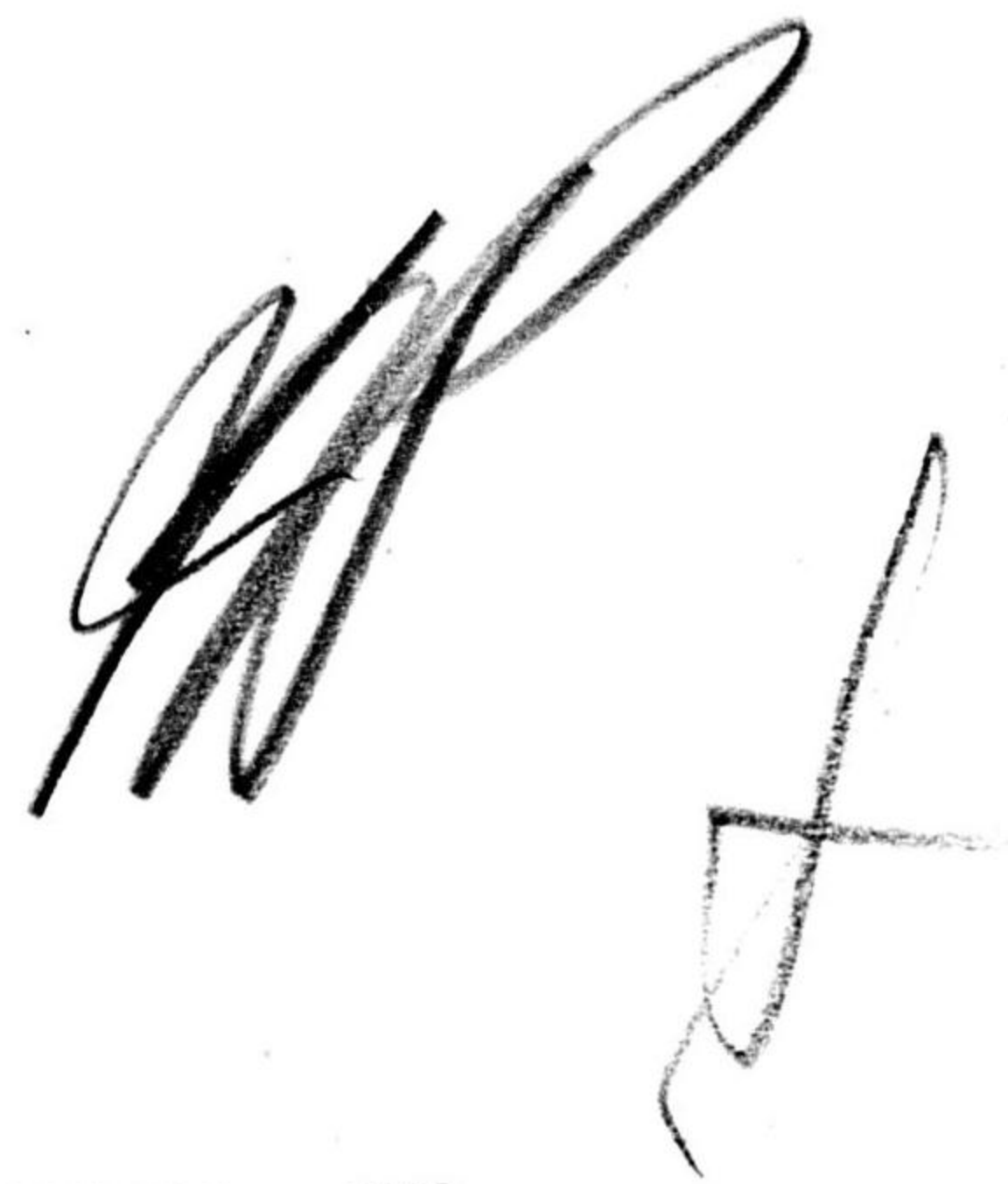


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AIRCRAFT IN BATTLE  
FOR LEYTE GULF

24-26 OCTOBER 1944

AIR INTELLIGENCE GROUP  
DIVISION OF NAVAL INTELLIGENCE  
OFFICE OF THE CHIEF OF  
NAVAL OPERATIONS, NAVY  
DEPARTMENT, WASHINGTON, D.C.

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Analytical Report

CARRIER AIRCRAFT IN  
BATTLE FOR LEYTE GULF  
24-26 October, 1944

Air Operations Research Group  
Air Research Report #18

AIR INTELLIGENCE GROUP  
DIVISION OF NAVAL INTELLIGENCE  
OFFICE OF THE CHIEF OF NAVAL OPERATIONS  
NAVY DEPARTMENT  
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BATTLE FOR LEYTE GULF  
24-26 October, 1944Table of Contents

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Analytical Report  
CARRIER AIRCRAFT IN  
BATTLE FOR LEYTE GULF  
24-26 October, 1944SECTION I - GENERAL1. Introduction.

The multiple engagements grouped under the title, "Battle for Leyte Gulf" are considered the best demonstration to date of the efficiency and deficiency of carrier-based air power opposed to major enemy warships. A total of 453 tons of bombs, 294 torpedoes, and 659 rockets were expended by naval aircraft against Japanese Forces in this action.

It is the purpose of this report to analyze the magnitude of attack against the three Japanese Forces in terms of accuracy and effectiveness of the airborne weapons employed.

2. Battle Narrative.

The landing of United States Forces on Leyte 20 October, precipitated strong naval counter action by the Japanese Fleet. The enemy, according to plan, converged three forces against the beachhead. These forces were met and defeated by Third and Seventh Fleets in three separate air-surface engagements, known collectively as the Battle for Leyte Gulf, 24-26 October. The enemy not only failed to penetrate to his objective, but also lost sufficient ships sunk and damaged to reduce seriously and permanently his naval power and to eliminate temporarily all his available major units.

The enemy naval command used almost all available warships. The three forces totaled 64 warships including one CV, three CVL's, seven BB's and three capital ships converted to hermaphrodite carriers. The Southern and Central Forces, drawn from bases in the Singapore and East Indies area, moved directly on Leyte via Surigao and San Bernadino Straits. The Southern Force was stopped and almost eliminated by the Seventh Fleet on 25 October, primarily by surface ships. The Central Force was damaged, slowed, and forced to withdraw by Third and Seventh Fleet air power in a series of strikes on 24-26 October. Surface action was limited to determined but small scale counterattack by DD's and DE's of the CVE screen in the Battle for Samar, 25 October, and by Third Fleet cruiser fire near San Bernadino Strait early on 26 October. The Northern Force, drawn from the Empire and from Formosa, approached to a point approximately 200 miles east of Cape Engano, Luzon. This force included the carriers. Effective enemy carrier action was forestalled and the force decisively defeated by Third Fleet aircraft on 25 October.

U.S. warships available for the battle totaled 169. Of these 93 were attached to Third Fleet and included eight CV's and eight CVL's. Seventh Fleet, which totaled 76, included sixteen CVE's.

United States ship loss and damage were small: CVL PRINCETON lost through air attack, CVE ST. LO through air attack and gunfire, CVE GAMBIER BAY, three DD's and one DE by gunfire. In addition, seven CVE's, one CL, three DD's and one DE were damaged.

Enemy air activity had no important bearing on the final outcome of the Battle for Leyte Gulf. The two most concerted efforts were attacks on Third Fleet ships east of Luzon on 24 October and suicide dive-bombing of Seventh Fleet CVE's on 25 October.

Air attack against the enemy's Southern Force was confined to light attacks by search planes on 24 October and single strikes by Seventh Fleet planes on 25 and 26 October.



The Central Force, largest and strongest of the three (except for carriers), was hit by five Third Fleet strikes on 24 October as it advanced toward San Bernadino Strait. The MUSASHI, one of the two largest and newest Japanese battleships, was sunk along with two heavy cruisers. The Force continued through San Bernadino Strait to the battle off Samar on 25 October. Two more CA's were sunk by aircraft in seven strikes launched by Seventh Fleet escort carriers and two strikes by a Third Fleet Task Group. Three follow-up strikes on 26 October sank a light cruiser and added to the damage of the other units.

The enemy Northern Force, which included the CV and CVL's was broken and turned back by a series of five Third Fleet air attacks and one cruiser attack on 25 October. The CV and two CVL's were sunk by air action alone, the third CVL crippled by air and sunk by cruiser fire. The use of Third Fleet battleships in this action was precluded by the dispatch of those ships to assist in the Battle off Samar Island.

