

U.S.S. ALCHIBA (AKA6)
 Torpedo Damage
 Solomon Islands
 28 November and 7 December 1942

Class.....Auxiliary, Cargo, Attack (AKA6)	Length (W.L.).....435'-0"
Launched.....1939	Beam (Molded.....63'-0"
Converted from..... Mormacdove (C-2)	Draft (designed Load)..... 25'-10"
Conversion Completed..... 30 June 1941	Displacement...13,876 Tons

References:

- (a) C.O. ALCHIBA ltr. AK23/A16-3(0015) of 15 December, 1942 (Action Report).
- (b) C.O. ALCHIBA ltr. AKA6/L11-1(005) of 5 May 1943 (War Damage Report).
- (c) C.O. VESTAL ltr. AR4/S11/(016) of 13 May 1943 (Repairs to War Damage).
- (d) Comdt. NYMI ltr. AKA6/L11-1(351-621866) of 19 October 1943 (War Damage Report).

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SECTION I - SUMMARY

1. On 28 November 1942 ALCHIBA anchored off Guadalcanal Island and preparations were made for the discharge of cargo.

2. At 0616 (thirty minutes after anchoring) a torpedo struck and detonated on the port side abreast No. 2 hold. Gasoline from ruptured drums stowed in No. 1 deep tanks and oil from ruptured fuel oil tanks in the double bottom were blown up through the 'tween deck spaces of No. 2 hold. The vapors ignited almost simultaneously with the explosion, resulting in a severe fire which spread into No. 1 hold through fragment holes in the bulkhead between Nos. 1 and 2 holds. Small arms ammunition on upper and lower 'tween decks of No. 2 hold soon began to explode.

3. Nos 1, 2 and 3 holds flooded as a result of ruptured boundaries. This caused a port list which increased rapidly. ALCHIBA was beached ten minutes after the torpedo hit. Fires in the 'tween deck spaces were fought by the crew using ALCHIBA's facilities and additional hose lines passed over by BOBOLINK. Fires were finally brought under control at 1435 on 2 December 1942.

4. Unloading of cargo was continued during the period of the fire and as soon as the latter was under control, salvage operations were commenced. Good progress had been made when, at 0800 on 7 December, a second torpedo struck the ship on the port side at about frame 50. Detonation of this torpedo resulted in considerable structural damage and flooding of the engine room and No. 4 hold. The ship began to settle aft and to rise forward.

5. On 27 December, ALCHIBA was towed to Tulagi. On 19 January 1943 she departed Tulagi under tow and arrived at Espiritu Santo on 22 January. After additional temporary repairs she got underway on 6 May 1943 for Navy Yard, Mare Island, making the entire journey under her own power. She arrived there on 3 June 1943.

6. ALCHIBA undoubtedly would have sunk after the first torpedo struck had she not been quickly beached. Fully laden and open for the discharge of cargo she was very vulnerable to both flooding and fire. The remarkably persistent and skillful efforts of her entire crew not only saved her but also most of her cargo, sorely needed at that time. The history of ALCHIBA, from the time she was torpedoed on 28 November 1942 until she was placed back in service on 7 August 1943, is marked by the inflexible determination of her personnel. This factor is the key to her ultimate survival and return to service.

SECTION II - NARRATIVE

(Plates I, II and III, Photos 1 through 18)

7. This report is based on information contained in the references. Photographs were furnished by the Commanding Officer and the Navy Yard, Mare Island. The plates

were prepared by the Bureau of Ships from plans furnished by the Navy Yard.

8. At 0546 on 28 November 1942 ALCHIBA, in company with BARNETT, anchored off Guadalcanal Island. The depth of water was 30 fathoms. Lunga Point bore 267 degrees true; distance two miles. Preparations were made for the discharge of cargo. LAMSON, LARDNER, HUGHES, McKEAN and MANLEY were disposed as the anti-submarine screen.

9. The weather was clear, the sea smooth, and the wind was moderate from the southeast. The draft forward was 20'-3" and the draft aft was 22'-9". ALCHIBA was loaded as shown on table No. 1. At 0555 the discharge of explosives from No. 5 hold was commenced.

