PRELIMINARY REPORT

U.S.S. SARATOGA

TORPEDO DAMAGE

January 11, 1942

Class.	Aircraft Carrier (CV3)	Length.	830'
Date Launched.	April 1925	Beam.	105'-6"
Displacement (standard). .	33,000 tons	Draft before damage.	32'-1"
		Draft after damage.	33'-2"

References:

(a) Navy Yard P.H. conf. despatch 180500 (January) to Buships.
(b) Combatfor conf. despatch 200400 (January) to Buships.
(c) Comdt. P.H. ltr. C-L11-1/CV3/NY10(Y0129) to Buships, January 23, 1942.
(d) Navy Yard P.H. conf. despatch 280510 (January) to Buships.
(e) C.O. SARATOGA ltr. CV3/A16-3/L11-1/(50-h1)(011) to Buships: War Damage Report, February 6, 1942.
(f) Cincpac ltr. L11-1(1)/50 Serial 0355 to Buships, forwarding C.O. SARATOGA report of liquid loading, February 2, 1942.

Circumstances of the Attack

1. U.S.S. SARATOGA was at latitude 19° N, longitude 165°-15' W in the early evening of January 11, 1942. The weather was clear with excellent visibility from starlight, and there were long swells running from the northwest. Torpedo wakes were seen by a screening vessel. At 1915 a torpedo struck the port side at frame 106, about 12 feet above the keel. It was fired from forward of the port beam, and the ship was silhouetted to the enemy by Venus low on the starboard quarter.

2. The explosion was dull and muffled, with possibly a reverberation rather than a single sound. Some observers reported a splattering flash (as when steel is poured) while others saw only a glow or reflection above the area hit. A

The ship was shaken perceptibly, but no general flexural vibration of the hull was observed.

3. Three boiler rooms abreast the explosion were flooded (B-8, B-10 and B-12). A list of about 6 degrees was corrected by counterflooding and transfer of oil. Speed before the attack was 15 knots, which was increased to 17 knots afterwards.

Structural Damage

4. This is shown by Plates I and II and the attached photographs, prepared by the Navy Yard, Pearl Harbor. The shell was fractured from frame 104 to frame 111, a distance of 28 feet, and from the bottom of the armor belt to the outboard docking keel. The shell was indented over a length of about 60 feet, as indicated on Plate I, with the plating dished between frames. The bilge keel remained practically in its original position (though distorted), with the shell fractured above and below it. The bottom was blown out between the bilge and outboard docking keels, the docking keel was bowed up about 6 inches, and the buckling of the bottom extended in to the inboard docking keel.

5. The blister plating was blown in against the armor in the large indentation seen in Photos 1, 2 and 3. This forced many of the transverse braces through the plating. A definite ridge separated the indentations in the blister and shell; this ridge was in way of the "hard spot" where cement had been used to fill the sharp corner formed by the juncture of the bottom of the blister with the shell plating. The armor itself remained in position. The top of the upper blister was blown upward, which can best be seen at the top of Photo 3.

6. The ripping of riveted seams and butts is quite noticeable, particularly in Photos 1 to 6. Points of countersunk rivets appeared to pull out readily, leaving the rivets still sticking in the other plate, as seen in the seam marked at 'B' in Photos 2 and 3. The tear between the bilge and docking keels was also along a seam, between 'F' and 'G' strakes as shown in Photo 8.

7. Longitudinal bulkhead No. 1 was torn loose at its top and bottom connections and blown in a maximum of about 5 feet, crushing the intervening webs to within about a foot of bulkhead No. 2. A hole was torn in it as indicated on Plate I, about 6 by 3 feet; this is just visible to the left in Photos 4 and 5.

8. Longitudinal bulkhead No. 2 held at the third deck but pulled loose at the bottom, deflecting inward a maximum of about 3 feet. It tore away from all the web frames behind armor belt except one, which ripped through the lightening holes as shown on Plate I. This bulkhead is also reported to have fractured, though no fracture is noted on Plate I.

9. Longitudinal bulkheads 3 and 4 appear to have held well. No. 3 tore loose at the bottom over a few feet and bulged inward about 2 feet. No. 4 had a maximum inward deflection of about 15 inches, where it was hard up against the foundations of No. 10 boiler.

