusion**

Each of the world's navies attach great importance to MCM operations and invest heavily in relevant areas to ensure their access to critical straits, passages, and coastal areas globally. Among these areas, the use of informatized warfare concepts in MCM operations is a critical measure for exploiting information technology to fundamentally change the face of MCM operations and greatly improve its effectiveness. MCM support ships can sufficiently meet China's future MCM operational requirements in coastal areas and the near, middle, and far seas. They rapidly upgrade the level of informatization in MCM systems and enable coordinated operations with MCM equipment, thereby maximizing MCM operational effectiveness. At the same time, MCM support ships have altered traditional approaches. Dangerous work can be conducted by various unmanned and helicopter systems deep within mined areas while human-operated ships command from the outside, reducing operational risk to personnel.



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## An Examination of the Use of Civil Helicopters in Mine Countermeasure Operations<sup>1</sup>

Zhang Wei, Zhang Xiuzhi, and Wang Jiufa<sup>2</sup>

### Introduction

Sea mines are undersea weapons with a fairly high performance to cost ratio. Many countries regard them as important naval weapons, using them to conduct blockade and counter-blockade operations. Since their advent, they have served important functions in past wars (such as the Russo-Japanese War, World War I, World War II, the Korean War, the Vietnam War, and the Gulf War).

Since World War II, more than 90 percent of U.S. Navy warships damaged in combat were sunk or damaged by sea mines. In order to effectively counter the threat of sea mines, Europe and the U.S. have researched and developed large numbers of shipborne mine countermeasure (MCM) equipment. However, the costs of building and maintaining MCM ships is high. Also, it is unnecessary to maintain large numbers of MCM ships in peacetime. Thus, most of the world's major naval powers only maintain a certain quantity of MCM equipment. As a consequence, existing MCM equipment is unable to satisfy corresponding requirements when confronted with a large-scale sea mine blockade.

In order to remedy deficiencies in their ability to build MCM forces and to enable the clearing of sea mine threats in large expanses of water in a short period of time, European countries and the U.S. proposed the COOP MCM plan. It involves the use of large numbers of non-specialized MCM platforms (civil vessels, civil aircraft, etc.) carrying MCM and mine sweeping systems to conduct MCM operational tasks in wartime.

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At present, China also faces a contradiction between requiring large numbers of MCM platforms in wartime while only requiring a certain number of MCM platforms in peacetime. As a result,

<sup>1</sup> 张炜, 张修志, 王久法 [Zhang Wei, Zhang Xiuzhi, and Wang Jiufa], 民用直升机在反水雷中的应用探讨 [“An Examination of the Use of Civil Helicopters in Mine Countermeasure Operations”], 数字海洋与水下攻防 [Digital Ocean & Underwater Warfare], vol. 3, no. 5 (October 2020), pp. 367-371.

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implementing the COOP MCM plan and using civil platforms (including air and surface platforms) to conduct emergency MCM in wartime is an effective way to resolve the abovementioned contradiction.

## **1. The Advantages of Helicopter MCM Equipment**

### **1.1 The Characteristics of Helicopter MCM**

In contrast with ship MCM, helicopter MCM is safe, rapid, and efficient. When ships conduct MCM operations, their acoustic, magnetic, and physical fields may detonate the mines. The safety of the platform is imperiled. But when helicopters perform MCM tasks, their acoustic, magnetic, and physical fields will not detonate the mines. Therefore, when helicopters conduct MCM operations they are safer than surface vessels. Helicopters can reach speeds of 250 km/hour, while surface vessels rarely exceed 35 km/hour. As a result, the emergency response times of helicopters is far shorter than surface platforms. At the same time, the working speed of helicopter MCM may exceed twice that of surface ships, greatly improving the efficiency of MCM.

### **1.2 The Number of Civil Helicopters in China**

China's civil helicopter industry began in the 1990s. By 2014, China had 574 civil helicopters. In 2014, 141 civil helicopters were purchased. In recent years, due to growth in China's economic power, the rapid development of China's general aviation industry, and the continuous expansion of helicopter applications, growth in domestic demand for civil helicopters has exceeded 20 percent per year. It is forecast that by 2020 the total number of civil helicopters in China will exceed 1,000.

