

U.S.S. BLOCK ISLAND (CVE21)

Loss in Action

South Atlantic Ocean
29 May 1944

Class...Aircraft Carrier, Escort Length (W.L.)...465 ft. 0 in
(CVE6 class - Converted from
Maritime Commission C-3 class, Beam (W.L.).....69 ft. 6 in
Cargo Type) Draft.....23 ft. 0-1/2 in
Launched.....6 June 1942 (Designed Full Load)
Displacement.....13,739 tons
(Designed Full Load)

References:

- (a) C.O. USS BLOCK ISLAND ltr. CVE21/A9, Serial 0027, of 29 June 1944 (Action Report).
- (b) ComAirLant ltr. FF13-2/L9-3/S1, Serial 02100 of 29 July 1944 to Buships.
- (c) Buships ltr. C-CVE21/L11-1(424) of 26 June 1944 (Report of Interview of Survivors by Buships Representative).
- (d) Buships ltr. C-CVE/S1-1(812) of 29 August 1944.

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PLATES I and II - Torpedo Damage

SECTION I - FORWARD

1. BLOCK ISLAND was converted from the Maritime Commission C-3 class, a single screw cargo type. She was the second U.S. escort carrier to be lost as the result of submarine torpedo attack. BLOCK ISLAND was struck initially by two torpedoes and later by a third. There is overwhelming evidence that the ship would have survived the first two torpedoes. Although the third torpedo destroyed nearly all of the buoyancy aft of the machinery spaces, more than an hour and a half elapsed before BLOCK ISLAND finally sank. Only six men were lost. Thus, this case stands in sharp contrast to the loss of LISCOME BAY (CVE56)*, in which it will be recalled that the bomb magazines detonated, destroying the after portion of the ship almost immediately and resulting in the loss of the vessel about 23 minutes after being torpedoed.

SECTION II - SUMMARY

(Plates I and II)

2. On the night of 29 May 1944, BLOCK ISLAND was operating in a task group against enemy submarines in the South Atlantic Ocean. While steamed on an aircraft launching course in condition BAKER with bomb magazines and gasoline system secured, BLOCK ISLAND was struck by two submarine torpedoes which detonated almost simultaneously. One torpedo detonated on the port bow at about frame 10, some 15 feet below the surface, blowing out both sides of the shell in that area and flooding the fore peak tank A-501-W and the adjacent automatic weapon magazines. Very little other damage was caused by this hit, and it is possible that the detonation was of low order.

3. The second torpedo struck the port side aft at about frame 169 some 15 feet below the surface. The detonation blasted a large hole in the port shell and in the second and first platforms, flooding the space between bulkheads 162 and 182 (about 51 feet) immediately and causing slower flooding in the space between bulkheads 149 and 162 (about 33 feet) and in steering gear room C-305-E. Steering control was lost. The detonation broke the propeller shaft and displaced it a considerable distance to starboard, resulting in severe damage to machinery in the engine room. The low pressure turbine casing carried away and the condenser ruptured. The condenser injection and discharge valves could not be closed completely and the engine room began to flood slowly. BLOCK ISLAND was without means of propulsion but in no apparent danger of sinking. The change in trim was about 9 feet by the stern. There was no list.

4. Electric power was shifted to the ship's service diesel generators in compartment A-528-AE, as the ship's service turbo-generators had lost steam. Steps were taken to control the flooding and investigate the damaged area. Personnel not required for damage control were ordered to the flight deck. There were no fires.

*Buships War Damage Report No. 45.

5. About ten minutes after the first two torpedo hits, a third torpedo detonated on the port side at about frame 140, directly opposite one bomb magazine and about 23 feet forward of the other. A large hole was opened in the shell and large holes were blown in the second and main (hangar) decks over the detonation. Recently authorized alterations to protect the bomb stowage had been accomplished and there was no bomb magazine explosion. All compartments between the after bulkhead of the machinery space and the forward edge of the previously flooded area were opened to the sea and flooded. No fires resulted.

6. The forward main distribution board was deranged and all power was lost although the ship's service diesel generators continued to operate. No mention was made of the functioning of the emergency diesel generator forward. For unexplained reasons, most emergency equipment, including the emergency diesel generator and relay-controlled hand lanterns, apparently failed to operate as intended.

7. Flooding after the third hit was so extensive that damage control measures were ineffective. The vessel slowly settled by the stern. The majority of the personnel abandoned ship about seventeen minutes after the third hit. A small salvage crew, including the Commanding Officer, remained on board more than an hour longer. About ten minutes after the last man left the ship and more than one hour and a half after the third torpedo hit, BLOCK ISLAND plunged by the stern without list.

