

## SECTION I - FOREWORD

1. The LST was designed and built to provide a seagoing vessel which would be capable of discharging 500 tons of tanks, under their own power, on a hostile beach in a minimum of time. As has happened in many instances of vessels designed to meet certain specialized operating requirements, the LST has proved to be satisfactory for a variety of tasks other than those for which primarily designed. For example, the LST has been used successfully for transporting all types of vehicles, for carrying high explosives and various kinds of ammunition, and for moving large quantities of aviation and motor gasoline. It has also been employed as a hospital ship for evacuating casualties from beaches while fighting was in progress. The fact that the usefulness of the LST has been so greatly extended beyond the original conception of its employment, is reflected in the characteristics of vessels of the new class which mount more AA weapons and have been provided with a more extensive fire main system and additional firefighting equipment.
2. Cargoes containing large quantities of aviation gasoline and high explosive ammunition have resulted in the LST being subjected to operating hazards of an unusually dangerous nature. Notwithstanding, the LST has demonstrated a real ability to withstand the effects of severe damage while engaged in any one of a large variety of amphibious operations.
3. The facts are eloquent witnesses to the ruggedness of these vessels and to the skill with which they have been handled. About 300 LSTs were in commission in the U.S. Navy on 7 December, 1943, the majority of which were engaged in active operations in all the theaters of the naval war. In spite of being subjected to the hazards of combat more frequently than is usual even for the major types of warships, only 24 were reported to have been damaged appreciably by enemy action up to that time. Of this number 17 were repaired and returned to service. The remaining 7 have been stricken from the Navy Register. Of these, only one was actually lost at sea, and this one sank while in tow. Two remain in limited service. Considerable equipment and machinery have been salvaged from the other four. One LST, not included in the 24 listed above, has been lost at sea by fire which was not the result of enemy action.
4. This report describes the circumstances, as reported to this Bureau, of the damage received as the result of enemy action to 18 of the 24 LSTs referred to in the preceding paragraph. Of the 6 cases omitted 5 suffered minor damage of an inconsequential nature; the sixth was stricken although no information has been made available to the Bureau as to the damage except by eye witnesses who reported that she was completely gutted by fire. In addition, the case of the one LST lost by fire has been included because of its general interest, and the similarity of this case to cases of fire caused by enemy action.

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## SECTION II - SUMMARY AND DISCUSSION

1. The large number of cases described in this report have resulted in a comparatively long publication. Much of the descriptive material included will be of interest only to the personnel employed in LST operations. In order, however, that the lessons drawn from these experiences will not be obscured by the length of the report, the usual organization of the Bureau's damage reports has been reversed. Thus, the discussion is presented before the narratives on which it is based.
2. The first LSTs placed in service in the fall of 1942 were the subject of considerable comment because of their appearance and operating characteristics. They presented an appearance which was radically different from that of conventional seagoing ships of equivalent size, and their operation posed problems of a nature not previously encountered by operating personnel. Their unconventional appearance and peculiar operational problems were the result of an unusual combination of characteristics. These included a comparatively large pay load with accommodations for numerous passengers, and large cruising radius and seaworthiness, combined with the shallow drafts necessary for successful beaching. Once operating personnel became familiar with LST characteristics, these ships proved to be one of the most valuable types in the amphibious forces.
3. Because its characteristics were combined in an unusual manner, the service performance of the LST has been subject to close scrutiny by the Bureau since the first one was commissioned. In particular, the ability to withstand damage received in action has been closely followed. The damage reports from the ships and the comments of other operating personnel have been given most serious attention. This section contains a discussion and analysis of the results of the Bureau's review of the battle damage experience of these vessels.
4. There are five cases of torpedo damage described in this report. In four of these the torpedoes struck close to the stern and aft of frame 52. In the fifth, the torpedo struck well forward of the stern. The large percentage of stern hits is attributable to the shallow draft forward. It is to be expected that not many torpedo hits will be received forward of amidships. Several reports which have described observations of torpedoes passing beneath the vessels without contact, tend to verify this.
5. Although these vessels are necessarily of relatively light construction\*, and in general, derive their longitudinal strength from longitudinal framing and comparatively light shell and main deck plating, very little damage to the hull girder has resulted from flexural vibrations of the hull. Only two of the four vessels struck at the stern received any damage whatsoever from this source, although torpedo hits at the stern and somewhat under the counter are most advantageously located for causing severe whip of the ship girder which often results in buckling of main strength members in locations remote from the point of detonation. On only one,

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\*In order to meet requirements for beaching drafts.

LST 333, was the damage of a serious nature. On this vessel it seems to have been aggravated by the heavy seas and surf which repeatedly lifted and dropped the stern when she was beached. Under the circumstances, the progressive failure of longitudinals and plating was a natural consequence. Final result was complete separation amidships of the two halves of the vessel.

6. In each of the four LST's which received torpedo hits at the stern, the extent of structural damage was approximately the same. For ships of this size and of relatively light, all-welded construction, the structure is considered to have withstood torpedo damage very well. In general, the structure aft of frame 41 has been wrecked and has required replacement. The hole in the shell caused by the detonation has been approximately 25 feet in diameter, and buckling of the shell has extended over an area about 40 feet in diameter. The third and second decks have been destroyed throughout an area somewhat larger than the hole in the shell. Adjacent structure, has, of course, been blown upward. Bulkhead 41, the after bulkhead of the tank space, has in general marked the forward limit of structural damage and has served to largely confine free flooding to spaces aft of this point.

7. The one vessel, LST 342, which was struck on the port side between frames 35 and 38 (rather than at the stern) also broke in two with the line of fracture crossing the main deck at the forward corners of the cargo hatch at frame 28. The reports in this case indicate that structural destruction of the hull in way of the detonation was extensive, leading to the conclusion that the warhead charge was quite large - possibly as large as 800 pounds. However, the evidence is clear that the fracture was forward of the area of structural destruction. The description of the fracture in this case indicates that it was markedly similar to recent structural fractures of the ship girder of some merchant ships. In the case of the latter it was found that the initial cracks started at points of high stress concentration and that complete fracture of the ship girder followed rapidly and progressively with the plates and frames tearing cleanly around the girth of the hull. The fracture of the main deck of LST 342 seems to have started as the result of high stress concentrations at the forward corners of the cargo hatch. It is conceivable that high stresses were induced in the main deck in this vicinity (close to the midship section) by the immediate and extensive flooding of the after compartments and the after tank space which undoubtedly created a severe hogging condition with resultant high tensile stress in the main deck amidships. Once initial cracks were formed, progressive failure resulting in tearing of the hull around the girth would have been rapid.

8. Early LST's\* were built with square corners in the cargo and elevator hatches. The danger of stress concentrations occurring in the main strength members around square corners has long been recognized, and the General Specifications for building vessels of the U.S. Navy, edition of 1929, for example, prescribed that such openings be fitted with round corners to prevent high stress concen-

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\*LST 342 was completed in December, 1942.

trations. Nonetheless, hurry-up detailed design and construction practices often result in such minor points being overlooked. In the case of the LST, however, this defect was noticed and remedial action ordered early in December, 1942. LST 342 probably did not have the hatch corner reinforcing prescribed, because the ship was completed so quickly after remedial action was directed and continuous operations did not permit availability for alterations up to the time she was damaged. The latest authorized installation for LST's provides that the hatch corners be fitted with 1/2-inch corner plates, rounded to a radius of 18 inches and faced with a 3/4-inch plate 6 inches in depth.

9. Several cases described in this report are evidence that fire is a most serious hazard when the LST is loaded. For example, the cause of the most serious damage to LST's 167, 313, 396 and 448 (the latter two were sunk and the other two were stricken from the register) was fire which almost completely gutted them. This was the natural result of carrying highly inflammable or explosive cargoes. The initial design (see Plate A) provided for a reasonable amount of firefighting equipment, based on the premise that tanks would be the principal cargo. When the LST was employed in many theaters for the transport of aviation gasoline in cans of drums, or high explosive ammunition it soon became apparent that the fire protection provided in the initial design was not adequate to combat the conflagrations which resulted once these types of cargo were ignited, regardless of source of ignition. The capacity of the two fire and flushing pumps initially provided totalled 500 g.p.m. at 100 pounds per square inch pressure. This was augmented by CO<sub>2</sub> hose reel units which could be employed on the tank deck. The installation of a 1000 g.p.m. at 125 pounds per square inch pressure diesel-driven fire pump, to be installed in compartment A-407-ET\*, has been authorized for the LST 1-541 classes and was accomplished on vessels of later classes prior to their completion. An additional main on the starboard side tied into the present main on the port side to form a complete loop under the main deck has been installed on the majority of LST's in service, and will be installed on the remainder as availability permits. The loop will be served by the two fire and flushings pumps and the diesel pump. Furthermore, the tank deck will be provided with four transverse water curtains with non-automatic fog heads which can be hooked up by fire hose to existing fire plugs on the main deck (see Plate A). Stop valves for sectionalizing the fire main in case of damage have also been authorized. Weight limitations imposed by the necessity of not exceeding beaching drafts precluded the installation of a fixed fog system covering the entire tank space, as has been recommended by some Type Commanders. Finally, a new type of handy billy pump with a capacity of 500 g.p.m. at 100 pounds per square inch pressure, with a 16-foot suction lift, has been made available to augment firefighting facilities on all vessels. The LST was assigned No. 1 priority to receive these pumps as they became available. These pumps can be used for unwatering purposes as well as for firefighting. It is anticipated that these improvements will result in a marked decrease in the seriousness of fires in tank deck cargo, if the equipment be promptly and efficiently employed.

\* Frequently referred to as the bilge control room.

In this connection, LST crews have been given training at Fire-fighters Schools located both in the United States and at advanced bases. The original fire main installation and subsequent improvements are shown on Plate A.

10. Damage from projectile attack has been comparatively minor, although it will be noted that LST's 375 and 336 were hit several times by 88mm (3.46 inches) projectiles. The LST is difficult to sink when afloat because of the high degree of subdivision below the waterline (i.e., beneath the tank deck) and the large amount of reserve buoyancy. Excellent stability characteristics almost completely preclude any chance of capsizing. Projectiles so far used against these ships have caused structural damage of a sharply localized nature compared to that caused by even the smaller bombs. The small explosive charge in projectiles (for example, the U.S. 5-inch AA common projectile contains only 7.2 pounds of high explosive) precludes extensive damage, and seldom will cause damage to more than one compartment, particularly if fused instantaneously. Possibly the greatest menace to the LST from moderate-caliber shore batteries is fire in the tank space cargo prior to unloading. However, the chances of successfully combatting such fires are quite favorable compared to those of fighting fires started by bomb detonations. In this connection the case of LST 399, which successfully handled a number of small fires started by projectiles among highly inflammable cargo, is outstanding.

11. The case of LST 396, which was lost by fire following a gasoline vapor explosion, is of particular interest because it so well typifies the operational hazards to which the LST is subjected. As noted in the comments on that case the escape scuttles in the tank deck to the shaft alleys are to be blanked off. If the check valves in the drainage lines from the tank deck be in good condition the shaft alleys should no longer be a source of danger with respect to gasoline vapor explosions. It is emphasized, however, that thorough knowledge of the dangerous characteristics of gasoline and the precautions necessary to reduce the hazard entailed in carrying gasoline is the most effective means of preventing gasoline fires and explosions.

12. There have been a few cases where the original installation provided for the drainage of the main and auxiliary machinery spaces has been inadequate. As previously noted, the total capacity of the two fire and bilge pumps is 500 g.p.m. The slow flooding of the two machinery spaces in several instances indicated that a reasonable increase in drainage capacity would have resulted in much less damage and, in a few cases, would have prevented light and power failure. A simple alteration has been authorized which will provide a means of draining these two spaces with the ballast pumping system. The ballast system is equipped with two centrifugal 1500 g.p.m. pumps. Although these pumps are of the low-head type, rated at a discharge pressure of 25 pounds per square inch, they should be valuable in controlling moderate leakage.

13. The capacity of the six fresh water tanks, located aft of the machinery space, is 434 tons. Operating experience, as well as battle damage, has indicated that it would have been highly desirable to have a means of rapidly emptying these tanks. Accordingly, a simple alteration has been authorized to provide a cross-connection from the fire and flushing pump suction to the fresh water tanks which can be used to unwater the latter in an emergency.