Given the many advantages of helicopter MCM and the fact that China has large numbers of civil helicopters, if civil helicopters can be used to conduct MCM operations this would largely resolve the contradiction between wartime and peacetime needs for MCM equipment and boost China's MCM capabilities.

## **2. The Current Situation and Operational Employment of Helicopter MCM Equipment in Foreign Navies**

Foreign navies have been using helicopters for MCM for over 50 years. Countries with helicopter MCM equipment primarily include the U.S, Japan, Russia, the United Kingdom, and France. The U.S. in particular places great emphasis on researching helicopter MCM technology and equipment research and development. It has already fielded many types of equipment.

### **2.1 The Current State of Equipment Use**

The MH-53E is the U.S. military's current active MCM helicopter platform. It is a reconfiguration of the CH-53E helicopter used by the U.S. Navy and U.S. Marine Corps for combat support missions. Its loadout for MCM includes MK-103 contact mine sweeping equipment, MK-104 acoustic mine sweeping equipment, MK-105 electromagnetic mine sweeping equipment, MK-106 acoustic magnetic joint mine sweeping equipment, MOP magnetic orange pipe mine sweeping equipment, AN/AQS-14 mine hunting sonar, AN/AQS-20

mine hunting sonar, and the “Magic Light” laser mine detection system. When towing the MK-104 and MK-105, the MH-53E can operate at a speed of 20-25 knots. When towing AN/AQS-20 mine hunting sonar, it can search for and locate moored mines and bottom mines at a speed of 25 knots.



图 1 MH-53E 直升机反水雷  
Fig. 1 MH-53E Helicopter in MCM



图 2 MH-60S 直升机反水雷  
Fig. 2 MH-60S Helicopter in MCM

Given that the MH-53E is a heavy helicopter, there are limited numbers of platforms from which it can take off and land. So, the U.S. military began searching for a mid-weight general helicopter to serve as a MCM platform. Starting in 2004, the U.S. military selected the MH-60S as its new generation of MCM helicopter. The MCM equipment developed by the U.S. military for MH-60S was modularized and miniaturized. Based on combat requirements, it can switch out mine sweeping, detection, and neutralization modules. These include towed mine hunting sonar (AQS-20A), the airborne mine neutralization system (AMNS), the towed mine sweeping system (OASIS), the airborne laser

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mine detection system (ALMDS), the rapid airborne mine clearance system (RAMICS), and other MCM equipment.

The AN/AQS-20A airborne mine hunting sonar is a helicopter towed system. It is used to rapidly reconnoiter and hunt mines. It can detect, identify, and locate unburied bottom mines, short-tethered mines, and moored mines located in shallow and deep water. AMNS is a type of self-

propelled remote-control system that eliminates unburied sunken mines and anchor mines by means of explosive methods. OASIS is a high-speed non-contact acoustic magnetic mine sweeping system used to support the conduct of mine sweeping in waters where mine hunting could be ineffective. ALMDS is a LIDAR system installed on a helicopter. It can detect, identify, and locate moored mines and floating mines close to the surface of the water. RAMICS combines LIDAR and supercavitating projectiles. It can safely and rapidly eliminate moored mines and floating mines near the water's surface.

After years of development, the U.S. military now possesses a fully-equipped, technologically-advanced, and combat-experienced helicopter MCM force. During this development process, helicopters have gone from being special purpose large and medium sized aircraft to multi-purpose and general purpose aircraft, and MCM equipment has gone from being specialized for mine sweeping to being capable of both hunting and sweeping. Its MCM helicopters carry a wide range of platforms, and they can carry out trans-oceanic combat tasks in conjunction with carrier strike groups, distant-ocean strike groups, and littoral combat ships, providing timely and effective MCM capabilities for the fleet.