10. The transverse bulkheads bounding No. 10 boiler room were deeply wrinkled adjacent to longitudinal bulkhead No. 4 (see Plate II) but did not rupture. The third deck

was reported undamaged, although it must have leaked because oil rose into compartments C-310-A, C-308-L and B-332-A, which are on the third deck directly over the torpedo bulkhead system.

Damage in Machinery Spaces

11. The three boiler rooms B-8, B-10 and B-12 flooded, as described in Paragraph 18, page 5. This flooding must have been principally oil from the outboard tanks.

12. The outboard side of Boiler 10 was crushed and tubes were bent. The lower outboard burner of Boiler 8 was crushed. Brickwork of all three boilers was, of course, soaked. Boilers 8 and 12 were reported as practicable of repair, with doubt that 10 could profitably be reconditioned. The access trunks to B-8 and B-10 were severely damaged (Plate II) and the airlock crushed in B-10.

13. Piping and operating gear were destroyed, displaced or jammed for a considerable distance on each side of the impact. Items listed in reference (e) as requiring renewal include:

(a) All oil piping in B-8 and B-10.

(b) Main drain piping in B-8 and B-10.

(c) A section of the 8" fire main in B-10.

(d) Bulkhead spools in B-8 and B-10.

(e) Fire main riser in B-10 and plugs in B-8 and B-10.

14. Shock effects on machinery are included in the following section of the report.

Shock Effects

15. Shock to the ship did not cause widespread damage. Piping and fittings in the boiler rooms were fractured, though

how much of this damage was due to the distortion of bulkheads and how much to shock is not clear. Items of damage definitely attributable to the shock were:

(a) In the engine room abreast the explosion, the main throttle tripped (but was reset at once).

(b) The condenser head was cracked.

(c) The 750-KW generator brush rigging carried away.

(d) A number of circuits, including I.C., engine order telegraph, telephones, call bells, general alarm and lighting circuits were shorted (cause not stated).

(e) Circuit breaker opened in lead to shell hoist in No. 2 turret.

(f) Cast aluminum pedestal ring for forward FC Radar cracked beyond repair.

(g) Gauge board in engine room damaged (no details).

Fires

16. There were five small electrical cable fires of no serious consequence.

Liquid Loading Before Damage and Subsequent Flooding

17. This information is shown graphically on Plate III for the spaces and tanks in the general vicinity of the damage. All layers of the torpedo protection system were filled except C-12-F, which was 70% full. The upper void compartments outboard of the armor belt were empty. There was not much liquid in the port double bottom tanks abreast the damage.

18. Boiler rooms B-8, B-10 and B-12 flooded rapidly through broken piping, holes where fittings had carried away, and leaky tank tops. B-10 was full in about 10 minutes, and by 1950 (35 minutes after the hit) all three were reported full. Outboard inner bottom tanks beneath these boiler rooms also flooded. All spaces not hitherto full over a length of 84 feet, between boiler rooms B-6 and B-14, were flooded from the third deck to the skin of the ship, and inboard to the longitudinal bulkhead between the boiler and machinery spaces. About 4 feet of oil rose into the third deck provision compartments C-310-A and B-332-A, and the 'E' division office, C-308-L, which were directly above the explosion.

19. References (a) and (b), later confirmed by the Commanding Officer, reported some flooding of starboard boiler rooms. Although this flooding was not reported in reference (e), and complete details are not available, it is understood from reference (a) that at least one starboard boiler room was flooded to a depth of about 2 feet above the inner bottom. This apparently occurred through air holes in the uptake casings as indicated on Plate III, and if the ship's draft had been a little greater the three starboard boiler rooms, corresponding to those flooded to port, might have been completely flooded.

20. An alteration subsequently directed by the Bureau of Ships removes this danger of cross-flooding via uptakes. The port and starboard uptakes are to be made entirely separate between the third and hangar decks. A new watertight bulkhead is to be placed between them, curved in the transverse plane as necessary. This will prevent water from crossing the third deck whether the uptakes and casings are watertight or not.