The Southern Force, composed of two BB's one XCVS-CA, two CA's, one CL and ten DD's embarked troops and sortied toward Leyte Gulf from Lingga. This force was attacked and damaged by our aircraft off the west coast of Mindanao on the morning of the 24th and was engaged and turned back by Seventh Fleet surface units in Surigao Straits early on the 25th. Further air attacks were made on scattered units of the Southern Force on the 25th and 26th. The air attacks against this force represent only a minor portion of the total weight of attack which it sustained. Both battleships, FUSO and YAMASHIRO were damaged by air and sunk by surface action. CA-XCVS MOGAMI was damaged by air and surface and sunk by unknown agent. Two CA's and one CL escaped. Four DD's were sunk and six DD's were damaged, extent undetermined.

### 3. Summary.

#### (A) General

In the Battle for Leyte Gulf, 24-26 October, sorties flown were as follows:

Strikes against Japanese Forces	- -	1686
Searches	- - - - -	372
Fighter Sweeps	- - - - -	37
Defensive: Encountering enemy	- -	161
Not encountering enemy	- - -	706
ASP	- - - - -	289
Support Leyte operations	- - - - -	502
Abortive	- - - - -	94
		Total 4169

Strike sorties flown against the three Japanese Forces were as follows:

Southern Force	- - - - -	96
Central Force	- - - - -	1063
Northern Force	- - - - -	527
		Total 1686

A total of 750 enemy aircraft were engaged, of which 297 were bombers and 453 fighters. 376 enemy aircraft were destroyed, of which 149 were bombers and 227 fighters. In addition 14 enemy aircraft were destroyed by ships AA and 7 were self-destroyed in suicide attacks on U.S. naval vessels.

Own plane casualties totaled 180 damaged, and 181 lost in flight plus 44 lost on the ground.

Personnel casualties were as follows:

	Pilots	Aircrewmen
Dead	10	7
Missing	51	63
Wounded	12	5
Survived		
Unwounded	92	66

### (B) Analysis of Weapons Accuracy and Effectiveness

During the Battle for Leyte Gulf 453 tons of bombs were dropped, 294 torpedoes were launched and 659 rockets were fired against Japanese Forces. The purpose of Sections II and III is to analyze the effectiveness with which these weapons were used with respect to (1) accuracy, (2) proper weapon selection and (3) damage in terms of sinking which may be expected to have been caused to the Japanese Force as a result of the number of bomb, torpedo and rocket hits it is reported to have sustained. The findings of these two sections are presented below in abbreviated form.

1. Accuracy. The accuracy achieved with bombs, rockets and torpedoes is presented in the following table. It should be pointed out that the percentage of hits is based on pilot's claims and not on photo-cover. Those percentages which are based on less than twenty attacks are put in parentheses.

Target	BOMBING ACCURACY		
	Hits as % of Bombs Dropped		
	VB	VT	VF
BB	32%	29%	20%
CV	47%	(29%)	29%
CA	27%	23%	12%
CL	(7%)	14%	17%
DD	7%	10%	6%

Target	TORPEDO ACCURACY		ROCKET ACCURACY	
	Hits as % of Torpedoes Launched		Hits as % of Rockets Fired	
	VT	VT	VF	
BB	43%	(64%)	(23%)	
CV	66%	-	-	
CA	51%	(32%)	(34%)	
CL	28%	(9%)	(7%)	
DD	(20%)	20%	34%	

Comparison of the bombing and torpedo accuracy obtained in the Battle for Leyte Gulf with that obtained in previous actions shows a remarkable improvement in accuracy for both types of weapon. This improvement may be only apparent since large numbers of planes over the target simultaneously can easily lead to duplicated claims of hits. The improvement in the torpedo accuracy may also be explained by the improved aircraft torpedo in use during this battle but not in the actions with which it is compared. (See Section II for a detailed discussion of the comparison.) That the reported accuracy may be greater than that actually obtained is further supported in Section III. In that section an analysis was made of the sinking damage which each vessel of the Japanese Forces of CL or larger category would be expected to have sustained as a result of the hits claimed to have been scored against it.

In several instances it was evident that the number of hits claimed was in excess of that obtained. This was true, for example, in the case of ZUIKAKU and ZUIHO. There were several other instances, ISE and HYUGA, for example, in which it was possible to reconcile the claimed number of hits with the fact that the vessel survived only by assuming in every instance that the distribution of torpedo hits was most unfortunate and that the Japanese damage control was always thoroughly efficient - never having been disrupted by bombing or strafing.

Reliable information concerning accuracy is essential for several different problems. Among these are (a) the determination of the relative effectiveness of various weapons in sinking vessels, (b) the evaluation of the efficiency of various tactics and (c) the estimation of force requirements. The only completely reliable source for such information is a photographic record of the attack.



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2. Weapon Selection. The following table lists the types of bombs and the torpedo depth settings used by Task Forces 38 and 77 in attacks on various categories of Japanese vessels. For a table showing similarly the fuzes used with these bombs see Table 7 of Section II.

TABLE OF BOMB SELECTION AND EXPENDITURE

TASK FORCE 38									
Target	100GP	250GP	500GP	500SAP	1000GP	1000SAP	1000AP	2000GP	DB
BB	64	32	31	76	21	72	58	10	-
CV	16	-	15	31	-	58	61	5	-
CA	8	11	31	29	6	16	2	1	-
CL	4	5	24	36	10	10	6	-	-
DD	2	16	24	47	3	4	17	-	-
Total	94	64	125	219	40	160	144	16	-

TASK FORCE 77									
Target	100GP	250GP	500GP	500SAP	1000GP	1000SAP	1000AP	2000GP	DB
BB	29	8	27	42	-	-	-	-	-
CV	-	-	-	-	-	-	-	-	15
CA	44	5	61	99	-	-	-	-	-
CL	20	7	73	24	-	-	-	-	-
DD	20	13	11	12	-	-	-	-	-
Total	113	33	172	177	-	-	-	-	15

TABLE OF TORPEDO DEPTH SETTINGS

Depth Setting	BB	CV	CA	CL	DD
8'	7	-	10	11	-
10'	20	3	9	6	6
12'	24	28	7	6	1
15'	15	9	10	3	1
16'	2	9	-	-	-
18'	6	7	2	-	-
22'	19	-	-	2	-
unknown	13	-	7	4	2
Total	106	56	45	32	10

NOTE: An additional 45 torpedoes were expended against Japanese Forces but have been omitted from the above table because information as to type of vessel against which they were launched is not available.

A detailed analysis of the sinking damage which each vessel of CL or larger category of the Japanese forces is expected to have sustained as a result of the number of hits reported scored against it will be found in section III. As a result of an analysis of the above tables and of the analysis referred to above, the following conclusions with regard to weapon selection were drawn:

(a) Against Battleships.

A discussion of the bombs, fuzes and torpedo depth settings selected for use in attacks on the various vessels in the Japanese Fleet is presented in detail in sections II

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and III. It is pointed out there, that the 1000 lb. AP bomb when dropped below 4000 feet will not penetrate the armor deck of a BB and that its use is not essential for penetration of the armor of a CV or CA. Furthermore it is clear that no bomb, with the possible exception of the 1600 lb. AP, presently in use is capable of penetrating the armor deck of a BB when dropped below 4000 feet. The 1600 lb. AP, if dropped in a 70° dive at 3000' from 4000', will penetrate approximately 4½ inches of STS. It is possible but not probable, that the armor decks of old Japanese BB's total less than 4½ inches of STS.

It appears unlikely, in the light of the above discussion, that Naval bombing can succeed in penetrating to the vitals of a BB. There remains, then, to consider the damage which can be done above the armor deck.

The armor above the armor deck is usually 1½" of STS. The 1000 lb. GP, 2000 lb. GP, and 1000 lb. SAP bombs can penetrate this armor when dropped at 3000' in a glide or dive from as low as 1000 feet. It is doubtful that the 500 lb. GP can and certain that the 250 lb. GP bomb cannot penetrate 1½" of STS.

The approximate weight of explosive carried by each of the bombs which can penetrate the first deck is as follows:

1000 lb. AP	150 lbs.
1000 lb. SAP	300 lbs.
1000 lb. GP	550 lbs.
2000 lb. GP	1100 lbs.

