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Analysis on U.S. Sealift Innovation Pioneer: Chester Nimitz

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Abstract

Sealift is not only the essential maritime tactics and techniques for modern navy, but also an important indicator to measure the naval combat capability. In the transformation of modern maritime refueling technology, Nimitz played a greatly important role. Nimitz was more than a famous militarist and strategists. In fact, he was a pioneer in promoting the innovation of marine fuel supply with excellent command capacity and mastery of technology. In 1917, Nimitz originated the riding-abeam fueling method suitable for small warships. During the early period of World War II, he reformed and developed broadside fueling suitable for aircraft carriers and other large warships, which were a leap development with historical significance. The technology of broadside fueling has successfully withstood the test of actual combat in World War II, and proved to be the important guarantee for the United States to win the Pacific war.

Key words: Nimitz; Riding-abeam refueling at sea; Broadside refueling; Aircraft carrier refueling; Sealift

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INTRODUCTION

At the mention of Nimitz, what more often appears in our mind is his impressive record in terms of carrier-based combat, but his contribution on the development of sealift has been almost unknown without much historical account. In fact, this Sea Knight is also the pioneer to promote the innovation of maritime fueling technology. According to Mahan (1911, p.212),

> Fuel stands first in importance of the resources of the fleet. Without ammunition, a ship may run away, hoping to fight another day but without fuel she can neither run, nor reach her station, nor remain on it, if remote, nor fight,

which vividly indicates the importance of replenishment at sea for the ocean fleet and its victory in naval warfare.

On December 31, 1941, Nimitz was entrusted with the mission at the critical moment, and turned the tide in the Battle of Midway, defeating the aggressive Japanese army. Up to now, although a great deal has been written about the intervening carrier raids and the Battle of Midway, the sealift of the American navy has been frequently overlooked. There was no doubt that the U.S. deciphering the Japanese telegraph and obtaining the intelligence about the attempts of the Japanese attack had helped the U.S. military prepare for the hostilities. However, compared with Japanese Navy, the U.S. Navy had better refueling technology and more sophisticated logistics, which helped to win the "precious five minutes" for the U.S. aircraft carriers and air force to fight against Japan (Meads, 2004). What contributed to the remarkable performance of U.S. military was not only the fact that the Air Force fought bravely at war, but the perfect replenishment system at sea, thanks to the "broadside refueling" technique innovated by Nimitz.

1. SEALIFT AROUND THE 20TH CENTYRY

The U.S. Navy had tasted the bitterness of the failure of underway replenishment in the Spanish-American War in 1898. Although the U.S. military had a coaling ship fighting side by side with the fleet, due to lack of experience, the U.S. military was at wit's end about coaling at sea when sea conditions were poor. In the naval operation of blockading San Diego, in order to secure a solid base near Santiago for coaling supply and provide maintenance support for the advance of the naval fleet, the U.S. military had dispatched 650 marines fighting for seven days, and finally landed successfully at Guantanamo on June 10 (Potter, 1981). From then on, the U.S. Navy determined to develop the first replenishment system.

As an old saying for military commanders says, "rations and forage go before troops and horses", it goes without saying that the sealift is of vital importance in sea warfare and naval operations. And the modern methods and facilities of sealift only appeared at the end 19th and early 20th century. In 1899, the American engineer Spencer Miller firstly employed the ropeway method, setting a precedent for vertical navigation replenishment (coal) at sea. With the advent of the internal combustion engine, warships began to use oil fuel, and the vertical marine refueling system was developed (Nimitz, 1961). Before the practice of "horizontal refueling", the UK had successfully implemented the longitudinal refueling. In 1906, the British tanker "Peter Lou" conducted a longitudinal refueling test successfully to the battleship "Victor Rees". When vertical navigation refueling was conducted, the refueling ship was in front, and the receiving vessel was right after it, sailing at the same course and speed in columns formation, with vertical space of 80 to 100 feet. The greatest advantage of vertical navigation refueling was simple equipments, easy operation and low cost, and therefore it was easy to implement. But it was applicable only to small or medium vessels. At the same time, another naval refueling prevailing method is "anchorage refueling", which was conducted only at the resting state in protected waters with special fueling gear and the vessels moored together.