14. In his report on the bomb damage to LST 343, the Commander LST Flotilla 5 commented on the facility with which bomb detonations in or adjacent to the tank space could be vented. To this end he recommended that the cargo hatch be left open, the elevator be in the down position, the bow doors be open and the ramp be down, and further that these precautions be taken when in dangerous operating areas as practicable. He referred to the case of LST 343 as an example of how damage can be minimized by this procedure, although in that case only the forward end of the tank space was open. As discussed in the Bureau's War Damage Report No. 23 (which describes bomb damage to the YORKTOWN (CV5) ), experiments and other war damage experience have indicated quite clearly that little diminution of damage can be expected by deliberate efforts to vent detonations occurring within the hull of conventional ships. The tank space, with its comparatively large openings, however, indicates that conceivably the effects of detonations of quite small bombs can be lessened by opening the space in the manner recommended above, although there is no evidence to support an opinion of the size of the explosive charge which can be vented in this manner.\* For moderate-sized and larger bombs little, if any, reduction in damage can be expected to result from leaving the tank space open. In addition, if the tank space be open, a natural draft will be provided which will cause any fire in the tank space to spread with a much greater rapidity than if the space be closed. A typical example of this will be found in the case of LST 167 in which the open cargo hatch and bow doors (the ramp was down) provided a strong natural draft which greatly accelerated the spread of the fire which caused her to be abandoned. Summarizing, the practice of deliberately opening the tank space is not recommended for venting bomb detonations and if done definitely will increase the fire hazard.

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\* The bomb which caused damage to LST 343 detonated slightly above the main deck in the officers' country (see Plate VII) rather than in the tank space. From the damage it seems to have been a 60Kg. general purpose bomb with an explosive charge of about 85 pounds. This is a small bomb. The fact that it did not detonate in the tank space proper makes it difficult to assess the value of having the ramp down beyond the observation that some blast unquestionably passed through the opening at the bow.

LST469

TORPEDO DAMAGE

Tasman Sea (Australia)

16 June, 1943

Reference:

- (a) C.O. LST469 ltr. 469/L11-1, Serial 001 of 29 June, 1943, (War Damage Report).
- (b) Comdr. Service Force Seventh Fleet ltr. LST/L11-1, Serial 0994 of 8 July, 1943, (Report of Damage).
- (c) C.O. LST469 ltr. of 9 July, 1943, (Action Report).

Photographs Nos. 1 through 6

Plate I

1. On 16 June, 1943, LST469 was a part of a convoy steaming north off the east coast of Australia in the Tasman Sea. Convoy speed was 7 knots. The afternoon was clear and sunny with a force 2 wind blowing from the northwest. At 1521 the wake of a torpedo was observed approaching on the starboard quarter. A few seconds after the wake was sighted, and before any evasive maneuvers could be executed, the torpedo struck and detonated on the starboard quarter at about frame 52. From the wake the observers estimated the torpedo to be traveling at a depth of about 8 feet. The ship swung to starboard immediately and began to settle by the stern. Simultaneously, a moderate list to starboard developed. Water flooded the tank deck through a rupture in the lower starboard side of bulkhead 41, and also through the doors leading from the crew's quarters on the second deck to the tank deck space.

2. The starboard propeller and propeller shaft were blown off. The port shaft and port engine remained operable for about 12 hours. The one shaft and propeller gave sufficient steerage way to clear the SS PORTMAR, which also had been torpedoed and set afire. On LST469 a number of small fires occurred from time to time in the wreckage, but these were extinguished with CO<sub>2</sub> extinguishers and buckets of water. Many of these were electrical fires caused by short-circuits in various cables, and CO<sub>2</sub> was effective in extinguishing them.

3. When LST469 had cleared the burning PORTMAR a safe distance, the forward ballast tanks, containing cargo fuel oil, were pumped empty using the ballast pumping system. This raised the forward part of the ship and restricted flooding of the tank deck to the after end. At this point the draft forward was about 3 feet and the draft aft was about 18 feet. The shallow draft forward caused the water on the tank deck to collect at the after end where most of it was removed via the drainage system, utilizing the fire and bilge pumps. The starboard list gradually disappeared.

4. Plate I and the photos indicate the extent of structural damage. A hole approximately 25 feet in diameter was blown in the shell. The third deck was ruptured over an area extending almost completely across the ship aft of frame 41. The second deck was badly ruptured over a comparable area and pushed up against the main deck. The main deck (photos 3 and 4) also was pushed upward aft of frame 41 and torn loose from the shell on the port and starboard sides. The boat deck from frame 41 to the after end was deflected upward about 3 feet (photo 5). The main deck hatch at frame 38, port side, was blown upward and left hanging by only one hinge. The ready service boxes for the two after 20mm guns were blown off of their foundations. The after bulkhead of the deck house, at frame 48, was split open and buckled where it joined the main deck on the starboard side. The starboard longitudinal bulkhead of the deck house also was torn loose from the main deck at the after end. Bulkhead 41, the after bulkhead of the tank space, was pushed forward and torn loose at the starboard lower corner. The two doors opening into the tank space from the crew's quarters on the second deck in bulkhead 41 were blown open by blast. These doors are hinged to swing forward.

5. Both shaft alleys were opened to the sea. All compartments below the waterline after damage, aft of bulkhead 41, flooded immediately. The depth of water at the after end of the tank space reached a maximum of 3 feet. Fresh water tanks C-413-W and C-417-W were contaminated through fragment holes in the bounding bulkheads.

6. The starboard propeller and the propeller tail shaft were blown off (photos 1 and 2). The starboard line shaft was deflected upward aft of frame 41 to the point of fracture. The starboard rudder was intact but rotated inboard about 45 degrees. The port propeller and propeller shafting (photo 6) remained intact and in operation until about 0300 on 17 June. At this time a grinding noise was heard in the main machinery space, immediately following, which the vessel lost way. It was found later that the shaft was fractured. The point of fracture was not reported, but the failure probably was the result of misalignment of the shaft.

7. The stern anchor and about 15 feet of the wire cable were lost - the cable parting at the drum. The gyro was rendered inoperable because of shock at the time of the hit. The gyro repeater in the conning station was knocked out of the gimbals. The radio antenna was carried away by shock.

8. When the port shaft fractured, the ship was taken in tow for Sidney, Australia, where permanent repairs were made. In repairing the ship for service, it was necessary to rebuild the entire hull aft of frame 41 and to install new equipment in the spaces aft of this point.

9. Although the damage was more or less complete aft of frame 41, there was only minor damage forward of this point. Damage control measures, although not reported in detail, apparently were effective, and the ship was never in danger of sinking or breaking up.



In reviewing the damage it appears consistent with that which would be expected to result from the detonation of a warhead containing about 660 pounds of explosive. The majority of the seagoing Japanese submarines (as distinct from the 2-man submarines) are believed to carry 21-inch torpedoes with warheads containing about 660 pounds of Hexa.

TORPEDO DAMAGE

New Guinea  
4 September, 1943

Reference:

- (a) C.O. LST471 ltr. of 11 October, 1943, (Report of Battle).
- (b) C.O. Task Force ltr. FE25/S3-1, Serial 00104-43 of 12 September, 1943, (Battle Damage Report).
- (c) C.O. Service Force Seventh Fleet LST/L11-1, Serial 00314 of 25 September, 1943, (Damage Report).

Photographs 1 through 4

Plate II

1. At 0700 on 4 September, 1943, LST471, a unit of a task group, departed Milne Bay, New Guinea, and proceeded en route to an assigned beach to land equipment and troops. The day was clear and sunny with no wind and sea. The task group speed was 8 knots. At 1350, the task group was about 20 miles east of Morobe Harbor, New Guinea, when enemy planes were sighted approaching to port of the formation. At 1400 the planes divided into two groups, one composed of bombers and the other of torpedo planes. Two torpedo planes attacked LST471, coming in at mast height on the port side. Both released torpedoes at a distance of approximately 1000 yards. One of the torpedoes passed ahead and clear of the ship, but the second one struck and detonated on the port quarter at about frame 55. Both planes were shot down by the AA guns of LST471, but after they had released their torpedoes.

2. The ship's structure and equipment aft of frame 41 were largely wrecked (photos 1 through 4). The port rudder, propeller and the tail section of the port shaft were carried away. Although the starboard rudder and propeller remained intact, the rudder was jammed at hard right and the propeller shaft suffered a considerable misalignment. The port stern tube and stern tube casting later were found to be missing. The starboard stern tube and stern tube casting were damaged beyond repair. The shell was ruptured over an area extending from frame 46 to the after perpendicular and from the B strake on the starboard side to the second deck on the port side. The third and second decks were ruptured throughout a comparable area. The main deck was deflected upward in way of the damaged area below, and split at some seams on the port side. The steering gear compartment was completely wrecked and the steering gear demolished. The crew's quarters likewise were wrecked.

3. The location of the point of impact, well aft and under the counter, resulted in moderate flexural vibrations of the ship girder. This was evidenced by some buckling of the main deck at frame 28,

on the starboard side outboard of the cargo hatch. Apparently the buckle was neither deep nor did it extend down the starboard shell inasmuch as no difficulties were reported which would indicate that longitudinal strength was seriously impaired.

4. For a short time after the hit the ship steamed in circles. Excessive vibrations of the starboard shaft soon made it necessary to secure the starboard engine. As noted above, it was found later that the starboard shaft was considerably out of alignment.

5. All compartments aft of frame 41 flooded to the waterline. Both shaft alleys flooded to the after bulkhead in the main engine space. Some water leaked into the main engine space through the shaft stuffing tubes and through minor leaks around the peripheries of bulkhead 35. A moderate list to port developed immediately which later was corrected by flooding forward starboard compartments. Emergency repairs were accomplished by OTUS (AS20). Temporary repairs consisted primarily of making bulkhead 41 watertight, shoring bulkhead 35 in the main engine space, caulking the shaft stuffing tubes, cutting off damaged structure below the waterline, removing the starboard propeller and the starboard rudder and blocking the shaft. When these were completed, the ship was towed to Sidney, Australia, where permanent repairs were made.

6. From the photos and Plate II, it is evident that the structural damage was quite moderate to be the result of a torpedo. The Japanese are known to employ aircraft torpedoes approximately 18 inches in diameter, one type of which has a warhead with about 338 pounds of Hexa and another of which has a warhead of about 484 pounds of Hexa. The damage to LST471 could have been caused by either of these charges. The damage does not appear to have been extensive enough to have been caused by a larger warhead, although the Japanese have other aircraft torpedoes with warheads of about 600 pounds and 840 pounds of Hexa\*.

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\*Hexa, or as classified by the Japanese, "Type 91," is an explosive comparable to TNT.

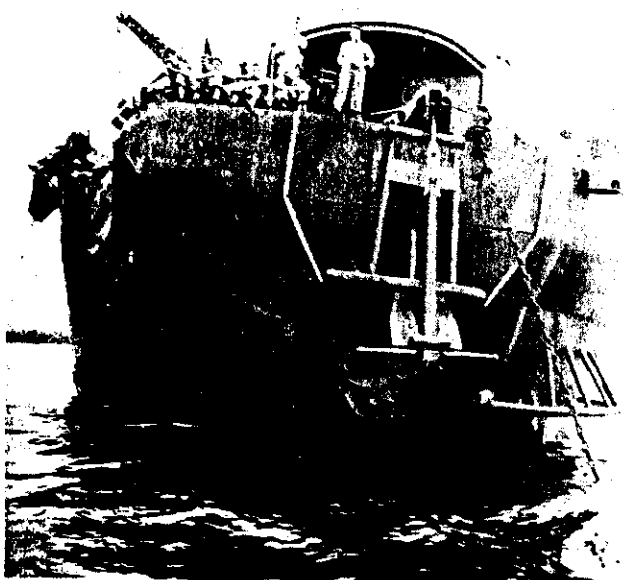


Photo 1: LST471 - Stern view showing torpedo damage to shell.

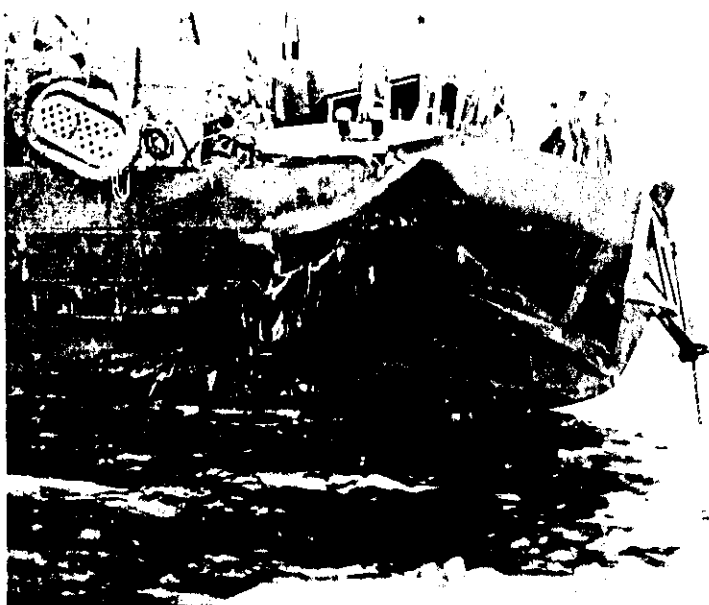


Photo 2: LST471 - View from port quarter.



Photo 3: LST471 - Crew's quarters.