10. At 0616, a torpedo struck ALCHIBA and detonated on the port side abreast No. 2 hold in the vicinity of frame 130 slightly below the level of the third deck. The explosion was accompanied by a column of orange flame and dark brown smoke on the port side which was estimated to have been approximately 150 feet high. A column of water was lifted as high as the crow's nest and deluged the fore deck when it fell. Fire immediately filled the 'tween deck spaces in No. 2 hold and quickly spread to No. 1 hold through fragment holes in the forward bulkhead of No. 2 hold. As the spaces flooded the fire was pushed upward on the surface of the water. Oil and gasoline, which had been blown outside the ship onto the surface of the water, ignited immediately and added to the damage control problems.

11. The CO₂ smothering system in the forward holds and deep tanks was turned on and fire hose lines were led out and played on the fire. The forward magazine in the No. 1 lower hold was intentionally flooded.

12. Flooding from the sea was immediate in No. 2 hold. Port deep tank No. 2 had been ballasted with salt water prior to damage but was open to the sea. Starboard deep tank No. 1 flooded gradually. Flooding of No. 1 hold was fairly rapid through fragment holes in bulkhead 137 and through ruptured plating at the boundary of port No. 1 deep tank. Flooding of No. 3 hold was slow at first through fragment holes in bulkhead 113 but when the level of the water in No. 2 hold reached the level of the coaming of a damaged door on the third deck in this bulkhead (this door had been blown open and warped) flooding was rapid. Flooding of starboard deep tank No. 1 through fragment holes in the centerline bulkhead between frames 125 and 137 was gradual. Almost immediately the ship listed to port and in view of the rapid flooding of the forward holds and the increasing list (despite the transfer of ballast from port to starboard in No. 4 deep tank) it was decided to beach the ship. The anchor was heaved in and the ship was beached at 0621 using a speed of six knots. The port list had increased to 17 degrees but by going ahead with revolutions for ten knots after grounding, ALCHIBA gradually was righted and finally came to rest with only a 1-1/2 degree port list. The ship was aground from frame 115 to the stem; a length of about 150 feet.

13. The center of impact was in the vicinity of frame 130 about eight feet below the waterline at the seam between "E" and "F" strakes. The detonation resulted in an irregular hole in the shell plating (photos 2, 3 and 4) approximately 28 feet long (frames 125 to 135) and 20 feet high extending across "E", "F" and "G" strakes. At the top of the opening, "H" strake was split and deflected inward and at the bottom, "D" strake was also split and deflected inward. The split in the shell plating at the bottom extended across "C" strake. The inward deflection of the shell plating extended beyond the periphery of the opening forward to frame 140 and aft to frame 120 and vertically between the keel and "K" strake. Between frames 128 and 129 there was a concave buckle extending from the split in "C" strake across "B" and "A" strakes on the port side and the keel, "A" and "B" strakes on the starboard side. The flat and vertical keel plates were distorted and buckled but remained intact.

14. The floors, intercostals and tank top plating of the inner bottom structure were buckled and distorted on the port side between bulkheads 113 and 137.

15. Bulkhead 125 (photos 7 and 8) between deep tanks Nos. 1 and 2 was distorted and deflected aft and inboard on the port side. Bulkhead 137 between deep tank No. 1 and No. 1 hold was distorted and deflected forward and inboard on the port side, and ruptured at the third deck connection. In addition, this bulkhead was penetrated by fragments on the port side in the hold. Bulkhead 113 between deep tank No. 2 and No. 3 hold was distorted and ruptured at the third deck shell connection on the port side. Considerable leakage occurred through this bulkhead. The centerline bulkhead between port and starboard deep tanks No. 1 was deflected to starboard but held intact. There was some fragment penetration of this bulkhead. On the third deck (lower 'tween deck No. 2) directly above port deep tank No. 1 the port longitudinal bulkhead of the refrigerator space was ruptured and considerably distorted between frames 122 and 131 (photo 6). Transverse bulkhead 131 of this compartment also was ruptured and distorted. The watertight door in bulkhead 113 on the third deck port side was blown aft and warped so that it could not be closed.

16. A section of the third deck extending from frame 125 to frame 133 on the port side (the top of port deep tank No. 1) was torn away from its connections and blown upward almost a full deck height (photo 7). The deck structures and plating immediately forward and aft of this section were buckled and distorted. At bulkhead 137 on the port side the outboard deck girder was torn loose. The port No. 1 and No. 2 deep tank hatches were distorted and the hatch cover on port No. 1 deep tank was blown open and twisted out of shape. The second deck was deflected upward over the damaged area on the port side.