The damage effected is roughly proportional to the weight of explosive. Therefore, the 2000 lb. GP, the 1000 lb. GP and the 1000 lb. SAP are to be preferred, in that order, to the 1000 lb. AP for attacks on BB's. This conclusion is in agreement with FTP 224, Selection of Bombs and Fuzes for the Destruction of Various Targets, October 1944.

It is of interest to compare the weight of explosive actually delivered on the Japanese BB's by 1000 lb. AP bombs in the Battle for Leyte Gulf with that which would have been delivered had the same weight of 1000 SAP or 1000 or 2000 lb. GP bombs been used. Such a comparison is made below:

1000 lb. AP bomb hits		Weight of Explosive in same weight of	
No.	Weight of Explosive	1000 lb. SAP bombs	1000 or 2000 lb. GP bombs
32	4800 lbs.	9600 lbs.	17,600 lbs.

It is shown in section II that the torpedo depth settings used against BB's were too shallow in at least 60% of the cases and that in no case was an optimum depth setting used. This of course served to reduce the effectiveness of the torpedoes. Another and perhaps more important factor was the considerable time interval between successive hits, and the unfortunate distribution of the hits about the hull of the BB's. The most feasible method of sinking a battleship is to cause it to capsize or plunge. Capsizing may be caused by obtaining at least 5 hits, essentially simultaneously, on one side of the vessel. Plunging may be caused by flooding either the entire bow and at least one main compartment close astern of the bow, or by flooding the stern and one main compartment just forward of the stern (BuShips). To cause plunging, therefore, it is necessary to secure many hits essentially simultaneously, all concentrated well forward of amidships or well astern of amidships.

It may not be feasible to design torpedo attack tactics which would ensure a proper distribution of hits to cause plunging. It does, however, appear quite feasible to design tactics which would ensure the scoring of hits on one side rather than on both sides of a BB during a given strike. The potential value of such tactics is well illustrated by considering that ISE would almost certainly have sunk if the 5 torpedoes which were reported to have struck her during the first strike had all hit on one side, rather than 2 on one and 3 on the other.



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(b) Against CV's and CVL's.

The 1000 lb. SAP is capable of penetrating the armor of CV's and CVL's when dropped in the usual naval bombing attack. It is probable that the 2000 lb. GP is not. In the Battle for Leyte Gulf the Japanese aircraft carriers were struck with thirty-three 1000 lb. SAP bombs. Although all, or very nearly all, of these bombs had sufficient terminal velocity to penetrate the armor of the carriers, none of them penetrated to the vitals of the vessel. This is so because the bombs were fuzed .025 sec. delay instead of the more desirable .1 sec. delay.

The 1000 lb. AP bomb which can be fuzed .08 sec. delay only, is undesirable for attacks against aircraft carriers. There are two reasons for this:

- (a) it carries a relatively small charge of explosive;
- (b) it may explode before penetrating into the vitals of the vessel.

The torpedo protection system of CV's is similar to that of BB's. For this reason it is desirable that torpedo tactics against CV's be the same as those against BB's. That is the tactics should be such as to score 5 or more hits on one side during a single attack. If the torpedo hits reported to have been made against ZUIKAKU during the first strike had been all on one side rather than two on one side and three on the other, there is no doubt that she would have sunk before the second strike.

The distribution of the torpedo hits on CVL's is not as important as on CV's and BB's. Three or four hits, wherever they occur, are almost certain to sink a CVL.

(c) Against Cruisers.

Because of the light armor of these vessels (2 to 2½ inches) it is clearly unnecessary to use 1000 lb. AP bombs against them. The more heavily charged 1000 lb. SAP bomb dropped in a 70° dive at 3000 and 2000', will have sufficient terminal velocity to penetrate the armor of a CA. If fuzed .1 sec. delay the bomb will explode deep in the vessel even if the fuze is initiated by the super-structure. It is probable that a .05 sec. delay fuze would be more desirable than a .1 sec. delay fuze for attacks against CA's and CL's. However, because no such fuze exists the .1 sec. delay fuze is clearly the most desirable one.

The torpedo protection system of cruisers is such that three or four hits, regardless of location are almost certain to sink them.

(d) General.

It has been shown above that the 1000 lb. AP bomb is not a suitable weapon for naval air attack against any warship. It is not desirable as a weapon against merchant vessels. FTP 224 does not recommend its use against any land targets. In view of the above, the question as to whether U.S. aircraft carriers carry any 1000 lb. AP bombs merits consideration.

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SECTION II - ANALYSIS OF U.S. AIR EFFORT WITH RESPECT TO ACCURACY; BOMB AND FUZE SELECTION, AND DISTRIBUTION OF ATTACKS

4. Introduction.

The purpose of this section is to present (1) the accuracy achieved with weapons employed (2) the bomb types and fuzes and the torpedo depth settings used in attacks against particular types of Japanese combatant ships and (3) the distribution of the attacks by Task Forces 38 and 77 on the three Japanese Forces.

This section is divided into three parts. In the first part the accuracy achieved is tabulated and compared with accuracy obtained in other attacks. The accuracy as reported in the Battle for Leyte Gulf is somewhat higher than that shown in the earlier operations with which it is compared. The higher accuracy may be due to a real improvement or to duplication in claimed hits. It is concluded that for more reliable assessment of accuracy more complete photo-cover is necessary.

The second part contains tables of the bombs and fuzes and of the torpedo depth settings used against the several types of Japanese warships. These tables are compared with bombs and fuzes recommended in FTP 224 and torpedo depth settings recommended by BuShips. From this comparison it is concluded that for the usual Navy dive and glide bombing tactics (release less than 4000') the 1000 lb. AP bomb is not as effective as the 1000 lb. SAP or 1000 lb. GP bomb. In addition, it is concluded that the SAP bomb would generally be more damaging with a .1 sec. delay fuze rather than the customary .025 sec. delay. If .025 sec. delay is desirable, a GP bomb is generally more effective than a SAP bomb of the same weight. Of the torpedoes released at BB's about 50% were set shallower than the most effective range of depths.

In the third part, tables are given which show the magnitude of attack against the three Japanese Forces by the various plane types, air groups, and Task Forces.

5. Reported Accuracy.

In preparing the summary of the accuracy obtained with various types of airborne weapons, the source of information has been the ACA-1 Reports. In recording numbers of hits only those actually claimed as hits are counted; "probable hits" and "near misses" have not been counted. The reported accuracy is presented in two ways. One is to give the percentage of attacking planes which actually scored at least one hit. The other is to give the percentage of weapons expended (excluding those jettisoned) which hit the target. Number of planes attacking means the number actually attacking with bombs, rockets or torpedoes, so that, for example, planes whose bombs could not be released are excluded. In certain cases, VF bombing and VT torpedo attacks, these two percentages will be the same, for each plane carries only one bomb or torpedo respectively. In many cases, however, they will be different. There is a certain advantage in the two methods of presentation for planes releasing more than one bomb in a single attack. The first method gives an estimate of the percentage of planes which made a successful aiming operation. The second method gives an estimate of the percentage of bombs which were successful in damaging the enemy. The results of the two methods may differ due to the ballistic dispersion of the bombs or to their being dropped in train.

These two percentages have been tabulated by type of weapon used (bombs, rockets or torpedoes) type of plane attacking (VF, VB or VT) and type of ship attacked (BB, CV, CVL, CA, CL or DD). Bombing accuracy is presented in Table 1, rocket accuracy in Table 2, and torpedo accuracy in Table 3. A more detailed tabulation of accuracy of torpedo attacks as related to torpedo depth settings as well as ship type, is presented in Table 9.



The accuracy reported in attacks against various types of ships may be briefly summarized by the following table based on claims.

Target	VB		VT		VF	VT
	Attacks with at least 1 hit	Bomb Hits	Attacks with at least 1 hit	Bomb Hits	Attacks with at least 1 hit	Torpedo Hits
BB (Yamato Class)	56%	37%	-	-	(30%)	40%
BB (other)	46%	29%	52%	29%	18%	46%
CV (Zuikaku)	56%	55%	(40%)	(40%)	(40%)	74%
CVL	54%	43%	(67%)	(25%)	25%	61%
CA	36%	27%	49%	23%	12%	51%
CL	(11%)	(7%)	31%	14%	17%	28%
DD	12%	7%	30%	10%	6%	(20%)

Percentage figures are enclosed in parentheses if less than twenty attacks were made.