Once Mahan's "Sea Power" was put forth, it gained world-wide popularity, promoted debates and also stimulated worldwide naval expansion frenzy as the "catalyst" of promoting the development of marine industry in many countries. Thus, different countries made warships for their navies with increasing ship armor and artillery caliber, as the efficient weapons to capture "sea power". Meanwhile, a lot of destroyers, frigates, cruisers had limited oil capacity and short range; only through sealift could they complete the combat mission. This became a great burden for the navies in various countries which had been afflicted by the lack of oil tankers in their fleet, just as Mahan (1894) indicated, while the scope of the Navy's operations has expanded, and the speed of the vessels was impressive, yet still fuel and supplies were badly needed.

With the rapid development of science and technology, new inventions and creations emerged in endlessly, among which internal combustion engine and electric motor became a landmark. They not only promoted the researches and advent of new technologies, but also caused a revolution in military equipment, especially the invention of the internal combustion engine, which brought about great improvements for the Navy and flourishing development of surface vessels. "Lager fleet with more ammunition" had become the goal for every nation (Chen, 1995). Warships supported by internal combustion engine and thermal weapons needed undoubtedly enormous fuel, and the operations at sea consumed large amounts of ammunition. Besides, with the expansion of the operation range of the fleet and extension of the operation time, the living consumption of the seamen also increased drastically. Warships designed within a specified tonnage, could not achieve the fastest speed, the strongest firepower, the thickest armor, as well as the farthest endurance at the same time. And it was really difficult to take every aspect into account. Considering various new demands, it was far from enough to meet the needs with only the fuel and supplies carried by the warships, and additional sealift could extend both the combat radius and combat capability of the warships. Therefore, some countries began the test for the fleet replenishment with logistical vessels to ensure the long-term fleet activities and ongoing operations at sea. In this case, replenishment at sea came into being, and was increasingly favored by the world's naval power.

2. NIMITZ AND THE DEVELOPMENT OF SEALIFT

2.1 Riding-Abeam Refueling

Nimitz first became acquainted with fueling at sea while serving abroad the USS "Maumee". On December 28, 1916, he was assigned as executive officer and chief engineer of this tanker, commanded to go to Gulf of Guacanayabo in Cuba to supply fuel and fresh water for the U.S. destroyers, battleships and cruisers (Potter, 1976). It was in this period that he designed a set of refueling technique with the assistance of G. B. Davis, Matt Higgins and Lieutenant F. M. Perkins, taking the responsibility for the implementation and operation of refueling at sea, and devised the "riding-abeam refueling" method.

After the outbreak of the First World War, German launched the "unrestricted submarine warfare" desperately, and the British merchant marines near the island of Ireland were strangled brazenly by the German submarines to a dangerous level, putting the United Kingdom almost on the verge of failure, and eventually the United States was drawn into the war, as the American merchant ships were implicated and suffered great loss. Thus, the U.S. began to aid the British fleet in danger, sending escort destroyers to protect against the German submarines.

On April 6, 1917, American declared war, the war to "make the world safe for democracy" (Morris, 1991, p.181). Nimitz joined the battle along with "Maumee".

During the overhaul of "Maumee", Nimitz, as the executive officer and chief engineer, carefully studied the set drawings of the destroyer deck, got a thorough understanding towards the fueling filling valves, chocks, bitts and towing rigs together with the officers aboard. They designed a refueling device including a fuel pump, buoy for heaving lines (wooden), a 10-inch towing hawser, two 6-inch breast lines, a fifty-foot lengths of 4-inch-diameter rubber fuel hose. The refueling hose was connected with the tanker "Maumee" on one end, with the other end into the fuel tank of the warship across the forecastle. The key point was to drag the destroyer with the two 6-inch-in-diameter towlines in order to prevent the rupture of the refueling hose between the two vessels. Meanwhile, in order to improve efficiency, a fuel pump was used to refuel the destroyer through two hoses (Nimitz, 1961).

In April 1917, "Maumee" was embattled. Although they had made the plan about refueling underway, yet due to the poor conditions of the Atlantic, the refueling could not be conducted as planned at the speed 10 knots. To ensure safety, the destroyer slowed down to 5 knots. When it came to 50 feet away from the oil tanker, the staff on "Maumee" heaved the fueling hose to the forecastle of the destroyer with a cable shot gun. The destroyer dragged a 10-inch Manila hose through its bridge, and got the hose fixed firmly with the wooden wedged pad. When everything was ready, the winch on the bow of "Maumee" pulled the oil hose into tight. At this moment, on the one hand the vessels needed to slow down and skilled captains were needed to keep the steady distance of 50 feet between the two vessels. On the other hand, the 10-inch hose between the two vessels needed to be kept away from great constant tension. Despite the bad weather, "Maumee" fulfilled the supplement successfully and refueled the destroyers totally about twenty thousand gallons (one gallon is approximately 3.785 liters) of fuel (at the rate of 32,000 gallons per hour) (Wildenberg, 1993). In spite of the fact that all the crews were "green hands" and poor sea conditions, the time from approach to disconnect averaged just 75 minutes—such an extraordinary feat.

