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The Logistics Considerations of the Landing Ship Tank and its Evolution as an Auxiliary Repair Ship in World War II

Joel H. Berry III
University of New Orleans, jhberry@uno.edu

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Joel H. Berry III

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Nomenclature and Abbreviations

Auxiliary—A category of support ships in the US Navy that functioned in roles such as repair or replenishment.
Beach Gradient—A measurement of the rate of decrease in water depth as an amphibious ship or craft approaches a beach. A steep gradient allows a ship to remain buoyant up to (or nearly to) the shoreline, while a shallow gradient causes a vessel to ground further from the shore. Gradient is usually expressed as a ratio, such as 1:50 (depth decreases one foot for every fifty feet of approach).
Broach—When a ship or landing craft turns sideways, or perpendicular, to the surf near a beach. When broached, a vessel is dangerously exposed to both waves and the bottom upon which it is usually grounded. Broached vessels can sink or sustain major damage to propellers and rudders.
Causeway or Pontoon—A buoyant, rectangular-shaped extension connected to the bow of a grounded LST, allowing vehicles to drive over (rather than through) short spans of water separating the ship from the beach. These fixtures came in various sizes and shapes and included other names such as barges and rhino ferries.
COMINCH—Commander-in-Chief, US Fleet. The most senior admiral in the US Navy during World War II. COMINCH was a dual position, combining the roles of Chief of Naval Operations (CNO) and Commander of all US Navy Fleets. Admiral Earnest King served as COMINCH.
Davit—A small crane affixed to a ship, usually of two arms, used to stow, lower, and raise small boats. On many ships, davits house lifeboats. Davits on LSTs housed small landing craft.
Liberty Ship—A US cargo ship in the Merchant Marine noted for its simplicity, low cost, and rapid construction.
Lighter—A general term to describe a small craft or barge used to offload a ship. Ships to be offloaded would typically be anchored near a port, but not alongside a pier.
Milk Run—A routine, repetitive resupply operation, often delivering the same material to the same place.
Pintle—A steel post, usually rounded, connecting an LST to a causeway. Normally, a pintle on the causeway connected through a hole in the ship's bow ramp, allowing for a moderate degree of movement in shoreline waves.
Shakedown Cruise—A short, administrative deployment concentrating on testing equipment, validating the effectiveness of repairs, and training.
Ship's Log—The written journal of a ship, serving as the official chronological record of location, course, speed, significant events, and which sailors were on watch at any particular time (e.g., officer of the deck).
War Production Board—The US government agency responsible for supervising wartime construction. The Board oversaw the conversion of civilian industry to support military requirements, managed resource allocation, established priorities, and directed distribution.
Wardroom—A collective term for the officers who are assigned to a particular Navy ship. The wardroom is also a physical space in a ship — the officers' dining room.

Abstract

This study reveals how the US Navy's Landing Ship Tank (LST) of World War II functioned in logistics support roles from the outset of its wartime participation and to a greater degree than many military planners ever envisioned. The ship's simple design proved so versatile that, within one year of the first LST, the Navy began converting dozens of the ships to Landing Craft Repair Ships (ARL) and other auxiliary classes supporting myriad naval logistics tasks. Both the standard LST and the ARL made significant logistics contributions to ship to shore operations in addition to amphibious assaults.

Keywords: Landing Ship Tank; Landing Craft Repair Ship; Naval Logistics, World War II

Introduction

The amphibious operation was a critical component of United States and Allied strategy in World War II. Major campaigns in both Europe and the Pacific — Sicily, Italy, Normandy, the Marianas, Leyte, and Okinawa to name a few — required large-scale landings from the sea to face Italian, German, or Japanese defenders. Some landings met with fierce enemy resistance on the beaches while others were virtually unopposed. Whatever the opposition, amphibious operations required thousands of amphibious vessels, from small landing craft to amphibious transports. By the end of 1944, the Navy possessed some 70,000 amphibious ships and landing craft of all varieties.[1] Small landing craft accounted for most of the inventory and came in fourteen shallow-draft and self-propelled hull styles. Improvements, modifications, and changes to functional uses resulted in a larger number of landing craft identifications.[2]

One of the most valuable amphibious ships was the Landing Ship Tank (LST). Between 1942 and 1945, the US Navy ordered 1,051 of these revolutionary and versatile ships, though it reduced the LST inventory by transferring 115 ships to Great Britain in Lend-Lease and converting 133 others to various auxiliary classes.[3] Recently, naval scholar Arthur Donovan referred to the World War II naval construction program as the "…greatest… in American history."[4] Amphibious vessels competed with escorts, Liberty ships, submarines, and other warships for a national shipbuilding priority. Amphibious construction (landing craft and the

1. James. C. Fahey, *The Ships and Aircraft of the US Fleet: Victory Edition* (1945; repr., Annapolis, MD: Naval Institute Press, 1994), 78.

2. George E. Mowry, *Landing Craft and the War Production Board, April 1942 to May 1944* (Washington, DC: War Production Board, 1944), 1-6, 28.

3. Gordon L. Rottman, *Landing Ship, Tank 1942-2002*. (Oxford, UK: Osprey Publishing, 2005), 177, 187, Kindle.

4. Frederic C. Lane, *Ships for Victory: A History of Shipbuilding Under the US Maritime Commission in World War II* (1951; repr., Baltimore: Johns Hopkins University Press, 2001), xi-xvi. Donovan, professor emeritus at the US Merchant Marine Academy, offers his comments in the preface to the 2001 edition.

LST in particular) received special attention equal with more glamorous warship cousins.[5] For instance, in 1942, the US War Production Board (WPB) listed the LST as the top shipbuilding priority. This advantage was short-lived, however, as the WPB soon displaced the LST in favor of escort ships after realizing a cross-channel invasion would not come to pass in 1943. The Battle of the Atlantic and the persistent U-boat threat justified the elevated priority of escorts and other ships over the LST. By mid-1943, the LST reclaimed a higher station in the shipbuilding queue after Allies gained momentum against the U-boats and serious invasion discussions resumed.[6]

The World War II LST is no stranger to research and scholarship, and the legacy of the ship is quite secure. Plenty of secondary literature exists to summarize the LST story, including the compelling reasons for the design, how and where the LST was built, the ship's popularity, shortages, and allocation dynamics. The broad history of the LST and its impact on amphibious warfare have also been the subject of a number of studies, particularly at military war colleges.[7] Among professional scholars, naval historian Craig Symonds spotlights the LST with stand-alone chapters in two recent books.[8] Beyond background introduction, this study does not repeat the well-known LST backstory or praise the ship's important tactical contributions in amphibious landings, but rather will investigate the broad uses and functional versatility of the ship over the course of the war.

5. Craig L Symonds, *World War II at Sea: A Global History* (New York: Oxford University Press, 2018), 498, Kindle.

6. Ibid.

7. Brandon C. Montanye, "Analysis of the Landing Ship Tank (LST) and its influence on Amphibious Warfare during World War Two" (master's thesis, US Army Command and General Staff College, 2013). Lieutenant commander Montanye's thesis is an example of a general overview of the LST, including its origin, design characteristics, conversion statistics, and the ship's impact on amphibious doctrine.

8. Craig, L. Symonds, *Neptune: The Allied Invasion of Europe and the D-Day Landings* (New York: Oxford University Press, 2014), 146-171. LSTs are featured in chapter 7, entitled "Some God-Damned Things Called LSTs". Symond's other LST book-chapter appears in *World War II at Sea: A Global History.*

Throughout US participation in WWII, commanders did not hesitate to use the LST in myriad support functions extending well beyond its primary amphibious mission. Like amphibious ships in general, the LST existed for the primary purpose of landing combat and supporting vehicles in amphibious operations. But the WWII LST did much more than its primary mission. This research follows the evolution of the LST in its many logistics roles during the war, particularly noting the significant scope and duration of these new duties. To be sure, the US Navy and LST designers envisioned the potential for naval logistics tasks from the outset, but many unforeseen functions emerged on-the-fly. In some cases, commanders made immediate use of the LST in logistics roles, even before using the ship in amphibious assaults. This research recognizes that the LST was not the only amphibious vessel to contribute to naval logistics in WWII. For example, the Landing Ship Dock (LSD), with a floodable well deck, offered its own revolutionary capabilities to amphibious warfare. The LST was, however, so adaptable for such a broad range of assignments that it outpaced other ships by a wide margin.

In 1943, while the LST was in full production stateside and in short supply overseas, the US Navy found justification, after observing early amphibious operations, to convert some LSTs to separate classes of auxiliary support vessels. The LST-auxiliary decision was significant, as the Navy was willing to send already-built and available-to-deploy LSTs back to shipyards for conversion to ships of significantly different configurations and non-amphibious missions. While available statistical summaries provide the types and numbers of the conversions, other sources identify more details of the factors prompting the conversions, as well as the administrative structure guiding the process. The first conversion design, the Auxiliary Landing Craft Repair Ship (ARL), serves as a representative case indicating how other LST-auxiliaries functioned and evolved over the course of the war. The ARL description includes the timing of

the ship's arrival in forward areas, the details of how the ship integrated with the fleets it joined, and first-hand accounts of the repair services ARLs provided to landing craft and other vessels.