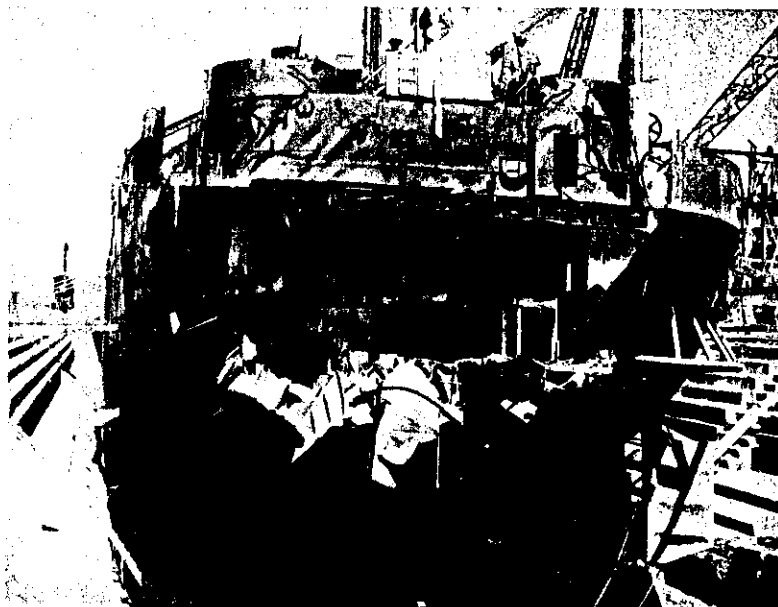


Photo 4: LST471 - View of stern after decks had been cut away.

LST 387

TORPEDO DAMAGE

North African Waters  
22 June, 1943

Reference:

- (a) C.O. LST387 ltr. LST387/A2-11, of 1 July, 1943,  
(Action Report).
- (b) C.O. LST387 ltr. LST387/A9 of 3 July, 1943,  
(Damage Report).
- (c) C.O. LST387 ltr. LST387/S88 of 26 September, 1943,  
(War Damage Report).

Plate III

1. On 21 June, 1943, a convoy departed Mostaganem for Bizerte. Among other LSTs of the convoy was LST387, with a cargo of Seabee equipment and command cars. Draft forward was 5 feet, and aft was 12 feet-1 inch. At nightfall of 22 June, the Mediterranean was calm with light easterly winds, and the atmosphere was clear. At this time the course of the convoy was 084 degrees true, and the speed 6 knots.
2. At 2136 (another LST reported the time as 2037) three torpedo wakes were sighted approaching the starboard quarter. One of these passed clear of LST387 and struck LST333, the second torpedo missed by several hundred yards astern, but the third struck LST387 on the port quarter at the base of the port propeller strut (frame 55).
3. The torpedo detonated upon impact with a dull thud. There was no noticeable flame, but there was a heavy black smoke with a sickening odor. The shock was very moderate and no appreciable flexural vibration of the ship girder was noted.
4. The effects, although localized, were extensive. The entire stern was raised and assumed a permanent upward tilt with the knuckle at about frame 41 (see Plate III). A hole was blown in the port side between frame 50 and the after perpendicular. Large holes were blown in the second and third decks. The main deck remained substantially intact even though it was pushed up at an angle of about 30 degrees. Wrinkling of the side and bottom plating extended as far forward as frame 35.
5. The port rudder and the port propeller were blown off and the stub end of the port shaft was bent upward at an angle of about 20 degrees. The starboard rudder post and rudder were bent somewhat aft and

outboard, and the rudder was jammed at an angle of 10 degrees right. The starboard propeller was damaged only slightly although the propeller shaft was bent sharply upward. All compartments aft of frame 41 flooded to the waterline. The after spaces of both shaft alleys (C-414-E and C-415-E) were opened to the sea. The forward spaces of the shaft alleys (C-406-ET and C-405-ET) flooded through leaks around the shaft stuffing tubes and cable stuffing boxes in bulkhead 38. There was considerable leakage into the main engine space through the shaft stuffing boxes in bulkhead 35. This leakage, however, was controlled by the ship's fire and bilge pump.

6. The damage to the stern and shafts stopped both engines immediately. However, there was no appreciable damage in the engine room with the exception that the housing of the port reduction gear was cracked, presumably as the result of shock. The housing for this gear possibly may have been cast iron, rather than cast steel as specified, because of a critical shortage of steel casting facilities at the time the early ships of this class were built. The fresh water pumps in C-414-E were damaged beyond repair. The steering gear compartment with its equipment was demolished. All piping aft of bulkhead 41 was distorted and ruptured to the extent that it required replacement.

7. A considerable change of trim by the stern occurred, but no list was reported. The trim was corrected by shifting ballast water from the after ballast tanks to the forward ballast tanks. The main engine space was made completely tight, and bulkhead 35 was shored.

8. At 2230 the ship was taken in tow by two LSTs, and at 0315 on 23 June arrived at Delley's Harbor. The ship was later towed to Bizerte where she is serving as a receiving ship and floating workshop. It is the present intention to make permanent repairs when time and docking facilities permit.

9. There is some evidence that the torpedo which struck LST387 was controlled by an acoustic homing device. The wake of the torpedo was first observed on the starboard quarter, yet the point of impact was on the port quarter. From the extent of damage and the fact that the wake was sighted, it appears that the torpedo probably was one of the German or Italian 21-inch air-driven torpedoes with a charge of about 660 pounds of an explosive comparable to TNT.

10. It is noteworthy that bulkhead 41 marked the forwardmost point of severe damage and further that no flooding occurred on the tank deck. Damage control measures were effective and the vessel was never in danger of sinking. It was found that after damage, bulkhead 38, separating the forward and after shaft alley spaces on both sides of the vessel, was non-watertight. Unblanked 4-inch diameter holes permitted considerable flooding into the forward shaft alley spaces on both sides of the ship. These holes apparently were intended originally for cable stuffing boxes which were not installed. Air testing of watertight compartments should have revealed the presence of these holes.

TORPEDO DAMAGE

North African Waters  
22 June, 1943

Reference:

- (a) C.O. LST333 ltr. A16-3/LST333 of 29 June, 1943, (Final Report on Torpedoing and Beaching).

Plate IV

1. On 21 June, 1943, LST333 departed Arzeu, Algeria en route to Bizerte with other ships of a convoy. This convoy joined another which departed Mostaganem on the same day and which contained LST387, the torpedoing of which has been previously described. As noted in the case of LST387, one of the three torpedoes fired at the convoy struck LST333.

2. The point of impact was on the starboard quarter in the vicinity of frame 55. Detonation occurred upon impact. Neither flash nor the usual geyser of water was noted, but there was some smoke with an odor of sulphur fumes.

3. The stern below the main deck aft of frame 48 was almost completely demolished. Both rudders and both propellers were blown off. The shell was more or less completely obliterated aft of frame 48. The third deck, including the steering gear room, was missing upon inspection. A hole 15 feet in diameter was blown in the second deck. The main deck remained substantially intact, but was deflected upward, assuming a permanent set with maximum distortion of about 3 or 4 feet.

4. Although severe whipping motion of the hull was not reported, it is apparent that this did occur. By reference to Plate IV, it will be noted that the main deck buckled at a transverse lap weld in the plating at frame 31 on the starboard side between the shell and the cargo hatch. Inspection shortly after the hit revealed a crack with an opening of about 1/2 inch at this point. A similar crack, extending half way across the main deck, also occurred at frame 26 on the port side with an opening of about 2 inches. A smaller crack also was opened in the main deck just outboard of the port corner of the cargo hatch, but was confined to one strake of plating.

5. A somewhat similar failure of the bottom flange of the ship girder must have occurred inasmuch as the auxiliary engine room flooded quite rapidly with a mixture of diesel oil and salt water as observed from the port escape trunk, B-401-ET. It thus appears that the fault was located between frames 25 and 28. It also appears that bulkhead 28, the forward bulkhead of the auxiliary engine space, was ruptured. Apparently this



was the source of the diesel oil (the diesel oil tanks are located just forward of bulkhead 28) which entered the auxiliary engine space. All personnel escaped from the auxiliary engine space after securing the engine space and turning on the CO<sub>2</sub> system. This space was completely flooded in about 8 minutes. The main engine space flooded somewhat more slowly through a ruptured seam in bulkhead 31, which separates the two machinery spaces. All compartments aft of bulkhead 41 flooded immediately. The tank deck also flooded, although the source was not reported. Probably it flooded through ruptures in bulkhead 41 or through the doors in this bulkhead at the second deck level. Within a very short time the main deck at the stern was awash.

6. Two LCTs came alongside and passed over towing lines to LST333. Considerable difficulty was experienced in towing because the lines available were too small for the task. After some were parted, slow progress eventually was made toward the beach, approximately 8 miles distant. Some 2-1/2 hours after the torpedo had struck, the ship was well down by the stern and the after section was sagging aft of amidships. At this time, the tank deck had approximately 8 feet of water at the after end.

7. The decision was made to beach the ship rather than continue to Delley's Harbor. At 2230 (variously reported as late as 0030) the ship was beached. The LCTs then came alongside and forced LST333 further up on the beach. Actually, the bow of the ship was aground on a rock ledge with the stern in deep water. Although it was a calm night, a heavy surf (not unusual on the north coast of Africa) was running. The after part of the ship continued to flood, and this, with the pounding from the heavy surf, caused the breaks in the main deck to become progressively worse. The cracks eventually extended down the sides. In the early morning hours the vessel was abandoned, with some personnel left on the beach as a guard. At daybreak an inspection of the vessel was made, at which time it was found that the stern was settling slowly and actually was almost completely submerged.

8. Salvage personnel inspected the vessel during the mid-morning hours and reference (a) reports that the decision was made to attempt her salvage. There is no information available to the Bureau as to whether or not a salvage attempt was made. Personnel returning from this particular operation have orally informed the Bureau that the stern subsequently broke clear and sank in deep water. At some time after 23 June, the forward portion of the vessel was stripped of salvageable equipment. LST333 was stricken from the Navy Register in July, 1943.

9. In comparing the damage with that which occurred to LST387, no logical explanation is apparent as to why LST333 should have received such serious damage to the hull girder amidships. Unfortunately, the loading in neither case was reported. Probably the answer, if it were found, would lie in the distribution of cargo and liquids, before damage, aboard the two vessels. It appears that the cracks in the main deck occurred before much water had entered the tank deck; but the fact that bulkhead 41 leaked, permitting a large amount of flooding in

the after end of the tank deck, contributed materially to the hogging moment which finally caused the after part of LST333 to break off. Certainly the structural damage received at the stern was almost identical on both ships, and it likewise is almost certain that the torpedoes which struck the two vessels were fired in the same salvo. It should be noted here, however, that up to 7 December, 1943, LST333 is the only LST which has been lost by failure of longitudinal strength following damage at the stern.

LST 342

TORPEDO DAMAGE

Solomon Islands  
18 July, 1943

Reference:

- (a) C.O. LST342 ltr. LST342/A16-3 of 28 July, 1943,  
(Report of Torpedoing).
- (b) C.O. USS PAWNEE ltr. AT74/L11-1, Serial 019 of  
4 August, 1943, (Salvaging of Hulk of LST342).
- (c) ComLSTFlot 5 1st End. on Ref. (a), Serial 090, of  
31 July, 1943, (Report of Torpedoing of LST342).

Plate V

1. At about sundown on 17 July, 1943, LST342 departed Wernham Cove, Russell Islands, and proceeded toward Rendova Island. She was neither in convoy nor escorted. The ship was loaded with about 500 tons of cargo, the bulk of which was ammunition, and her passenger spaces were filled with U. S. Army troops. Drafts were 5 feet -9 inches forward and 11 feet -6 inches aft. After passing through heavy rain squalls in the early evening hours the weather cleared and by midnight a full moon was out, and the sea was calm.
  2. At 0125 on 18 July, the wake of a torpedo was sighted approaching the vessel at a distance of about 40 yards on the port beam. It appeared to the Commanding Officer as if the torpedo would hit in the vicinity of frames 37 or 38. Before the Commanding Officer had time to issue a warning or turn the vessel, the torpedo struck and detonated on the port side between frames 35 and 38.
  3. This location is abreast the bridge. It appears from the references that a major portion of the stern of the vessel was almost immediately demolished. In any event, the Commanding Officer, who had been on the bridge, found himself in the water. He was pulled under by suction, presumably as the stern sank, and upon regaining the surface he could see plainly the after cross-section of the forward part of the ship; but the after portion, from about frame 28, was missing.
  4. There were only six known survivors, including the Commanding Officer, of the entire ship's complement. Three of these were from the after part of the ship. There were, however, 147 known survivors of the 190 troop passengers aboard, all of whom were in the passenger quarters forward of frame 28 at the time of the hit. Most of the troop survivors remained aboard the hulk.
  5. The Commanding Officer and those personnel who were in the water were rescued the following afternoon by an LCI(L). The forward
-

section drifted aground on the outer reef at Oliana Bay, New Georgia. After grounding, the survivors were removed. On 26 June the PAWNEE (AT74) arrived to salvage the hulk. It was aground lightly forward, but was resting heavily on the after port corner. After some difficulty, PAWNEE floated the hulk and towed it to Renard Sound, Russell Islands. The remaining cargo was unloaded there and the after end of the hulk was made watertight. After removal of the cargo, salt water ballast was adjusted to give an almost even keel and the hulk was towed to Florida Island.