Implemented from World War I, the riding-abeam refueling required the tanker and receiving vessel to sail in row formation, and to keep the same speed and direction (lateral spacing of 50 feet at the speed of 5 knots). In operation, the tanker first cast the heaving line with the cable shot gun, and set up a saddle as the hose carrier with the heaving line and the towing lines to keep the hose clear of the sea. Then, the fuel hose was put on the saddle through the conveying device on the oil tanker. After the hose was connected to the fuel bunker to be filled, the fuel could be transferred underway. Yet the process of the replenishment at sea was easily influenced by the sea conditions. And the saddle together with the fuel hose between the two vessels was vulnerable to great constant tension. To prevent the rupture of the saddle and the fuel hose into the water, a rig for constant tension control was devised, which increased the complexity of the riding-abeam refueling. In addition, this method was not applicable under any sea conditions. Considering the low flow rate, low degree of automation, high labor intensity, and operation difficulty in the rough sea of the first generation of underway riding-abeam refueling, it was not suitable for transoceanic navigation and the wartime sealift of the fleet.

2.2 Broadside Refueling

After World War I, the Navies in Europe and many other countries conducted a number of tests and maneuvers for underway replenishment at sea, improving the underway riding-abeam fueling replenishment. However, even if the sealift technology and equipment were developed, it was still far from satisfaction in many respects, especially the attempt to refuel the large vessels in broadside refueling wound up with failure. During the middle 1920s, the Navy conducted a series of experiments with an alternative approach to fuel capital ships—known as the over-the-stern refueling method. Although some success was achieved, this approach proved of limited value due to the use of the single hose and thereby the small amount of fuel that could be transferred, not suitable for the development of the Navy.

In the early 1930s, with the spread of the U.S. economic crisis, the development of the Navy stepped into "ice age" and remained stagnant, due to the increasingly tight budgets. The Navy was operating under such austere budget constraints that funds even for routine repairs and maintenance were severely limited, not to mention any input to develop the technology of refueling at sea. Many Navy officials were quite indifferent, as the refueling experiment itself was a big risk full of hazard. Needless to say, no one wanted to be responsible for incurring damage to any ship that would involve additional repair costs, just as a senior officer told the American historian Samuel Eliot Morrison, "The pencil became sharper than the sword. Everyone tried to beat the target practice rules, and too many forgot there was war getting closer" (Miller, 1977, p.227).

However, with different countries' Navy expansion towards the ocean, the shortcoming of the short range of the fleet was totally exposed. Thus, the technology of the offshore refueling gained attention once again and got "rebirth". The problem of the huge fuel consumption not only attracted great attention from the officials of the Naval War Plans Bureau, but also became an urgent difficulty to overcome immediately, especially when the carrier fleet went to perform missions far from home base. In 1935, the United States held a military exercise of its special Task Force Fleet ⅩⅤ. Although the exercise lasted only for five days, yet with the participation of the aircraft carrier USS

"Lexington", the amounts of the daily fuel consumption were so staggering that the replenishment at sea became particularly conspicuous and important (Friedman, 1981). In 1936, the U.S. Navy Department led the maneuver of Task Force Fleet XVI from the West Coast to Midway Island, and the issue of fuel shortage once again was exposed. The aircraft carrier "Saratoga" consumed an average amount of about one-tenth of her total capacity in a single day, especially when operating aircraft. Flight operations became the main reason of high fuel consumption. No matter for increasing lift force while launching the aircrafts, or for decreasing the landing speed while recovering the aircrafts, the carrier had to steam at relatively high speed into the wind. As a result, she had to maintain the high speed of 25 knots to ensure safe, smooth take-off or landing of the carrier-based aircrafts, which would inevitably consume enormous amount of fuel. The fuel consumed by the "Saratoga" exceeded 30 tons per hour. At this rate, her steaming radius was only shortened to 4,421 nautical miles, much less than half of the original ten thousand (at the speed of 10 knots) specified by her designers. As a stopgap, the Commission had proposed to increase the capacity of the tank of the carriers. But this proposal worked only as a temporary solution. At the same time, the idea of refueling the carriers at sea was put forward in a big way. Some suggested refueling the battleships and aircraft carriers in lateral navigation, but due to the great risks of riding-abeam refueling to large vessels, many officials were skeptical about this method and couldn't afford to run the risks, which resulted in the stagnancy of the refueling technology.