## 2.2 Actual Combat Employment of Helicopter MCM

The first time helicopters were used for MCM was October 1950, during the Korean War. The mines deployed by the North Korean military in the channel to Wonsan Harbor delayed the U.S. landing. In order to remove the mine barrier, the U.S. military used helicopters to search for mines in the channel and had a marksman shoot drift mines and mines near the surface of the water.

After the Vietnam War, the U.S. military used the helicopter MK-105 electromagnetic mine sweeping system and mine sweeping orange pipe to conduct non-contact magnetic mine sweeping to clear the mines deployed by the U.S. military at the entrance to Haiphong Harbor. During the 1973 war in the Middle East, Egypt deployed mines on the Suez Canal and the waters at its mouth. The U.S. military used RH-53D helicopters to clear 310.8 km<sup>2</sup> of waters.

In 1984, mines were laid in the Gulf of Suez and the Red Sea, and airborne MCM once again was a key factor in MCM operations. During the 1991 Gulf War and during the Desert Shield and Desert Storm operations, airborne MCM forces answered the call again to conduct MCM operations in waters near Kuwait. The airborne MCM forces of the U.S. (including 15 MH-53E heavy MCM helicopters and SH-2F "Sea Sprite" helicopters equipped with "Magic Lantern-30" laser mine detection systems) served as part of the largest scale MCM force since the Korean War. In 2003, during Operation Iraqi Freedom, U.S. airborne MCM forces participated in the joint MCM force, serving an important function in MCM operations.

## 3. Introduction to Helicopter MCM Systems

In the case of the United States, helicopter MCM mainly comprises airborne minesweeping systems, airborne mine detection systems, airborne mine neutralization systems, airborne laser mine detection systems, and rapid airborne mine neutralization systems. Although the types of equipment in airborne minesweeping, detection, and neutralization each have different functions, they do have similarities. For example, they all need to be deployed on a helicopter platform and

controlled onboard. These components with similar functions can be used interchangeably if produced as standardized modules. This not only improves the modularity of equipment, but also reduces research and development and manufacturing costs.

According to the above ideas, the whole system can be divided into different general and special modules based on their different functions. General modules refer to modules for airborne minesweeping, detection, and neutralization systems that can be used together to accomplish missions. Special modules are modules unique to a single system. Modules are connected through standard mechanical, electrical, and software interfaces. Once they are designed, various modules can be integrated to form airborne mine sweeping, detection, and neutralization systems.

General modules for airborne MCM systems include integrated control modules, launch and recovery system modules, and towed system modules. Special modules for airborne minesweeping systems are mainly acoustic and magnetic minesweeping systems and those for detection systems include high-speed acoustic mine detection systems. Special modules for airborne mine neutralization systems include a transmission processing and acoustic tracking module as well as a mine neutralization system comprising disposable mine neutralization vehicles.

The command and control system is the man-machine interface for communication between the MCM operator and the MCM system. The operator controls all MCM systems through the command and control system.

The main function of the launch and recovery system is to deploy towed minesweepers from inside the aircraft and recover the towed [system] from the water after minesweeping work is completed. Safety requirements are high when the platform is airborne due to the small cabin space inside aircraft. Launched and towed systems must therefore be able to automatically complete launch and recovery procedures with the assistance of a small number of personnel. This system is mainly composed of aircraft winches and launch and recovery devices.

Towed systems mainly comprise towing cables and streamlined body components. Among them, tow cables provide the minesweeping, detection,

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and neutralization systems with the necessary towing force and electricity, while also providing information transmission. The streamlined body is used to reduce resistance to the tow cable during high-speed towing.

Acoustic and magnetic minesweeping systems include towed minesweepers, acoustic minesweeping vehicles, and magnetic minesweeping vehicles. Acoustic minesweeping vehicles are based on the MK-104, which adopts principles of cavitation and is an unpropelled acoustic generator. Magnetic minesweeping vehicles use a two-electrode method to generate a magnetic field in which the streamer part acts as a cathode and the tail part acts as an anode.