For bombing attacks no separation is made here between level, glide and dive bombing or between different altitudes of release. In the case of VB's and VT's there is no essential loss of information since the VT's almost always glide bomb and the VB's usually dive bomb. In the case of VF's there seems to be no sharp distinction between glide and dive bombing, and, since only five cases of level bombing were recorded, all VF bombing has been grouped together. Because altitudes of release are not given for individual planes, but only for whole squadrons, it is not feasible to try to separate attacks by altitude of release. However, all release altitudes seem to have been less than 4000'. No masthead attacks against combatant ships were reported.

TABLE I - Accuracies Reported in Bombing Attacks by Task Forces 38 and 77.

Target	Number of Attacks	Attacks with at least 1 hit	%	Number of bombs dropped	Number of Bomb Hits	%
<u>VB</u>						
BB (Yamato Class)	55	31	56%	99	37	37%
BB (other)	87	40	46%	157	45	29%
CV (Zuikaku)	34	19	56%	47	26	55%
CVL	61	33	54%	88	38	43%
CA	36	13	36%	55	15	27%
CL	18	2	11%	27	2	7%
DD	26	3	12%	42	3	7%
<u>VT</u>						
BB (Yamato Class)	-	-	-	-	-	-
BB (other)	48	25	52%	143	41	29%
CV (Zuikaku)	5	2	40%	5	2	40%
CVL	3	2	67%	12	3	25%
CA	78	38	49%	260	60	23%
CL	45	14	31%	146	20	14%
DD	27	8	30%	80	8	10%
<u>VF</u>						
BB (Yamato Class)	10	3	30%	10	3	30%
BB (other)	51	9	18%	51	9	18%
CV (Zuikaku)	10	4	40%	10	4	40%
CVL	25	6	25%	25	6	25%
CA	24	3	12%	24	3	12%
CL	46	8	17%	46	8	17%
DD	47	3	6%	47	3	6%



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TABLE 2 - Accuracies Reported in Rocket Attacks by Task Forces 38 and 77.

Target	Number of Attacks	Attacks with at least 1 hit	%	Number of Rocket Releases	Number of Rocket Hits	%
BB	15	8	53%	70	16	23%
CA	13	7	54%	56	19	34%
CL	14	1	7%	56	4	7%
DD	20	8	40%	83	28	34%
						VT
BB	6	6	100%	44	28	64%
CA	6	4	67%	44	14	32%
CL	4	1	25%	32	3	9%
DD	28	15	54%	165	33	20%

TABLE 3 - Accuracies Reported in Torpedo Attacks by Task Forces 38 and 77.

Target	Number Released	Number of Hits	%
BB (Yamato Class)	43	17	40%
BB (other)	63	29	46%
CV (Zuikaku)	23	17	74%
CVL	33	20	61%
CA	45	23	51%
CL	32	9	28%
DD	10	2	20%

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Comparison of the bombing accuracies of the three plane types discloses interesting differences. If one compares\* the percentages of attacks with at least one hit, neglecting those cases in which less than twenty attacks were made, it appears that the VT are most accurate, the VB next and then the VF. On the other hand, if one compares the percentages of bomb hits by the three plane types, the order of accuracy is approximately VB, VT, VF. This order holds only approximately, for in the attacks on smaller ships, CL's and DD's, the order changes. This discrepancy does not necessarily indicate any real difference when one considers the effect that a slight change in the number of hits will have. For example, if the three hits obtained on DD's by VB were changed to five hits, the 6% would change to 12%. The two orders which one obtains for the two different sets of percentages are not surprising. The VT generally bomb in train and consequently have more leeway in their aim than the VB, which bomb in salvo, or the VF, which drop only one bomb. Also, dropping more than one bomb in salvo, gives the VB greater leeway in aim than the VF. On the other hand, since the VT do drop in train, it is not unreasonable that they should obtain a smaller percentage of bomb hits than the VB, for, if a VB has made a successful aiming operation, its salvo of bombs has a fair chance of getting more than one hit, particularly against large ships. Summarizing, one may say that the VT make a greater per cent of attacks with at least one hit than the VB, but that they also carry somewhat more bombs per bomb hit than the VB.

## 6. Comparison with previous accuracy reports.

In order to have some basis for judging the accuracy obtained in the Battle for Leyte Gulf two sources are used for comparison. One is the reported accuracy obtained by carrier-based planes in attacks during the months January-June 1944 against combatant ships. The other is the reported accuracy obtained by VB squadrons against land targets.

For the January-June 1944 carrier-based attacks the accuracy in bombing is presented in Table 4, the torpedo accuracy in Table 5. No rocket attacks against combatant ships were reported. Between Tables 1 and 4 for bombing and Tables 3 and 5 for torpedoes only those cases should be compared in which a sufficient number of attacks were made to overcome to some extent the effect of chance fluctuations. To facilitate comparison we give a short table abstracted from those mentioned above. Percentages are put in parentheses if they are derived from less than twenty attacks.

Table Comparing Accuracy for January-June 1944 and Leyte Gulf

Target	VB - Bombing				VF - Bombing			
	January-June, 1944		Leyte Gulf		January-June, 1944		Leyte Gulf	
	Attacks with at least 1 hit	Bomb Hits	Attacks with at least 1 hit	Bomb Hits	Attacks with at least 1 hit	Bomb Hits	Attacks with at least 1 hit	Bomb Hits
BB(all)	(100%)	(100%)	50%	32%	-	-	20%	20%
CV(all)	41%	32%	55%	47%	12%	12%	29%	29%
CA	33%	26%	36%	27%	(0%)	(0%)	12%	12%
CL	21%	14%	(11%)	(7%)	(50%)	(50%)	17%	17%
DD	7%	9%	12%	7%	(0%)	(0%)	6%	6%
			VT - Bombing		VT - Torpedo			
					Torpedo Hits		Torpedo Hits	
BB	(100%)	(67%)	52%	29%	(0%)		43%	
CV	95%	46%	(50%)	(29%)	(44%)		66%	
CA	-	-	49%	23%	15%		51	
CL	22%	13%	31%	14%	(29%)		28%	
DD	18%	9%	30%	10%	15%		(20%)	

\* The comparison is somewhat easier to make in the short Table on page 8 than in Table 1.







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damage to Japanese ships. The escape of some ships reported frequently hit strongly suggests duplication of claims. In addition, all previous experience with airborne weapons indicates that the accuracy obtained under operational conditions is considerably less than that obtained under training conditions. It seems clear that the only feasible method for accurate recording of numbers of hits and assessment of damage during a strike in which intense AA is present is to have continuous photo-cover by planes at high level or to have cameras on each plane so arranged as to take photographs of the hits.

7. Weapons Selection.

Tables 6 and 7 show the selection of bombs and fuzes used against the various Japanese combatant ship types. Table 8 is a table extracted from FTP 224 (Selection of Bombs and Fuzes for the Destruction of Various Targets, October 1944) showing the bombs and fuzes recommended for glide and dive-bombing attacks against Japanese combatant ships. Table 9 is a table similar to Table 7 showing the torpedo depth settings used. In connection with this the summary of a BuShips confidential letter (C-S75-1 (374), dated March 26, 1943) concerning best torpedo depth settings is included.

TABLE 6 - Expenditure of Bombs Against BB's, CV's, CA's, CL's and DD's. Tabulated by Type, Weight and Task Force Attacking\*

Target	100GP	250GP	500GP	500SAP	1000GP	1000SAP	1000AP	2000GP	DB
<u>TASK FORCE 38</u>									
BB	64	32	31	76	21	72	58	10	-
CV	16	-	15	31	-	58	61	5	-
CA	8	11	31	29	6	16	2	1	-
CL	4	5	24	36	10	10	6	-	-
DD	2	16	24	47	3	4	17	-	-
Total	94	64	125	219	40	160	144	16	-
<u>TASK FORCE 77</u>									
BB	29	8	27	42	-	-	-	-	-
CV	-	-	-	-	-	-	-	-	15
CA	44	5	61	99	-	-	-	-	-
CL	20	7	73	24	-	-	-	-	-
DD	20	13	11	12	-	-	-	-	-
Total	113	33	172	177	-	-	-	-	15
<u>TASK FORCE 38 and 77</u>									
BB	93	40	58	118	21	72	58	10	-
CV	16	-	15	31	-	58	61	5	-
CA	52	16	92	128	6	16	2	1	15
CL	24	12	97	60	10	10	6	-	-
DD	22	29	35	59	3	4	17	-	-
Total	207	97	297	396	40	160	144	16	15

\* The aircraft Action Reports for the FRANKLIN, BELLEAU WOOD, FANSHAW BAY, KITKUN BAY, WASP VF and SANTEE VF are not available. Consequently, their bombs are not included in these tabulations.