In the autumn of 1938, the situation in Europe was becoming more intense, and the war was about to come. At this point, there was still not any breakthrough on the underway refueling technique which the Navy concerned. Some naval officers not only showed too much worry which had prevented them from innovation in their refueling experiments, but also lacked the experiences to refuel battleships, aircraft carriers and heavy cruisers. Under this situation, in October Admiral William D. Leahy, the Chief of Naval Operations, issued a memorandum to the commander in chief of the U.S. Fleet, requiring that the whole Navy undertake all steps necessary to develop means for fueling battleships, carriers, and cruisers from tankers while underway. On October 27, Admiral Claude C. Bloch, Commander in Chief of the U.S. fleet responded quickly to Leahy's memo. He instructed the commanders of the Battle Force and the Scouting Force to submit plans and take all measures required to develop the underway refueling technique for various types of the vessels as battleships, carriers, and cruisers. Admiral Bloch assigned Rear Admiral Nimitz to be responsible for conducting the tests, considering the achievements he had made on the riding-abeam refueling technique, as Nimitz was the only flag officer then in the Navy who had participated in the design and operation of fueling at sea. In two weeks, Nimitz prepared a detailed report on the technology of refueling large vessels at sea, with references to no less than 16 documents.

With great foresight and sagacity, Nimitz put forward decisively that broadside method for fueling at sea instead of over-the-stern method was to be tried with, as he pointed out, "the fueling experiments…be limited to the fueling of a heavy cruiser at sea under favorable conditions by the 'Broadside' (or some approximation thereto) method" (Wildenberg, 1993, p.57). Given the great risk of collision while refueling underway, Nimitz recommended to conduct the station-keeping tests among large destroyers to ensure security. From 1938 to the early 1939, Nimitz conducted extensive station-keeping tests between "Chester" and "Mugford", and then he tested the broadside fueling method between the oiler "Brazos" (AO 4) and either the heavy cruiser "Chester" or "Vincennes". The ease with which the tests were accomplished not only paved the way for the fueling exercises that were subsequently scheduled between the oiler "Kanawha" (AO 1) and the aircraft carrier "Saratoga", but also accumulated some experiences about underway refueling to large battleship.

In order to reduce the error rate of broadside refueling and increase the flexibility, Nimitz assigned the crew of the two oilers to get familiar with the procedures and conducts of refueling and spend one day in practicing without actual attempt of refueling operation. With careful preparation, attentive organization and thoughtful arrangement, Nimitz made a detailed operation plan and security preparedness to ensure successful refueling along with the relevant personnel. First, the two boats steamed in company at seven knots in the same direction. Then oiler "Kanawha" conveyed the towing hawser, two fueling hoses and the breast line to the carrier with the cable shot gun, and the fueling to "Saratoga" commenced and continued for several hours without interruption. During the operation, they at least made one change of their navigation route. With the careful coordination and tacit cooperation of the crew on "Kanawha", the refueling and food supply was accomplished at the same time. The refueling operation on the aircraft carrier "Saratoga" demonstrated conclusively the practicality of the broadside refueling underway. Before long, the broadside method used to fuel "Saratoga" was quickly generalized to the fueling of the other large vessels.

With the increase of the oilers to the Pacific Fleet, added logistic support was required to maintain the fleet; together with the unaccustomed base and hydrological environment at the Pearl Harbor, all these factors continued to strain the Navy's refueling capacity. In April 1940, the Pacific Fleet at Pearl Harbor organized an unprecedented maneuver on aircraft carriers refueling at sea. Through this maneuver, U.S. Navy improved its refueling equipment and refined the broadside refueling method at sea, which opened the door for the wide-ranging carrier raids later conducted in the war.