High-speed acoustic mine detection systems include towed mine detectors, sonar detection and recognition systems, and power control systems. Detection and recognition systems comprise

forward-looking sonar and synthetic aperture sonar as the chief means of detecting underwater targets. The power control system includes an instrument power distributor, control unit and steering gear. It mainly supplies power to the internal electronic equipment of the towed body while also controlling its depth and height.

Mine neutralization systems include disposable mine neutralization vehicles and hydroacoustic positioning devices. Disposable mine neutralization vehicles are used to identify and destroy suspected mines that have been detected and located. Hydroacoustic positioning devices are used to guide the disposable mine neutralization vehicles to the location of the suspected mine.

To ensure the three main systems of airborne minesweeping, detection, and neutralization can share common modules, the following requirements should be met: an identical towing cable; identical connections at the dry and wet ends of the towing [cable]; identical mechanical connections on launching devices for towed minesweepers, detectors, and mine neutralization vehicles; and towing points on towed minesweepers and detectors should be identical.

Airborne laser mine detection systems consist of a laser transmitter, laser receiver, optical equipment, a signal processor, positioning and navigation system, and a power supply. The laser is installed within a pod on the helicopter. During an initial detection, the laser emits hundreds of pulses into the water every second and the camera within the pod captures the reflected information in a digital format, which is fed back into the control system. An analyst uses this to identify the mine. Once the mine target is identified, the control system then works with the positioning and navigation system to record the location of the mine.

Rapid airborne mine neutralization systems mainly comprise a positioning and navigation system, a supercavitating launcher, and supercavitating [projectiles]. The helicopter flies to the mine target area and the control system calculates the attack results based on previous mine detection information. It then conducts mine neutralization work by controlling a launcher firing supercavitating projectiles.

#### **4. Analysis of the Feasibility of Equipping Civil Helicopters**

At present, China has more than 30 types of domestically-produced helicopters. They form a relatively complete product series from one to thirteen-ton classes, including civil helicopters such as the one-ton class AC310, the two-ton class AC301A, the six-ton class AC352, and the thirteen-ton class AC313. At the same time, China has imported a series of civil helicopters from western countries such as Russia and the United States, including the Mi-17/171 and Mi-26 helicopters.

In order to carry airborne minesweeping, detection, neutralization, laser detection, and rapid neutralization systems to conduct MCM operations, civil helicopter platforms should satisfy the following basic requirements: 1) helicopter platforms should have sufficient lift capacity; 2) they should have sufficient towing power; 3) and they should have sufficient endurance to ensure operating time.

Minesweeping systems have the most demanding requirements on helicopter platforms. If a helicopter platform type can meet the needs of minesweeping systems, then it can definitely also meet the requirements of airborne mine detection, neutralization, laser detection, and rapid

neutralization systems. Based on the requirements of helicopter minesweeping systems in the U.S., the helicopter's maximum payload should be about four tons. Thus, given these requirements, the helicopter platforms that are suited to work with helicopter MCM systems chiefly include the AC313, Mi-17/171, and the Mi-26 civil helicopters.

The AC313 filled a gap in China's production of large civil helicopters. Its maximum takeoff weight is 13.8 tons and it is suited for use in marine climate conditions and other various complex and harsh environments. The AC313 is equipped with three engines. The effective volume of its passenger cabin is 23.5 cubic meters with a height of 1.83 meters. Its maximum internal payload is four tons and it can carry five tons externally by sling. With its internal fuel tanks full, it has a range of 900 kilometers.

The Mi-171 helicopter is an improved modernized variant of the famous Mi-8T and Mi-17. Its performance and reliability are significantly improved over the Mi-8T and Mi-17. There are around 150 of this aircraft in China. The Mi-171 helicopter's maximum takeoff weight is thirteen tons and its maximum payload is around four tons. Its maximum range is 495 kilometers and maximum endurance 7.5 hours.