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TABLE 7 - Number of Bombs of Different Type, Weight, and Fuze Categories Expended Against BB's, CV's, CA's, CL's and DD's.

	100GP	250GP	500GP	500SAP	1000GP	1000SAP	1000AP	2000GP
<u>All Combatant Ships</u>								
Inst.	133	66	181	3	25	-	-	-
.01	10	8	92	93	6	1	-	-
.025	-	-	16	277	-	156	-	16
.08	-	-	-	-	-	-	144	-
.1	-	-	-	-	7	-	-	-
4-5	-	-	5	6	2	3	-	-
Unknown	64	23	8	7	-	-	-	-
<u>BB</u>								
Inst.	73	24	33	-	10	-	-	-
.01	-	2	16	11	4	-	-	-
.025	-	-	7	97	-	71	-	10
.08	-	-	-	-	-	-	58	-
.1	-	-	-	-	7	-	-	-
4-5	-	-	-	-	-	1	-	-
Unknown	20	14	2	-	-	-	-	-
<u>CV</u>								
Inst.	16	-	4	-	-	-	-	-
.01	-	-	11	-	-	-	-	-
.025	-	-	-	21	-	58	-	5
.08	-	-	-	-	-	-	61	-
.1	-	-	-	-	-	-	-	-
4-5	-	-	-	6	-	-	-	-
Unknown	-	-	-	4	-	-	-	-
<u>CA*</u>								
Inst.	12	10	63	2	3	-	-	-
.01	-	-	25	5	1	-	-	-
.025	-	-	1	1	-	15	-	1
.08	-	-	-	-	-	-	2	-
.1	-	-	-	-	-	-	-	-
4-5	-	-	1	-	2	1	-	-
Unknown	40	6	2	-	-	-	-	-
<u>CL</u>								
Inst.	20	9	58	1	9	-	-	-
.01	-	-	31	11	1	-	-	-
.025	-	-	4	45	-	10	-	-
.08	-	-	-	-	-	-	6	-
.1	-	-	-	-	-	-	-	-
4-5	-	-	4	-	-	-	-	-
Unknown	4	3	-	3	-	-	-	-
<u>DD</u>								
Inst.	12	23	23	-	3	-	-	-
.01	10	6	4	6	-	1	-	-
.025	-	-	4	53	-	2	-	-
.08	-	-	-	-	-	-	17	-
.1	-	-	-	-	-	-	-	-
4-5	-	-	-	-	-	1	-	-
Unknown	-	-	4	-	-	-	-	-

\* 12x1000 lb. bombs of unknown type and fuze not included.



TABLE 8 - Recommended Bombs and Fuzes

Ship Type	Preferable Bomb(s)	Fuze		Alternate Bomb(s)	Fuze	
		Nose	Tail		Nose	Tail
BB(YAMATO)	2000 GP	.1	.025	1000 GP	.1	.025
BB(other)	1600 AP	None	.08	1000 AP	None	.08
	2000 GP	.1	.025	1000 GP	.1	.025
CV(ZUIKAKU)	2000 GP	.1	.025	1000 GP	.1	.025
	1000 SAP	None	.1			
CVL	2000 GP	.1	.025	1000 GP	.1	.025
	1000 SAP	None	.1			
CVE	1000 GP	.1	.1	500 GP	.1	.1
CA	2000 GP	.1	.025	1000 GP	.1	.025
	1000 SAP	None	.1			
CL	1000 GP	.1	.025	2000 GP	.1	.025
	1000 SAP	None	.1			
DD(large)	1000 GP	.1	.025	500 GP	.1	.025
DD(small)	500 GP	.1	.025	1000 GP	.1	.025

In this table, extracted from FTP 224, the recommendations are for dive or glide bombing attacks with release altitudes less than 4000'. Information from BuShips states that, although the 1000 lb. AP bomb is listed as an alternate bomb for attacks on BB's other than the YAMATO class, it is very unlikely that this bomb will be able to penetrate the armored deck of a modernized OBB. The recommendations in Table 8 are for damage in terms of sinking. For disruption of activity on the top deck, instantaneously fuzed GP bombs are preferable because of their large charge/weight ratio.

In comparing Tables 7 and 8, the following observations seem worthy of mention: (1) The 144 x 1000 lb. AP bombs expended were probably not as effective as an equal number of GP or SAP bombs would have been, (2) The SAP bombs would have caused more sinking damage if they had been fuzed .1 sec. delay rather than the prevalent .025 sec. delay, (3) Many 500 lb. SAP bombs were dropped although they do not occur at all as recommended types in Table 8. A more detailed discussion of these points is not made here since the underlying reasons are set forth in the study where damage to Japanese ships is analyzed.

TABLE 9 - Distribution of Torpedo Depth Settings Used Against BB's, CV's, CA's, CL's, and DD's.

Target	Depth Setting	No. Released	% of Total	No. of Hits	% of Total Hits
BB	8'	7	6	3	6
	10'	20	19	9	20
	12'	24	23	15	32
	15'	15	14	6	13
	16'	2	2	2	4
	18'	6	6	3	7
	22'	19	18	5	11
	Unknown	13	12	3	7
	Totals	106	100	46	100
	CV	10'	3	5	1
12'		28	50	17	46
15'		9	16	4	11
16'		9	16	9	24
18'		7	13	6	16
Totals		56	100	37	100
CA		8'	10	22	3
	10'	9	20	6	26
	12'	7	16	3	13
	15'	10	22	6	26
	18'	2	4	1	4
	Unknown	7	16	4	18
	Totals	45	100	23	100
CL	8'	11	34	1	11
	10'	6	19	4	45
	12'	6	19	3	33
	15'	3	9	-	-
	22'	2	6	-	-
	Unknown	4	13	1	11
Totals	32	100	9	100	
DD	10'	6	60	1	50
	12'	1	10	1	50
	15'	1	10	-	-
	Unknown	2	20	-	-
	Totals	10	100	2	100



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In connection with the discussion of the torpedo depth settings it is convenient to state the following table of lengths and mean drafts of various types of Japanese combatant ships:

<u>Ship</u>	<u>Length</u>	<u>Mean Draft</u>
BB (YAMATO)	850'	probably 35'-37'
BB (other)	673'-704'	33'-34'
CV (SHOKAKU)	826'	26'
CVL	628'-668'	21'-22'
CA	656'-660'	22'
CL	535'-550'	19'-20'
DD (TERUTSUKI)	435'	12'-14'
DD (other)	336'	11'-13'

The following quotation is from BuShips letter, C-575-1(374), dated March 26, 1943. "Summarizing, the evidence available to this Bureau leads to the following conclusions:

(a) Against capital ships having torpedo protection systems (battleships and probably large aircraft carriers) -- the most promising torpedo attack is one in which a number of torpedoes hit along one side at about four feet above base-line (depth setting about 4 feet less than draft). Next best attack is with underbottom hits (depth settings slightly greater than draft).

(b) Against unprotected and lightly protected ships (cruisers, destroyers, auxiliary aircraft carriers, merchant ships), the shallow-running torpedo offers advantages in increased incendiary effect, and topside structural damage. (Recommended depth - as shallow as feasible without danger of broaching.)

(c) Offsetting to some extent the advantages of shallow-running torpedoes, is, of course, the disadvantage that they are more readily detected and avoided than those which run at greater depth."

A BB has an armor belt extending down to a maximum of about 15 ft. below the water line. A torpedo hit somewhat above the bottom of the armor belt of a BB will not in general rupture the holding bulkhead. A hit at or near the bottom of the armor belt has a very good chance of rupturing the holding bulkhead. Consequently, a torpedo aimed at a BB should have a depth setting of 12 ft. or greater. In addition to this criterion for depth setting, there is also the known fact that on ships with torpedo protection systems (BB's, CBB's and CV's) a hit low down on the hull will generally do more damage than one higher up. On the basis of this information it appears that the torpedoes aimed at BB's would have been more effective if depth settings greater than 15 ft. had been used. Actually, as seen in Table 9, 7 were set at 8', 20 at 10', and 24 at 12', totalling 50% of all released.