6. The references reported that the portion of the ship aft of frame 28 was blown off, but that the remaining forward section was intact. All machinery in the forward section was found to be in good condition.

7. As of 7 December, 1943, LST342 was the only LST which had received a torpedo hit forward of frame 52. The torpedo which hit this ship obviously was running at a shallow depth as the draft amidships was only about 8-1/2 feet. The point of impact was not accurately located, but the best estimates place it somewhere between frames 35 and 38. Reference (a) described the cross-section at frame 28 as being a "clean break" with the appearance of having been cut by a torch. Reference (c) reported that all compartments forward of frame 25 were intact with the three tanks between frames 25 and 28 contaminated. The fact that most of the troop passengers, who were in their quarters at the time of the hit, were survivors is further evidence that damage forward of frame 28 was practically nil.

8. In reviewing this case, it is difficult to correlate the damage with a warhead of less than 660 pounds of explosive. The Japanese 21-inch submarine torpedo, employed by their seagoing submarines, contains this amount of explosive. The Japanese midget submarine employs an 18-inch torpedo with about 792 pounds of explosive. Although there is no evidence which serves to give an indication of the type of submarine which torpedoed LST342, it is believed that the structural damage inflicted is more apt to have been caused by the larger of the two warheads.

9. It is also possible that a detonation of part of the cargo, presumably high explosive ammunition, may have occurred and assisted in the destruction of the stern of the vessel. The type of ammunition carried was not reported in detail beyond the fact that 155mm ammunition was included in the cargo. However, the major portion of the cargo was undamaged and therefore it is difficult to ascribe the loss of the stern to a mass detonation of only a part of the cargo.

10. It seems more probable that the stern section was lost from a combination of the destruction of a substantial portion of the strength members and a severe hogging condition imposed as the result of extensive and immediate flooding of the hull aft of frame 31. The character of the structural failure indicates that, under these severe conditions, cracks probably started at the forward corners of the cargo hatch, where stress concentrations are high, and progressed rapidly

around the girth of the hull, giving a clean type of break such as has been noted in certain recent cases of merchant ships failures. Reenforcement of the hatch corners to relieve stress concentrations had been directed by the Bureau before this incident occurred, but probably had not been accomplished on this ship.

11. Although LST342 has been stricken from the Navy Register, it is pertinent to observe that approximately 60% of the hull remained afloat and in a usable condition, if the situation had indicated a necessity for rebuilding the vessel.

LST 340

BOMB AND PROJECTILE (STRAFING) DAMAGE

Solomon Islands  
16 June, 1943

Reference:

- (a) C.O. LST340 ltr. LST340/A16 of 26 June, 1943, (Action Report).
- (b) C.O. USS WHITNEY ltr. (AD4)/L11, Serial 058, of 16 October, 1943, (War Damage Report - Repairs).

Photographs Nos. 1 through 8

Plate VI

1. Shortly after the noon meal on 16 June, 1943, LST340 got under way and stood across the channel from Florida Island to Kukum Beach, Guadalcanal. She was loaded with a cargo of various types of army vehicles and carried a number of troop passengers. The vehicles were fully gassed and ready to operate. A number of the vehicles were trucks, all of which were loaded with various types of highly inflammable cargo such as cans of gasoline and lubricating oil, crates of ammunition, bedding and barracks bags.
2. The afternoon was clear and warm. As the ship approached Guadalcanal, the sea was calm although a force 3 wind was blowing from the northwest.
3. At 1350 nine enemy bombers were observed overhead at altitudes of approximately 20,000 feet. They peeled off and dived, with one group of three planes attacking LST340. One of these planes made a direct hit on the main deck just outboard of the port forward corner of the cargo hatch. Two other bombs were released in the same stick, but these missed and detonated in the water about 50 feet on the starboard beam. Another plane scored two near misses on the port side and also strafed the ship as it passed down the port side.
4. The bomb which struck the vessel passed through the main deck at frame 30 (photo 1) and detonated in the tank space below. The references indicate that comparatively little damage was done to the ship's structure by the detonation, possibly because of the fact that the tank space was almost completely full of vehicles and other equipment which may have served to smother fragments and blast. The detonation, however, started a fire immediately among vehicles and equipment.
5. Unfortunately, the fire main riser and cut-out valves on the port side at frame 32 underneath the main deck (see Plate A) were fractured, effectually precluding the use of the fire main in controlling the conflagration which followed. The fire progressed swiftly and within a

few minutes the entire tank deck cargo was ablaze.

6. Bomb fragments penetrated the tank deck in way of the auxiliary engine space, and burning gasoline vapors passed down through the holes. This made it necessary to secure and abandon this space. The CO<sub>2</sub> smothering system was turned on and eventually extinguished this fire. In the main engine space, the temperature was rising rapidly because of the fire in the space overhead. A few minutes after the attack, the port engine stopped for reasons which were not reported. A little later, the heat became unbearable and it was necessary to abandon this space. Prior to abandoning, however, personnel put the starboard throttle over to flank speed and the Commanding Officer headed the ship toward the beach.

7. When about 500 yards from the beach, the clutch of the starboard engine kicked out, but fortunately the ship had sufficient way on and beached under her own momentum with some help from the wind. LSTs 353 and 398 came alongside promptly and passed over hose lines and assisted in fighting the fire. The fire was definitely under control in about 4 hours, although it continued to smolder in isolated areas throughout the next 2 days. It eventually was completely extinguished by the use of rescue breathing apparatus, cutting torches, and plenty of water from assisting vessels. All vehicles aboard were completely ruined, and it was with some difficulty that these were removed. Eventually, the ship was emptied, and on 24 June refloated and towed to Carter City.

8. Structural damage caused by the detonation of the bomb was quite minor compared with that which resulted from the fire. Fragments from the near misses and strafing on the port side left more than 100 holes in the hull above the waterline between frames 15 and 25.

9. The structural damage from the fire was extensive. The main deck between frames 35 and 16 sagged deeply between the longitudinal bulkheads which form the outboard peripheries of the tank space (see photos 1 and 2). Maximum sag occurred at the forward end of the cargo hatch at frame 28 where it reached a depth of 23 inches. Most of the main transverse web frames in the overhead tank space failed by laying over. Photo 4 shows one of the worst of these.

10. At Carter City, the ship was stripped of considerable equipment for use as spares on other LSTs of Flotilla 5. WHITNEY made very extensive temporary repairs in order to make the ship seaworthy for towing to the United States. These repairs included patching all holes in the hull, patching the longitudinal tank space bulkheads, patching the main deck in way of the bomb hole, plating over the after hatch, reinforcing the main deck by a centerline row of stanchions in the tank space (photo 6), installing temporary transverse beams fabricated from 20-pound plate (photo 5), and installing three longitudinals to reenforce the longitudinal strength between frames 25 and 37 (photo 5). When these were completed LST340 was towed to the United States Naval

Drydocks, Hunters Point, San Francisco, where she is being fully reconditioned for service.

11. In examining the record, it is apparent that the bomb which struck LST340 was quite small. The Commanding Officer estimated it as a 300-pound bomb. There has been no evidence that the Japanese have employed a bomb of this size against naval targets. However, the Japanese are known to use 60 kg. bombs of the general purpose type with short delay fuzes. The charge weight of this type has been estimated to be about 85 pounds of an explosive equivalent to TNT. This bomb has excellent fragmentation characteristics as noted in war damage report No. 10 in the case of CHESTER. Of the little that is known about the structural damage to LST340 and which is attributable to the bomb (as distinct from that caused by fire), it is consistent with that which would be expected to result from the 60 kg. G.P. bomb described above.

12. This case constituted the first and one of the most serious examples of the fire hazard to which LSTs are subjected when carrying highly inflammable cargo. LST340's casualty demonstrated the need for improvements to the fire main system and the necessity of providing two widely separated pumping plants. The improvements which have been made are shown on Plate A and are discussed in Section II of this report.



LST 343

BOMB DAMAGE

Solomon Islands  
21 July, 1943

Reference:

- (a) War Diary LST343 for July, 1943.
- (b) C.O. LST343 ltr. of 30 July, 1943 (Itemized List of Damage).
- (c) C.O. LST343 ltr. of 27 July, 1943 (Report of Action).
- (d) Cdr. LST Flotilla 5 (Second End.) of 1 August, 1943.
- (e) Cdr. LST Flotilla 5 ltr. LST Flot 5/S38, Serial 084 of 28 July, 1943 (Venting to Lessen Effects from Explosions).
- (f) Cdr. LST Flotilla 5 ltr. LST Flot 5/A16-3, Serial 0137 of 10 August, 1943 (Report of Action).

Photographs Nos. 1 through 8

Plate VII

1. At 0801 on 21 July, 1943, LST343 beached at West Kokurana Island in Rendova Harbor and commenced unloading. At 1418, unloading of cargo was completed. At 1707, before the ship had retracted, six enemy planes appeared overhead. Two dive bombers attacked LST-343, releasing bombs just a few seconds after being detected. Two bombs missed, but a third struck the navigating bridge (photo 1) and penetrated to the wardroom country where it detonated.
2. The detonation caused extensive damage throughout the deck house structure (photos 2 through 7). A fire was started but was extinguished quickly. All bulkheads between frames 34 and 41 were demolished. All main deck plating in the same area was distorted and a hole was blown in the deck between frames 37 and 38. Transverse girders 36, 37, 38 and 39 (photo 3) under the main deck were deflected downward. The forward bulkhead of the deck house was pushed forward and torn loose at the bottom. The starboard bulkhead of the deck house was demolished from frames 36 to 41 and badly damaged from frames 34 to 36 (photos 6 and 7). The port bulkhead of the deck house was deflected outboard between frames 34 and 39. All the overhead structure in the officers' country was pushed upward.
3. Equipment throughout the deck house back to frame 41 was wrecked. The starboard boat davits were badly damaged and both davit winches were made inoperable by fragments and distortion of foundations.
4. Relatively minor damage resulted on the second deck. Frames 27 and 38 were buckled slightly. Reference (b) reported that fresh

water tanks C-412-W and C-413-W were ruptured. It is believed that fragments penetrated the overhead of these tanks.

5. At the time of the hit, LST343 was beached with the bow doors open and the ramp down. The elevator was up and the cargo hatch cover was in place. When the bomb detonated, a few men were standing on the beach in front of the open doors. These individuals were knocked down. The elevator was deflected upward and assumed a permanent set (photo 8). The references do not report any damage to the cargo hatch cover.

6. In reference (e) the Commander LST Flotilla 5 commented on the facility with which bomb detonations in or adjacent to the tank space can be vented by having the bow doors open and the ramp down, the cargo hatch cover off and the elevator in the down position. He used this case as an example of how structural damage can be minimized by the above procedure, although only the forward end of the tank space was open. It seems possible that the effects of small bombs can be minimized by this procedure, but it is doubtful if any material advantage in venting blast or gases will result if the bomb be even of moderate size. Certain other disadvantages are inherent in deliberately attempting to vent the detonation of bombs. The subject of venting detonations will be discussed more fully in Section II.

7. The Commanding Officer estimated the bomb to have been about 300 pounds in weight. From the damage reported in the references and shown on the photographs, it is probable that this bomb actually was one of the 60 kg. G.P. type with a short delay fuze, previously described in the report for LST340. It will be recalled that this bomb has an explosive charge of about 85 pounds.

LST 167

BOMB DAMAGE

Solomon Islands  
25 September, 1943

Reference:

- (a) C.O. LST167 ltr. LST167/A16 of 15 October, 1943, (Action Report).
- (b) C.O. LST167 ltr. of 27 October, 1943, (War Damage Report).

Photographs Nos. 1 through 7

Plate VIII

1. Early in the morning of 24 September, 1943, a task group of which LST167 was a unit departed Kukum Beach, Guadalcanal, for Vella Lavella Island. At 0745, 25 September the ship was beached at Vella Lavella and immediately commenced unloading her cargo of gasoline and oil, army vehicles and other equipment. The weather was clear and sunny with a breeze blowing from the southeast.
2. At about 1115, three enemy bombers were observed on the starboard quarter coming down from out of the sun. The bombers were well into their dive when they were detected and apparently had released their bombs. Two bombs struck the ship and the third was a near miss close aboard on the port quarter.
3. The detonation of the near miss threw a heavy column of water over the bridge but apparently did not cause any structural damage as none was reported from this source.
4. One bomb struck the main deck just inboard of the port rail, frame 137, and detonated upon impact. A hole about 5 feet in diameter was blown in the main deck (photo 1). The door leading into the officers' quarters was blown off and the longitudinal bulkhead was pushed inboard between frames 35 and 38 (photo 2). Immediately below the main deck, a hole about 2 feet long was blown in the sheer strake (photo 3). Compartment C-202-L, on the second deck between frames 35 and 38, was completely wrecked. Photos 4 and 5 show the rupture of the port longitudinal bulkhead of the tank space and of the second deck respectively.
5. The other bomb struck the main deck just forward of frame 28 outboard of the port forward corner of the cargo hatch, passed through the port longitudinal bulkhead of the tank space and detonated at the second deck level at about frame 27 (photo 6). A large hole was blown in the second deck and another in the port longitudinal bulkhead of the tank space. Both A-216-L, on the second deck and A-318-A on the third

deck were completely wrecked with the bounding decks and bulkheads either being destroyed or riddled by fragments. The cover on the cargo hatch was blown off.