8. Not a single man was lost in abandoning ship. The total loss of life was six, all of whom were lost or died as the result of wounds caused directly by the detonations. Although no ship of this class can be expected to survive three torpedo hits located as these were, the performance of BLOCK ISLAND was reassuring evidence of the general ruggedness of hulls of this type.

SECTION III - NARRATIVE

(Plates I and II)

9. BLOCK ISLAND and four escort vessels constituted a task group operating offensively against enemy submarines in the South Atlantic Ocean. The task group departed from a European port about 23 May, 1944, and had been at sea about six days at the time of the action. The evening of 29 May was clear with light winds. The sea was smooth. Planes had been fueled and the VTs armed with depth bombs. The bomb magazines and gasoline system had been secured, but the gasoline system had not yet been purged with inert gas. BLOCK ISLAND was in material condition BAKER with all "X" and "Y" fittings below the main deck secured. Mean draft was about 25 feet.

10. At about 2001, BLOCK ISLAND steadied on an aircraft launching course and prepared to launch two night search planes against a submarine known to be in the vicinity. At about 2013, a heavy detonation occurred forward followed within five seconds by another detonation aft. General Quarters was sounded and battle stations were manned within two or three minutes. Inspection revealed that two torpedoes had struck the vessel on the port side. Neither the submarine nor torpedo wakes were seen prior to the explosions.

11. The first torpedo struck about 15 feet below the waterline, to be about 26 feet long and 20 inches in diameter on the port and starboard sides at the second platform and forward platform spaces above the deck of the chain locker. No water damage to the C.P.O. berth fire main riser at frame 22, forward topside stations and flight deck. An athwartships edge of the flight deck and the deck forward of frame 23, and into an approximately vertical track. The portion of the position was severely damaged and

12. Some projectiles fell to 22 below the second platform that might have resulted was were no bombs in the incendiary

13. The second torpedo struck frames 165 and 175, probably was about 10 to 15 feet below the port side and possibly a breadth of the ship in way of alley was flooded. Above the compartments between bulkhead side of the first platform in ants' area. This compartment C-301-L, immediately forward to the lower portion of bulkhead in C-204-1L was broken and room, C-305-E, reported that the bulkhead buckled. This was damaged and rendered inoperable

14. The detonation broke considerable distance, resulting and main thrust bearing in the of the low pressure turbine pedestal, Kingsbury thrust tubes in the main condenser into the low pressure turbine also entered through the damaged the flooded shaft alley and the ejection sea chest. The main charge valves could not be opened in the engine room where room began to flood slowly.

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11. The first torpedo struck the port bow at about frame 10, about 15 feet below the waterline. A relatively small hole (estimated to be about 26 feet long and 20 feet high) was blown through both the port and starboard sides at this point. All compartments below the second platform and forward of bulkhead 22 were opened to the sea. It was reported that no flooding occurred aft of bulkhead 22. No second platform spaces above the detonation were inspected with the exception of the chain locker. No water was reported in this space. There was no damage to the C.P.O. berthing space, A-301-1/2L, other than a broken fire main riser at frame 22. A column of oil and water drenched the forward topside stations and damaged the port forward corner of the flight deck. An athwartships tear occurred at frame 23 between the port edge of the flight deck and the catapult track. The portion of the flight deck forward of frame 23, and outboard of the catapult track was blown into an approximately vertical position with the fold along the catapult track. The portion of the port catwalk forward of No. 2 40mm gun position was severely damaged and bent upward, killing two lookouts.

12. Some projectiles in the 20mm and 40mm stowage (frames 12 to 22 below the second platform) detonated individually, but any fire that might have resulted was extinguished quickly by the flooding. There were no bombs in the incendiary bomb magazine, A-502-M.

13. The second torpedo struck the port side aft in the area between frames 165 and 175, probably at about frame 169. The point of detonation was about 10 to 15 feet below the waterline. A large hole was blown in the port side and possibly a smaller hole in the starboard side, as the breadth of the ship in way of the hit was only about 16 feet. The shaft alley was flooded. Above the shaft alley, flooding occurred in all compartments between bulkheads 149 and 182. A hole was opened in the port side of the first platform in compartment C-302-1L in the mess attendants' area. This compartment flooded to the waterline. Compartment C-301-L, immediately forward, flooded slowly, probably through damage to the lower portion of bulkhead 162. The fire main riser at frame 177 in C-204-1L was broken and was isolated. Personnel in the steering gear room, C-305-E, reported that the door in bulkhead 182 was sprung and the bulkhead buckled. This space flooded slowly. The steering gear was damaged and rendered inoperative by shock.