A review of LST and ARL training will also summarize the Navy's overall amphibious training program during WWII, which was a convoluted process involving all military services, multiple training bases along both US coasts, and forward-deployed locations under the control of theater commanders. The training discussion will make the distinction between formal training programs for individual sailors and collective training designed for entire ship crews. For both the LST in logistics roles and the ARL as an important auxiliary support ship, the training review will reveal that the crews of these ships more often developed skills and procedures from on-the-job experience than from formally-organized training programs.

Case examples — LSTs and ARLs —add theater-specific perspective to the logistics contributions and operational history of both ship types. Primary-source ships' logs, war diaries, operational summaries, and personal memoirs from ships officers and crew provide insight into how the crews of these ships trained and operated. Ship examples will not only reveal the expansive list of logistics duties performed by LSTs and ARLs, but will also call attention to techniques the crews refined over time in combat conditions.

Finally, a conclusion will reflect on the many logistics contributions by the LST and ARL, highlighting the US Navy's achievement in rapidly adapting to meet the sustainment requirements of combat operations.

Chapter 1—The Versatile LST as a Logistics Platform

Figure 1— LST-1 in 1942 (from Naval History and Heritage Command)

The LST did not join the US fleet in WWII with logistics as its main priority, although any amphibious ship bore some inherent responsibility for logistics support to landing forces ashore. The LST's principal mission, and the foremost inspiration for its unique design, was to land tanks and other heavy tracked and wheeled combat vehicles directly across beaches as part of an amphibious assault. By doing so, the LST revolutionized amphibious operations in its

ability to provide supporting arms to infantry units already ashore. Logistics, however, turned out to be a mission of nearly equal importance for the LST.

Beyond the basic operational consideration of whether an amphibious landing would be opposed or unopposed by the enemy, there were two general categories of amphibious landings in WWII: shore-to-shore and ship-to-shore. Shore-to-shore amphibious landings required access to ports of embarkation close enough to amphibious objectives that ships (and sometimes small landing craft) could travel directly between the two sites. The key feature of shore-to-shore operations was that they allowed for regular reinforcement and sustainment. OPERATION HUSKY, the invasion of Sicily, and OPERATION OVERLORD, the Normandy invasion, were two clear examples of shore-to-shore landings in WWII. Sicily relied on supply bases and ports in North Africa, while Normandy used bases in Britain to reach the French coast. Conversely, operations in the Pacific often featured geographically-isolated island objectives that could not depend on nearby land masses for support. These operations, therefore, were ship-to-shore landings, with the amphibious ships themselves serving as sustainment bases until they might be resupplied. Intuitively, troops landing in shore-to-shore landings could arrive carrying smaller sustainment load than others involved in ship-to-shore landings. Drawing on his wartime experience in Europe, a US Army officer evaluated four WWII amphibious operations in terms of logistics planning. He compared operational summaries of Saipan with Sicily — then Luzon with Normandy — concluding that the ship-to-shore operations, unable to rely on timely resupply (Saipan and Luzon), called for up to six times the initial supply load as the shore-to-shore operations (Sicily and Normandy).[9] All amphibious operations featured some component

9. Lyle W. Bernard, "Supply Build-up in Amphibious Operations," *Military Review* XXVIII, no.7 (October 1948): 49-56. Lieutenant colonel Bernard wrote this monograph while a student at the Army Command and General Staff College, class of 1946-47. Bernard was an infantry battalion commander in the 3rd Infantry Division in Europe during WWII.

of ship-to-shore operations. For example, the phase in any amphibious operation where small landing craft proceeded from ships offshore to beaches were always classified as ship-to-shore. Likewise, entire amphibious operations that were geographically removed from a nearby base of support — a large percentage of Pacific-theater amphibious landings occurred this way — relied on whatever sustainment the amphibious ships carried with them and were, hence, ship-to-shore operations. The distinction between shore-to-shore and ship-to-shore landings was important for the LST. In ship-to-shore operations, LSTs operated much in the same way as other amphibious ship types, delivering whatever sustainment they carried with them to forces ashore. Conversely, shore-to-shore operations called on LSTs, logistically, in a major way. In these operations, LSTs shuttled a significant tonnage of cargo and supplies from the nearby supply bases to the amphibious operating areas. For some operations, such shuttles numbered the dozens to hundreds. Moreover, LSTs returning to sustainment bases from amphibious areas never made those trips empty; they carried wounded troops, enemy prisoners of war, damaged equipment, or virtually anything else that might need to leave the combat zone.

In early 1943 in the Pacific, logistics lines of communication were daunting. Amphibious objectives — Japanese-held islands — were typically hundreds or thousands of miles apart. The Pacific theater did not enjoy the same advantage of geographically-proximate land masses as did its European counterpart. Unlike the maritime countries of Europe, the wide expanse of the Pacific Ocean called for the immediate use of logistics ships on a large scale. To prosecute a drive toward Japan, the use of unoccupied or captured islands as staging bases was the only practical solution. Cargo aircraft certainly played a role in transporting supplies and equipment between some islands, but these flights were limited in hauling capacity and range. The only realistic way to deliver large amounts of material over long distances was by ship. In a

manner of speaking, establishing island staging bases in the Pacific amounted to a series of administrative shore-to-shore operations. In individual amphibious operations against specific islands, however, shore-to-shore amphibious operations were rarely feasible in the Pacific war. The first major campaign in the Pacific, the Solomon Islands, illustrates not only the great distances involved, but also why the not-yet-arrived LSTs would soon play such a large role in delivering logistics. By mid-1942, Pacific commanders concluded that Auckland, New Zealand was the only staging base deemed adequately safe from Japanese attack to support the Solomon campaign, but Auckland was 1,825 miles from Guadalcanal.[10] Resupplying Auckland was even more challenging; commanders concluded in early 1942 that logistics agencies on the US west coast were a better alternative than Pearl Harbor, which did not have the resources or personnel to handle the early logistics requirements.[11] One admiral remarked that these logistics issues limited the pursuit of strategic operations to around fifty percent of what was actually desired.[12] With this reality, the Pacific Fleet chose to use the first-arriving LSTs for logistics**.** Commanders took note of the ship's simplicity, efficiency, and carrying capacity, marking the LST as the clear choice to move supplies between islands.

In the same moment, operational commanders did little to dissuade the logisticians' initiative, because many had doubts about LST crews and their readiness to perform in combat operations.[13] These reservations about LST crews' preparedness for combat amphibious

10. George C. Dyer, *The Amphibians Came to Conquer: The Story of Admiral Richmond Kelly Turner* (Washington: Government Printing Office, 1972), 406.

11. Ibid., 405.

12. Daniel K. Blewett, "Fuel and U.S, Naval Operations in the Pacific, 1942," in *The Pacific War Revisited*, eds Günter Bischof and Robert L. Dupont (Baton Rouge, LA: Louisiana State University press, 1997), 57.

13. Chester W. Nimitz, *Nimitz Graybook*, vol. 3, January 1, 1943 through June 30, 1943 (Honolulu, HI: United States Pacific Fleet, 1945), 1583. *Graybook* is a collection of primary source documents covering Admiral Nimitz's four-year command of the US Pacific Fleet in WWII. The collection includes running summaries and estimates, written transcripts of conversations, statistics, observations, and after-action reports. *Graybook* is a chronological collection of documents of all varieties, archived in original format. Many documents do not include page numbers.

operations grew from the ad hoc nature of amphibious training in general. As the US entered the war in December 1941, despite more than two decades of interwar attention to amphibious warfare, its amphibious forces still had plenty of room for improvement in "doctrine, organization, … equipment, and training".[14] The challenge of organizing training for amphibious forces was a large task, as the Navy, Marine Corps and the Army all contributed equipment and personnel to a collective, "joint" effort. Compounding the need to operate jointly, most military planners also considered amphibious warfare the most complex of all military operations. As the US entered WWII, virtually all training was the responsibility of the separate military branches. This arrangement was workable, so long as each branch operated independently. But this was not a realistic option in war. For example, Marine Corps and Army units operating in the same land battlespace would need to follow common procedures for communications, fire support, close air support, boundaries, and passages of line. An amphibious operation was even more complicated.

The first amphibious training challenge related to the physical equipment — amphibious ships and landing craft. In December 1941, after the Japanese attack on Pearl Harbor, and with the nearly-simultaneous declaration of war by Germany, the US certainly recognized that the coming war would be a global conflict, and that large-scale amphibious operations would be necessary in both theaters. The lack of amphibious ships marked the first deficiency for the US military. During the interwar years, the Navy considered amphibious ships as auxiliaries — not warships — and was content to modify older ships rather than build new ones.[15] Many of these

14. Allan R. Millett, "Assault from the Sea: The development of amphibious warfare between the wars – the American, British, and Japanese experiences," in *Military Innovations in the Interwar Period*, eds Williamson Murray and Allan R. Millett (New York: Cambridge University Press, 2009), 75, 87; US Army, *Lessons of Operation Torch*, Allied Force Headquarters, Staff Memorandum no. 7 (London, 1943), 3.