6. There were approximately 1,000 gallons of 80 octane gasoline in 5-gallon metal containers and 250 drums of various grades of oil stowed on the tank deck. A number of cans of gasoline were split open by the detonation of the bomb in A-318-A and the vapors were ignited immediately. The fire accelerated rapidly and spread aft through the tank space and other compartments aft of frame 25 above the tank deck. A strong draft, caused by the open bow doors and the open hatch, aggravated the fire. Reference (a) reported that an attempt was made to control the fire but that lack of pressure on the fire main, precluded effective measures. Although damage to the fire main was not reported, it is probable that it was ruptured in 2 places; at frame 37 and at frame 27. The fire spread up and aft. Photo 7 shows the forward portion of the after deck house structure and is evidence that the fire in this area was of moderate intensity. Ammunition carried on the main deck detonated from the heat. The after magazine, C-418-M, contained 3-inch ammunition which also detonated from the heat. This apparently was not a mass detonation but rather individual low order detonations as determined by fragment holes in the peripheries of this space. The fire in the after portion of the tank deck underneath the after deck house seems to have been particularly severe inasmuch as the main deck throughout this area sagged considerably. Intensity of the fire was due to burning gasoline stowed in this portion of the tank space. The fire in the forward part of the tank space does not seem to have been so severe although vehicles stowed there were ruined.

7. The low order detonations in C-418-M opened the shell in various places permitting water from the sea to flood C-418-M, the after peak tank and both shaft alleys. Fresh water tanks C-412-W and C-413-W were contaminated. It appears from the references that the main engine space was also flooded although the manner in which this space flooded was not reported. Reference (b) reported no damage or flooding in the auxiliary machinery space but did report fragment holes through the tank deck above. For this reason and because the ship was beached, it is apparent that the tank deck did not flood. The main engine space therefore must have flooded from aft through the shaft alleys.

8. At 1140, the ship was abandoned. At 1400, a destroyer put aboard a fire party and one portable pump and several small CO<sub>2</sub> extinguishers. It was decided that this equipment could not be employed with any hope of success against such an intense fire and it was not put into operation. The fire burned unabated until the afternoon of 26 September when the ship was reboarded and a portable fire pump was rigged and the fire finally extinguished. It probably had about burned itself out by this time.

9. The next day (27 September) LST167 was pulled off the beach and towed to Rendova. Later she was moved to Tulagi where she was stripped of usable equipment and then placed in service as a floating ammunition depot.

10. From the description of the damage in the references and the photographs, it appears likely that the bombs were of the 100 kg. G.P. type with about 115 pounds of explosive. Intelligence information indicates that the Japanese have such bombs although evidence of their use is meager compared to that which reveals that the 60 kg. G.P. and 250 kg. S.A.P. types are most frequently used against small naval targets.

11. This is another case of extensive damage caused by fire following the detonation of comparatively small bombs. It is possible that this fire could have been confined or extinguished prior to serious damage had the improvements discussed in Section II been available.

LST 334

BOMB DAMAGE

Solomon Islands  
1 October, 1943

Reference:

- (a) C.O. LST334 ltr. LST334 of 3 October, 1943, (Action Report).
- (b) C.O. VESTAL ltr. AR4/L9-3, Serial 038 of 29 October, 1943, (Repairs to War Damage).

Plate IX

1. At 0920 on 1 October, 1943, LST334 was attacked by enemy planes while being unloaded on the beach at Ruravai, Vella Lavella.
2. A bomb released from an altitude of approximately 300 feet (as estimated by observers) struck the main deck on the port side at about frame 25, passed down and forward through the ship and detonated below the hull. Reference (a) reported that a second bomb glanced off the port side and detonated in the water abreast frame 20, but VESTAL (AR4) reported that damage from only one bomb was found when LST334 was repaired.
3. The detonation was under the ship, possibly 15 feet to port of the centerline. The ship was beached at the time and detonation probably was within 2 or 3 feet of the bottom. The bottom shell was ruptured between frames 16 and 19, the fracture extending from the keel to just above the turn of the port bilge. The keel was deflected upward between frames 13 and 20, a maximum of 7 inches. The longitudinals and frames were ruptured and distorted in way of the damaged area. Butt welds in the starboard sheer and I strakes and in the starboard stringer strake, all in the vicinity of frame 19, were opened. The shell plating on the starboard side of the bottom was buckled and deflected upward between frames 17 and 18. The tank deck was pushed up on the port side between frames 16 and 19. Bulkheads bounding A-414-W were ruptured. The deck of A-312-A was bulged up. The elevator motor foundation was broken and the elevator guides were bent. There was some minor failure of welds in locations somewhat removed from the principal damage, probably as the result of whipping of the hull.
4. LST334 successfully retracted from the beach at 1421 and proceeded en route to Barakoma to join a convoy prior to returning to Purvis Bay, Florida Island. Another air attack was made on this ship at 1425 but no damage was sustained. After a brief stop at Purvis Bay, LST334 proceeded to Espiritu Santo.
5. At Espiritu Santo, the ship was drydocked in a floating drydock

(YFD21) and the battle damage was repaired by VESTAL (AR4). Repairs consisted of replacing and strengthening damaged structure and replacing damaged piping and wiring. VESTAL also completed overhaul of miscellaneous items not connected with battle damage. All repairs were completed by 27 October, 1943 and LST334 returned to service on that date.

6. The Commanding Officer estimated the weight of this bomb to be 100 pounds. It was dropped from a low altitude (300 feet), yet passed completely through the ship, detonating below the hull. Damage to the hull was fairly extensive. It is doubtful if a small thin-cased bomb could perform in this fashion. It seems more probable that this was one of the 250 kg. S.A.P. type with 133 pounds of explosive known to be used by the Japanese with long delay fuzes.

7. The structural damage was quite sharply localized, as is typical of under-the-bottom detonations, when in close proximity to the hull. Of some interest is the fact that damage to the ship girder as a whole was minor in nature, despite the location of the detonation beneath the flat bottom. Detonations located such as this are apt to induce whipping, or flexural vibrations, in the ship girder which, in some cases, will cause buckling of longitudinal strength girders in the vicinity of the midship section or quarter points, particularly in lightly constructed ships.

BOMB DAMAGE

Solomon Islands  
1 October, 1943

Reference:

- (a) C.O. LST448 ltr. LST448/A16-3 of 9 October, 1943, (Action Report).
- (b) Comdr. LST Group 15, Flot 5 ltr. LSTGR15/A16-3, Serial 0015 of 12 October, 1943, (Action Report LST Task Group).

Plate X

1. On 1 October, 1943, LST448 was beached at Vella Lavella, unloading her cargo of ammunition and gasoline. At 0936, the ship was attacked by three enemy planes. Three direct bomb hits and one near miss bomb were received during this attack and later in the day a fourth bomb hit was received.
2. One bomb (No. 1) struck the forward port corner of the 3-inch gun platform on the stern, passed through the main deck and detonated in the crew's quarters, compartment C-205-EL. A fire was started in this space and in the commissary store room. A second bomb (No. 2) struck the main deck just forward and to port of the cargo hatch. This bomb detonated on impact with the main deck. Fragments from this hit penetrated the tank deck over the auxiliary engine room. A third bomb (No. 3) detonated as it penetrated the main deck on the port side at frame 16. A fourth bomb was reported to have detonated in the water off the port bow but apparently did not cause any damage.
3. The detonations of bombs Nos. 2 and 3 ignited the cargo of gasoline and ammunition, and within a few minutes the fire engulfed the entire tank deck space. Fragments penetrated into the auxiliary engine room and caused considerable damage to the machinery. The shell apparently was ruptured also as this space flooded from the sea. Apparently, the main engine space also was damaged as the ship was without power. With no fire main pressure available, the fire spread unchecked. Exploding drums of gasoline and ammunition aggravated the fire. Ammunition in C-418-M detonated from the heat, and fragments perforated the adjacent decks, bulkheads and shell. At 0950, the ship was abandoned.
4. At 1130, LST485 came alongside and passed over seven hose lines to combat the fire. Portable gasoline-driven pumps were also employed. By 1400, when it appeared that the fire was being brought under control, preparations were made to take LST448 in tow. A second bombing attack developed, however, and another bomb hit the vessel, causing the fire to break out anew. This bomb (No. 4) pene-



trated the main deck to starboard of the cargo hatch at frame 21 and detonated in the tank deck space. Diesel oil tank A-418-F was ruptured. The ship immediately began to settle by the stern. Towing was thus impractical and the ship was abandoned for the second time.

5. On the morning of 2 October, some officers with a working party from LST448 returned to fight the fire and attempt to salvage the ship. Portable gasoline-driven pumps were used and by nightfall the fire was extinguished, although some piles of rubbish continued to smolder. Draft aft was 14 feet. On 3 October, work was begun to unwater the ship and to prepare for towing. During the morning of 5 October, BOBOLINK pulled LST 448 free and took her in tow, proceeding south toward Carter City. Freeboard was 3 feet at the stern. Progressive flooding, however, seems to have continued and she sank while in tow late in the afternoon, going down by the stern.

6. Detailed information concerning the extent of structural damage was not reported. Nonetheless, it is evident from the near success of salvage efforts that the bombs probably were small in size and weight. Officers present estimated them to be quite moderate in size. Probably they were of the 60 kg. G.P. type previously described and fitted with delay action fuzes.

7. Structural damage from the fire, as in the case of LST340, probably was equally as severe as that caused by the bomb detonations. The loss of all power precluded use of the fire main even in the unlikely event that it escaped damage from bombs Nos. 2 and 3.

8. Tactical considerations demanded that the ship be removed from Vella Lavella as soon as possible. It thus was not possible to make more thorough repairs prior to refloating. Possibly the augmentation of firefighting and pumping facilities discussed in Section II, had they been installed on this vessel, would have assisted in controlling the fire in its early stages and permitted more effective repairs in the limited time available. Of the LSTs damaged as the result of enemy action up to 7 December, 1943, LST448 was the only one actually to have been lost at sea.

BOMB DAMAGE

New Guinea  
4 September, 1943

Reference:

- (a) Extracts from LST473 War Diary of September, 1943.
- (b) ACTF ltr. dated 2 September, 1943, (Battle Damage Report).

Photographs Nos. 1 through 8

Plate XI

1. On 4 September, 1943, LST473 was a unit of the same task group which contained LST471, the torpedoing of which has previously been described. It will be recalled that this task group departed Milne Bay, New Guinea, early in the morning and proceeded en route on an assigned mission. The task group speed was 8 knots, and by early afternoon the task group was about 20 miles east of Morobe Harbor, New Guinea, in the Solomon Sea. LST473 was loaded with army vehicles and gasoline and was carrying a capacity load of troop passengers. The ship was in condition of Readiness II and material condition YOKE. At 1355, a formation of 18 enemy planes was sighted at an extreme altitude. General Quarters was ordered immediately and the ship went to flank speed with full right rudder. Some two minutes later about six dive bombers dove on LST473 and released their bombs. Two of these hit the ship and two were near misses. The near misses seem to have done no damage as they were not mentioned further in the references. Some two minutes after the hits were received six torpedo planes attacked. Six torpedo wakes were sighted somewhat abaft the port beam. Of the six torpedoes, one missed astern and another was observed to pass under the ship at about frame 10. Of the remaining four, one hit LST471, as previously described.

2. One bomb (No. 1) struck the navigating bridge deck just forward of the wheel house and inboard of the starboard 20mm gun. As nearly as can be judged, it penetrated a few feet prior to detonation. A hole was blown in the bridge deck (photos 1 and 2) over the Captain's cabin. The 20mm gun, with its shield, was practically destroyed (photos 1 and 2). The forward bulkhead of the wheel house was pushed in and all controls and compasses were wrecked. The starboard davits were twisted and made inoperable. The 20mm ready service boxes on the bridge deck were riddled by fragments (photo 3). The Captain's cabin was wrecked (photo 4).