17. Fire in the 'tween deck spaces above the level of the water in the flooded spaces in No. 2 hold quickly got beyond control. It spread to No. 1 hold through fragment holes in bulkhead 137. A number of gasoline drums stowed in port No. 1 deep tank were torn open by the explosion and fuel oil tanks in the inner bottom immediately below were ruptured. This caused the release of high octane gasoline and fuel oil which greatly aggravated the fire. Gasoline and oil vapors were largely responsible for the very rapid acceleration of the fire, and vapors which permeated

compartments resulted in many subsequent internal explosions.

18. At 0645 (approximately 30 minutes after the impact) small arms ammunition and bomb fuzes stowed on the upper and lower 'tween decks No. 2 began to explode and continued exploding throughout the following day.

19. At 0801 a very heavy explosion occurred in No. 2 hold which carried away the hatch cover on the main deck even though the latter was covered with bundles of heavy landing mat (pierced steel plank). This permitted the fire to pass upward through the hold more freely and caused an increase in intensity of the conflagration.

20. The watertight door on the starboard side of the third deck which led into No. 3 hatch was blown open and warped so it could not be closed. This opening allowed vapors and flames to enter No. 3 hold. From this source, fire broke out in No. 3 hold but was quickly controlled. Outbreaks of fire continued to occur intermittently in No. 3 hold but were extinguished. Two 2-1/2-inch hose lines were continuously played on the door opening to keep the fire from spreading aft of No. 2 hold. Holes were cut in decks to permit inserting nozzles to combat fires inaccessible by other means. Decks and bulkheads were constantly sprayed with fog nozzles to cool them.

21. At 1020 BOBOLINK came alongside and passed over five hose lines which were brought to bear on the fires and to cool decks and bulkheads. By 2336 shell plating along the port side began to buckle and to open up at the seams, permitting flames to come out the openings. At about this time the main deck began to sag as a result of the intense heat and the weight of the pierced plank. Successive internal explosions caused flames to shoot high above the main deck. Hose streams from BOBOLINK next were played on the shell plating. Burning vapors from the gasoline and oil on the surface of the water were kept clear of the ship by mooring Higgins landing boats to the ship's side and forcing the fire away with the back wash of the boat's propellers.

22. At 2108 on 29 November a heavy explosion occurred in No. 1 hold which appeared to cause active fires to decrease in intensity. Reference (a) reported that the cause of this explosion was not apparent as the cargo in this hold was not explosive in character; however, it seems reasonable to assume that gasoline vapors entering this space from No. 2 hold caused this explosion.

23. During the afternoon of 2 December fires were finally brought under control and extinguished shortly afterwards. Some cargo, however, continued to smolder.

24. Damage resulting from the fire, which burned for a total of 104 hours, was extensive. The port and starboard shell plating forward of bulkhead 113 above the waterline was badly wrinkled. All bulkheads and decks were also badly warped and buckled out of shape. The second and third decks (photo 9) in way of the fire were bowed downward under the weight of heavy cargo and equipment. At

the forward starboard corner of hatch No. 1 on the second deck, the distortion in connecting structures caused the hatch coaming to break away from the deck.

25. The equipment in the refrigerator space (photo 6) in lower 'tween deck No. 2 was completely demolished by the blast and subsequent fire. The blower room was a total wreck and throughout the remaining spaces in way of the damage all piping, coils, ventilation ducts and insulation were damaged to such an extent that complete renovation was necessary.

26. Nos. 1, 2 and 3 holds flooded to the waterline, slightly above the level of the third deck. No. 2 hold flooded from the sea, No. 1 hold flooded through fragment holes in bulkhead 137 and No. 3 hold flooded through the open door on the third deck and through leaks in bulkhead 113.

27. At the time of impact, unloading of cargo had commenced from Nos. 3 and 5 holds, and unloading was continued during the fire. By 1745 on 29 November all explosives from No. 5 hold had been unloaded. Unloading of ammunition from upper and lower 'tween decks No. 3 was made difficult by smoke, fumes and intermittent fires which broke through the open door on the third deck. After ammunition from Nos. 3 and 5 holds was unloaded, the remaining cargo was unloaded.

28. Immediately after all fires were extinguished, removal of debris was commenced. During the period while ALCHIBA was beached the ship's company, except those engaged in combatting fires, unloading and manning guns, were camped on the beach nearby. Air raids from enemy planes were frequent but fortunately no hits or near misses were received. There were many air raid alerts.

29. At 0656 on 3 December a torpedo was seen approaching on the port quarter but curved off and missed astern about 300 yards. A second torpedo nosed into the sand 400 yards on the port beam but failed to explode.