The Mi-26 is currently the world's largest helicopter. It has a maximum takeoff weight of 56 tons, maximum payload of 25 tons, and maximum external load of 20 tons. Its internal cargo bay is 12 meters long, 3.2 meters wide, and 3 meters high. Its maximum range is 1920 kilometers with an endurance of 7.5 hours.

The above analysis reveals the AC313, Mi-17/171, and Mi-26 civil helicopters can satisfy the relevant requirements for MCM systems.

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The selected civil helicopters can be further improved to better perform MCM missions, such as power improvements to satisfy the electricity demand of MCM equipment, improvements in installation spaces to provide larger space for airborne MCM equipment, and improvements to helicopter trajectory control to meet the needs of mine detection, identification, location, and destruction.

## **5. Conclusion**

The Chinese navy is currently actively striving to achieve an overall transformation. [It seeks] to gradually achieve a transformation from near-seas defense into a combination of near-seas defense and far-seas protection to ensure the navy can protect both China's traditional "territorial frontiers" as well as "the frontiers of national interests." As the navy's vanguard force, MCM forces should adapt to developments in the new situation. For this reason, the navy has put forward requirements in safety and speed in MCM.

Helicopter MCM is safe, fast, and mobile. To improve efficiency in MCM operations, we should fully leverage the advantages of shipborne and airborne MCM equipment to build a three-dimensional air, surface, and underwater MCM equipment system, forming a systems-on-systems confrontation with mines. In order to effectively use China's current civil helicopter platforms while integrating developments in foreign helicopter MCM equipment, China should

accelerate development of standard helicopter MCM equipment such as small airborne towed mine hunting sonar, airborne mine neutralization systems, towed minesweeping systems, airborne laser mine detection systems, and rapid airborne mine neutralization systems. This ensures they can be quickly installed on civil helicopter platforms and expand the MCM force during wartime, thereby effectively breaking the enemy's mine blockade against our military and carrying out active, rapid, and efficient MCM operations.



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## Research on Combined Support for Torpedoes and Sea Mines<sup>1</sup>

Jin Mudan, Lu Hui, Feng Shaowei, and Chai Kai<sup>2</sup>

### 1 Introduction

During the conduct of emergency mobile operations at sea and informatized war, the emergency supply of munitions (*leidan*) to combat vessels directly impacts one's ability to sustain maritime mobile operations and may even determine the course and outcome of the maritime campaign. Torpedoes are not only an effective anti-submarine warfare weapon in naval combat; they are also an important means to strike surface vessels and aircraft carriers and damage shore-based installations. Sea mines are an important weapon for maritime blockade and counter-blockade operations. Researching the topic of combined support for torpedoes and sea mines, rationally constructing an ordnance support process for these two types of munitions, and efficiently using personnel, equipment, and technical support areas (*jishu zhendi*) are urgent tasks for improving core ordnance support capabilities. They are both extremely significant and very necessary.

### 2 The Advantages of Combined Support for Torpedoes and Sea Mines

In future naval conflicts, [navies] must rely on information advantage, employ large numbers of "high [tech], precision, and advanced" (*gao, jing, jian*) informatized weapons, and carry out sudden strikes. The timescales for operational early warning and support preparation will be extremely short and hurried. All of these factors generate very high requirements for munitions support. Rapid and highly efficient emergency supply of ordnance will create opportunities to win the initiative on the battlefield.

#### 1) Support Orientation is the Same, Increasing the Efficiency of Munitions Support

Torpedoes are mainly carried by large- and mid-sized surface vessels, helicopters, and fixed-wing aircraft, and they are used to destroy and damage enemy conventional submarines and nuclear submarines.

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Sea mines are mainly employed by surface vessels, submarines, aircraft, and unmanned

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underwater mine-laying systems, and they are used to blockade ports and sea lanes and attack large and mid-sized surface vessels or submarines, and, in some cases, small vessels.

These two types of munitions can be fired or deployed from tubes on surface vessels, and they can also be dropped by helicopters and fixed-wing aircraft. Achieving combined support for these two types of munitions can enhance support links and improve support efficiency.