3. The second bomb (No. 2) which hit the vessel struck the bridge deck between frames 37 and 38 about 6 feet inboard from the port side of the deck house. It penetrated the bridge deck leaving a hole about 11

inches by 16 inches, next passed through the main deck leaving a hole about the same size, and then went through the top of the cab and driver's seat of a truck on the tank deck and finally passed through the tank deck and detonated in C-413-W. Photos 5 through 8 show the holes on the various decks and the distortion which occurred to the tank deck between frames 38 and 41. It will be noted from photo 8 that the tank deck was ruptured on both sides of the tank space. A hole was blown in the bottom between frames 38 and 41 which extended transversely from about 3 feet to starboard of the keel around the girth up to the waterline on the port side. Some 10 compartments below the third deck and aft of frame 35 were opened to the sea.

4. Both propeller shafts were broken and the shaft bearings in the main engine space were damaged. The rudders remained intact. Main and auxiliary machinery were undamaged and neither space flooded.

5. Bomb No. 2, in passing through the truck on the tank deck, ruptured the gasoline tank and caused a small fire which was promptly extinguished with CO<sub>2</sub>.

6. About 2000 the same evening, LST473 was taken in tow by LST454 and towed to Morobe Harbor, New Guinea, where temporary repairs were made by RIGEL (AR11). The temporary repairs consisted primarily of removing shell plates, locking the shafts and removing the propellers, renewing the tank deck, patching bulkheads 38 and 41 and reenforcing the damaged side with a heavy longitudinal and supporting frames.

7. Prior to being taken in tow for Australia, she was given a slight permanent starboard list in order to lift the hole in the port quarter somewhat out of the water. Permanent repairs were completed in Australia, and LST473 was returned to service in a comparatively short time.

8. It was fortunate that the fire was extinguished promptly as LST473 was carrying a highly inflammable cargo which might well have resulted in the loss of the ship had a general conflagration occurred, as on other LSTs.

9. The bombs in this case probably were of the 60 kg. G.P. type with about 85 pounds of explosive which have been previously described.

BOMB DAMAGE

New Guinea  
12 September, 1943

Reference:

- (a) ACTF ltr. of 17 September, 1943, (Report of Damage).
- (b) Comdr. Service Force Seventh Fleet ltr. LST/L11-1, Serial 00314, of 25 September, 1943, (Report of Damage and Repairs).

Photographs Nos. 1 through 7

Plate XII

1. At about 1100 on 12 September, 1943, LST455 was attacked by enemy planes while anchored at Morobe Harbor, New Guinea. The ship had received an air raid alert from a shore station and had gone to General Quarters several minutes prior to the attack. Three bombs were released from an altitude of 300 feet. One fell on the shore about 100 yards off the bow; one detonated in the water off the port bow and one struck the ship abaft frame 41 about 14 feet to port of the centerline. It passed through the bridge deck and the main deck and then detonated just above the second deck in compartment C-205-EL.
2. A fire was started in the crew's quarters which spread up to the galley on the deck above. The gasoline drums (ships service) stowed in the rack on the port side of the fantail split open from the heat and aggravated the fire. In 15 minutes, the fire was under control and in 35 minutes it was extinguished. Probably the drums were dumped over the side. This was a noteworthy performance inasmuch as the fire main was broken aft of frame 41.
3. In penetrating the decks, the bomb made a hole in the bridge deck (photo 1) approximately 11 x 26 inches and in the main deck (photo 2) approximately 14 x 18 inches. A hole was blown in the second deck (photo 3), roughly 8 feet in diameter, centered about 10 feet aft of frame 41 and 4 feet to the port of the centerline. Bulkhead 41 (photo 4) was blown forward, and ruptured at the bottom on the second deck; it was also deflected forward on the third deck. All doors in this bulkhead on the second deck were blown out. The main deck (photos 6 and 7) was bowed upward a maximum of 44 inches from frame 41 to the stern. Across the stern, the main deck was pulled way from the shell (photo 5). The boat deck was raised aft of frame 41. The two upper strakes of the shell were deflected outboard between frames 41 and 51 on both the port and starboard sides. The second deck was

deflected downward. Stanchions were pulled away from the main deck. Fragmentation damage was extensive. The third deck in way of the blast was penetrated in numerous places.

4. The steering gear suffered minor damage but was later repaired. The fire main and other pipe lines aft of frame 41 were damaged. The degaussing cable and other electrical circuits were destroyed aft of frame 41 on the second and main decks. The after 3-inch gun was raised slightly and damaged by fire. The stern anchor engine and winch were not damaged although foundations were misaligned by distortion of the main deck. The stern anchor dropped off.

5. Apparently, the hull below the waterline and the fresh water tanks were undamaged. There was some leakage of water into the shaft alleys, presumably through the stern tube glands.

6. After damage, the ship was towed to Milne Bay by SONOMA (AT12) where emergency repairs were accomplished by RIGEL (AR11). These repairs consisted of renewing bulkhead 41, installing stanchions between the main and second decks, installing temporary plates on the main deck aft and repairing the steering engine.

7. LST455 then proceeded to Australia under her own power where permanent repairs have been made. She was then returned to service.

8. Observers estimated the bomb to have been about 300 pounds in weight. Judging from the size of the penetration holes in the bridge and main decks and the extent of damage it seems probable that the bomb was of the 100 kg. G.P. type, with a diameter of about 10 inches and which is believed to contain about 115 pounds of explosive.

LST 313

BOMB DAMAGE

Sicily  
10 July, 1943

Reference:

- (a) C.O. LST313 ltr. of 19 July, (Action Report and War Diary).

Plate XIII

1. On 8 July, 1943, LST313, as a unit of a task force, got under way and proceeded toward Sicily. On 10 July at 0125, the locale of landing operations was reached and the ship stood by and waited for orders to beach.

2. The cargo consisted of LCV(P)s in davits, DUKWs, trucks, jeeps, half tracks, ambulances and some 37mm guns. All vehicles were gassed. The trucks were loaded with equipment, ammunition and land mines.

3. Fifteen DUKWs and two LCV(P)s were launched during the day. At 1830, the ship was beached about 300 yards from the shore. At 1835, a bomb struck the main deck on the port side at about frame 20. The bomb passed through the main and tank decks and detonated in a void ballast tank at about frame 18, slightly to the starboard of the centerline. The detonation of the bomb was followed almost immediately by a second explosion on the tank deck which was reported to have been a low order detonation of land mines loaded on some trucks. Fires immediately broke out and were rapidly spread by gasoline in the trucks. Subsequent explosions of land mines and ammunition added to the damage and confusion. The fire main was fractured by the initial explosion and consequently no water was available to fight the fires.

4. The successive explosions demolished decks and other structure over a large area. Reference (a) stated that equipment and personnel were thrown in the air high above the ship.

5. The fires accelerated rapidly and soon the ship was one blazing conflagration from bow to stern. By 1850, the ship was completely abandoned and left to burn out. All salvageable equipment has been removed from the hulk and LST313 has been stricken from the Navy Register.

6. The actual structural damage caused by the detonation of the bomb seems to have been relatively minor. The fire in the highly

inflammable cargo burned for several days and left the ship a useless hulk. This was the worst LST fire on record in the Bureau. It is improbable that any firefighting facilities would have been adequate in such a situation where the cargo is so highly inflammable that any fire, once started, is apt to spread with uncontrollable rapidity.

LST 3

BOMB DAMAGE

Sicily  
6 August, 1943

Reference:

- (a) C.O. LST3 ltr., Serial 101 of 10 September, 1943,  
(War Damage Report).
- (b) C.O. LST3 ltr., Serial 121 of 10 September, 1943,  
(War Damage Report).
- (c) War Diary of LST3 for Period 6-12 August, 1943.

Plate XIV

1. On the afternoon of 6 August, 1943, LST3 was beached approximately two miles west of San Stefano, Sicily, preparatory to loading troops and DUKWs. At 1520, a single plane made an attack from the starboard beam.
2. One bomb struck an LCVP (moored alongside on the starboard quarter) and then apparently passed into the hull somewhat below the waterline at about frame 40. It then detonated in or adjacent to the starboard shaft alley.
3. The force of the detonation lifted the stern and caused the ship to float free of the beach. The port engine was turned over and found operative and the ship went ahead at 1/3 speed until the bow beached again.
4. Structural damage aft in the vicinity of the detonation was severe. Compartments below the third deck aft of frame 35 flooded almost immediately and the ship settled gradually by the stern. The main engine room flooded at a somewhat slower rate, presumably through ruptures in the after bulkhead on the starboard side.
5. The 250 g.p.m. fire and flushing pump in the auxiliary engine room, the handy billy pumps and the submersible pumps were put on suction in the main engine room and the port shaft alley but the flooding could not be controlled. It was then decided to attempt to broach the ship. The stern anchor cable was cut and the bow cable was secured to concrete piling on the beach. With the assistance of four LCVPs and LCT31, LST3 was broached at about 2100.
6. Information was received that no salvage vessel would be available for several days, and in view of the severe damage to LST3, it was decided that the ship should be stripped of all salvageable material. Stripping was begun by the ship's company on 8 August. On 13 August, the salvage vessel NARRAGANSETT (AT88)



arrived and began salvage operations. At this point stripping was discontinued.

7. A diver from NARRAGANSETT was put over the side to examine the damage to the underwater body. It was reported that the shell below the shaft alleys was buckled and a crimp approximately 18 inches wide extended across the bottom of the ship. The deck in C-305-AE was blown up and ruptured. The starboard bulkhead of the tank deck was buckled from the after end forward to frame 38 and was torn away from the deck at the bottom. The hole in the tank deck extended from the after end (frame 41) forward to frame 38 and from the starboard bulkhead inboard to the centerline. The third deck aft of frame 41 was raised on the starboard side. There was considerable damage to the structure between the second and main decks aft of frame 41.

8. The main deck in way of the after deck house was buckled. Considerable flexural vibrations seemed to have occurred inasmuch as a deep wrinkle was formed across the main deck, extending from frame 25, starboard side, to frame 28 on the port side. Both the port and starboard stringer strakes were cracked open at the outboard sides. Deep wrinkles extended down the port and starboard sides. Both sheer strakes were cracked at the top in way of the buckles. It will be noted from Plate XIV that the main deck wrinkle extended across the deck between the two ventilators at frame 26-1/2.

9. The shell buckles seem to have extended down to the bottom and possibly inboard beyond the turn of the bilge on both sides inasmuch as A-422-F (port) and A-423-F (starboard) were contaminated, apparently as the result of cracks in the shell.

10. There was considerable shock damage to such widely separated equipment as the port bow door operating gear, the stern anchor winch and radio equipment.

11. After minor repairs to the auxiliary engines, construction of a concrete dam 8 feet high across the tank deck at frame 35, and unwatering of several spaces aft by NARRAGANSETT, the ship was floated and towed to Palermo, Sicily. Inspection at Palermo indicated that it was worthwhile to repair LST3 and further repairs were undertaken to make her seaworthy for towing to North Africa where permanent repairs were undertaken at Oran.

12. The references reported that the bomb detonated outside the vessel on the starboard quarter. It is apparent from the details of the damage which were included in the references, however, that the bomb must have detonated within the ship. The Commanding Officer estimated the bomb to have been about 500 pounds in weight. From the extent of damage and data on German bombs, it appears probable that this bomb was at least a 250 kg. G.P. type (sometimes classified as S.C., or thin-walled) with an explosive charge of about 250 pounds. This type of bomb has been used on numerous occasions by the Germans against shipping in the Mediterranean.

13. Flexural vibrations of the hull appear to have been severe, as manifested by the deep wrinkles in the main deck and sides in the vicinity of the midship section. Such damage is usually associated with under-the-bottom detonations, and it is possible that in this case the detonation actually was beneath the bottom rather than where it is indicated on Plate XIV. Nonetheless, the structural damage reported is rather strong evidence that the detonation actually occurred within the ship rather than below the ship. Possibly the fact that LST3 was beached, at the time, had some effect on the violence of the vibrations induced in the ship girder. A heavy reaction at the fore-foot, when beached, quite possibly would tend to increase the amplitude of any hull vibrations set up in the hull girder.

14. Repairs, both by NARRAGANSETT and at Palermo, probably included reenforcement of the ship girder in way of the buckles and cracks, although such was not reported. Otherwise, the journey across the Mediterranean possibly might have resulted in further damage to the hull.

LST 318

BOMB DAMAGE

Sicily

7,9 & 10 August, 1943

Reference:

- (a) C.O. LST318 ltr. LST318/00 of 13 August, 1943, (Action and Damage Report).
- (b) ACTF ltr. of 20 August, 1943, (Action and Damage Report).