30. At 1816 on 6 December, pumping of No. 3 hold was commenced. Suction lines passed over from BOBOLINK augmented ALCHIBA's pumps. Unwatering of No. 1 hold was subsequently commenced. It was necessary to repair damage to bulkheads 113 and 137 with temporary soft patches before headway could be made in clearing the water from Nos. 1 and 3 holds. Working parties continued to unload cargo and to remove debris.

31. At 0759 on 7 December what appeared to be the conning tower of a midget submarine was sighted close aboard on the port quarter and immediately a torpedo struck ALCHIBA in the vicinity of frame 50 in way of No. 4 hold just below the third deck level. A second torpedo was seen to pass close under the stern.

32. No. 4 hold, the engine room and the evaporator room were flooded immediately. Upper 'tween deck No. 5 and No.5

hold partially flooded as a result of an unsecured door in bulkhead 37 on the second deck, (see paragraph 42). The ship began to settle by the stern and lift slightly by the bow. She apparently pivoted about a point close to frame 145 (plate 1).

33. The blast from this torpedo appeared to be much heavier than the one forward. It was accompanied by a "tearing" sound, like tearing cloth in a gigantic manner. No smoke or flame was noticed. Water and debris were thrown into the air to at least masthead height. Explosive fumes were noted in the crew's quarters immediately after the water settled. No fires resulted from this hit.

34. Detonation of this torpedo resulted in an irregular opening in the shell plating (photos 10, 11 and 12) which extended about 40 feet between frames 42 and 59 and about 25 feet vertically across "E", "F", "G" and "H" strakes. Above the opening the indentation of the shell extended up through "K" strake to the shelter deck edge. Below the opening, "D" and "C" strakes at the turn of the bilge were deflected inward and split. Distortion of "A" and "B" strakes on both sides of the keel occurred between frames 43 and 58. The flat and vertical keel plates were buckled considerably but held intact.

35. The entire port side of the inner bottom structure between bulkheads 37 and 61 was buckled and distorted.

36. The port side of bulkhead 49 (photo 12) separating deep tanks Nos. 3 and 4 was crushed and pushed inboard tearing away at the shell connections. The port longitudinal bulkhead and transverse bulkhead 55, enclosing the liquid cargo pump room, were practically demolished. The shaft alley, centerline bulkhead and bounding bulkheads of hatch No. 4 between the second and shelter decks were distorted and penetrated by fragments (photos 13 and 15).

37. A section of the third deck on the port side between frames 47 and 56 was torn and blown upward to the second deck (photo 14). The hatch cover for hatch No. 4 was blown off and apparently the hatch cover for port deep tank No. 3 was blown up and out of the hatch as it was never found. The hatch cover for port deep tank No. 4 fell into the deep tank because of the warping of the hatch coaming. The port side of the second deck was deflected upward about 15 inches between the shell and the hatch from frame 43 to frame 56.

38. Storerooms and living spaces in the lower and upper 'tween deck spaces between bulkheads 37 and 61 were badly wrecked.

39. The evaporating plant in port deep tank No. 3 (in way of the detonation) was completely destroyed. The auxiliary boiler located inboard of the evaporating plant was extensively damaged. The casings on the outboard side, the fuel oil burners and all attachments were crushed. The steam and water drums were damaged less extensively. All electrical equipment in way of the damage was wrecked. Additional damage resulted from salt water corrosion.