Counterflooding and Transfer of Liquid

21. The five following compartments in the starboard torpedo protection layers were counterflooded:

B-31-F	B-47-F
B-39-F	B-49-F
B-41-F	

Oil was transferred from port tanks

C-36-F	D-12-F
B-38-F	D-16-F
C-48-F	D-20-F
D-10-F	D-24-F

to starboard tanks

B-21-F	C-13-F
B-23-F	C-21-F
B-29-F	B-47-F

These moves are best visualized by reference to the flooding effect diagram in the ship's Damage Control Book.

22. About 1100 tons of water entered the ship from the damage, and about 320 were admitted by counterflooding. Transfer of oil from port to starboard was continued until the port list was removed and the list to starboard was about 1-1/2 degrees. The counterflooded tanks were then pumped out and a slight list to starboard was maintained.

Remarks on Torpedo Protection

23. It has been said in despatches that this incident indicates that Japanese torpedoes are unusually destructive, and a charge of from 750 to 1000 lbs. is estimated by reference (e). Very little information is available on Japanese submarine torpedoes. The Bureau, however, does not agree that this damage was exceptionally severe. It was little if any more than might be expected from one of our submarine torpedoes carrying 500 lbs. of explosive.

24. All layers in the torpedo protection system were filled with liquid, whereas at least one void layer is essential

for good protection. In particular, the innermost full tank permitted the transmission of shock directly to the boiler room bulkhead. Had this space been void (a primary objective in all such systems) it is likely that the boiler rooms would not have flooded.

25. It appears that the shell and the first two bulkheads were holed by the explosion; the third was torn loose at the bottom, and the fourth was virtually intact. Experience, both from war damage studies and from experiments, is that no better resistance can be expected. From several viewpoints the torpedo protection served better than would have been predicted. It is consequently believed that the torpedo carried not more than a 500-lb. charge, possibly less. The damage in the boiler rooms resulted from the direct transmission of shock due to the lack of a void layer (or layers) next to the boiler room bulkhead, and to the oil flooding which followed.

26. It has been past practice in LEXINGTON and SARATOGA to carry the torpedo bulkhead system full on the port side in order to balance the island on the starboard side. This permits the maximum amount of fuel to be carried without list. As fuel is consumed, however, the liquids should be distributed for best protection. New instructions for liquid loading have recently been issued, based on the following principles:

(a) To retain present capacity to which ship can fuel without list.

(b) Recent experiments have shown that a full tank next to the shell plating is better than an empty one. The extent of damage to shell plating is somewhat reduced. Moreover, carrying one or two layers of liquid outboard has a very important effect in reducing the angle of heel after damage because:

(1) The fore-and-aft extent of damage to a void layer is apt to be less if the void layer is inboard rather than outboard. Less water is, therefore, admitted to the ship if outboard rather than inboard layers are filled before damage.

(2) The heeling moment produced by water admitted in damage will be less when an inner void rather than an outer void is flooded because its distance from the centerline of the ship is less.

(c) The innermost bulkhead in a torpedo protection system has the best chance of holding if tanks immediately outboard of it are empty.

NOTE: FTP 170 (Damage Control and Chemical Warfare Instructions) is being revised in accordance with the above general principles.

27. The liquid loading instructions recently issued, however, still leave much to be desired because it is necessary to carry more liquids to port than to starboard for balancing the island. This condition can only be remedied by the installation of a blister on the starboard side. Such a blister was proposed some years ago, but was not approved at that time, primarily because its installation would have prevented passage of the present Panama Canal locks. The damage to SARATOGA has emphasized the importance of the question and at the same time has provided an opportunity to install the blister without undue extension of the damage-repair period. The blister is now being installed on SARATOGA and special liquid loading instructions are being issued for that ship. In addition, major changes are being made in the battery

which will materially reduce weights and starboard heeling moment.

28. The alterations on SARATOGA will give the following advantages:

(a) Increased buoyancy and stability provided by the blister, and further increase in stability due to reduction in topside weights will improve the ability of the ship to resist damage.

(b) The reduction of starboard weight and increase in starboard buoyancy will permit a greater total amount of fuel to be carried without list, and

(c) permit carrying two complete layers of liquid outboard next to the shell in way of boiler rooms, with the inner row of tanks left empty - the best liquid distribution for resisting underwater damage and minimizing heel after damage.

(d) The blister will provide additional torpedo protection structure on the starboard side which will materially improve resistance to torpedo attack on that side.