15. Millett, "Assault from the Sea," 83.

ships were little more than merchant ships painted gray. While a convenient, quick, and relatively inexpensive means of producing an amphibious ship inventory, limited boat-hoisting capacity of these ships, cranes and elevators required such specialized landing craft that the Navy ultimately turned to civilian industry for craft design and production assistance. Eventually, amphibious production blossomed, and purpose-built amphibious ships accompanied the several variants of landing craft joining the fleet by the thousands. The deployment of 1,051 LSTs certainly spotlighted the accomplishment. But the arrival of myriad new variants of amphibious vessels, including the LST, required extensive training for the sailors who would operate them, as well as the soldiers and Marines who would land from them. But before amphibious training procedures could be codified across the Navy, Army, and Marine Corps, questions of overall roles, responsibilities, and authorities over amphibious operations lingered among the services. The Marine Corps, having devoted considerable effort to studying amphibious warfare, emerged from the interwar period as nation's best-trained landing force and its repository of amphibious doctrine, but the Corps was too small to rapidly expand to meet the massive landing force requirements for the amphibious operations the nation would likely face.[16] Over the same period, the US Army had focused more extensively on its predominant role as a ground force. For as much as the Marine Corps was the amphibious force of choice, the Army was uncontested in its role as the nation's land army. But there would be far too many amphibious operations for the two services to limit themselves to their primary doctrinal roles. The Army would also need to train as an amphibious landing force and was candid enough to admit its shortcomings in the early months of US involvement in the war. In 1942, after OPERATION TORCH in North Africa, the operational summary from [then] Lieutenant General Eisenhower's Allied

16. John T. Greenwood, "The US Army and Amphibious Warfare during World War II," *Army History* 27 (Summer 1993): 4.

Headquarters staff stated the problem directly and bluntly, also revealing the lingering service-centric perspective. “Our great weakness is the lack of adequate doctrine and technique for amphibious operations ... and the remedy appears to be to organize a training center employing officers from our Divisions.”[17] During and immediately after TORCH, the Army not only argued that it should organize its own amphibious training, but that soldiers, not sailors, should operate the landing craft.[18]

In early 1942, the Navy assigned its fleet training division to the staff of Commander in Chief, US Fleet (COMINCH). Amphibious training, however, was barely addressed within the staff. As a part of the small instruction section, amphibious warfare had but one desk, with one Marine Corps officer (a major) manning it. As 1942 unfolded, amphibious planning requirements were on the rise. Rear Admiral Richmond Kelly Turner was among the first senior officers to appreciate the need for the COMINCH staff to consolidate all aspects of amphibious planning — including amphibious training — into a robust and fully-staffed directorate. By April 1942, COMINCH had established amphibious commands in both the Atlantic and Pacific Fleets.[19] At a conference at COMINCH headquarters in April 1942, representatives of both amphibious commands codified the status of amphibious operations and training by simply stating that “more of everything is needed”.[20]

By mid-1942, in addition to Amphibious Forces, Atlantic and Pacific, the Navy also established Training Commands for both fleets. With this more robust and diverse command structure, the potential for well-organized amphibious training had certainly improved.

17. US Army, *Lessons of Operation Torch*, 3, 6, 11, 16, 18.
18. Ibid., 6.
19. Dyer, *The Amphibians Came to Conquer*, 210. Amphibious Force, Atlantic Fleet was established on March 14, 1942; Amphibious Force, Pacific Fleet was established on April 10, 1942.
20. Ibid.

Gradually, the Navy established amphibious training bases— or at least facilities with some responsibility for amphibious training — on both US coasts and the Gulf of Mexico. The Navy's major amphibious training sites included stations in Maryland, Virginia, Florida, Louisiana, and California.

While such organizational efforts might have improved amphibious functioning within the US Navy, including training, overall responsibilities and authorities between the Navy and the Army remained largely unsettled. Well into 1942, the Army maintained a position that it should be responsible for all amphibious operations — training included — in the European theater, also proposing the same responsibility for the Marines in the Pacific. Compounding the dilemma, the role of theater commanders in amphibious operations and training was equally muddled. Eventually, in March 1943, the Army Chief of Staff and Commander in Chief US Fleet (also functioning as Chief of Naval Operations) signed an agreement aimed at clearing up the confusion. The agreement moved the preponderance of amphibious training responsibility to the Navy. The summary of this agreement reveals what the issues were in the first place:

- The Army would discontinue all amphibious training activities, except as specifically noted.
- The Army would retain responsibility for Army-specific training, but that amphibious training of Army units would be under the cognizance of the Navy.
- The Navy would conduct training of amphibious boat operations and maintenance personnel, and that Army personnel might be trained later, if necessary.
- The Army would complete the amphibious training and retain control of two Engineer Amphibian Brigades until they arrived at their operational destination in the Southwest Pacific area. After this training was completed, the Army would transfer boats, shops, spares, tools, and other facilities not part of Army-specific organizational equipment to the Navy, if it requested such. Two Army amphibious training facilities — one in Massachusetts and the other in Florida — would be made available for Navy use, as determined by the Navy.
- Control of amphibious training activities in overseas theatres would be as determined by the theatre commander concerned.[21]

21. Dyer, *The Amphibians Came to Conquer*, 217.

Overseas amphibious training, though duly authorized by service headquarters to be at the behest of theater commanders, faced its own set of challenges. On March 1, 1943 in Australia, the Joint Operational Overseas Training School, HMAS Assault, and US Advanced Base Unit, combined to form a single Amphibious Training Command under the supervision of the US Navy. The school identified many of the training challenges it faced, noting that the single-biggest limiting factor in organizing training programs in forward areas was a lack of equipment to train with. The Amphibious Training Command in Australia routinely bemoaned that it was limited to one assault transport ship (APA) and, perhaps, two or three landing craft. Any other nearby amphibious ships and craft were already fully committed to ongoing combat operations. Additionally, advanced amphibious training for ships' crews competed — usually unsuccessfully — with requirement for basic troop training. Many amphibious ships that might detect an opportunity to train in the advanced features of amphibious warfare were often dispatched to ferry troops to combat zones. Often, operational requirements left both troops and ships' crews wanting for training opportunities and the proper equipment with which to conduct the training. When APAs were not available, LSTs sometimes substituted and were equipped with debarkation nets to simulate amphibious landings from the larger ships. In some cases, no ships were available for overseas amphibious training and mock ship sides were constructed on land or in port facilities.

The enormity of the amphibious training task in WWII — combined with ever-present pressure to deploy ships to combat theaters without delay — produced the practice of on-the-job training for ships' crews. Sailors certainly received formal training before joining ships for duty, but this training was general in nature and applied to any ship type. Radio operators, boiler

technicians, boatswains' mates, and quartermasters — to names just a few occupational specialties — received training in the basic functions of their jobs. The physical differences in dozens of warships and auxiliary classes called for advanced shipboard training that could only be accomplished once a sailor reported for duty.

The larger training challenge was in teaching entire ships' crews to work together to accomplish the assigned primary mission of the ship. For example, submarine crews might practice and perfect submerging the boat or firing torpedoes, or aircraft carrier crews would hone their processes for arming, fueling, launching, and recovering aircraft. Amphibious ship crews required the same level of mission-specific training.

Despite the training misgivings among some of his subordinates, Admiral Nimitz projected early confidence in the potential of the yet-unproven LST. For example, in January 1943, Nimitz disapproved a suggestion from an army general to send LSTs to Alaska because the crews lacked experience.[22]

Notwithstanding Nimitz's ultimate confidence in the amphibious capability of LSTs, the ships still concentrated on logistics on a large scale in the Pacific, and this never really abated through the end of the war. A memoir from a crewmember of LST 222 captures both the experience and the sentiment. "…we found ourselves in the Solomons, making those 'milk runs' familiar to any member of the amphibious forces…we busy ourselves with the unexciting but necessary task of keeping logistics on an even keel; of seeing that island garrisons are supplied".[23] Rogers Aston was a sailor from LST-446, which, according to him, was the first

22. Nimitz, *Graybook*, vol. 3, 1355.

23. James L. McGuinnes, "The Three Deuces," *United States Naval Institute Proceedings* (September 1946): 1157-1161.

LST to see service in the Pacific theater.[24] Aston reflected on the early operations of LST-446, recalling that on its first deployment to Hawaii, the ship was full of "6x6" trucks instead of tanks as the crew expected. When asked if the crew was trained in handling tanks, Aston said no. Aston recalls cargo dominating the ship's first missions, with the tank deck full of all sorts of cargo. Aston recalled one memorable cargo LST-446 carried on a regular basis: 1000 drums of 100-octane aviation gasoline. When asked what else the ship was tasked with, Aston remembered the ship being readied for handling wounded, including cutting access holes in the main deck for stretchers.[25]

Ultimately, LSTs in the Pacific did move beyond logistics duty — though that responsibility never disappeared —and participated in amphibious assaults in combat conditions. The shallow beach gradients of many islands, however, combined with an abundance of dangerous coral reefs, often relegated LSTs to the still-vital role of landing tracked amphibian assault vehicles (LVTs) from seaward positions to negotiate the hazards independently.