#### 2) Shorten the Personnel Training Cycle and More Efficiently Employ Personnel

The specialized curricula that engineers (and assistant engineers) and specialist sailors (*zhuanye shibing*) study for these two types of munitions is weighted towards expertise in underwater weapons. There is a high degree of overlap between the two curricula. Personnel specializing in torpedoes normally would only need a short, 3-month training period to master the technical capabilities for sea mines. Compared with personnel training for a single type of munition, this would shorten the training cycle by 6 months. Therefore, by combining support for torpedoes and sea mines personnel can specialize in one skill while being good at many others (*yizhuan duoneng*), the personnel training cycle can be reduced, and personnel can be more efficiently employed.

#### 3) Shared Use of Technical Support Areas, Reducing Construction Costs

Construction of munitions technical support areas involves a high level of security protection, requires massive capital outlays, and takes a long time. By combining support for torpedoes and sea mines one technical support area can support multiple types of munitions. Some of the operations rooms (*caozuojian*), storage rooms, and supporting equipment can be shared, creating a combined support area that specializes in one skill while being good at many others and that is connected and orderly.

Combining support for torpedoes and sea mines can reduce the number of explosive initiator (*huogongpin*) inspection rooms, initiator storage rooms, fuze explosion-proof test rooms (*yinxin fangbao ceshi jian*), munitions storage areas of different grades, cloakrooms, and data rooms. It can also reduce duplication of equipment such as truss cranes (*hengdiao*), hauling equipment, and airtight inspection chambers. Effectively resolving the issue of one munitions type per technical support area would greatly lower the cost of building support areas.

#### 4) Support Requirements are Similar, Enabling Resource Sharing

First, the maintenance cycle is the same. The maintenance cycle for each grade of torpedo or sea mine is the same, so maintenance can be performed uniformly.

Second, the storage method is the same. Torpedoes and sea mines should both be placed in a room that is dry and clean with good air circulation. Ambient air should be 20 degrees Celsius +/- 15 degrees Celsius, relative humidity should not exceed 75 percent, ground atmospheric pressure should be normal, and there should be no corrosive gas pollution or strong

electromagnetic wave radiation. Workrooms and warehouses must be protected against lightning and possess good grounding wires. Work rooms and warehouses used to tune/debug (*tiaoshi*) and store mine sections and other explosives must use explosion-proof electrical devices, and floors should be covered with asphalt or conductive rubber sheeting.

Third, transportation requirements are the same. After the munitions are packed into containers (*zhuangxiang*) as required, they can be transported by road, rail, waterway, or air or any combination of the above. Munitions that lack protection devices (*baohu zhuangzhi*) or have not been fixed securely in place are prohibited from being transported. Mines (*zhanlei*) shall not be transported by rail or air. When transported by truck, they should be placed in a packing container (*baozhangxiang*) and fixed firmly in place. Munitions placed in containers can be stacked up in the vehicle, but no higher than two levels. The transport vehicle should be equipped with a rain tarp. The transport vehicle cannot exceed 15km/hr on class-three (*sanji*) roads, 25 km/hr on class-two roads, 50 km/hr on class-one roads, and 70 km/hr on highways. When torpedoes packed in containers are transported, their tails must face the front of the vehicle and their heads must face the rear of the vehicle. When the vehicle is moving in reverse, speed should be kept as slow as possible. The speed of the vehicle must be kept slow and steady (*pinghuan*) throughout the whole transport process. Rapid acceleration and deceleration should be avoided, with no sudden braking.

Fourth, the loading and unloading process is the same. Torpedoes and sea mines are similar in volume and weight. Operators can quickly master the loading and unloading of both types of munitions. When the munitions are hoisted, protective ropes should be tied to both their heads and tails, and two specialists should be responsible for keeping the munitions in a level state in order to prevent the munitions from slipping off or colliding with other objects. After the munitions are transported to an airport or ship dock, they should be hoisted with a special mine vehicle (*leiche*) or mine frame (*leijia*) and fixed [in place].