Broadside refueling involved the oiler steaming to the specified channel to be side by side with the receiving vessel, the constant route and speed of the two vessels, the consistent spacing of the two vessels about 40-80 feet, and the auxiliary facilities as the breast line, the fueling hoses, the towing hawsers, and the handling line. "With accumulated experience and with more reliable and sensitive speed and rudder controller and skilled seamen on both ships, the tanker is put on the desired course, the ship to be fueled comes to the designated side, and both ships steam at the same speed with the fuel lines connecting them" (Nimitz, 1961, p.29). Gradually,

> with a lot of practice and a steady hand on the wheel of both ships, oiler and customer ,they did not have to be tethered by stout mooring lines but could steam safely at a separation of about fifty feet, with the only connection between them being the fueling hose and a telephone line. (Harris, 2012, p.58).

Without the towline, one vessel could keep position on the other by adjusting her engine speed and using "seaman's eye" to correct for small deviation in course so that the two vessels could be maintained on the same course and speed, which required superb seamanship.

The innovation of the refueling technology at sea adapted to the needs of the booming development of the Navy, and more importantly, promoted the improvement and upgrading of the refueling ship. For a long time, oilers were converted from merchant ships or oil tankers, and backwardness of the refueling equipment prohibited the development of the refueling technique. Not until 1920, the new refueling ship "Tippecanoe" and "Neches" launched the service. The emergence of new refueling ships had helped with the improvement and development of refueling technology. But these refueling oilers were designed only for small vessels, and were not applicable to large vessels. At that time large refueling oilers were quite rare. Although the Navy had begun to access new oilers of the fast "Cimarron" class, due to budgetary constraints, the number of such tankers that could be procured was very limited and it was difficult to meet the needs of the development of the Navy. Until the late spring of 1940, after the enactment of the "Two Ocean Navy" bill, five more of these tankers were acquired from the Maritime Commission and quickly added to the U.S. fleet. The need for oilers was so great at that time that their fitting-out was given first priority, over construction of new warships. To meet the urgent needs, before the end of 1940, four of the five tankers obtained from the Maritime Commission were converted for naval use and commissioned as fleet auxiliaries. By the early 1941, seven "fast Cimarron-class" oilers had been commissioned—the "Cimarron" (AO 22), "Neosho", (AO 23), "Platt" (AO 24), "Sabine" (AO 25), "Kaskaskia" (AO 27), "Sangamon" (AO 28), "Santee" (AO 29), as well as "Salamonie" (AO 26) undergoing conversion (Wildenberg, 1993, p.58).

3. THE USE OF UNDERWAY REFUELING SUPPLIES DURING THE WAR

As the breakout of World War II, both the amounts of the battleships at war and the ranges of their activities increased, which brought about a significantly increasing need for replenishment at sea. Successful combat operations couldn't be achieved without reliable logistics. In the Pacific theater, the broadside refueling initiated by Nimitz was tested and perfected in a large number of naval battle practices.

The fleet of the aircraft carrier task forces was an offshore floating air base, blazing a trial to fight against Japan across the Pacific. Meanwhile, the Marines Corps and the air force also needed mobile maritime supply. To ensure carrier task forces to go into battle immediately, not only supply ships, repair ships, and floating docks, but also refueling oilers were needed to go together with the carriers.

Under different operational environments, the combat replenishment at sea of the U.S. Navy aircraft carrier fleet was also developed, with three modes of supply—the accompanying supply, the relay supply and the advancing base supply. Replenishment tankers generally awaited the command in designated waters. When refueling was needed, the fleet of task forces navigated to the edge of the war zone in confluence with the replenishment tanker. Once they were within the operational distance, fuel, ammunition, food, fresh water, and all kinds of equipment were transferred immediately to the carrier from the replenishment ship. And then the carrier group would return to the operational area to relieve another group (Nimitz & Potter, 1960). In this way, the oilers fighting side by side with the aircraft carriers guaranteed long-term engagement with the enemy at sea of the entire fleet to capture every opportunity for combats. Before the battle of Coral Island, in order to ensure continued operations, Nimitz instructed Fletcher to spend five days replenishing troops, supplies and fuel, to guarantee enough fuel for consumption, which was of great importance and value for carrier operations (Potter, 1981).