As the size of Pacific amphibious operations grew, culminating with the invasion of Okinawa in 1945, LSTs were similarly burdened (as they had been in Europe) with the double duty of conducting amphibious landings and supporting naval logistics. Toward the end of the war in the Pacific, Admiral Nimitz found it necessary to instruct his subordinates to moderate logistics taskings so that more ships could perform their primary amphibious mission.[26]

In Europe, Britain served as an immense staging base, complete with an abundance of available trucks and trains to move military equipment and material between ports and staging areas. Bases and supply depots in Britain first supported OPERATION TORCH in North Africa.

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24 Rogers Aston, interview by Richard W. Byrd, May 4, 1993, transcript, Admiral Nimitz Foundation, University of North Texas, San Antonio, TX.

25 Ibid., 5, 6, 7, 29.

26. Nimitz, *Graybook*, vol. 7. n.p.

After TORCH, in a follow-on series of shore-to-shore operations, North Africa then served as a staging base for operations in Sicily and Italy. Finally, in 1944, Britain — where the staging started — served again as the launch point for OPERATION OVERLORD, the Normandy invasion. In short, throughout the European campaign in WWII, most amphibious operations could be conducted as shore-to-shore operations.

Chronologically, although the LST made its first combat appearance in the Solomon Islands campaign in the Pacific, OPERATION HUSKY, the invasion of Sicily, was the first major amphibious operation involving a significant number of LSTs.[27] By May 1943, notwithstanding doubts emanating from the Pacific about the combat readiness of LST crews, preparation for the Sicily invasion were well underway. Although a few LSTs participated in the largely unopposed landings of OPERATION TORCH in 1942, 1943 brought new LSTs and other landing craft to captured North African ports.[28] With these ports serving as the staging bases and launch points for the coming Sicily operation, new LSTs arriving from the US soon conducted the same sort of logistics work — shuttling cargo between ports— as their Pacific counterparts.[29]

After HUSKY, Vice Admiral Kent H. Hewitt, commander of the Western Naval Task Force,[30] prepared an extensive operational summary of the Sicily campaign. Hewitt's report, in addition a full chronology of the battle, contained observations and recommendations on virtually every aspect of naval warfare, including the logistics use of the LST. The LST observations from the Sicily summary revealed what worked well, what did not work well, and

27. Symonds, *World War II at Sea*, 426.

28. Kent H. Hewitt, *The Memoirs of Admiral H. Kent Hewitt*, ed. Evelyn M. Cherpak (Newport, RI: Naval War College Press, 2004), n.p.

29. Ibid.

30. Hewitt had commanded the same force in OPERATION TORCH.

included recommendations on physically modifying the LST to do its amphibious job better.

According to the Sicily report, LST-related observations and recommendations from the Western Task Force included:

- That the LST was not structurally suited to receive stores from another ship alongside.
- That the unloading of bulk stores after beaching placed a tremendous burden on LST crews and distracted the crews from their primary duties.
- That modifications to the pintle connection between LSTs and the new pontoon causeway systems were necessary.
- That extra davits were installed on LSTs so that the ships could carry more LCVPs (landing craft, vehicle and personnel).
- That temporary facilities were installed to improve the LST's ability to function as a hospital ship.
- That LSTs could be intentionally overloaded with personnel for short trips, but sanitation facilities were inadequate for more than 500 persons in any case.
- That LSTs should not be used to unload other ships.
- That excessive additional cargo loaded on LSTs beyond assigned combat equipment increased the ships' forward draft to the detriment of favorable beach landings.
- That if LSTs must be employed carrying bulk cargo, the ships should have winches, booms, and other mechanical means of assistance installed.
- That LSTs delivered rations, gasoline, and ammunition to other islands near Sicily.
- That LSTs carried 195,000 field rations from North Africa to Sicily.
- That LSTs made 414 trips logistics trips to and from Tunisian ports over a six-week period.
- That LSTs traveling from Sicily back to Tunisian ports transported enemy prisoners of war.
- That some LSTs were loaded with spare parts and equipment whose destination often did not match the amphibious orders for the ships.
- That LST should have equipment installed to facilitate delivering fresh water through the largest available hose assemblies (three-inch connections).
- That LSTs should have 10,000 gallon-per-day water distillation plants installed. [31]

The Sicily observations revealed that logistics dominated much of the LST-related recommendations and conclusions made by commanders during and after OPERATION

31. US Navy Department, *Action Report: Western Naval Task Force: The Sicilian Campaign: OPERATION "HUSKY": July – August 1943* (Washington, DC: Navy Department, 1944): 48, 50, 51, 52, 71, 99, 101, 103, 121.

HUSKY. The most significant LST logistics issues in Sicily focused on the burden of handling bulk cargo. Offloading an LST fully loaded with bulk cargo could take a full day or longer. This slow process was especially hazardous for ships attempting to offload bulk cargo during, or soon after, the assault waves. An LST only partially loaded with bulk cargo might still be delayed for several hours on the beach, not only exposed to possible enemy fire, but also monopolizing a landing spot that another waiting ship might use to offload more combat forces.

Figure 2 — LST-61 and LST-197, Sicily, 1943 (from The National World War II Museum)

After securing beaches and fixed ports in Sicily, bulk cargo offloads of LSTs became less hazardous, but remained slow, manpower-intensive, and inefficient operations. Not all LST notes from Sicily were strictly about logistics, however. For example, while the decision to install additional davits for LCVPs, or make modifications to improve LST-to-pontoon connections, were operational considerations aimed at improving LST efficiency in amphibious combat, these tactical improvements also helped with logistics operations. By July 1943 in Europe, especially after LSTs were already busy with logistics in the Pacific, the Sicily

observations strongly suggested an acknowledgment that LSTs would be involved in significant logistics work for the rest of the war. The Sicily report also confirmed that the physical characteristics of LSTs, as well as the techniques and procedures to operate the ships, would need to evolve to enhance logistics support. The LSTs of OPERATION HUSKY certainly did their fair share, not just in terms of providing logistics, but as a learning resource for LST operations to come.

After Sicily, refinements to LST logistics support continued in the Italian campaign. In OPERATION SHINGLE, the Anzio landing, better techniques emerged for rapidly and efficiently delivering cargo and supplies from LSTs. At a January 1944 planning conference for SHINGLE, no doubt considering the observations about bulk cargo operations in HUSKY, Army Colonel Edward J. O'Neill introduced the idea of loading bulk cargo on trucks at the secure port of Naples, then embarking the loaded trucks aboard LSTs bound for Anzio.[32] This procedure would allow loaded trucks to simply drive off LSTs and move directly to inland supply depots, not only dramatically reducing offload time, but also delivering supplies directly to intended destinations. While it was acknowledged that LSTs loaded in this manner would be largely limited to logistics duty, the efficiencies of the technique ultimately returned LSTs to availability for amphibious landings much sooner. After some initial resistance from Allied headquarters, General Mark Clark ultimately approved the concept. Over the course of SHINGLE, the Army loaded roughly 1500 trucks in this manner, and LST offload times dropped from a full day to as little as one hour. Logisticians in the Pacific found the same procedure useful as well, with similar reports coming from the 7th Fleet announcing equally favorable results.

32. Milan Vego, "The Allied Landing at Anzio-Nettuno, 22 January–4 March 1944: Operation Shingle." *Naval War College Review* 67, no. 4 (Autumn 2014): 110. Colonel O'Neill's idea is a technique now commonly known as "mobile loading", a practice still widely used in present day amphibious operations.

In June 1944, OPERATION OVERLORD saw LSTs continue in substantial logistics roles. In HUSKY, and to a slightly lesser degree SHINGLE, LSTs gravitated toward logistics duties that might not have been planned for in advance or articulated in operations orders. By 1944, however, for operations OVERLORD and NEPTUNE (OVERLORD's naval campaign) planners did anticipate LSTs fulfilling greater logistics duties and reflected this reality in operational plans. OPERATION NEPTUNE, for example, called for LSTs to begin shuttling follow-on sustainment from British ports as early as D+2.[33] The LST shuttle operation made full use of both directions of travel. Before beginning a trip back to Britain, LSTs at Normandy loaded damaged equipment, friendly and enemy wounded personnel, and enemy prisoners. LSTs returning from the French coast performed very similar functions as in earlier operations at Sicily and Italy, only OVERLORD/NEPTUNE planned for these duties in advance. LST resupply shuttles at Normandy used several British ports, but the majority originated from Portland, Newhaven, and Isle of Wight.[34] NEPTUNE clearly widened the LST's role. LST-338, also a veteran of the Sicily operation, aptly represented the range of functions typical LSTs at Normandy performed. According to the reflections of a pharmacist mate, LST-338 landed on Omaha Beach with assault troops and equipment on D+2; immediately transported wounded soldiers, both to hospital ships at sea and to British hospitals ashore; made 60 round-trip shuttles between various British ports and the Normandy beaches, delivering every class of supply in the military inventory and transporting German prisoners to camps located in Britain.[35] Beyond the utility of an LST, this sailor also underscored how busy the ships could be by recalling that his

33. US Navy, *OPERATION NEPTUNE: Neptune Operations Plans,* vol. 5, *c*hap. IV, United States Naval Administrative History of World War II (Washington, DC, n.d.). D+2 is a time reference based on D-Day, the schedule first day of any amphibious landing. D+2 denotes two days after D-Day, or June 8 in the case of NEPTUNE/OVERLORD.