The ZUIKAKU CV may have an armor belt extending down as far as 11 ft. below the waterline, although it is not as heavy as that of a BB. However, the same remarks concerning depth setting apply to it as to BB's. Of the torpedoes released at the ZUIKAKU, 16 were set at 12' and 7 at 16' (this separation is not made in Table 9). These torpedoes are all set at depth for which a hit can be expected to do great damage, although the 16 torpedoes set at 12' would possibly have been more effective with deeper settings.

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Although CA's, CVL's and CL's have armor, it terminates at about 8 feet below the water line and, in any event, is not heavy enough to give much protection against a torpedo (FTP 224 states: "A hit on light armor, such as fitted in small cruisers, will produce great damage, particularly if the armor is light enough to break up in fragments.") For such ships FTP 224 states that a shallow-running torpedo is to be preferred. However, for these ships almost any torpedo hit is likely to cause serious damage. In view of this, the depth settings shown in Table 9 seem satisfactory except for two torpedoes set at 22' and aimed at a CL. These would likely pass beneath the vessel and, in fact, no hit is claimed.

There is no armor on a DD. Since its mean draft appears to be about 12 ft., torpedo depth settings should probably be 8 ft. Table 9 shows one torpedo to have been released at a DD with 15 ft. setting, one with 12 ft. setting and six with 10 ft. setting. The first would almost certainly pass beneath the ship. Although a hit is claimed for the torpedo set at 12 ft., this is a dangerously deep setting for a DD. In general, an aircraft torpedo is an extravagant weapon to use against a DD and, if choice is possible with respect to target or weapon, would probably not be used. Only ten torpedoes were released against DD's, 4% of all torpedoes released.

If it is not known in advance what type of ship is to be attacked it would appear from the foregoing discussion that the best depth setting would be 15 ft. It is assumed here that DD's are not to be attacked with torpedoes. A torpedo with this depth setting would not pass beneath the lighter ships and yet would strike in regions of great vulnerability on all types. If it is known that BB's or CV's are to be attacked, the torpedoes to be used against these ships would be most effective with depth settings of 25' and 22' respectively.

#### 8. Distribution of Attack.

Tables 10 through 12 give the numbers of bombing, rocket and torpedo attacks by: air group (Table 10); date of attack, Japanese Force attacked, and task force attacking (Table 11); type of ship attacked in each Japanese Force and type of plane attacking (Table 12). No attacks on merchant ships have been included.



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TABLE 10 - Bomb, Rocket and Torpedo Attacks on the Japanese Forces by Carrier Air Groups

T.F. 38	Number of Attacks			Number of Attacks With at Least One Hit		
	Bomb	Rocket	Torp.	Bomb	Rocket	Torp.
T.G. 38.1						
HORNET, AG 11	75	-	11	13	-	1
WASP, AG 14	40	-	13	7	-	2
COMPENS, AG 22	4	5	5	1	5	3
HANCOCK, AG 7	51	8	14	16	2	3
T.G. 38.2						
INTREPID, AG 18	84	-	30	29	-	16
CABOT, AG 31 (29?)	7	-	10	-	-	2
T.G. 38.3						
ESSEX, AG 15	135	-	31	61	-	17
LEXINGTON, AG 19	99	-	27	38	-	19
LANGLEY, AG 44	16	-	9	1	-	4
T.G. 38.4						
ENTERPRISE, AG 20	62	49	19	31	17*	19
SAN JACINTO, AG 51	1	-	15	1	-	7
Total	574	62	184	198	24	93
T.F. 77						
T.U. 77.4.1						
SANGAMON, AG 37	13	-	1	1	-	1
SUWANNEE, AG 60	13	-	9	4	-	5
PETROF BAY, VC 76	2	-	9	-	-	2
T.U. 77.4.2						
KADASHAN BAY, VC 20	27	10	7	6	5	1
MARCUS ISLAND, VC 21	23	11	3	16	7	2
SAVO ISLAND, VC 27	20	8	9	11	8	3
OMMANEY BAY, VC 75	10	2	11	9	1	3
MANILA BAY, VC 80	16	2	6	4	1	2
NATOMA BAY, VC 81	38	4	6	7	1	2
T.U. 77.4.3						
KALININ BAY, VC 3	7	5	1	6	4	1
WHITE PLAINS, VC 4	5	-	2	5	-	-
GAMBIER BAY, VC 10	6	1	2	4	-	-
ST. LO, VC 65	7	2	2	1	-	2
Total	187	45	68	74	27	24

\* There were 20 attacks of which an undetermined number obtained hits. These hits are not included in the total of 17 reported as obtaining hits.

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TABLE 11 - Distribution of Attacks on Japanese Forces by Task Forces 38 and 77.

	24 Oct.		25 Oct.		26 Oct.		Totals	
	No. Attacks		Attacks with hit*		No. Attacks		Attacks with hit*	
	TF 38	TF 77	TF 38	TF 77	TF 38	TF 77	TF 38	TF 77
North Force								
Bomb	-	-	-	-	327	-	98	-
Rocket	-	-	-	-	20	-	-	-
Torpedo	-	-	-	-	84	-	55	-
Totals	-	-	-	-	431	-	153	-
Central Force								
Bomb	99	-	44	-	81	132	21	55
Rocket	15	-	9	-	8	31	2	19
Torpedo	47	-	25	-	-	63	-	20
Totals	161	-	78	-	89	226	23	94
South Force								
Bomb	12	-	5	-	-	17	-	9
Rocket	14	-	8	-	-	1	-	-
Torpedo	-	-	-	-	-	4	-	3
Totals	26	-	13	-	-	22	-	12

\* Attacks in which at least one hit was obtained.



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TABLE 12 - Distribution of Bomb, Rocket and Torpedo Attacks by VF, VB, and VT  
Against Different Types of Japanese Warships.\*

	BB			CV			CA			CL			DD			Other			All Ships		
	B	T	R	B	T	R	B	T	R	B	T	R	B	T	R	B	T	R	B	T	R
<u>All Attacks on Ships by TF 38 and 77</u>																					
VF	61	-	15	34	-	-	24	-	13	40	-	14	45	-	20	-	-	-	204	-	62
VB	142	-	-	95	-	-	36	-	-	17	-	-	23	-	-	2	-	-	315	-	-
VT	48	106	6	8	56	-	78	45	6	45	32	4	27	10	28	-	3	1	207	252	45
<u>Attacks by TF 38 on Northern Japanese Force **</u>																					
VF	34	-	-	34	-	-	4	-	-	12	-	13	6	-	7	-	-	-	90	-	20
VB	27	-	-	95	-	-	1	-	-	3	-	-	2	-	-	-	-	-	128	-	-
VT	10	19	-	8	56	-	1	-	-	-	8	-	-	1	-	-	-	-	19	84	-
<u>Attacks by TF 38 and 77 on Central Japanese Force</u>																					
VF	27	-	7	-	-	-	19	-	11	17	-	1	36	-	9	-	-	-	99	-	28
VB	103	-	-	-	-	-	35	-	-	14	-	-	21	-	-	2	-	-	175	-	-
VT	30	83	6	-	-	-	70	43	6	25	23	3	23	9	15	1	3	1	149	163	31
<u>Attacks by TF 38 and 77 on Southern Japanese Force</u>																					
VF	-	-	8	-	-	-	1	-	2	11	-	-	3	-	4	-	-	-	15	-	14
VB	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-
VT	8	4	-	-	-	-	7	-	-	20	1	1	4	-	13	-	-	-	39	5	14
<u>All Attacks by TF 38</u>																					
VF	56	-	15	34	-	-	9	-	13	26	-	14	32	-	20	-	-	-	157	-	62
VB	142	-	-	95	-	-	36	-	-	17	-	-	23	-	-	2	-	-	315	-	-
VT	19	67	-	8	56	-	16	19	-	10	30	-	15	-	9	-	3	-	68	184	-
<u>All Attacks by TF 77</u>																					
VF	5	-	-	-	-	-	15	-	-	14	-	-	13	-	-	-	-	-	47	-	-
VT	29	39	6	-	-	-	62	26	6	35	2	4	12	1	28	1	-	1	139	68	45

\* Attacks on Japanese ships which could not be allocated to one of the three fleets are not included herein.