14. The detonation broke the propeller shaft and displaced it a considerable distance, resulting in severe damage to the reduction gear and main thrust bearing in the engine room. As a result, the forward end of the low pressure turbine casing carried away, damaging the turbine pedestal, Kingsbury thrust bearing, and main condenser. The condenser tubes in the main condenser ruptured, allowing circulating water to pour into the low pressure turbine and out into the engine room bilge. Water also entered through the damaged shaft stuffing box in bulkhead 122 from the flooded shaft alley and through cracks in the main condenser low injection sea chest. The main condenser low injection and overboard discharge valves could not be closed completely, and pumps and other equipment in the engine room were damaged and jarred out of line. The engine room began to flood slowly.

15. After the second torpedo hit, BLOCK ISLAND slowed rapidly and turned sharply to the left until she came to a stop. All power was

lost but the ship's service diesel generators in compartment A-526-AE were put on the line immediately, restoring full electrical power and lighting throughout the ship. There were no fires. BLOCK ISLAND was down by the stern some 9 feet, but there was no list. There was progressive flooding only in the main machinery space and this was in the process of being controlled. Light and electrical power were available and the situation was stabilized. The ship appeared to be in no danger of sinking.

16. At 2023, ten minutes after the first two torpedo hits, a third torpedo struck the port side at about frame 140. Since the vessel was trimmed by the stern, the point of detonation was considerably higher than that of the second torpedo hit, probably somewhat below the level of the second platform. Large holes were blasted in the second and hangar decks. The hole in the hangar deck was reported to have extended from about frame 137 to frame 148 on the centerline and to be about 30 feet square. One man on the hangar deck was killed and three men stationed on lower decks were missing. The detonation resulted in almost complete flooding between the after bulkhead of the machinery space and the forward end of the spaces flooded from the previous torpedo. The immediate flooding caused by the third hit put the vessel well down by the stern with the waterline above the second deck. Progressive flooding on the second deck through the non-watertight second deck hatches commenced in almost all spaces aft of the after machinery bulkhead (bulkhead 122).

17. All electrical power was lost and lights went out. The ship's service diesel generators continued to operate but a failure occurred in the ship's service switch board (diesel generator and distribution) between the generator circuit breaker and the main bus due to the shock of the third torpedo hit. The emergency diesel generator in compartment A-406-AE, which is automatic starting, apparently did not operate. Consequently, all intra-ship communications failed, and inter-ship communications were reduced to signal flags and hand lamps. Relay-controlled automatic hand lanterns did not operate. With the loss of power, the slow flooding in the engine room could not be controlled by the ship's pumps. The engine room and ship's service diesel generator room were abandoned about ten minutes after the third hit, when the water reached the floor plates in the engine room. The distribution board had not been re-oriented at this time.

18. At 2040, seventeen minutes after the third torpedo struck, BLOCK ISLAND was abandoned by a majority of the officers and crew. A small group of officers and men remained aboard in an effort to save the ship, although it was believed that little could be done, due to the great extent of the flooding water. An inspection made about 45 minutes after the third hit revealed that water within the ship aft of bulkhead 162 was almost to the main deck, and between bulkheads 122 and 149 was about six feet deep on the second deck. Between bulkheads 149 and 162 water was just about at the level of the second deck and was beginning to come through the non-watertight hatches. At 2140 (about one and one-half hours after the first hit) the waterline aft was above the main deck level and the bow was rising more rapidly. There was no list. At this point the Commanding Officer directed all hands to leave the vessel. Some ten or twelve minutes after the last man left the ship, BLOCK ISLAND plunged by the stern, the bow rising high in the air to an estimated angle of 70 or 80 degrees from the horizontal. Although

there were some sub-survivors, the vessel sank, which accounts for one was injured. No one of life consisted of the survivors as a result of the first hit and

19. The BLOCK ISLAND was damaged by the first torpedo which may have been electric and perhaps all, of these torpedoes. The German electric-driven torpedo, known as the "T.5", is believed to be the one that struck. The normal German electric-driven torpedo head containing 660 pounds of TNT. German torpedoes have

20. The damage to the vessel is consistent with this torpedo. It indicates that the first hit was the one that caused the detonation and that the detonation was not further in the following

21. The Commanding Officer's estimation of the first torpedo hit. Several survivors reported seeing shells in this area. Few of the inaccessibility of the area. Leakage aft of bulkhead 122 is probable that the point of detonation is based on the description of the damage and the age. Inasmuch as bulkhead 122 is of detonation and the diameter of the hole is smaller than average, it is probable that the detonation has been of low order. The point of detonation is not correct.