34. Ibid.

35. Frank R. Feduik, "Recollections of Pharmacist Mate Frank, R. Feduik on LST 338," adapted from "A Corpsman Remembers D-Day." *Navy Medicine* 85, no. 3 (May-June 1994): 13-17.

Captain was “gung-ho”, “volunteering the ship for everything”.[36] He also recalls that “hundreds” of German prisoners would sit in the ship’s empty tank deck, guarded by sailors manning machine guns from elevated platforms. It is unlikely that the ship’s crew had any training on how to transport and secure enemy prisoners. In a new twist, after the Allies secured the ports of Cherbourg and Le Havre, LST-338 had train tracks installed in its tank deck. The modification enabled the ship to embark rail cars loaded with cargo from specially-designed British piers; once in France, waiting train engines would unload the cars at similar facilities.[37] The rail-track modification to LST-338 and other ships revealed an evolution in cargo-handling efficiency built on Colonel O’Neill’s truck-loading concept in Italy. Robert Jagers, a veteran of another LST from Normandy, added perspective to the tasks of handling both wounded and prisoners. Jagers said that the Navy ultimately decided that assigning both missions to a single LST was “too much”, and that LSTs would be assigned one function or the other. If tasked with moving German prisoners (but not wounded), an LST would temporarily transfer most of its available hospital corpsmen and medics to another LST assigned to transport wounded. On the subject of German prisoners, Jagers remembers routinely carrying 1000 prisoners on his LST. Recounting the occasional aggressiveness of some German prisoners, Jagers remembers that the simple act of fixing a bayonet on his rifle — which Germans apparently feared — instantly improved the behavior of the Germans.[38]

Difficulties with direct beach landings — ordinarily overcome by the unique landing capability of the LST — produced even more logistics work for the ships. Normandy beaches featured shallow beach gradients across much of their frontage, limiting the sites where LSTs

36. Feduik, 15.
37. Ibid., 16.
38 Robert Jagers, interview by Larry Rabalais, February 9, 2008, transcript, Nimitz Education and Research Center, National Museum of the Pacific War, Fredericksburg, TX.

could land with a dry bow ramp. Compounding the gradient challenge were significant tide ranges that could strand an LST for an entire tidal cycle. During assault phases and follow-on logistics sustainment operations, operational orders directed conservative decision-making regarding LST beach landings. The orders stipulated that LSTs would not attempt to land directly on a beach unless tides and approach gradients were favorable for reasonably-dry ramps, as well as the prospect of timely beach extractions. Planners worried about exposing LSTs to enemy action by stranding the ships on beaches for extended periods, which would reduce LST availability for logistics shuttles. To mitigate tidal constraints, LSTs connected pontoons or rhino ferries to their bow ramps to bridge the gap between where they grounded and the dry beach. These pontoon operations were similar to beach operations in HUSKY and SHINGLE. To further compensate for the limitations of direct beach landings by LSTs and other landing craft, allied planners (primarily British) devised a concept for two artificial harbors, called Mulberrys, which would allow LSTs and other ships to deliver troops, supplies, and equipment through semi-fixed port facilities. The intent behind the Mulberry harbors was to provide an interim, artificial port facility for follow-on sustainment and reinforcements until other French ports became available. Fewer beach landings, pontoons and causeway bridges, and artificial harbors — all aimed at accelerating the throughput of sustainment and reinforcements — ended up producing more logistics work for LSTs. Earlier, at Sicily, LSTs generally attached causeway sections to their hulls during the transit from North African ports. At Normandy, however, LSTs more frequently towed barges, causeway sections, or rhino ferries behind them as they crossed the English Channel. In addition to causeways and ferries, LSTs also towed many of the block components of the Mulberry harbors.

Figure 3— LST connected to a causeway (from Naval History and Heritage Command)

For many of the logistics tasks LST crews faced during WWII, training came on-the-job. Through some formal training, LST crews learned the basics of amphibious operations. Crews were reasonably comfortable with how to land on a beach, or how to load and unload tanks, trucks, and the standard military equipment the ship was designed to carry. But for on-the-spot procedures such as loading and securing rail cars, these new functions called for crews to simply figure out the procedure through fundamentals and a degree of trial and error. It is equally unlikely that LST crews received specific training for handling large numbers of wounded soldiers or enemy prisoners of war.

Chapter 2 — The Auxiliary Landing Craft Repair Ship (ARL) Emerges

In the early stages of US participation in WWII, amid full-on LST production at home, observations and after-action reports of early amphibious operations compelled the Navy to physically modify LSTs to three auxiliary ship configurations.[39] Each of the initial conversions focused in some way on repairs or tending to smaller vessels or lighters. Over the course of the war, the Navy continued to modify the LST for a variety of other support functions, including temporary barracks facilities and aircraft support. Related to amphibious operations, in 1942, after OPERATION TORCH in North Africa, the US Navy specifically recognized a need to improve landing craft repair.[40] Though most of the landings in North Africa were lightly opposed, and the Allies were able to make use of several fixed ports, landing craft still suffered mechanical breakdowns and other damage requiring repairs before they could support subsequent operations. Anticipating larger and more difficult amphibious operations to come — not the least of which would be the eventual cross-channel invasion into Western Europe — the Navy realized it needed to augment its existing options for repairing landing craft with an expedient and efficient alternative. To be sure, by 1942 the Navy was already repairing landing craft. Landing craft crews were trained and equipped with basic tools to perform routine maintenance and some emergency repairs. Many of these repairs occurred on a beach, at a dock, or alongside a ship. But crew maintenance had limits. Boat crews had neither the training nor the equipment and facilities for more extensive repairs. During an amphibious operation, landing craft might also receive a slightly higher level of maintenance when they returned to their

39. Stephen S. Roberts, "Shipscribe," Data on US Naval Auxiliary Ships and French Warships, US Navy Auxiliary Vessel Ship Types, 1920-1945, Amphibious Assault Ships (Auxiliary Types), accessed October 9, 2020, https://www.shipscribe.com/usnaux/type.html#phibs. Dr. Roberts is an historian who has co-authored books and consulted on French sailing warships and US Navy warships.

40. Ibid.

assigned transport or cargo ship. But, ultimately, extensive or complex repairs required either a land-based facility or a ship designed for the purpose. Land-based facilities and shipyards, in war, usually depended on the availability of captured or friendly ports. Such ports and shipyards, if available, were often well beyond the traveling range of non-seagoing landing craft. The Navy did possess repair ships, which certainly had some ability to repair landing craft, but these larger vessels also had repair responsibilities for the rest of the fleet. Moreover, deep-draft repair ships often could not operate near the beaches or shallow waterways frequented by landing craft. After North Africa, the Navy realized it needed a repair ship that was large enough to accommodate machine shops and storerooms, yet small enough to operate near the landing craft in need of repair. The shallow-draft LST hull fit the bill perfectly.

By 1943, the US Navy already had an administrative organization well-suited to pursue an auxiliary repair ship for landing craft. In January 1941, the Secretary of the Navy established the Auxiliary Vessels Board.[41] The Board's function was to assist the larger Bureau of Ships — responsible for the entire US Navy fleet — in all matters pertaining to auxiliary ships. These responsibilities included recommendations on procurement, resources, budgeting, and modifications for ships that would serve in a supporting role for warships and other combatants.

For most of 1942, after the North Africa campaign, the Navy employed its Auxiliary Vessels Board to identify potential solutions for the landing craft repair challenge. In mid-1942, when the LST became temporarily less critical to the Navy's needs, the Auxiliary Vessels Board secured Navy approval to convert LSTs to Auxiliary Landing Craft Repair Ships (ARL). With LSTs less important to the Navy — if only momentarily — the Auxiliary Vessels Board

41. Roberts, "Shipscribe," Appendix 2: The Auxiliary Vessels Board, 1941-1948, accessed March 24, 2021, https://www.shipscribe.com/usnaux/auxvessboard.html. This page displays a copy of the Auxiliary Vessels Board establishment letter, including the assignment of its members.

recognized an opportunity to use already-built and newly-commissioned LSTs for the ARL program. In December 1942, Commander in Chief, US Fleet (COMINCH) ordered the conversion of the first three LSTs to ARLs. Later in the month, COMINCH also directed similar LST conversions to Battle Damage Repair Ships (ARB) and Motor Torpedo Boat Tenders (AGP). The Navy, also by recommendation of the Auxiliary Vessels Board, awarded a modification design contract to the Gibbs and Cox Company, which designed all three new classes (ARL, ARB, AGP). The Navy also awarded the first ARL conversion contract to the Bethlehem Steel Shipyard in Baltimore. In addition to Baltimore, the Navy awarded conversion contracts to four other US shipyards, including Jacksonville (FL), Mobile, New Orleans, and San Francisco. The Navy also arranged for the final two LST-ARL conversions to be completed in Australia. Bethlehem Steel, Baltimore converted nineteen ships, the most of any shipyard.[42]

In February 1943, the Navy ordered the reclassification and conversion of USS LST-10 to become an ARL.[43] The order further stipulated the administrative process for this conversion and those to follow. Already-commissioned LSTs, after receiving conversions orders, deployed from whichever US port they might reside and sail to one of the conversion shipyards. Often, the departure point was at or near New Orleans.[44] After LSTs arrived at conversion shipyards, the Navy decommissioned those ships before work commenced.[45] After a shipyard completed

42. "NavSource Naval History," Amphibious Ships, LST Tank Landing Ship, accessed February 15, 2021, http://www.navsource.org/archives/10/16/16idx.htm.