40. Rupturing of the after bulkhead of the engine room on the port side resulted in some damage to machinery in that space. The long period of submersion in salt water caused rapid corrosion of machinery to set in when this space was later unwatered.
41. Port deep tanks Nos. 3 and 4, the engine room and lower 'tween deck No. 4 were opened to the sea and flooded immediately. The shaft alley, starboard deep tanks Nos. 3 and 4, and upper 'tween deck No. 4 flooded rapidly through ruptures and fragment holes in bulkheads and decks. The flooding in this area caused the vessel to gradually settle by the stern.
42. The partial flooding in upper 'tween deck No. 5 and No. 5 hold was the result of an error which was discovered in time to prevent complete flooding of these spaces. Apparently, one of the crew went through the port door in bulkhead 37 on the second deck and failed to secure it. A short time later it was noticed that water was flowing through this door and aft through the non-watertight door in the after bulkhead of the crew's room into upper 'tween deck No. 5, then overflowing the hatch coaming into the No. 5 hold. The water had reached the level of the top of the shaft alley on the port and starboard sides of No. 5 hold when discovered. After properly dogging the watertight door in bulkhead 37 the water was immediately pumped out of the hold and upper 'tween deck No. 5 (suction lines were passed over from BOBOLINK).
43. With the flooding of the shaft alley and shaft alley recess the water continued upward through the shaft alley escape trunk and through the access door leading into the steering room, completely flooding that space. This door apparently had been left open.
44. As the ship settled by the stern, water increased in depth in holds Nos. 2 and 3. Fortunately, ALCHIBA did not slide off the sand and gravel ledge when this occurred.
45. Salvage operations were continued. As salvage tugs could be spared they lent their efforts toward the primary job of restoring buoyancy. Temporary patching of bulkheads and pumping of Nos. 1 and 3 holds was continued for two weeks. On 27 December ALCHIBA was pulled off the beach and towed across the bay to Tulagi by NAVAJO and ORTOLAN. At Tulagi the remainder of the cargo, with the exception of a number of drums of her original cargo of aviation gasoline in port deep tank No. 1, was discharged. The work at Tulagi consisted largely of replacing enough structural strength to allow her to be towed to a larger repair base. Two minor fires were started in No. 2 hold. These resulted from the ignition of vapors by welding operations. Each was promptly extinguished.
46. On 19 January, 1943 ALCHIBA was again taken in tow by NAVAJO assisted by ORTOLAN on the port quarter. She arrived at Espiritu Santo on 22 January. Nos. 2 and 4 holds and the engine room were still flooded. Pumps in Nos. 1, 3 and 5 holds were rigged and used as required. The additional temporary repairs at Espiritu Santo consisted of further replacement of structural strength, unwatering the engine room and overhauling the machinery.
47. During the process of pumping out the machinery spaces, a condition of negative GM developed. When pumping

of this space was commenced, draft of the ship forward was 18'-4" and the draft aft was 33'-8". Three 10-inch pumps were employed. As pumping was continued ALCHIBA gradually listed to port. When the angle of heel was about 8-1/2 degrees, operations were stopped. About 3000 gasoline drums completely filled with water and some scrap iron were placed in the bottom of No. 3 hold for ballast. When this was completed she was upright and unwatering of the machinery spaces was resumed.

48. After temporary repairs had been completed and some additional ballast added to improve the trim and stability, a check inclining experiment was conducted. This indicated a GM of approximately 1.9 feet in the departure condition. This was considered sufficient for the trip to the mainland.

49. ALCHIBA got under way on 6 May and proceeded to the mainland under her own power at a speed of 10 knots. Nos. 2 and 4 holds were still flooded to the waterline. The draft forward was 20'-4" and the draft aft was 25'-6". The trip to the mainland was uneventful until heavy swells were encountered shortly before arrival at Mare Island. The working of bulkhead 137 at this time caused additional leaks to occur through the degaussing cable stuffing boxes and it was necessary to knock the cables out and plug the holes. This warped bulkhead had been strengthened with horizontal beams at Espiritu Santo. These did not prevent bulkhead 137 from working although the bulkhead did not fail. Some leakage occurred around the periphery, however, and a 10-inch pump which had been temporarily installed in No. 1 hold was used at regular intervals to control flooding. ALCHIBA arrived at Navy Yard, Mare Island on 3 June where repairs and many authorized alterations have been completed

III - DISCUSSION

(Plates I, II & III, Photos 1 to 10 incl.)

A. Torpedoes

50. The approach of the first torpedo was not observed nor was the submarine which was believed to have fired it detected. It was a relatively shallow running torpedo. The detonation was accompanied by a column of orange-colored flame and dark brown smoke. It is possible that at least part of this flame resulted from ignited gasoline vapors. There was relatively minor fragment damage. The refrigerators in way of the detonation undoubtedly had some effect in reducing fragment damage and in absorbing the blast. From the structural damage it is probable that the warhead contained about 660 pounds of explosive inasmuch as the Japanese are known to use, among others, a 21-inch submarine torpedo containing this quantity of hexa.

51. The second torpedo apparently was fired from a midget submarine. What was believed to have been the conning tower of a midget submarine was seen just prior to the attack. Such submarines are known to carry 18-inch torpedoes with warhead charges of between 750 and 800 pounds.

Structural damage caused by this torpedo was somewhat greater than that forward and tends to substantiate the assumption of a larger charge.