22. The second torpedo hit was about 20 feet forward of the first hit, probably about 5 feet below the surface. The torpedo struck in way of the main deck and tends from side to side across the starboard sections of the vessel by an equalizing trunk. The 5-inch projectiles might have been in view of the lack of a list from the probable point of detonation. The explosion occurred

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there were some sub-surface detonations two or three minutes after
the vessel sank, which are attributed to depth bombs detonating, no
one was injured. No one was lost in abandoning ship. The total loss
of life consisted of the six men killed by the detonations, two as a
result of the first hit and four as a result of the third.

SECTION IV - DISCUSSION

A. Torpedoes

19. The BLOCK ISLAND was struck by three German torpedoes, which may have been electric. It is also possible that at least two, and perhaps all, of these torpedoes were of the acoustic homing type. The German electric-driven acoustic homing torpedo, usually referred to as the "T.5", is believed to contain about 660 pounds of explosive. The normal German electric-driven torpedo is known to have a warhead containing 660 pounds of hexanite. About ninety per cent of all German torpedoes have a warhead charge of 660 pounds of hexanite.

20. The damage from the second and third hits on BLOCK ISLAND is consistent with this size of warhead. The damage to the bow, however, indicates that the first torpedo was either smaller than the others, or that the detonation was not of a high order. This possibility is discussed further in the following paragraph.

B. Structural Damage

21. The Commanding Officer's report places the point of detonation of the first torpedo at frame 14, about ten feet above the keel. Several survivors report seeing a large hole in both port and starboard shells in this area. Few other details of damage are known because of the inaccessibility of the area. It was reported that there was no leakage aft of bulkhead 22. On the basis of other war experience, it is probable that the point of detonation was at about frame 10. This estimate is based on the intact condition of bulkhead 22 and the reports describing the damage as a hole, indicating a forward limit to the damage. Inasmuch as bulkhead 22 is only 24 feet from the estimated point of detonation and the dimensions of the hole in the shell are somewhat smaller than average, it is possible that the detonation might have been of low order. The extensive damage to the flight deck caused by the detonation is not consistent with this conclusion.

22. The second torpedo probably detonated at about frame 169 about 20 feet forward of the 5-inch projectile stowage C-407M, and probably about 5 feet below the bottom flat of this magazine. The torpedo struck in way of C-510-F, the aftermost fuel oil tank, which extends from side to side between frames 161 and 171 with the port and starboard sections of this tank being connected through the shaft alley by an equalizing trunk. This tank was empty. It thus appears that the 5-inch projectiles might well have been subjected to fragment attack in view of the lack of a liquid layer and the comparatively short distance from the probable point of impact to the stowage. However, no magazine explosion occurred.

23. The extent of structural damage caused by the two aftermost hits is consistent with the estimated warhead charge. A large hole was opened in the first platform, 16 feet above the point of detonation of the second hit. No damage to the second deck was reported. Some bulging of this deck undoubtedly occurred and probably escaped notice because the damage was located in the after elevator pit C-204-1L. Bulkhead 182, in way of the steering gear room C-305-E, about 40 feet from the detonation, was buckled and strained. Both the second and hangar decks were blown out in way of the third hit, which detonated only about 14 feet below the second deck, due to the increased draft at the time. The hangar deck was approximately 25 feet above the point of detonation. Under normal conditions, the hangar deck should not have sustained serious damage. This class of vessel was converted from a group of C-3 cargo vessels. Upon conversion, the large cargo hatch openings in the hangar and second decks and in the present second platform were closed by installing deck beams between the hatch girders and plating over the openings. These plated-over hatches were points of weakness in the decks due to the lightness of the added plating and beams, the short span of the added beams, and the inherent strength of the hatch coaming structure and surrounding deck. No. 4 cargo hatch was located between frames 132 and 144, directly over the detonation. It appears that the second deck hatch plating aft of bulkhead 136 was blown up against this bulkhead, allowing the force of the detonation to destroy the hangar deck hatch plating. This explains the apparently incongruous fact that the hole in the hangar deck appeared on the centerline rather than over the torpedo detonation on the port side. Survivors' reports that the hole had no ragged edges and that the edges were bent downward (probably due to the sagging of the heavy hatch girders) substantiate this conclusion.