43. Most of the US Navy's WWII LSTs did not have names, with their LST hull number instead serving as the ship's name (e.g. USS LST-1). LSTs carried the USS (United States Ship) designation because they were commissioned vessels of the US Navy. LSTs modified to auxiliary ship classes had names.

44. United Press, "Last of 817 (sic) LSTs Commissioned in New Orleans," *Baton Rouge Advocate*, July 1, 1945. With nearly three-fourths of the WWII LSTs commissioned and fitted out in New Orleans, or conducting shakedown cruises or amphibious training nearby, there is a good chance ships selected for ARL conversion traveled from the Gulf Coast to Baltimore or other conversion ports. The article's title indicating 817 LSTs is almost certainly a typographical error. The article notes 718 ships commissioned in New Orleans.

45. Decommissioning ships prior to major shipyard conversions was, and remains, standard US Navy procedure. Ships are recommissioned following the work, often with new class designations.

the conversion, former LSTs emerged as ARLs. USS LST-10, the first ARL, became USS *Achelous* (ARL-1).[46]

With repair" and tending as common functions, and all three LST-auxiliary conversions (ARL, ARB, AGP) beginning with already-built LSTs, the three new classes were physically and functionally similar. But the ARL with landing craft as its repair customer, bore the closest direct connection to amphibious operations.[47]

Despite its alignment with amphibious operations, an LST converted to ARL forfeited amphibious capability. Apart from the ARL retaining the hull and shallow draft of the LST, the other changes were significant in limiting beach landings. On the main deck, usually a place to stow lighter vehicles and equipment, the modification extended the original aft deckhouse forward, producing more space for navigation and the ship's administrative functioning. With cranes and A-frame hoists added to the main deck, useful in lifting engines and other heavy machinery aboard for repairs, topside stowage all but disappeared. Storerooms and repair shops also occupied the interior tank deck, formerly dedicated to stowing tanks and other heavy vehicles. The first iteration of ARLs also had bow doors welded closed, another distinct LST feature sacrificed in the ARL.[48] Finally, the entire stern anchor assembly, which LSTs used to extract from beaches, moved to a new location near the bow. So, while the physical layout of the ARL physical layout provided useful features for repairing landing craft, the ship was no longer

46. *"*NavSource Naval History,*"* Amphibious Ships, LST Tank Landing Ship, accessed Dec 4, 2021, http://www.navsource.org/archives/10/16/16idx.htm.

47. LST hulls would form the basis for several auxiliary conversions in WWII and beyond, including battle damage repair ships, auxiliary barracks ships, small aircraft carriers, and dedicated hospital ships. See Appendix D.

48. Roberts, "ShipScribe," Amphibious Assault Ships (Auxiliary Types), accessed March 10, 2021, https://www.shipscribe.com/usnaux/type.html#phibs. The Navy produced the ARL in three groups, with each group differing slightly in armament. After the first group, the Navy reversed its decision to weld bow doors shut and restored functioning doors in the other two groups.

capable of landing vehicles and equipment on beaches like its LST predecessor.

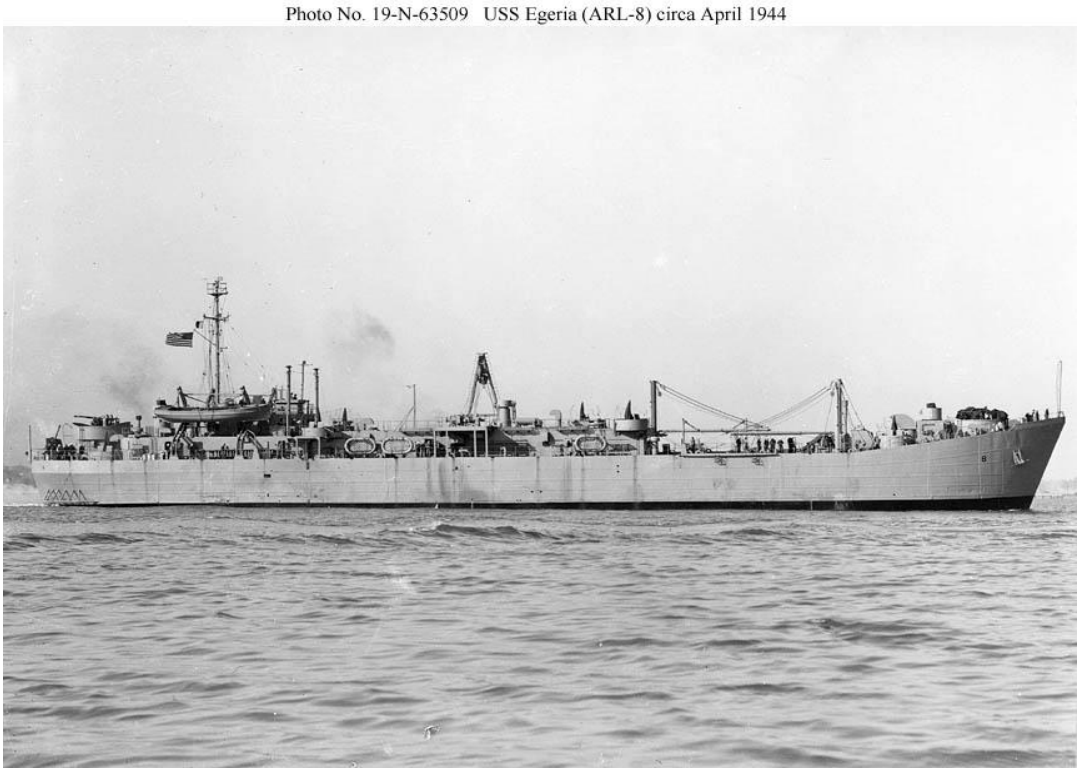

Figure 4 — USS Egeria (ARL-8) (from the National Archives)

The Navy converted thirty-nine LSTs to ARLs in WWII, although two went to Great Britain by Lend-Lease arrangement. Operationally, three ARLs served in the European theater then redeployed to the Pacific. Of the thirty-four ships serving only in the Pacific theater, nineteen arrived before the Japanese surrender in August 1945. After the war ended, ARLs arriving in the Pacific joined the postwar effort, which focused on preparing ships and larger landing craft for the long voyage home. A handful of ARLs ended up in Hawaii, and the "converted" became the "converters". These ships modified the smaller— but still sea-going — Landing Craft, Infantry (LCI) to better accommodate troops on long voyages.[49]

49. "NavSource Naval History," LST Tank Landing Ship, accessed February 24, 2021, http://www.navsource.org/archives/10/16/16idx.htm.

With repair replacing the amphibious mission, the ARL did not require the LST troop accommodation spaces. The ARL crew size more than doubled, however, making use of that berthing[50] While the navigation, engineering, and deck departments remained about the same as in LST crews, manpower increased substantially in supply and in an entirely new repair department comprised of a variety of mechanics and technicians. LST commanding officers were often lieutenants (junior grade) or lieutenants, both somewhat junior and inexperienced officers.[51] With larger crews and more assigned officers, ARL commanding officers tended to be lieutenants or lieutenant commanders.[52]

USS *Adonis* (ARL-4) was one of two US Navy Landing Craft Repair Ships supporting OPERATION OVERLORD at Normandy.[53] A synopsis of the ship's history during the Normandy operation, taken from its deck logs and war diary, reveals the scope of the repair work this class of ship performed in WWII combat operations. *Adonis* followed the standard path for converting a completed LST to an ARL. Originally commissioned as USS LST-83 on August 6, 1943[54], the Navy decommissioned the ship for around two months of modifications at Bethlehem Shipbuilding in Baltimore; on November 12, 1943, the ship was recommissioned as USS *Adonis*

50. "NavSource Naval History," LST Tank Landing Ship, accessed February 24, 2021, http://www.navsource.org/archives/10/16/16idx.htm. WWII LST crews consisted of 13 officers and 113 enlisted. ARL crews were 253 sailors: 22 officers and 231 enlisted.