B Structural Damage

52. Direct damage to the ship structure resulting from the first hit, while considerable, very probably would have been more extensive had it not been for the fact that the impact was at about the longitudinal center of No. 2 hold and the principal damage was confined to that space. The refrigerator compartments on the third deck in way of the impact apparently had an appreciable effect in absorbing some of the force of the detonation and also in resisting fragmentation. The heavily loaded condition of this hold also aided in restricting the damage. The size of the opening in the shell was about what would be expected; however, the damage athwartships and upward was less than might have been anticipated.

53. The second hit resulted in more extensive direct damage than from the first torpedo. There were several reasons for this; first, this torpedo apparently was considerably larger; second, it was running nearer the surface; and third, No. 4 hold contained the living spaces and ship's stores and did not have the benefits of heavy cargo in 'tween deck spaces and on the squares of the hatches. The opening in the shell plating was considerably larger than the rupture in the shell resulting from the hit forward.

C. Fires

54. The force of the first detonation ruptured the deck plating on the third deck which forms the top of the deep tanks. A number of drums containing high octane gasoline, stowed in No. 1 deep tank, were also ruptured and gasoline was carried up by the blast and on the surface of the water as the spaces flooded. This would account for the rapid acceleration of the fire. Vapors from the gasoline permeated the 'tween deck spaces and No. 1 hold. Ruptured fuel oil tanks in the double bottom allowed oil to rise to the surface of the water in the flooded spaces, which further aggravated the fire.

55. The rapid flooding of the deep tanks in No. 2 hold undoubtedly prevented the ignition of additional gasoline as it is believed that only the gasoline from the drums opened by the explosion burned. Mention was made in reference (a) that additional drums of gasoline exploded as a result of the fire; but in view of the fact that the hold containing the drums flooded rapidly, this seems unlikely. The subsequent internal explosions probably were the result of accumulated gasoline vapors. The unexplained explosion in No. 1 hold (noted in paragraph 22) must also be attributed to accumulated gasoline vapors.

56. It is interesting to note that it was approximately thirty minutes after the fire started before small arms ammunition and bomb fuzes stowed in the 'tween deck spaces of No. 2 hold began to detonate singly. There was no tendency for this ammunition to detonate en masse and it continued to go off with low order detonations throughout the following day. Some 3-inch ready service ammunition on the main deck detonated with low order detonations after being roasted for some time. Additional ready service ammunition which had become heated was thrown overboard.

57. It was only by the effective work of damage control personnel that the fire was confined to and forward of No. 2 hold. Fire broke out intermittently in No. 3 hold entering through the door opening on the third deck, but was successfully pushed back by using two hose streams on the door opening. Cargo ammunition in No. 3 hold was never allowed to become heated sufficiently to ignite. All during the period of the fire unloading of cargo ammunition and other cargo was continued.

58. The ultimate damage resulting from the fire was probably more extensive than the direct damage done by the first torpedo detonation. Decks, bulkheads and shell plating in the vicinity of Nos. 1 and 2 holds were buckled and warped by heat from the fire and required replacement. The weight of landing mat (pierced steel plank) stowed on the main deck was a big factor in causing the deck to sag.

59. It is not improbable that the explosion referred to in paragraph 22 caused a decrease in intensity of the fire in No. 1 hold. Accumulated gasoline vapors ignited, and in exploding probably dispersed the air in the relatively confined space. This had, for the moment, the effect of reducing the oxygen necessary to sustain combustion. Except for the fact that water was being poured into this hold, and possibly that the fire had almost burned itself out, it would have been quickly rekindled.

60. The Commanding Officer commented on the fact that the CO₂ smothering system was ineffective due to the many explosions which destroyed the inert blanket. He recommended that the CO₂ system be replaced by a foamite system. With a fire of this size and intensity CO₂ cannot be expected to be effective. It is considered suitable only for fires in relatively small confined spaces and is effective in such cases. It is particularly efficient in controlling incipient fires. Installation of a fixed foamite system in cargo spaces is not considered practical as foam from this type of apparatus will not flow freely enough or in quantities sufficient to cover all spaces where cargo is stowed.

61. In the absence of any mention in the references of the use of foam from hose nozzles on this fire, it is assumed that none was used, or if it was employed, the supply was inadequate. Unquestionably this fire could have been more effectively fought if an ample supply of foam powder had been available. The explosions would have

disturbed a foam blanket but with the volume of firefighting water available (five hose streams from the BOBOLINK, plus those from ALCHIBA) foam nonetheless would have been of real value.