24. The third torpedo detonated on the port side just above the aircraft ammunition magazine C-507-M in the hold. This was directly opposite bomb magazine C-507-M, located on the starboard side. These two magazines were separated by the shaft alley and connected by equalizing trunks. The second bomb magazine, C-403-M, was located on the second platform between frames 149 and 155, about 23 feet aft of the detonation. Both of these bomb magazines were protected by liquid layers on the outboard side. The inner bounding bulkhead of the liquid layer and the athwartships bounding bulkheads of the bomb magazines were composed of 1-inch STS. There was no protection on the interior longitudinal bulkheads of the magazines. However, the shaft alley which had flooded formed an effective liquid layer for bomb magazine C-507-M. This liquid layer, in combination with the medium steel shaft alley bulkheads, apparently stopped any fragments which may have attacked the magazine from the detonation about 36 feet away. The after bomb magazine C-403-M was protected by the 1-inch STS transverse bulkheads installed during alterations accomplished by the Norfolk Navy Yard in April. The forward bulkhead of this compartment was about 23 feet from the detonation of the third hit and the after bulkhead was about 35 feet from the detonation of the second hit. There was no detonation of bombs in either magazine.

Because of the distances conditions would have occurred. The Commanding Officer's stowage to the alteration which had been accomplished.

25. The first two hits in the quarter, were so located on the hull. Some damage of these hits would not have incurred, nonetheless, were observed on the second platform at the service diesel generator of the main strength structure.

26. After the third hit of the flight deck expansion observed to have opened, estimated to be about five feet, any tendency to break up strength was not a factor.

27. Despite the possibility as to cause considerable and other light structure COME BAY, which was azine detonations, the doors and other light structure personnel and injured was reported on BLOC below deck spaces was

28. The shock of the 2 boilers by actuating the boiler was lighted off in way of the torpedo resulted in severe damage. The forward end of the element carried away, bearing and journal and the shock from the bro gear into the rotor of the served from the dumm the rotor rubbing at high turbine rotates at about The condenser tubes in tured, allowing circulation turbine and out into the these ruptures were d

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Because of the distances involved, there is a possibility that no detona-
tions would have occurred had the alterations not been accomplished.
The Commanding Officer attributed lack of any difficulty with the bomb
stowage to the alterations which had been authorized by the Bureau, and
which had been accomplished in this ship.

25. The first two hits, one at the extreme bow and the other under
the quarter, were so located as to cause probable severe flexural vibra-
tion of the hull. Some damage to the main strength members as a result
of these hits would not have been unusual. The actual damage which was
incurred, nonetheless, was very minor. Buckles about six inches deep
were observed on the starboard side of the second deck at frame 100
the second platform at frame 90 and the hold at frame 95 in the ship's
service diesel generator room A-526-AE. None of these decks are part
of the main strength structure.

26. After the third hit, a slight droop of the stern was noticed aft
of the flight deck expansion joint at frame 143. The expansion joint was
observed to have opened up about two feet and the angle of droop was
estimated to be about five degrees. Beyond this, there is no evidence of
any tendency to break up and it is evident that failure of longitudinal
strength was not a factor in the loss of BLOCK ISLAND.

27. Despite the position of the first two hits, which were so placed
as to cause considerable shock and flexural vibration, partition bulkheads
and other light structure apparently stood up well. In the case of LIS-
COME BAY, which was subjected to severe blast effect from the mag-
azine detonations, the collapse of partition bulkheads, bunks, joiner
doors and other light structure seriously impeded the evacuation of
personnel and injured many. Although some disorder of loose gear
was reported on BLOCK ISLAND, it was not serious and evacuation of
below deck spaces was not impeded.

C. Machinery Damage

28. The shock of the second hit extinguished fires in Nos. 1 and
2 boilers by actuating the solenoid quick-closing fuel oil valves. No. 2
boiler was lighted off again immediately. The propeller shaft was broken
in way of the torpedo hit and the forward section bent out of line. This
resulted in severe damage to the reduction gear and main thrust bearing.
The forward end of the low pressure turbine casing in way of the astern
element carried away, damaging the turbine pedestal, Kingsbury thrust
bearing and journal and the main condenser. This was probably due to
the shock from the broken shaft being transmitted through the reduction
gear into the rotor of the low pressure turbine. A ring of fire was ob-
served from the dummy piston and astern impulse wheel, caused by
the rotor rubbing at high speed against the casing. The low pressure
turbine rotates at about 5400 revolutions per minute at standard speed.
The condenser tubes in the main condenser were reported to have rup-
tured, allowing circulating sea water to pour into the low pressure
turbine and out into the engine room bilges. It is not probable that
these ruptures were due to a hydraulic shock, inasmuch as the torpedo

detonation was about 150 feet aft of the condenser. It appears more probable that several tubes jarred loose from the tube sheets because of mechanical shock transmitted through the condenser and turbine foundations and casings as the result of the broken shaft. A similar conclusion was reached in the case of a main condenser on HORNET* which was reported to have "collapsed internally". BLOCK ISLAND's condenser was of commercial design in which the tubes were not expanded into the tube sheets, but were caulked. As a consequence, it would naturally be subject to greater damage from shock than a condenser of the HORNET type. It is possible, also, that fragments from the broken turbine casing may have punctured several tubes.