In October 1943, to support the operations across the vast distances of the central Pacific, Nimitz ordered two service squadrons of the mobile forces to the Pacific, and deployed 13 "Cimarron-class" oilers to maintain the endurance of cruising and operations at sea to support the engagement with the enemy, with every oiler carrying 80,000 barrels of fuel oil, 18,000 barrels of aviation gasoline and 6,800 barrels of diesel fuel (Weigley, 1976, p.284). As a result, the U.S. Pacific Fleet stepped into the era of replenishment at sea without depending upon land bases ever since the evolution from the sailing boats to the armored steamboat.

4. COMMENTARY ON THE DEVELOPMENT OF OFFSHORE REFUELING BY NIMITZ

In fact, Nimitz was not only a talented commander but also an excellent engineer with professional techniques, and his early military practice—especially his contribution to the reform of marine supplies and logistical support should not be ignored, as it laid a solid professional foundation for his future as a great strategist. Since sealift, as an important aspect for maritime logistics, guarantees the fighting capacity and survivability of the Navy, its role and status can never be underestimated.

As the most important logistical support of the Navy, the underway replenishment at sea can consolidate and improve the lifeline of maritime combat. Meanwhile, the underway refueling technology is also an important indicator to measure the ability of naval combat. The broadside refueling method initiated by Nimitz is the development by leaps and bounds, with the epoch-making significance. With westward advance of the battlefront by the U.S., due to the backwardness of the replenishment at sea, after each battle the entire fleet had to return to the land base for supply and rest, which not only widened the interval of the battle, but also provided time for the Japanese to rest, replenish and strengthen their defense. With the reform of the supply, the frequency, the duration and the intensity of the campaigns also increased significantly, leaving the Japanese troops no time to rest, replenish or strengthen their maritime defense. Plus the continual air strikes and bombardments of the U.S. forces, the Japanese were too overwhelmed to parry, as was shown in the battle of Midway. On June 7, 1942, in the Battle of Midway, a large number of oilers accompanied the U.S. Task Force ⅩⅥ and ⅩⅦ through tough waves, supplying constantly for the combat aircraft carriers and the entire fleet. This practice not only increased the combat radius of the Pacific Fleet, but also ensured long-term engagement of carriers near the northwest of the Midway. The U.S. defeated the Japanese with a force inferior in number and strength and won amazing victory.

Firstly, from the technical perspective, the design of the warship, on the one hand has to meet the demand of the highest speed, maximum combat radius, and on the other hand has to meet the requirement to take the combat substances to the utmost. But it's difficult to attain the two goals at the same time. The warship can either reduce the supplies it carries so as to strengthen its armament and increase its speed, or increase the carrying supplies at the cost of reducing its armament and decreasing its speed. Only one goal can be achieved at one time. This is the contradiction between the ship's carrying capacity and its navigation performance. Yet refueling at sea is an important means to resolve this contradiction. Only through underway refueling at sea can the combat radius be increased, the weapons load be improved, and the time of operations be extended. The broadside refueling designed by Nimitz simplifies the connection process between the oiler and warship, saves a lot of time, reduces the labor intensity of the crew, and shortens the refueling time so as to improve the efficiency of maritime refueling. Besides, the oilers can refuel more warships at one time so as to shorten the time that the entire fleet spends on offshore operations. Thus, the cruising ability and the combat capability of the warships can be further enhanced and the probability of suffering from attacks from enemy submarines can be decreased.

Secondly, the creation of the broadside refueling has enriched the combat tactics of the Navy. With adequate fuel supply, the naval fleet is freer to advance or retreat, which not only facilitates the implementation of tactics, but also ensures the safety of the fleet. Especially the reform on refueling technique, it solves the problem of enormous fuel consumption of the aircraft carriers and enables the carriers to participate in fast attacks, which have brought significant impact on the mode of operation of modern navy.

Finally, the broadside refueling technique has enhanced the strength of the U.S. Navy objectively, which played an important part for the U.S. Navy to win the Pacific War. Shortly after the experiments, the broadside refueling was applied in the actual combat, and withstood the test of practice. Broadside refueling technique has optimized the logistical support of the U.S. Navy. With adequate fuel supplies, the U.S. fleet could gallop flexibly in the vast Pacific theater and ultimately achieved one of the greatest battlefield reversals.

The Pacific theater of World War II has become the main practicing stage for the large-scale applications of replenishment at sea. With the great efforts of all the staff of Pacific logistical troops, the broadside refueling technique initiated by Nimitz has been perfected gradually and come to meet the needs of the Pacific naval warfare, and it has improved the combat capability of the U.S. Navy and laid a solid foundation for destroying the militaristic Japanese.

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