\*\* TF 77 did not attack the Northern Japanese Force.

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SECTION III - ANALYSIS OF DAMAGE TO VESSELS OF THE JAPANESE FLEET

- References: (a) ONI 22-J July 1944, A Statistical Summary of the Japanese Navy.  
(b) OpNav-16-V #A43, July 1944, Striking Power of Air-borne Weapons.  
(c) OpNav-16-4 #A6, March 1944, Selection of Bombs and Fuzes for the Destruction of Various Targets.  
(d) FTP-224, October 1944, Selection of Bombs and Fuzes to be used against Various Targets.  
(e) CinCPac CinCPOa Weekly Intelligence. Vol. 1, No. 22, Dec. 8, 1944.

9. Introduction.

In this section an attempt will be made to evaluate the damage (in terms of the probability of sinking) that the ships of the Japanese Fleet sustained. For the purposes of evaluation, it will be assumed that the number of hits which the various ships of the three Japanese Forces sustained is that reported in the ACA-1 forms (Hits claimed by Air Groups for which no action reports are available are not considered. This, of course, will serve to reduce the claimed number of hits but will not alter the main conclusions of this section). Furthermore, it will be assumed, unless definite evidence to the contrary exists, that the identification of the vessel attacked, as reported in the ACA-1 form, is correct.

It is recognized that these two assumptions may lead to an over-all exaggeration of the number of hits obtained and in addition, to an incorrect distribution of the hits among the ships. These possible distortions will be referred to again in a later portion of this section.

10. Damage to Northern Force.

This fleet, as previously indicated, consisted of 2 ISE Class BB's; 1 CV, the ZUIKAKU; 3 CVL's, the ZUIHO, the CHITOSE, and the CHIYODO; 1 CA, IBUKI; 4 NATORI Class CL's and 6 DD's. It was possible to distinguish by virtue of their positions, which of the BB's was under attack in all except one instance involving two torpedo hits. One BB was arbitrarily called the HYUGA; the other the ISE. It was possible also to determine which CVL was under attack in every instance (again by virtue of their positions). They have been arbitrarily designated in accordance with the names given above. The attacks against the CL's were also successfully identified with a given CL. The CL's were designated as CL-1 through CL-4. The positions of the vessels of the enemy Northern Force during each of the 5 attacks of 25 October are shown in Chart A on the following page.

A. Battleships

In assessing the damage that a BB is expected to have sustained from torpedo hits, the following assumptions are made:

(a) That the torpedo defense system is designed, as a minimum estimate, to limit flooding as the result of a torpedo hit to the torpedo protection space when the warhead contains 700 lbs. of TNT (this is equivalent to the U.S. BB defense system) and, as a maximum estimate, to limit flooding as above when the warhead contains 1000 lbs. of TNT (this is equivalent to that claimed for British defense design.)

(b) That the belt armor is not thicker than that on U.S. BB's and does not extend further below the water line than that on the older U.S. BB's, namely, 10' to 14'. From this assumption it follows that torpedoes set at 10' or 12' will strike in the region of the lowermost portion of the armor belt or miss it altogether. In the former case the armor belt will have little or no influence on the effectiveness of the torpedo and in the latter none at all.

(c) Estimates of the superiority of torpex over TNT varying from 1.5 times to 2.0 times have been given. If the latter value is correct, the present warhead carrying 600 lbs. of torpex used in this engagement is sufficient to defeat any known torpedo defense system. If the former value is correct, a modern torpedo defense system somewhat heavier than that of current



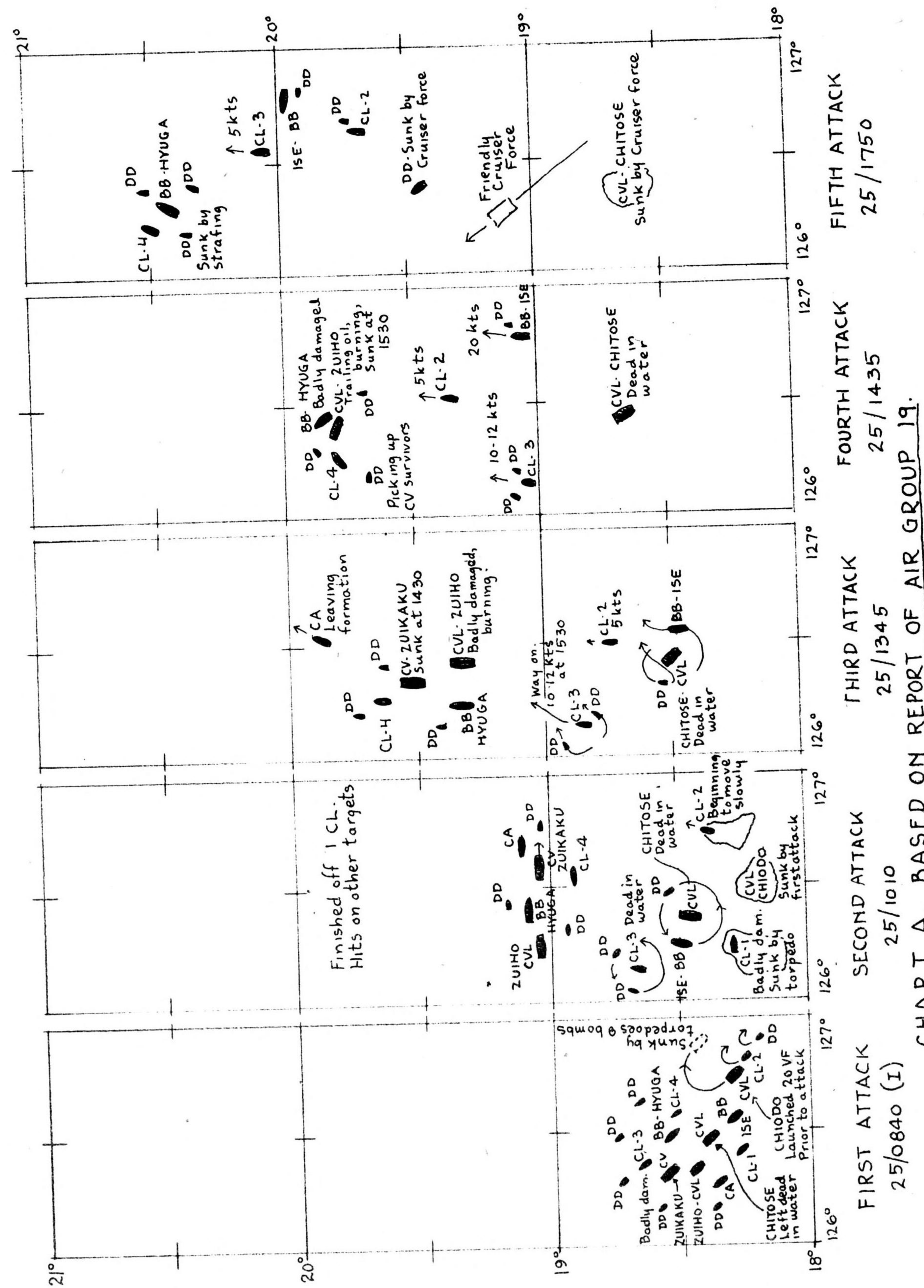


CHART A. BASED ON REPORT OF AIR GROUP 19.

U.S. battleships could conceivably prevent internal flooding from a torpedo hit. No choice is made between the two values in the discussions that follow. Both values will be referred to when a major difference in the probability of sinking is to be expected.

1. ISE Class.

Reference (a) lists the following description for this class.