29. Derangements of several auxiliary machinery units occurred due to shock. Two condensate pumps were torn from their bases and circulating lines from the main condenser were carried away. The floor plating and supports for the condenser were twisted and buckled. The bilge pump and bilge and ballast pump were jarred out of line. It is not clear whether these pumps were made operable in the interval between the second and third hits. It does not appear that the shock damage in the engine room was important or that it was a critical factor in the final loss of the ship. Both steering rams were reported to have been twisted from their bases and the trick wheel damaged. Under the existing conditions, the loss of steering control was not important since the vessel was immobilized with a broken propeller shaft.

30. After the first two hits, which were practically simultaneous, the turbo-generators in the main machinery compartment were shut down due to loss of steam. Electric power was regained immediately when the two ship's service diesel generators were placed on the line. These generators were located in A-526AE, directly forward of the main machinery space on the port side. The third torpedo hit moved the ship's service diesel generator switchboard out of line, making it impossible to get power on the board although the diesel generators were running with 240 volts at their terminals. This failure to get power on the line was attributed by the Engineering Officer to either rupture of the circuit breaker contact or severance of the leads from the circuit breaker to the bus. This casualty had not been repaired at the time the engine room was abandoned. The loss of all electrical power after the third hit had a hampering but not critical effect on the following events. Communications were lost within the ship and also with the other ships of the task group, except by hand flashlight. The loss of lighting within the ship hampered evacuation of personnel and undoubtedly influenced the early abandonment of the engine room, although little could be done in the engine room due to loss of power. Type JR-1 hand lanterns, manually controlled, furnished sufficient light for evacuation of personnel. The loss of pumping facilities in the engine room made it necessary to abandon this space. The flooding aft of the engine room, however, was the controlling factor in the loss of the ship.

*Buships War Damage Report No. 30.

31. No mention was made of the emergency diesel generator automatic starting, but reference is made to emergency lighting forward "given up". Actually, according to the report, which can be connected to

Fire control
I. C. Switch
Emergency
Ammunition

It will be noted that no emergency relay-controlled automatic emergency lighting. The fire control circuit simultaneously energized is not apparent.

32. The Commandant recommended that certain sea chests in escort aircraft carriers be secured with cement or by providing shock as apparently happened. This recommendation referred to the tank top. This report reported by personnel on the flooding which was so severe when the engine room was being entered through bulkheads and that the main condenser was closed only about 75 percent required to determine whether a pre-fabricated steel structure to shock. On the other hand, it has been considered unnecessary reinforcement has been considered for sea chests of cast iron. In other vessels, reinforced

33. Reference is made to aircraft carriers, the least one main watertight bulkhead, and that where placed in opposite ends of the compartment A-506-A

It appears more tube sheets because condenser and turbine shaft. A similar condenser on HORNET* . BLOCK ISLAND's tubes were not exposed as a consequence, it was a shock than a condenser fragments from the tubes.

machinery units occurred from their bases and carried away. The tubes twisted and buckled. They were pulled out of line. It was in the interval year that the shock was a critical factor. It was reported to be a wheel damaged. Under the wheel was not important propeller shaft.

Electrically simultaneous, compartment were shut down and regained immediately and placed on the line. The tubes forward of the torpedo hit moved out of line, making it necessary to stop diesel generators. This failure to get the attention of the Officer to either check the leads from the condenser has not been repaired at the expense of all electrical equipment. This had a critical effect on the operation of the ship and also with the flashlight. The loss of personnel and undoubtedly the propeller, although little could be done. Type JR-1 hand lanterns, for the evacuation of personnel. This made it necessary to leave the engine room, however, was

31. No mention was made in any of the reports of the functioning of the emergency diesel generator in compartment A-406-AE, which is automatic starting, but requires manual switching to energize desired circuits. Reference (a) states that, "a thought was given to the forward emergency diesel generator, but as this generator was for energizing emergency lighting forward and fire control circuits only, the idea was given up". Actually, according to the records of this Bureau, the loads which can be connected to this emergency generator are:

Fire control M-G set.....	420 amperes
I. C. Switchboard.....	170 amperes
Emergency Radio.....	35 amperes
Ammunition Hoists (3).....	12 amperes

It will be noted that no emergency lighting circuits are included. The relay-controlled automatic hand lamps, (type JR-1), are provided for emergency lighting. The generator can carry all circuits except the fire control circuit simultaneously. Thus, the reason that the emergency radio and the interior communication circuits could not have been energized is not apparent.