### **3 Important and Difficult Aspects of Combined Support for Torpedoes and Sea Mines**

#### **1) Diversifying the Munitions to Be Supported Increases the Difficulty of Coordination**

Modern naval warfare brings together the forces of multiple services and service arms (*bingzhong*) for joint operations. Naval combat platforms require supplies of ordnance of different models, quantities, and shapes, and the distribution of support platforms and docks is uneven. Thus, organizing and coordinating support is very difficult.

An important reason why the Japanese military lost the Battle of Midway was that torpedoes were replaced with bombs and bombs were then replaced with torpedoes and the switching out of the two types of munitions wasted lots of time. After [aircraft] were re-armed with bombs there was a series of explosions that directly led to a shift in the situation on the battlefield.

As a result, moving from single-type munitions support to combined support involving two types of munitions presents new challenges for planning and coordination of munitions technical support. How to methodically organize technical preparations for torpedoes and sea mines requires re-planning with respect to the setup of technical support areas (*zhendi shezhi*), technical preparation processes, and the division of labor among personnel, in order to ensure that the

combined lines [of support] do not interfere with each other. In wartime, personnel and support lines can be rapidly adjusted according to the needs of the battlefield, enabling the successful completion of support tasks for each type of munition.

## 2) Tasks are Multiplied Due to the Heavy Consumption of Munitions on the Battlefield

Conducting high intensity precision strikes on regional battlefields (*jubu zhanchang*) under informatized conditions has sharply increased attrition to and the consumption of munitions. It has also placed extremely high requirements for emergency support teams to carry out ample and precise emergency munitions supply. Consolidated support will result in a twofold increase in tasks in a short period of time, and emergency support teams will be extremely burdened by support tasks.

## 3) Support Forces are More Exposed Due to Difficulties in Concealment and Camouflage

The emergency deployment, loading and unloading, and transportation of large quantities of munitions make obvious targets. [Such activities] require tight secrecy, are difficult to maneuver, and are very hard to conceal and disguise. With the large-scale use of reconnaissance satellites, unmanned aerial vehicles, and maritime remotely-operated combat platforms with high detection accuracy, fast information transmission, large communication capacity, and high performance in jamming resistance and secrecy, naval battlefield transparency has vastly increased. Munitions technical support areas and supply chains will become important nodes for adversary and friendly strikes early on. Once hostilities are initiated, this will inevitably cause great difficulties for the survival and protection of technical support areas and emergency support teams, making it difficult to effectively organize and implement consolidated support operations.

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# 4 Exploring the Practice of Consolidating Support for Two Types of Munitions

## 1) Optimize the Organizational System and Strengthen Talent Building in the Ranks

An organization's functions are determined by its organizational system. A reasonable organizational system is the prerequisite for the effective and orderly implementation of emergency mobile combat support, and it is also an important factor for consolidated support to maximize the sustainment of combat effectiveness.

First, the backbone forces [performing] grass-roots work (*jiceng yewu gudan lilian*) should be enriched to ensure key technical backbone personnel are in good order. Based on the existing structure, personnel should be grouped flexibly according to various support requirements and the previous two exclusively torpedo and [mine]-focused support forces<sup>3</sup> should expand into a comprehensive support force for both munitions in order to satisfy the needs of consolidated munitions talent.

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<sup>3</sup> **Translator's note:** Likely error in the original text left out the word "mine."

Second, we should carry out “three-span” (*san kua*<sup>4</sup>) learning and rotational training to stockpile technical talent that are “specialized in one skill while being good at many others.” They can regularly go to scientific research institutes, manufacturers, and maintenance support units to train under personnel there (*genxun zhuxun*) to ensure that personnel master the technical support capabilities for both torpedoes and sea mines.

Third, we should explore approaches in military-civilian integrated support. While [support forces] complete normal service support tasks, civilian forces can be regularly organized to conduct break-in training (*mohe xunlian*) and implement combined support. Drawing on the platforms used in civilian automated assembly lines, we should modernize and transform [support] areas and improve the efficiency of support to meet the high demand for munitions in wartime.