62. The use of fibrous glass insulation in refrigerated spaces and living quarters was considered by the Commanding Officer to have been an important factor in preventing the spread of the fire. The insulating and non-inflammable properties of fibrous glass are well recognized, and it has been specified for combatant naval vessels of new construction for several years.

D. Flooding and Heel

63. Flooding of the forward magazines in the No. 1 lower hold was intentional and proper under the circumstances.

64. The rapidity of flooding can be fully appreciated when it is considered that by the time the ship was beached (10 minutes after the torpedo hit) Nos. 1 and 2 holds were full and the port list had increased to 17 degrees. Since the decision to beach was quickly reached, the only measure to improve list and trim which was undertaken was to commence the transfer of ballast water from port to starboard in No. 4 deep tank. The port list was due to a combination of low stability from flooding and a temporary upsetting moment caused by immediate flooding of port deep tank No. 1 and slow flooding of starboard deep tank No. 1. From table No. 1 it will be noted that both deep tanks contained drums of gasoline. The centerline bulkhead separating the two tanks, while deflected to starboard, was intact except for fragment holes which permitted only slow flooding into the starboard tank. Although the Bureau had directed deep tank centerline bulkheads on converted vessels of this type be perforated when the tanks are to be used for dry cargo, liquid cargo or water ballast, this alteration had not been accomplished on ALCHIBA. A substantial portion of the port list can be attributed to the initial watertight condition of this bulkhead which caused off-center flooding. The combined effect of forcing ALCHIBA hard aground and the equalizing moment caused by the eventual flooding of starboard deep tank No. 1 gradually righted the ship and it came to rest with a list of only 1-1/2 degrees to port.

65. The immediate flooding of the machinery spaces and No. 4 hold and the partial flooding of No. 5 hold following the second hit would have been fatal had it not been for the fact that the ship was hard aground. At the time of damage starboard deep tank No. 3 was empty, starboard deep tank No. 4 was approximately 50 per cent full of ballast water and port deep tank No. 4 was empty. The unequal moment produced by the immediate flooding of the port compartments undoubtedly would have caused a substantial heel to port had ALCHIBA been afloat. Flooding of the after spaces caused the ship to settle by the stern and to rise forward. From a study of the resulting drafts (plate I) the ship apparently pivoted about a point close

to frame 145 with the bow lifting three feet and the section from frame 145 to frame 115 digging deeper into the sand. It was fortunate that ALCHIBA did not slide off the beach and sink by the stern when the flooding aft occurred.

E. Stability While at Espiritu Santo

66. In paragraph 46 it was noted that during the unwatering of the machinery spaces while at Espiritu Santo a condition of negative GM developed. Although the basic design data regarding ALCHIBA in the possession of the Bureau is not extensive enough to permit a detailed stability analysis, the conditions which created the negative GM are of interest even though the amount cannot be evaluated.

67. It will be recalled that when ALCHIBA arrived at Espiritu Santo Nos. 1 and 3 holds were dry and the cargo had been discharged almost completely. Thus, Nos. 2 and 4 holds were open to the sea and the machinery space was flooded. This amount of flooding seriously reduced the intact water plane area and caused a corresponding decrease in GM. But ALCHIBA was definitely stable when she arrived at Espiritu Santo. This condition undoubtedly was due to the large amount of water taken aboard below the center of gravity and which thus had the effect of lowering the center of gravity. The amount by which the center of gravity was lowered was probably greater than the amount the metacenter (M) was lowered due to impairment of water plane area. At Espiritu Santo as the water was pumped from the machinery space, this had the effect of removing a weight, although liquid, from low in the ship and thus caused a rise in the center of gravity. The water plane area remained constant while the machinery space was being unwatered and hence the metacenter (M) remained approximately* fixed while G moved upward. Eventually, G reached a position above M and hence GM became negative.

68. This condition is by no means uncommon when undertaking the salvage of vessels of the merchant type. A similar effect occurred at Pearl Harbor during the salvage of OGLALA. It has also happened at least once in the past year during the salvage of a merchant vessel by a civilian salvage company. The important point is to recognize that in ships with large hold spaces, instability is likely to occur when these spaces are unwatered because water plane area and free surface effects remain constant, and a rise in the center of gravity occurs as the low weight is removed. In case of ALCHIBA, this condition was recognized (the resulting list will almost always occur gradually) and approximately 600

* Actually, the location of the metacenter (M) is determined by the formula $BM = \frac{I}{V}$ where BM is the metacentric radius, I is the transverse moment of inertia of the intact waterplane and V is the volume of displacement. In this case I remained constant, V decreased slightly as the water was removed causing a small increase in BM but the center of buoyancy (B) moved down by a slight amount. Thus, the small increase in BM was probably offset by the small movement down of B and M remained approximately fixed.

tons of low ballast was installed to correct the list. It should be noted that no attempt was made to counterflood. As pointed out in FTP-170-A counterflooding in the case of negative GM is very dangerous.