32. The Commander Aircraft, Atlantic Fleet, in reference (b), recommended that certain deficiencies in escort aircraft carriers, presumably brought to light by the loss of BLOCK ISLAND, be studied and remedial action taken where required. It was recommended that sea chests in escort aircraft carriers be improved in design by filling with cement or by providing additional bracing to prevent fracture under shock as apparently happened in the case of BLOCK ISLAND. This recommendation referred to the main injection sea chest which was reported by personnel on watch in the engine room to have fractured at the tank top. This report is somewhat inconsistent with the rate of flooding which was so slow that water had only reached the floor plates when the engine room was abandoned, despite the fact that leakage water was entering through bulkhead 122 and through the damaged condenser and that the main condenser injection and discharge valves could be closed only about 75 per cent. Normally, a dry dock inspection is required to determine whether a large sea chest has fractured, particularly in vessels with double bottoms. BLOCK ISLAND's sea chest was a pre-fabricated steel weldment, a type which has considerable resistance to shock. On the basis of other war experience, it has heretofore been considered unnecessary to reinforce steel sea chests. Such reinforcement has been confined to older types of conversions having sea chests of cast iron. In view of the lack of positive evidence as to fracture and the known excellent performance under shock of steel sea chests in other vessels, reinforcement does not appear to be justified.

33. Reference (b) also recommended, "that in future converted aircraft carriers, the emergency diesel generators be located with at least one main watertight subdivision between them and the main generators, and that where practicable, emergency diesel generators be located in opposite ends of the ship" and more specifically, "that in CVE6 class vessels, one emergency diesel generator be relocated to the forward hold, compartment A-506-A, and the other to compartment C-508-1/2-M".

This recommendation evidently refers to the ship's service diesel generators as "emergency diesel generators". These are distinct from the emergency diesel generator, and were installed to augment the power capacity of the three ship's service turbo-generators located in the main machinery space. The ship's service turbo-generators and the ship's service diesel generators are separated by a single watertight bulkhead at frame 102 in the CVE6 class. Since all main propulsion machinery is contained in a single space, it was considered not practicable nor necessary to effect further segregation of the ship's service electric power plant, since damage or flooding in the machinery space would make a vessel of this class dead in the water in any event. Under these conditions, it is probable that the emergency diesel generator would fulfill all essential requirements. In the case of BLOCK ISLAND the emergency diesel generator was not utilized (possibly the emergency diesel generator room was not manned); and unquestionably, the switchboard casualty could have been rectified and the ship's service diesel generators used, had time permitted.

34. The emergency diesel generator is separated from the ship's service diesel generators by two watertight bulkheads and a space of about 40 feet. War experience has indicated that this degree of separation is adequate for protection from a single hit. Restrictions on space and weight preclude the installation of an additional emergency diesel generator aft.

35. Emergency diesel generators are not provided for the CVE55-104 class because of weight and space considerations. These ships, however, have three main turbo-generators each in a separate main subdivision of the ship, being located in the spaces bounded by main transverse bulkheads 82 and 100, 100 and 118, 118 and 136, respectively. Ships of the CVE105-127 class also have a split plant with two turbo-generators being located in the auxiliary room between bulkheads 69 and 81, and the other two main turbo-generators located in the after engine room between bulkheads 101 and 117. These latter ships have in addition an emergency diesel generator forward on the starboard side of the first platform between bulkheads 42 and 44. These arrangements are consistent with the recommendations made in reference (b).

D. Stability and Flooding

36. The loss of BLOCK ISLAND is a clear case of loss of buoyancy, bodily sinkage and plunging by the stern. Transverse stability was ample at all times. Little or no list was reported. The floodable length curve for a Maritime Commission C-3 cargo vessel (from which the CVE6 class was converted) shows that 157 feet of the aftermost portion of the vessel may be flooded before the main deck approaches the waterline. This value is based on a 25-foot mean draft and an assumption of 80 per cent permeability for the compartments. Thus, the aftermost four main watertight subdivisions (or everything aft of bulkhead 136) must be flooded to bring the vessel to the critical condition. Actually, BLOCK ISLAND had flooding in eight main watertight subdivisions, the aftermost six (including

the engine room) and the forward compartments acting as counter-flooding in the after portion of the there any possibility of compartments, the engine room unwatered if power had been available. It also might have been under compartment C-20. Division was considerably shallow. There was no hope of unwatering the sea. If the remote possibility under C-203-L be discounted, the reach of any damage in the same manner, it can be seen that the vessel have survived the first two torpedoes in the opinion of the survivors.

37. Despite the fact that the vessel was unable after the third torpedo hit, the vessel remained afloat after the third hit, which is considered a success of this type.