Plate XV

1. LST318 was one of a group of landing craft at San Stefano, Sicily, which had been designated to participate in a "leapfrog" landing behind enemy lines. At 1250 on 7 August, 1943, prior to loading army equipment and troops and while under way some two miles off the beach at San Stefano, the ship was attacked by enemy bombers.
2. One bomb landed in the water 100 yards off the starboard bow without causing any damage. A second bomb (No. 1 on Plate XV) struck the water about 15 yards off the port beam. This resulted in the shell being pushed in on the port side to a depth of about 2 feet, the area of indentation being roughly 6 by 15 feet, centered at frame 19. The tank deck was deflected up about 9 inches over a comparable area in the same vicinity. There were two fragment holes in the shell on the port side at frame 19 just below the waterline. Tanks A-414-W, A-415-W and A-416-W were flooded from the sea through the fragment holes and some open seams. A number of pipe lines and electrical leads were broken. It was reported that both fire and bilge pumps were disabled although details of the failures were not given. Despite this damage LST318 participated in successful landing operations at Caronia, Sicily, on 8 August.
3. At 1705, on 9 August, while retiring to the westward at full speed about a quarter of a mile off the beach at Caronia, LST318 was attacked again by enemy planes, this time by three Focke-Wulf fighter bombers. The first bomb detonated in the water about 20 yards directly ahead, causing no material damage but sending up a column of water which completely drenched the two forward 20mm guns. This prevented the forward guns firing while the next two planes attacked. A second bomb (No. 2 on Plate XV) detonated from water impact just 3 feet off the starboard quarter, and a third bomb (No. 3 on Plate XV) landed 6 feet astern, both bombs falling close in succession. The ship was also strafed during this attack.
4. The rudders were jammed at full left. The steering engine room and steering machinery were badly damaged. Both shaft alleys

flooded rapidly. Drain lines in the shaft alleys were ruptured. The main engine space flooded at a rate faster than the fire and bilge pumps could match. The biggest leaks were around and through the shaft bulkhead stuffing boxes in bulkhead 35.

5. The ship whipped violently. At frame 22, a buckle was formed in the port shell plating and in the main deck plating. A welded deck seam was torn open for a length of about 10 feet. Another buckle was formed at the starboard after corner of the cargo hatch on the main deck. This buckle extended across the deck and down the starboard side.

6. An attempt was made to beach the ship, but the bow grounded on rocks a considerable distance off the beach. Next, an unsuccessful attempt was made to let the vessel broach. At 1930, the tank deck commenced flooding through the starboard escape hatch from the starboard shaft alley. The escape hatch had been so badly distorted that it could not be made watertight. At 2115, it was necessary to abandon the main engine space for at that time water was over the floor plates and continuing to rise slowly. At about 2130, the auxiliary engine space began taking water. Reference (a) reported that the water came through ventilation ducts from the main engine space. As will be discussed later, this report was somewhat inconsistent with a statement, also contained in reference (a), to the effect that at 10 minutes past midnight the main engine space had about 8 feet of water in it. In any event, it became necessary to abandon the auxiliary engine space because of flooding. Sometime after midnight the tank deck had 5 feet of water at the after end. By 0330, 10 August, the stern had settled on the bottom.

7. At 0700 the next morning, the ship was attacked again, this time by three planes. Two bombs were wild but a third (No. 4 on Plate XV) was a close near miss to starboard in the water abreast the electrical and machine shop A-311-E on the third deck. A hole about 18 feet in diameter and another about 10 feet in diameter were blown in the starboard shell and in the third deck, respectively. At 0930, LST318 was abandoned.

8. The ship subsequently was inspected by a salvage officer from Palermo and it was decided that the hull was not worth salvaging. Accordingly, NOB Palermo was directed to strip the ship of all removable machinery and equipment for shipment to the landing craft base at Bizerte. This was done and LST318 has been stricken from the Navy Register.

9. Observers estimated that each of the bombs which caused damage to LST318 was about 500 pounds in weight. Although none actually struck the ship, the four shown on Plate XV were all extremely close near misses and two caused large-scale ruptures of the shell. On the basis of the damage done, it is believed that they were no smaller than the 250 kg. bombs of the G.P. type, known to have been employed by the Germans against smaller types of shipping.

10. Bombs Nos. 2 and 3 caused severe whipping, or flexural vibrations, of the hull. This is to be expected in lightly constructed ships when subjected to detonations of moderate-sized, or larger, charges at either the bow or stern.

11. It was unfortunate that the main engine space flooded after near misses Nos. 2 and 3. The two fire and bilge pumps (total capacity 500 g.p.m.) were in operation at this time (they had been disabled two days prior to this attack), but were unable to control the flooding, which seems to have been at a moderate rate. Had the capacity of the ballast pumps been available for drainage, it is possible that LST318 might have been saved. Partly as a result of this case, the alteration (described in Section II) which will permit the two ballast pumps (with a total capacity of 3000 g.p.m.) to be used for drainage, was authorized.

12. It was reported (see paragraph 6) that the auxiliary engine space flooded from the main engine space through inter-connecting ventilation ducts. No details were given. It is noted, however, that the two spaces are not inner-connected by ventilation ducts, although the two ducts which supply the auxiliary space do traverse the main space. These two ducts, however, are of heavy watertight construction with no branch openings in the main engine space. In the absence of direct damage in the main engine space, it is difficult to conceive how flooding of the auxiliary engine space could occur via this means, particularly in view of the report that the main engine space had only 8 feet of water (total depth of this space is 9 feet -9 inches) some time after midnight. It is more probable that flooding of the auxiliary engine space occurred through ruptures of the shell caused by grounding on a rocky coast. In this connection, it will be recalled that the ship had been aground for about two hours before the auxiliary engine space started to flood, and that during this interval an attempt was made to let the ship broach.

## LST 399

### PROJECTILE DAMAGE

Mono Island, Solomon Islands  
26 October, 1943

#### Reference:

(a) C.O. LST399 ltr. of 30 October, 1943 (Action Report).

#### Plate XVI

1. LST399 loaded at Kukum Beach, Guadalcanal, on 24 October, 1943, in preparation for amphibious operations at Mono Island, off the southern tip of Bougainville. Her cargo consisted of army trucks, self-propelled guns, boxes of ammunition, and cans of gasoline. She arrived off Mono Island early in the morning of 26 October and was beached at about 0730.
2. Immediately after beaching, small arms fire was directed at the ship from an enemy pill box not more than 100 yards from the bow. The small arms fire did no damage to the ship, but made unloading hazardous until the pill box was silenced.
3. At about 0800, the vessel came under fire of an enemy 3-inch mortar battery. The first projectile hit the ship shortly after 0800. This projectile (No. 1 on Plate XVI) struck the port side at frame 30 between the main and second decks. It detonated upon impact, blowing a hole approximately 3 by 4 feet in the shell plating. Fragments started a small fire in the bedding in troop berthing compartment B-202-L. This fire was extinguished promptly, using hand extinguishers.
4. About 10 minutes later, another mortar projectile (No. 2 on Plate XVI) struck the main deck just abaft the elevator. It struck a dismounted 40mm gun and detonated upon impact. A second small fire was caused, but this was also extinguished promptly using CO<sub>2</sub> extinguishers.
5. Unloading continued, although rather slowly due to the ship being under fire and to the small number of trucks available. At about 1120, another shore battery took the vessel under fire. This battery apparently was a light field artillery battery using field guns of about 75mm in caliber. This battery was not more than 500 yards on the port bow when it commenced firing. About 5 minutes after opening fire, it scored two hits (Nos. 3 and 4 on Plate XVI) on the port side, one in way of troop berthing compartment A-208-L, slightly above the second deck, and the other in way of the capstan control room A-204-AE, also above the second deck. Both projectiles detonated upon impact, blowing holes in the shell plating about 2 to 3

feet in diameter. A fire was started in A-208-L, but again prompt action extinguished it within a few moments. The capstan control room seems to have suffered no damage beyond a fourth small fire which also was promptly stamped out. Structural damage from both of these hits was relatively minor although several electrical cables, including the degaussing coils, were severed.

6. Almost simultaneously with hits No's. 3 and 4, the same shore battery struck an ammunition dump on the beach, just in front of LST399, and ignited the ammunition. This fire was of considerable proportions, and heat from it blistered the paint on the shell at the bow and caused several small fires to break out in cargo stowed on the main deck which had not yet been unloaded. These fires were extinguished using hose streams. As a further precaution, the forward magazine was flooded through the sprinkling system.

7. Because of the burning ammunition dump and also because LST399 was still within range of enemy guns, the ship was moved. After retraction she beached again some distance away. Unloading proceeded all during the afternoon, and at nightfall she retracted. Joining a convoy she stood south for Guadalcanal. At about 2130, the convoy was attacked by enemy planes. One bomb missed and detonated upon water impact about 50 yards off the port quarter, and another one missed and detonated about 30 yards off of the port beam. The detonation of both of these bombs shook the ship considerably, but no shock damage resulted. Fragments, however, did penetrate the shell in a few places and also cut the radio antenna, the forestay, and the jackstaff.

8. After arrival at Guadalcanal, the structural damage was repaired, and severed cables were renewed. She was returned to service within a few days.

9. Actual damage in this case was relatively minor. Yet, the case serves to illustrate the operational hazards to which these ships are subjected, and also how prompt action serves to reduce this hazard. LST399's cargo was of a highly inflammable character, and several minor fires were started. Yet, all were extinguished without serious damage and before there was any possibility of their getting out of control.

BOMB AND PROJECTILE DAMAGE

Salerno, Italy  
9-10 September, 1943

Reference:

- (a) C.O. LST375 ltr. XX075/A-4/A9, Serial 099, of 18 September, 1943, (Action Report).
- (b) C.O. LST375 ltr. X1075/A-4/A9, Serial 0100, of 18 September, 1943, (Damage Report).

Photographs Nos. 1 through 8

Plate XVII

1. LST375 was a unit of a task group which participated in the amphibious operations at Salerno, Italy. To this end early in September, 1943, she was loaded at Bizerte with a cargo of tanks, trucks, ammunition and gasoline, and with the necessary troops to operate the vehicles. At dawn on 9 September, she started the approach to her assigned beach. Friendly destroyers had interposed a smoke screen between the wave, of which LST375 was a part, and the beach.
2. At 0705, LST375 passed clear of the smoke screen and headed directly toward the beach at full speed. At this point, about 1-1/2 miles from the beach, she was taken under vigorous fire by enemy shore batteries. These batteries were comprised principally of 88mm guns, although some minor caliber guns were also firing. Between 0710 and 0715, the ship was struck by two 88mm projectiles on the starboard side above the waterline. She continued to proceed to the beach and, almost at the instant the stern anchor was let go, an enemy bomber appeared overhead and dropped one bomb. This bomb was a near miss astern, and the detonation shook the ship quite violently, but did no other damage.
3. At 0715, the ship was firmly beached and the ramp was dropped on dry sand. The ship was still under fire from shore batteries as unloading commenced. Unloading was quite slow due primarily to congestion on the beach head. Between 0715 and 0900, at least six more hits were received and numerous shorts and overhead bursts caused considerable minor fragment damage. A gasoline vapor fire on the main deck was started, but fortunately was extinguished by energetic action on the part of the crew. Before the tank deck was completely unloaded, fragments severed the elevator hoisting cables, thus precluding unloading the main deck. At about 0915, the ship retracted without difficulty and passed out into the anchorage area.



4. When anchored, a jury rig was fitted to the elevator and a few trucks were lowered to the tank deck before the temporary cables parted under the weight of a heavy truck.

5. During the late afternoon the ship returned to the vicinity of the beach and stood by waiting to be called in to complete unloading. This did not occur, and at nightfall she moved further out into the gulf where she anchored again. At about 2130, an air alert was received and the ship went to General Quarters. Several planes attacked the anchorage and these released many bombs. One of these struck LST375 aft on the main deck at frame 48, just inboard of the port side. This bomb passed completely through the vessel and detonated well below the stern of the ship. The detonation caused a violent upward surge of the ship at the stern and a sharp shock to the ship as a whole. However, no general flexural vibrations of the hull seemed to have occurred as none was reported and no damage resulted from this source. Beyond flooding of the after peak tank through the hole in the bottom caused by the passage of the bomb, inspection did not reveal any other damage.

6. At dawn the next morning, the ship got under way and beached again in the same area. While under way a rather severe vibration of the port shaft was noted (later inspection revealed that this shaft had suffered a considerable misalignment). While on the beach the tank deck was completely unloaded. The references indicate that the ship was not under fire during this second period on the beach. Considerable difficulty, however, was encountered in retracting and required several LCI(L)s, some small tugs and finally the NARRAGANSETT (AT88) to pull her off. She then proceeded back to the anchorage area where she went alongside LST311 where the remaining vehicles and cargo on the main deck were transferred to the main deck of that vessel. Upon completion of the transfer LST375 got under way and returned to Bizerte with other vessels. At Bizerte she received permanent repairs and has been returned to service.

7. From the photos and Plate XVII, it can be seen that LST375 was quite badly battered. She received at least 8 projectile hits and one bomb hit. In addition to these, numerous shorts and overhead bursts caused extensive fragment damage to the sides and topside structures. Nonetheless, the minor nature of all damage received is quite surprising, particularly in view of the fact that she was subjected to accurate gunfire from shore batteries for a period of more than two hours.