51. Not all LST commanders were inexperienced. When it could, the Navy assigned "Mustangs", previously enlisted sailors who held senior enlisted or warrant officer rank before becoming commissioned officers.

52. Higher-ranking commanding officers (CO) in ARLs is not surprising. ARL wardrooms of twenty-two officers may have included full lieutenants. While a ship CO holds absolute authority by naval regulation, his job would be easier with a superior rank than his higher-ranking subordinates. For comparison, a lieutenant commander would also command a destroyer escort.

53. "NavSource Naval History," LST Tank Landing Ship, accessed March 20, 2021, http://www.navsource.org/archives/10/16/16idx.htm. The other US Navy ARL serving at Normandy was USS *Atlas* (ARL-7), assigned to Utah Beach. The British also had two similar ships at Normandy, which the Royal Navy classified as LSEs.

54. US Navy Department, "The History of USS Adonis (ARL-4)," World War II War Diaries, 1941-1945, Microfilm Serial 151525, roll A1970, Record Group 38, National Archives at College Park, MD., accessed March 27, 2021 https://www.fold3.com/image/302745219?terms=uss,adonis, 1.

ARL-4.[55] Over the next two months, *Adonis* completed her outfitting and shakedown cruises on the Chesapeake Bay and eastern seaboard, before deploying to Britain in January 1944. Eventually settling into her pre-invasion station at Devonport, then Portland, *Adonis* was able to develop some degree of on-the-job training in her primary mission by repairing various landing craft and small ships in port. Assigned to Omaha Beach for the invasion, *Adonis* departed Britain on D+1 with a pontoon drydock in tow. This portable drydock allowed ARL crews to perform hull, rudder, and propeller repairs on medium or larger sized landing craft. Arriving near Omaha Beach a day later, the ship found her first combat customer, a damaged LCVP that recognized the ship's purpose and tagged along to *Adonis'* first anchorage for repairs. *Adonis*, by learned experience, anchored so that landing craft could moor along both sides of the ship, and repaired a variety of landing craft, finding damaged engines a common problem. On D+4 (June 10), hampered by rough seas, the ship's Captain secured permission to move inside an artificial breakwater called a Gooseberry. *Adonis* tied up alongside an obsolete British battleship (part of the breakwater) and set to work. Over the next nine days, *Adonis* repaired every type of landing craft present for the invasion, as well as a variety of boats and larger Army tugboats. During this time, the *Adonis*' crew displayed commendable ingenuity, creating ad hoc solutions for problems they had never faced. For example, the crew positioned an Army tug with fouled screws (propellers) adjacent to the large A-frame hoist, and literally lifted the tug's stern clear of the water to make repairs. When pontoon drydock space was at a premium for hull repairs on LCVPs and LVTs, *Adonis* hoisted the smaller craft up to the decks of larger LCTs, which were also alongside for their own repairs. When damaged generators and refrigeration system

55. US Navy Department, "The History of USS Adonis (ARL-4)," World War II War Diaries, 1941-1945, Microfilm Serial 151525, roll A1970, Record Group 38, National Archives at College Park, MD. https://www.fold3.com/image/302745219?terms=uss,adonis (accessed on March 27, 2021

suddenly appeared in overwhelming numbers, the mechanics and technicians quickly devised and implemented an exchange program, whereby the owning landing craft received a working generator in exchange for the damaged one. *Adonis* then repaired the broken generator for stockpiling and exchange with a future landing craft customer.[56]

At Normandy, USS *Adonis* took on the additional duty of providing berthing and messing for landing craft crews while their craft were being repaired. The war diary suggests that while the crew did anticipate the requirement for some such support, Normandy operations nearly overwhelmed the ship. Temporary berthing support to landing craft crews was much more than *Adonis* anticipated, and ultimately contributed to the Navy's later decision to convert other LSTs to dedicated barracks ships (APB). In another example of initiative and resourcefulness in supporting the large number of landing craft crews living aboard, *Adonis* arranged for fresh food with several LST "cousins" making daily resupply shuttles between France and Britain.

On June 19, along with virtually every vessel, breakwater, and temporary harbor at Normandy, *Adonis* suffered the effects of a violent storm that descended on the French coast. The ship broke free from its mooring in the Gooseberry, lost its bow anchor due to a collision with another ship, and broached on Omaha Beach. While in this predicament, *Adonis* discovered one of the disadvantages of the ARL design. With its stern anchor and winch assembly removed, *Adonis* could not extract itself from the beach. An Army tug assisted, eventually rotating *Adonis* so that she could back off the beach with her engines. The tug assisted the damaged ship back to what was left of the Gooseberry, then became a new repair customer itself due to damaged sustained in the *Adonis* recovery. Though significantly damaged herself, *Adonis* located a piece

56. Component exchange, such as the type USS *Adonis* performed at Normandy, remains a practice in the modern military. The process is known as "maintenance float" in the US Marine Corps and has similar names in other services.

of its demolished pontoon drydock, secured it near the A-frame hoist, and continued repairing landing craft. The June 19 storm left nearly 300 damaged landing craft piled up on Omaha Beach. *Adonis* persevered, establishing beach-based welding teams, as well as creating an afloat welding team on an LCM, which the crew nicknamed "*Adonis Jr*.". After discovering a surprisingly high number of LVTs requiring engine replacement due to flooding, the *Adonis* maintenance department designed and built a 3-legged portable dolly for safely hoisting engines out of the tracked vehicles.

Between June 8 and 19, *Adonis* provided battle repairs to nearly forty landing craft of all varieties, also assisting several coastal patrol craft and four Army tugs. USS *Adonis* remained on station at Omaha Beach until August 1, 1944 and continued repairing all varieties of landing craft. *Adonis* repeatedly showed resourcefulness and ingenuity in finding ways to get damaged landing craft back into the fight, using the supplies it had on hand. For example, the repair department would install starboard-side engines — if that is all they had available — as port side engines along with a change of propeller. In another example of extending its repair mission beyond landing craft, *Adonis* provided 100 bottles of oxygen, 50 bottles of acetylene and 2.5 tons of welding rod to the Army. With this assistance, the Army constructed cutting blades for its Sherman tanks to better negotiate the dense hedgerows impeding the inshore advance. All told, *Adonis* repaired 293 vessels of all varieties while at Omaha Beach.[57]

After Omaha Beach, *Adonis* briefly returned to Britain for a much-needed refit of her own battered hull and machinery. Even while under repair, *Adonis* still managed to fix an assortment of landing craft while in port. On August 26, *Adonis* relieved her sistership, USS

[57] The History of USS Adonis (ARL-4), 16.

Atlas (ARL-7), at Utah Beach. *Adonis* remained at Utah Beach until November 1944, enduring another violent storm, and repairing 249 more vessels (including six Liberty Ships).[58]

USS *Adonis* repaired nearly six hundred landing craft, boats, LVTs, and ships over the course of her service in Europe. On-the-job training, ingenuity, and perseverance played the defining roles in the ship's impressive contributions as an auxiliary repair ship. The crew arrived in combat basically trained to navigate the ship, operate its machinery, and perform he general duties of specific occupational specialties (engineering, navigation, supply, repair, communications). The crew learned how to repair landing craft, damaged in every conceivable way, mostly through combat experience.

After its service in Europe, USS *Adonis* returned to the US for a complete overhaul before departing for duty in the Pacific theater. By the time the ship arrived at Pearl Harbor, the Japanese had already surrendered.

Beyond campaign participation medals and one battle star, USS *Adonis* received no special recognition for its wartime service.[59]

58. The History of USS Adonis (ARL-4), 20.

59. "NavSource Naval History," USS Adonis (ARL-4), accessed March 27, 2021, http://www.navsource.org/archives/10/19/1904.htm.

Chapter 3 — Conclusion

With the LST, the ARL, and other LST-auxiliaries that followed, the US Navy of WWII excelled in the art of adaptation, producing additional capability to meet naval logistics needs that became clear only through actual combat. Before June 1944 and the opening of a sustained land campaign in central Europe, most US and Allied military operations required major amphibious operations. Even after Normandy, the Pacific theater still called for extended naval logistics support in the island progression toward Japan. As a two-ocean global conflict, WWII produced naval logistics requirements on an unprecedented scale, and the job of sustaining hundreds of thousands of troops and associated equipment from the sea was an immense task. Ammunition, fuel, food, spare parts, and follow-on equipment all required reliable and efficient seaborne transportation and delivery. By choosing to apply the versatile LST to the many logistics challenges it faced, the Navy exhibited extemporized innovation that provided immediate solutions to pressing problems. The true benefit of the LST's logistics contributions was likely measured in time. Although difficult to tangibly measure, it is hard to imagine the four-year drive across the Pacific Ocean without LSTs in sustained logistics roles. Likewise, in Europe, LSTs delivering regular sustainment to Sicily and Normandy certainly enabled ground forces to move from beaches to inland objectives in a timely manner.