## 2) Improve Training Mechanisms and Strengthen Support Capabilities and Efficiency Training (*nengxiao xunlian*)

The performance of consolidated support capability and efficiency depends on whether the established training mechanisms are efficient and flexible, whether training methods are scientific and rational, and whether training content is close to actual combat. The key is to improve the rapid response capabilities of support teams.

First, it is necessary to make full use of information technology and methods to organize consolidated support training in line with the new outline on transforming military training. Training modes should shift from traditional models of organizing training for supporting a single-type of munition to the integrated training model of training for consolidated support of multiple types of munitions.

Second, we should strengthen basic service training and improve individuals’ professional knowledge and service operational skills for the two kinds of munitions. We should strengthen training in rapid decision-making; set up complex subjects according to the munitions support plan; conduct training at [support] areas, docks, in the field, and on mobile platforms; and focus on improving the organization and command capabilities of commanders, service cadres, and emergency team commanders.

Third, we should strengthen rapid maneuver support training and improve the adaptive training in key steps such as personnel selection, combining personnel and equipment, establishing [support] areas, and the loading and unloading of munitions.

## 3) Improve Support Methods and Establish Comprehensive Support Areas

Outdated facilities and equipment, backward support methods, and especially the lack of support methods are important factors restricting the improvement of support capabilities. Measures

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<sup>4</sup> **Translator’s note:** 三跨 normally refers to the most difficult scenario for graduate level examinations whereby a candidate is applying for a program not only at another school and region, but also entails a significant interdisciplinary change from their previous major.

should be taken as soon as possible to increase investment in infrastructure construction and improve the current methods of support.

First, we should establish modular comprehensive technical support areas (*mokuaihua zonghe jishu baozhang zhendi*). We should partition and transform existing [support] areas to be more flexible and mobile, and their functions can be changed according to requirements on the battlefield to rapidly conduct support for various types of munitions.

Second, we should improve the management of munitions. Tents, field shelters, and position platforms with advanced functions in waterproofing and resistance to moisture, heat, and radiation should be allocated. Rapid information collection and identification systems for munitions should be established as soon as possible, and we should establish visualized smart management systems to bring about intelligent integrated munitions quality status monitoring, diagnosis, and maintenance.

Third, we should establish a forward support system. To shorten support time in future wars, especially long-distance oceanic operations, and achieve the effect of exchanging space for time, we should establish, in accordance with certain standards, a forward munitions support system that is rationally distributed, comprehensively outfitted (*zonghe peitao*), and appropriately scaled. This can enhance the flexibility and timeliness of supply support. We should establish a forward support approach, equipped with high-power field shelters and loading and unloading equipment [capable of operating in] all-terrains, all-sea states, and all-weather. [These] can enhance mobility and concealment, improve the survivability of support forces, and improve the ability of forward support operations.

## **5 Conclusion**

Consolidated support must adapt to the requirements of future naval warfare. Warfare concepts determine development directions and operational deployments. With the continuous advancement of technology, developed Western countries—represented by the U.S. military—have actively adapted to the operational requirements of informatization and have comprehensively transformed their naval strategies. Under the premise of implementing global strategic deployment, they have accelerated the construction of rear support (*houzhuang baozhang*) capabilities and successively put forward a number of new theories and concepts, which will be reformed and implemented in actual combat. Going forward, we can further study consolidated support in the following aspects: First, we should part ways with the concept of traditional fixed positions to implement support and emphasize the reliance on forward mobility to improve efficiency in munitions emergency support. Second, ordnance support should implement integrated joint training and use the ideas of large-scale systems to guide training. We should seek the efficient synthesis of various elements in the system, such as various kinds of expert personnel, support units at various levels, and various support equipment. Third, we should achieve precision support conducted in advance based on the requirements of maritime combat platforms, emphasizing the major role of information in enhancing combat support.

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# 翻羽译

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TRANSLATIONS



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