8. The 88mm projectiles apparently were the common type fitted with impact fuzes. The holes blown in the shell were about 4 to 5 feet in diameter. The A frame supports for Nos. 2 and 3 davits were almost completely severed by direct hits (photo 5). Wire cables for all of the davits were severed by fragments as were the elevator hoisting cables. Numerous electrical circuits below the main deck were severed, including the degaussing coils. The shell above the waterline on both sides was pierced in numerous places by fragments which in many instances penetrated through the longitudinal bulkheads bound-

ing the tank space.

9. Shock damage from the single bomb hit was rather severe. The majority of fuel, lubricating oil and water gauges and all tachometers were damaged. The tachometers and some of the gauges were repaired and recalibrated by the ship's force. Many supporting brackets, instruments, and equipment were carried away by shock. The radio equipment seems to have stood up very well as no damage to it was reported. Much of the rigging and the radio antenna were severed by flying fragments.

10. LST375 was subjected to intense and accurate gunfire for a period of more than two hours while she was beached. It is difficult to conceive of conditions more favorable for maximum damage from gunfire attack than these. Notwithstanding, the damage suffered by LST375 was quite minor with the exception of the damage to the elevator which prevented her from promptly unloading her main deck cargo. It is particularly noteworthy that no fires of any consequence occurred. It is apparent from the record that the crew was well trained in damage control and firefighting techniques.

PROJECTILE DAMAGE

Salerno, Italy  
9 September, 1943

Reference:

- (a) C.O. LST336 ltr. of 14 September, 1943, (Action Report).
- (b) C.O. LST336 ltr. of 14 September, 1943, (Report of Damage).
- (c) C.O. LST336 ltr. AR9/L11-1/A16-3(026) of 17 September, 1943 (War Damage Report).

Photographs Nos. 1 through 10

Plate XVIII

1. LST336 participated in the amphibious operations at Salerno, Italy, in September, 1943. Like LST375, damage to which previously has been described, LST336 was loaded with troops, army vehicles, ammunition, and gasoline at Bizerte during the first week in September. She arrived off the invasion beaches in the early morning hours of 9 September, 1943. As also happened to LST375, she was taken under fire as she approached the beach. The enemy shore batteries were comprised principally of 88mm guns. In spite of vigorous and well directed fire from the enemy batteries, LST336 successfully discharged her tank deck cargo. While on the beach eleven 88mm projectiles and numerous smaller caliber projectiles struck the vessel. Some of the latter struck the vehicles stowed on the main deck causing some damage to the cargo. Structural damage to the ship was extensive, as will be noted from the photos and Plate XVIII.

2. The beach was closed before the main deck cargo could be unloaded, and LST336 retracted some time before noon. She retired to the anchorage area where a part of the main deck cargo was transferred to an LCT. The remainder of the main deck cargo was transferred the following morning, 10 September, to another LCT. LST336 then returned in convoy to Bizerte.

3. Damage to the ship was widespread. Two projectiles (Nos. 1 and 2 on Plate XVIII) passed through the port shell plating and wrecked the capstan control room, A-204-AE. Many electrical cables were cut, including the degaussing coils. Another projectile (No. 3) penetrated the shell on the port side at frame 12 and detonated in troop berthing compartment A-206-L (photo 2). The deck and bulkheads of this compartment were riddled with fragments. The degaussing coils were also severed. Another projectile (No. 4) detonated upon impact with the port shell at bulkhead 19 (between compartments A-210-L and A-212-L, photo 3). In A-212-L, a 6-inch diameter ventilation

duct was fractured. Many electrical cables were pierced in the two affected compartments. Still another projectile (No. 5) pierced the port shell and detonated in storeroom A-314-A. Fragments from this projectile pierced the deck (the top of ballast tank A-416-W).

4. The only projectile to cause underwater damage was No. 6. This one passed through the port shell about 3 feet below the waterline and 5 feet forward of frame 22. It was deflected sharply aft when it struck the bulkhead separating A-416-W and A-420-F. It penetrated the longitudinal bulkhead between A-420-F and A-418-F at bulkhead 25. It apparently exploded with a low order detonation in A-422-F where it was found intact except for the nose (see photo 10). This hit resulted in flooding of ballast tank A-416-W and contamination of A-420-F, A-418-F and A-422-F. A-420-F was almost empty when this occurred, and the filling of this tank and A-416-W resulted in a list of about 2 degrees to port when the vessel retracted.

5. Hit No. 7 passed through the port shell just abaft frame 25 and just below the main deck, and detonated in compartment A-216-L where several cables were severed and some piping was fractured (photo 5).

6. Hits Nos. 8 and 9 wrecked the chart house and demolished the radio room. The magnetic compass was badly damaged by fragments.

7. Hit No. 10 pierced the port shell abaft frame 38 below the second deck and detonated in compartment C-304-A (photo 7). Steam lines were fractured and electrical cables were severed in this space. Hit No. 11 struck the after davit for the No. 2 boat at the base and detonated upon impact, blowing a hole in the main deck at the base of the davit (photo 6). The degaussing coils were again cut and the steam line under the main deck was demolished.

8. All of the hits described above were obtained with 88mm projectiles, judged by the damage which was reported in the references, and by the fact that the enemy batteries were later identified as comprising 88mm field guns. In addition to the hits described, there were numerous others from smaller caliber guns which punctured the shell above the waterline in many places on the port side. Many vehicles stowed on the main deck were damaged by 20 and 37mm projectiles and by fragments from 88mm projectiles which burst in the air overhead.

9. It is evident from the damage described above that the Germans were employing 88mm (3.46 inches) projectiles with various fuze settings. The projectiles were somewhat similar to our 5-inch AA projectiles (see photo 10). Some projectiles detonated up impact, others penetrated a few feet prior to detonation, while at least one (No. 6) traveled about 30 feet from the point of impact to the point where it detonated low order:

10. No fires were reported, which is somewhat remarkable in view of the fact that main deck vehicles were reported to have been damaged. As in the case of LST375, the minor nature of the damage is surprising when it is considered that the ship was under fire for an extended period while stationary on the beach. The damage was repaired in a very short time and the ship returned to service.

## LST 396

### LOSS BY FIRE AND SINKING

Solomon Islands

18 August, 1943

#### Reference:

- (a) C.O. LST396 ltr. LST396/L11-1 of 22 August, 1943, (Casualty Report).
- (b) Comdr. LST Group 4 (Flot 5) ltr. A16-3, Serial 070, of 31 August, 1943, (Casualty Report - First End. to LST396 ltr. LST396/L11-1 of 22 August, 1943).

1. The loss of LST396 was not the result of enemy action. Such cases as this normally would not be discussed in a war damage report, but because the fire which destroyed LST396 was typical of the hazard to which LSTs are frequently subjected the case is described here as a matter of importance from the standpoint of fire protection and damage control.

2. On 17 August, 1943, LST396 beached with other LSTs at Barakoma, Vella Lavella and commenced unloading. Very little progress had been made when orders were received to retract and retire toward Rendova. The cargo remaining aboard on the tank deck consisted of 400 drums of aviation gasoline, 400 drums of diesel oil, and 100 tons of 90 and 155mm ammunition. In addition, the main deck was loaded with other cargo, some of which was inflammable. During the afternoon of 17 August the convoy of which LST396 was a part was subjected to numerous air attacks, but no damage was sustained by LST396. The next morning the convoy again was attacked several times by enemy planes, and again LST396 was undamaged. At about 1500, approximately 4 hours after the last air attack, orders were received to return to Barakoma. The convoy reversed course and began the return journey.

3. At 1515, a heavy dull explosion occurred aboard LST396. It seemed to be located deep within the vessel on the port side. Two subsequent explosions followed closely, but these seemed to be of lesser intensity than the first. Fire broke out on the tank deck and quickly engulfed the entire tank space. The ventilators served as huge torches, flames shooting high out of the tops. Lesser explosions continued with increasing frequency. A few minutes later the ship was abandoned. Despite the rapid spread and intensity of the fire, the ship was abandoned with no casualties. Approximately 30 minutes after the initial explosion an extremely heavy explosion occurred, accompanied by flames several hundred feet in height. This explosion blasted out the after section of the main deck with the after deck house. Subsequent heavy explosions blew out the sides of the

hull. About one hour after the first explosion the hulk, burning furiously from end to end, sank.

4. The references advance the following theories as to the cause of the initial explosion:

- (a) A delayed-action bomb, or
- (b) A torpedo, or
- (c) A gasoline vapor explosion.

5. There is little in the references and reports of other ships in convoy to substantiate the theory that a delayed-action bomb caused the initial explosion. This theory seems to be based on statements by a few of the crew (no details are given in the references) who reported seeing a hole in the main deck, although the location of this hole was not specified. It is a fact, however, that the initial explosion did not rupture the main deck. It also seems incredible that the bomb could have struck the vessel and remained unnoticed for four hours, the interval from the last reported air attack on the vessel.

6. The theory that a torpedo detonation was the first explosion also does not appear to be plausible. Several cases of torpedo damage to LSTs are described in this report and in each of these the main deck has been ruptured over a rather large area, as is to be expected in the case of vessels of light construction and shallow depth of hull. The main deck was not ruptured by the initial explosion, and there were no casualties from the first explosion. Furthermore, the convoy was well escorted and there were no reports of suspected submarines in the vicinity of the convoy on this particular day, which was clear and bright.

7. Personnel on watch in the engine room reported that, "the access plate between the port shaft alley and the engine room" was blown forward into the engine space. There is no access plate in this bulkhead (No. 35). The plate referred to apparently was the bolted plate containing the shaft stuffing box. This indicates rather clearly the location of the source of the initial explosion, and coupled with other reports, is evidence that it occurred deep within the vessel on the port side. The absence of casualties to personnel in the crew's living space on the second deck aft is a further indication that the initial explosion was deep within the vessel and that it was not comparable in magnitude to that of a torpedo warhead.

8. The type of cargo was such that it was almost inevitable that some gasoline had leaked onto the tank deck. If this occurred, and the escape scuttle from the port shaft alley (the scuttle is located in the after port corner of the tank deck under the ladder to the second deck) was opened, gasoline vapors could easily have accumulated in the port shaft alley. The two electric-driven fresh water pumps, automatically controlled, are located in the port shaft alley and unquestionably would have provided a source of ignition. It thus appears that a gasoline vapor explosion in the port shaft alley is the most probable cause of the initial explosion.

9. While this incident was being investigated, another LST report, in which it was definitely established that a gasoline vapor explosion had occurred in the port shaft alley, was received. On 1 January, 1944, LST446, while discharging cargo at Cape Torokina on Bougainville had a gasoline vapor explosion in the port shaft alley. The principal cargo on this vessel was aviation gasoline in drums. During the unloading process six empty drums had been found, and liquid gasoline was observed on the deck. All possible precautions had been taken during the unloading to prevent a gasoline vapor explosion on the tank deck. These precautions included running the tank deck ventilation fans, washing down the deck with fire hoses, and draining off the free gasoline. The tank space had been well cleared of fumes. However, there was a high concentration of gasoline fumes in both shaft alleys. The shaft alleys are not provided with means of ventilation and it appears probable that the crew was attempting to air them out by opening the escape scuttles in the after end of the tank deck, after the latter presumably had been cleared of fumes. At about this point in the operation, the vapor explosion occurred in the port shaft alley. On this vessel, fortunately, there were no further explosions.

10. It thus appears that the casualty to LST396 could well have been similar to that in the case of LST446.

11. In carrying cargo gasoline in drums on the tank deck of LSTs it is almost inevitable that leakage will occur either through loose caps on the drums or physical damage to the drums. The ventilation system for the tank space is adequate under normal circumstances to clear this space of fumes. However, with dense loading of packaged cargo it is possible that heavy fumes, such as gasoline vapor, may not be completely exhausted, particularly from crevices between the piles of cargo at or close to the deck. There is no remedy for this situation except vigilance and the hazard is almost certain to be present when large quantities of gasoline are carried in drums or other metal containers.

12. The presence of escape scuttles in the tank deck is a menace, and in November, 1943, instructions were issued for them to be removed, and further recommendations that this be done at the earliest practicable opportunity were issued in April, 1944. If the scuttle is removed, a major source of danger will have been eliminated.

13. There is another but less probable cause of accumulation of gasoline vapor in the shaft alleys. This is through the drainage system from the tank deck in the event that check valves in the drainage lines are not properly seated, in which case it is possible that liquid being drained from the tank deck can back up into the bilges of the shaft alleys. The check valves in the drainage lines should be periodically checked to insure that they are in proper operating condition.

14. Danger of gasoline leakage when the cargo contains gasoline



in drums or containers should be recognized. Particular care should be taken with the stowage of gasoline drums or containers in order to avoid damage which might result in leakage. Thorough familiarity with the dangerous characteristics of gasoline is possibly the most effective means of preventing such casualties. One of the most dangerous features of gasoline vapor is that it will follow along a current of air for a considerable distance and then if ignited, the flash will travel back to the source of supply.