For its part, the ARL, along with similar auxiliaries that followed, was a clear testament to the original LSTs versatility, adaptability, and simplicity. The LST's uncomplicated design and purpose, transporting and delivering a wide variety of equipment and cargo in shallow water, made the ship the logical choice for modification to other purposes. Even with the variety of specific LST-auxiliary conversion configurations (landing craft, motor torpedo boats, damaged ships), the redesigned ships could each — in a pinch —step outside their mission focus as the

war required. ARLs repaired more than just landing craft; AGPs more than just PT boats; ARBs more than just battle-damaged ships.

The US Navy accepted risk when it made the decision to modify ready-to-deploy LSTs to auxiliary configurations like the ARL. Absent this decision, more LSTs would have been available to early amphibious operations in Europe and the Pacific. But the ARL addressed a tangible logistics burden — repairing landing craft and tending to their crews — and it is not difficult to imagine this function otherwise falling to LSTs.

Equally impressive was the resourcefulness of the LST and ARL crews, who adapted to circumstances and learned so many functions on-the-job. It was almost as if the standing operating procedures were being written during the operations themselves.

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Appendix A— Amphibious Vessel Abbreviations and Descriptions[60]

Amphibious Ships: This list is not all-inclusive. It depicts only the ships that participated in most WWII amphibious operations and in large numbers.

Type	Description	Draft	Details
AK	Standard Cargo Ship	Deep	Some were former merchant ships. AKs generally required a port facility.
AKA	Attack Cargo Ship	Deep	Operated in amphibious areas and could carry, deliver, and recover cargo from landing craft. Often modified AKs
AP	Transport	Deep	Mostly troops. Limited cargo. Some from converted merchant ships. Generally required a port.
APA	Attack Transport	Deep	Mainstay of large troop and cargo movements in WWII. Operated in amphibious areas. Carried troops, vehicles, and cargo and could discharge and recover with embarked landing craft.
APD	High Speed Transport	Deep	Modified destroyer escorts designed to carry and deliver small landing parties such as frogmen or reconnaissance teams.
ARL	Landing Craft Repair Ship	Shallow	Converted LSTs designed to repair landing craft and small boats. Could not land on a beach like LSTs.
LST	Landing Ship Tank	Shallow	Carried troops, wheeled, and tracked vehicles, and cargo. Able to land directly on a beach. Most versatile ship of WWII. Modified to several variants of auxiliary ships.
LSD	Landing Ship Dock	Deep	Followed the LST. Could take on sea water ballast to partially submerge a well deck, allowing small landing craft to exit through a stern gate. LSDs could generally repair and maintain embarked landing craft.
LSM	Landing Ship Medium	Shallow	Smaller than LSTs, but faster and more maneuverable. Carried fewer vehicles in an open (no overhead covering) tank deck. Could land directly on beaches like LSTs.
LCI	Landing Craft Infantry	Shallow	Smaller than LSMs. Designed for troop transport (~200). Limited ability to discharge equipment or cargo. Could land on a beach but lowered temporary catwalks to the shoreline instead opening a bow ramp. Might also be considered a landing craft, but large enough to technically be classified as a ship.

60. Fahey, *The Ships and Aircraft of the US Fleet*, 57, 59, 61, 63, 64, 78.

Landing Craft and Amphibian Vehicles: Landing craft and amphibian vehicles were not sea-going vessels and required a larger ship for support. Like amphibious ships, landing craft received several modifications for a variety of purposes.[61]

Type	Description	Draft	Details
LCT	Landing Craft Tank	Shallow	Smaller than LCIs. Could land directly on beaches with three medium tanks or ~200 tons of cargo. Used a bow ramp. Capable of limited shore-to-shore transits.
LCM	Landing Craft Mechanized	Shallow	Smaller than LCTs. Could carry one tank, 30 tons of cargo, or 120 personnel. Landed directly on beaches with a bow ramp.
LCVP	Landing Craft Vehicle and Personnel	Shallow	Smaller than LCMs. Carried one small, wheeled vehicle, 36 troops, or 5 tons of cargo. Known as the "Higgins Boat" or "Papa Boat".
LCPL	Landing Craft Personnel Large	Shallow	Carried up to 36 personnel or 4 tons of cargo. Used a bow ramp. Preceded by slightly smaller "Eureka Boat" without a bow ramp. Also designed by Andrew Higgins.
LVT	Landing Vehicle Tracked	Shallow	An amphibian tracked vehicle, self-buoyant and featuring boat-like propulsion to navigate to a beach, then tank-like tracks to cross reefs and proceed inland. One variant carried combat troops; another was an amphibian tank with a turret.
DUKW	Utility Wheeled Amphibious Vehicle	Shallow	A small, buoyant amphibian truck-sized vehicle with through-water propulsion resembling LVTs but equipped with wheels instead of tracks for land propulsion. Nicknamed the "Duck". Offered little protection from enemy fire and was unstable in seas and surf.

61. Fahey, *The Ships and Aircraft of the US Fleet*, 78-79.

Appendix B—Landing Ship Tank Characteristics[62]

Figure B1— LST-759 circa 1945 (from Naval History and Heritage Command)

Length: 328’
Beam: 50’
Displacement: 1625 tons (light); 4080 tons (fully loaded); 2366 tons (beaching)
Maximum Speed: 11.6 knots
Maximum Range: Approximately 24,000 nautical miles
Complement: 13 officers; 104 enlisted
Troop Accommodations: 16 officers; 147 enlisted
Typical Load Capacity: 20 medium tanks; ~25 wheeled vehicles (on main deck)

62. NavSource Naval History, Photo Archive: Tank Landing Ship (LST) Index, USS LST-759 http://www.navsource.org/archives/10/16/160759.htm (accessed March 26, 2021).

Appendix C—Landing Craft Repair Ship Characteristics[63]

Figure C1— USS Amycus (ARL-2) in camouflage (from the National Archives)

Length: 328’
Beam: 50’
Displacement: 3900 tons (light); 4100 tons (fully loaded)
Maximum Speed: 11.6 knots
Complement: 20 officers; 230 enlisted
Complement Additions (beyond standard LST crew):

- Expanded supply department
- Newly-added repair department capable of landing craft hull, machinery, carpentry, electronic repairs

Cranes: Two (2) forward on main deck; A-frame crane amidships
Other major changes from LST design:

- Stern anchor moved from stern to bow
- Bow doors welded shut (this was reversed in later ARL sub-classes)

63. NavSource Naval History, Photo Archive: Tank Landing Ship (LST) Index, USS Amycus (ARL-2) http://www.navsource.org/archives/10/19/1902.htm (accessed March 15, 2021).

Appendix D —Auxiliaries derived from the LST during World War II*

Type	Description	Details
AGP	Motor Torpedo Boat Tender	Not all AGPs came from LST conversions; gunboats, seaplane tenders, and merchant ships also were converted. LST-converted AGPs resembled ARLs.
ARB	Battle Damage Repair Ship	Similar to ARLs and AGPs in configuration
ARL	Landing Craft Repair Ship	Beyond landing craft, ARLs also repaired a variety of boats, tugs, and ships alongside. There were even some cases of ARLs repairing LSTs. ARLs also modified LCIs for trans-oceanic voyages, enabling LCIs to carry postwar troops back to the US
APB	Self-Propelled Barracks Ship	APB modifications were inspired by the realization of larger-than-anticipated requirements to house and feed landing craft crews. APBs completely modified LST stowage areas to berthing, sanitation, and messing spaces. APBs served near war's end and into the postwar.
LST-H	LST Hospital Ship	Regular LSTs frequently transported both friendly and enemy wounded. Some LSTs served as temporary hospital ships, with minor modifications such as access hatches and welded racks for stretchers. At the end of the war, several LSTs received more extensive modifications (and the LST-H designation), including operating rooms and recovery wards.

* This list omits some LST-auxiliary conversions occurring after WWII. Some postwar conversions from later LST classes. LST-auxiliaries continued service into the Vietnam war in the 1970s.

Vita

Joel Berry was born in Honolulu, Hawaii and grew up in a naval family in Virginia Beach, Virginia. He graduated from Washington and Lee University with a Bachelor of Arts degree in 1984. Joel received his commission as a US Marine Corps officer in 1984 and served 28 years on active duty before retiring in 2012 at the rank of colonel. His military career includes more than five years of sea duty on a variety of amphibious ships; he served as Combat Cargo Officer (CCO) on an amphibious assault ship (LHA), also completing five Marine Expeditionary Unit (MEU) deployments and one amphibious Marine Expeditionary Brigade (MEB) deployment. Joel commanded a Combat Logistics Battalion, as well as the Marine Corps Combat Service Support Schools and Camp Johnson, North Carolina. Colonel Berry's career highlights include combat operations in OPERATION IRAQI FREEDOM in 2003, Hurricane Katrina relief operations in 2005, the non-combatant evacuation of 15,000 American citizens from Lebanon in 2006, and combat service support specialty training of over 19,000 officers and enlisted Marines. His decorations include the Legion of Merit (two awards), Bronze Star Medal, Meritorious Service Medal (two awards) and the combat action ribbon. Joel still enjoys being on the water, especially sailboat racing. His wonderful wife, Anne, encourages his academic pursuits and shows remarkable patience with the sailing.