38. Records of the Liberty ships struck by torpedoes and 90 per cent of those loaded Liberty ships and more torpedoes. Naval Escort Carriers in this respect show a greater resistance to damage than merchant types which is due to improvements were accomplished on the decks below the main deck. The weakness of the C-3 conversion plant and a single space.

39. Although free flooding of BLOCK ISLAND was apparent, the measures taken for the CVE6 class. These included the installation of about 20mm and 40mm ammunition.

40. There was little damage to BLOCK ISLAND after the first two torpedoes, with the exception of the flooding of the engine room. The 20mm and 40mm ammunition were promptly isolated and promptly extinguished by incoming

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the engine room) and the forward two compartments. Flooding of the forward compartments actually improved the situation somewhat by acting as counter-flooding to reduce the trim. Of the six compartments in the after portion of the vessel which were flooded, in only three was there any possibility of controlling the flooding. The extreme compartments, the engine room and the steering gear room, might have been unwatered if power had been regained and sufficient time had been available. It also might have been possible to keep even with the flooding under compartment C-203-L since the rate of flooding in this subdivision was considerably slower than in the neighboring compartments. There was no hope of unwatering other sections as they were open to the sea. If the remote possibility of controlling the flooding in the space under C-203-L be discounted, it is obvious that the vessel was beyond the reach of any damage control measures after the third hit. In the same manner, it can be shown that BLOCK ISLAND unquestionably would have survived the first two torpedoes. This was also the unanimous opinion of the survivors.

37. Despite the fact that the loss of BLOCK ISLAND was inevitable after the third torpedo hit due to the extensive flooding incurred, the vessel remained afloat for more than an hour and a half after the third hit, which is considered very satisfactory performance for a hull of this type.

38. Records of the first 2-1/2 years of the war show that of U.S. Liberty ships struck by one torpedo, about 60 per cent of loaded vessels and 90 per cent of those in ballast survived. About 20 per cent of the loaded Liberty ships and 30 per cent of those in ballast survived two or more torpedoes. Naval conversions from C-3 types, including the few Escort Carriers in this category, should be expected to have even better resistance to damage than the Liberty ships, particularly since some improvements were accomplished in the conversion. One weakness of merchant types which is apparent in this case, however, is the fact that the decks below the main deck are generally non-watertight. Another weakness of the C-3 conversion is that they have only one main propulsion plant and a single screw.

39. Although free surface flooding was extensive, the stability of BLOCK ISLAND was apparently positive at all times. This speaks well for the measures taken during conversion to increase the stability of the class. These included the issuing of liquid ballasting instructions and the installation of about 1800 tons of solid ballast in the hold compartments.

E. Damage Control Measures

40. There was little opportunity for actual damage control on BLOCK ISLAND after the third torpedo hit. The damage control situation after the first two hits appeared to be well in hand, with the possible exception of the flooding in the engine room. Two broken fire main risers were promptly isolated. No fires occurred other than a small one in the 20mm and 40mm ammunition stowage forward which apparently was quickly extinguished by incoming sea water. Electric power, lost after the

first two hits, was restored speedily. Inspection of the damaged areas was in progress when the third torpedo struck. Damage control after the third hit was concerned chiefly with maintaining the necessary emergency facilities for proper evacuation and rescue of personnel. Electric power never was regained. No use was made of the emergency diesel generator. Communications, as a result, were not maintained after the third hit, although the equipment was undamaged.

41. None of the type JR-1S relay-controlled automatic hand lanterns appears to have operated. This vessel undoubtedly was equipped with the older type of lantern with the split-prong type of plug connection which is subject to falling out as the result of shock or usage, unless maintenance precautions are taken. A recommendation for the maintenance of this type of plug was issued for the first time in a letter from the Bureau to all ships in commission (S64-4(8660d), EN28/A2-11 of 30 September 1942), and was repeated at various intervals. If these precautions had been carried out, it appears reasonable that some of the relay-controlled lanterns would have operated - as was true on LISCOME BAY. However, a new type of lantern with a bayonet-type joint for the plug is under procurement and will replace the present type when available.

F. Conclusion

42. BLOCK ISLAND absorbed the damage from two torpedo hits without danger of sinking. A third torpedo hit in a most unfavorable location brought about the loss of the vessel. Although two of the torpedo hits were in the vicinity of the bomb magazines, the authorized alterations by the Bureau to improve the protection of these magazines appear to have contributed to the prevention of a magazine explosion. The performance of BLOCK ISLAND is indicative of good hull construction and adequate transverse stability, and is reassuring with respect to other naval conversions from C-3 type hulls.