69. The check inclining experiment conducted at Espiritu Santo before ALCHIBA's departure for the mainland was a wise precaution. Although a check inclining experiment will not give complete stability information, it nonetheless will indicate the GM for the condition of the vessel at the time of the experiment, provided a reasonably accurate estimate of the displacement is available. It should also be pointed out that a check inclining experiment can be performed rapidly and the results evaluated in a short time. It is well worth while for a single voyage when there is doubt about a vessel's stability unless there are indications that GM is actually negative. In that case, low ballast should first be installed, and the inclining experiment then conducted as was done in the case of ALCHIBA.

F. Conclusions

70. ALCHIBA is not large even for a cargo vessel. After her conversion she could probably withstand the flooding of two main compartments without capsizing or sinking if she was fairly heavily loaded as in this case. It is extremely improbable that she could have withstood flooding of three main compartments as actually occurred from the first torpedo. Her loss would have been inevitable and rapid had she not been beached. Likewise, after the second hit, she would have sunk almost instantly had she not been aground at the time.

71. She was fully laden with a highly inflammable cargo of aviation gasoline and bombs as well as a large quantity of various types of ammunition. At the time she was hit by the first torpedo she had just completed breaking open her hatches in preparation for unloading. Her wide-open condition and her cargo made her very vulnerable to fire.

72. The disheartening effect of the second hit, after the expenditure of so much effort in controlling the damage from the first hit, can well be imagined. In spite of this major catastrophe the inflexible determination of her personnel was manifested by an increase in salvage efforts. The return of ALCHIBA to service certainly represents a triumph of first magnitude for her personnel and other personnel connected with her salvage and repair.

Table No. 1

Loading Prior to Damage

No. 1 Hold: 800 tons general stores, including clothing, flour, sugar, coffee, rice and case goods.

No. 2 Hold: Bomb fuzes for 800 tons aviation bombs in special locker, second deck. 150 tons machine gun and small arms ammunition in square of the hatches, second and third decks. 1000 drums 72 octane gasoline; 500 drums 100 octane gasoline in deep tank No. 1 port and starboard. Deep tank No. 2 port and starboard ballasted with salt water.

No. 3 Hold: 23 motor vehicles in lower hold, dunnaged with case goods. 200 tons ammunition details including hand grenades, machine gun ammunition, 75mm and 105mm "clover-leaf" field gun pieces, square of hatches, second and third decks.

No. 4 Hold: Ship's stores and living spaces in upper and lower 'tween deck. Auxiliary boiler and distilling plant in No. 3 port deep tank; starboard deep tank empty. Approximately 12 feet of water in No. 4 port deep tank for trim; starboard tank empty.

No. 5 Hold: 800 tons aviation bombs - (300, 500 and 1000 pounds).

Main Deck: Approximately 250 tons pierced plank landing mat on No. 2 hatch, 9 ribbons N.L. pontoons abreast No. 3 hatch, port and starboard.

Double Bottoms: Fore peak full - fresh water
No. 1 Bottoms - P & S - full - bilge water
No. 2 " " - empty
No. 3 " " - 6" down - fuel oil
No. 4 " " - 6" down - fuel oil
No. 5 " " - full - fuel oil
No. 6 " " - full - fuel oil
No. 7 " " - full - fresh water
No. 8 " " - full - fuel oil
No. 9 " " - full - fuel oil
No. 10 " " - full - fuel oil
After Peak - - full - fresh water

Loading at Time of Second Torpedo Hit

No. 1 Hold: Flooded to just above deep tanks; approximately 400 tons damaged cargo. 'Tween decks gutted by fire.

No. 2 Hold: Flooded to just above deep tanks; 'tween decks gutted by fire.

No. 3 Hold: Flooded; lower hold still had 23 motor vehicles dunnaged by case goods. All ammunition details discharged. Refrigerated stores jettisoned.

No. 4 Hold: Same as before.
No. 5 Hold: Empty.
Main Deck: Completely discharged.
Double Bottoms Same as before except No. 2 port flooded,
No. 3 port and starboard and No. 4 port
flooded.