<p><u>Hull</u>                  Displacement 32000 tons                  Dimensions 683' x 94'                  Mean Draft 28' 8"                  Speed 23K.</p>	<p><u>Armor</u>                  Deck = 7 1/4" *                  Belt - 12" amidships, 5"-3" ends                  Watertight integrity-good (Bulges)                  Damage Control - good</p>
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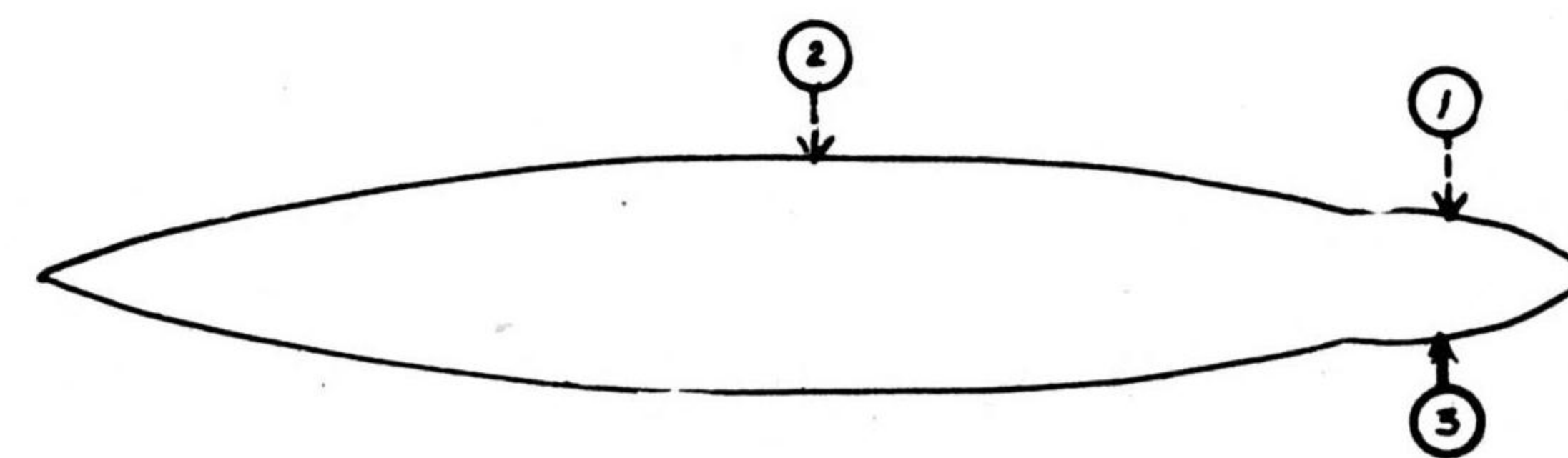
\* For deck armor, BuShips considers 4" to 5" more likely.

Both the ISE and HYUGA of this class were present throughout the day. They were hit by the following bombs and torpedoes:

Strike No.	No. of Hits	HYUGA	
		Weapon	Fuzing or Depth Setting
3	1	Torpedo	15'
4	3	Torpedo	15'
5	1	1000#SAP	.025 Sec.
5	10	1000#AP	.08 Sec.
<u>ISE</u>			
1	1	1000#SAP	.025 Sec.
1	2	Torpedoes	12'
1	2	Torpedoes	10'
1	1	Torpedo	15'
2	1	Torpedo	12'
5	2	Torpedoes	15'
5	3	500#GP	Inst.
5	8	1000#AP	.08 Sec.
5	2	2000#GP	.025 Sec.
<u>Unknown</u>			
1	2	Torpedoes	16'

Unless the two torpedoes listed above as hitting an unknown BB (that is either the HYUGA or the ISE) hit the HYUGA, it was not hit until the third strike. (There is slight evidence to indicate that these torpedoes did hit the HYUGA.) These two torpedoes, set at 22' depth, hit on the port side -- one at the bow, and the other about amidships. Figure 1 shows the distribution of these hits.

Figure 1.



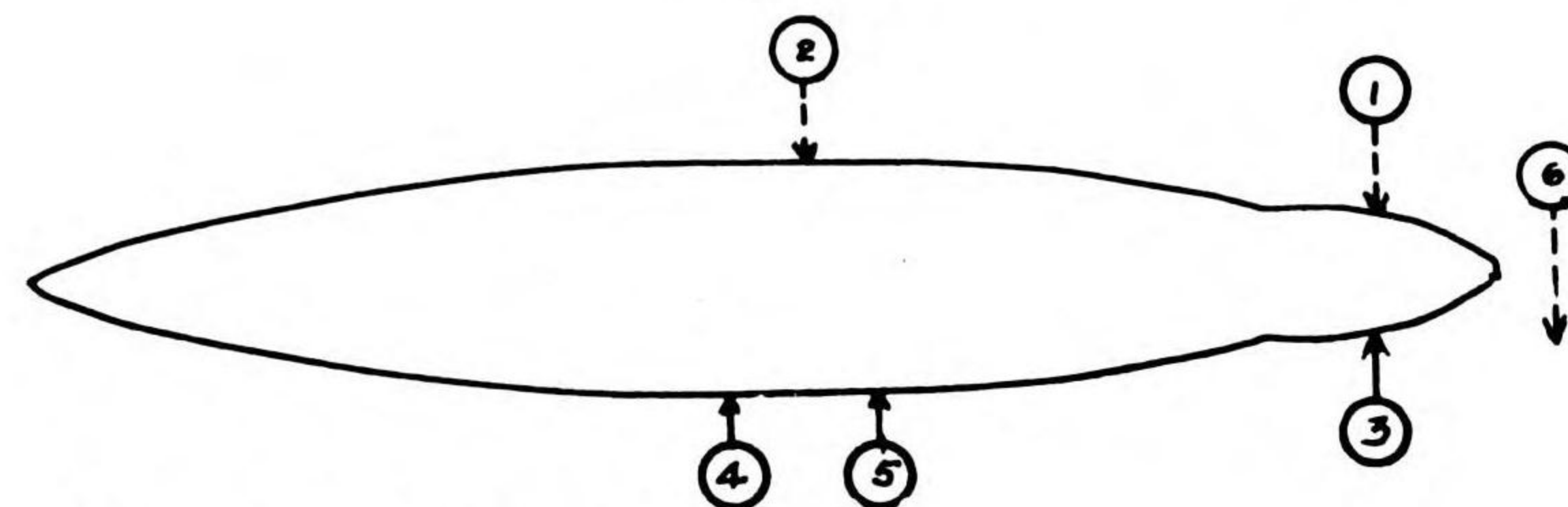
↓ = Uncertain that this torpedo hit this vessel.



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Even if it is assumed that the torpedoes, succeeded in rupturing the holding bulkhead, there are only about 5 chances in 100 that the BB would sink (reference b).\* The HYUGA was not definitely hit until five hours later when a torpedo set at 15' hit it on the starboard bow. Because this torpedo hit in an already flooded region, it is likely that the combined damage would not result in any greater probability of sinking. Two hours later, two torpedoes set at 12' hit the HYUGA amidships on the port side. Ten minutes later a third torpedo struck the HYUGA at an unspecified point. Figure 2 shows the final distribution of hits.

Figure 2.



Location of hit number 6 was not reported.

The two torpedoes which struck the bow would contribute little toward sinking the HYUGA. Hence there were at most four effective hits. Because of the time interval (six hours) between the first torpedo hit on the port side amidships and the next hits on the same side, the later hits may be considered as essentially independent of the earlier hit. If it is assumed that all three hits obtained during the fourth strike occurred on the starboard side and that there was no overlapping of the flooded regions, the HYUGA had about six chances in ten of surviving. Any other distribution of these hits would increase its chances of surviving.

During the fifth strike, the HYUGA was struck by ten 1000# AP and one 1000# SAP bombs. The maximum penetration of the armor deck expected from the AP bombs is  $3\frac{1}{2}$ " (they were dropped below 4000' in either a glide or dive) and therefore would not pierce the armor deck.

Inasmuch as it is probable that none of the bombs penetrated the armor deck and at most six and probably only four torpedoes, widely spaced in time so as to permit damage control measures, struck the vessel, the expected result of the attacks against the HYUGA is moderate to serious damage.

## 2. ISE

The ISE was hit by one 1000# SAP and 5 torpedoes during the first strike.

The bomb was dropped in a dive at from 1000' to 1500' altitude and therefore would not be expected to penetrate more than 2" of armor plate. Two of the 5 torpedo hits were scored by VT-19. The 3 others were scored approximately 30 minutes later by VT-15. The torpedo hits were well spaced around the BB, 3 on the starboard side amidships and the other two not located as to port or starboard, but one amidships and the other astern. The torpedoes were set as follows: 2 at 10', 2 at 12' and 1 at 15'.

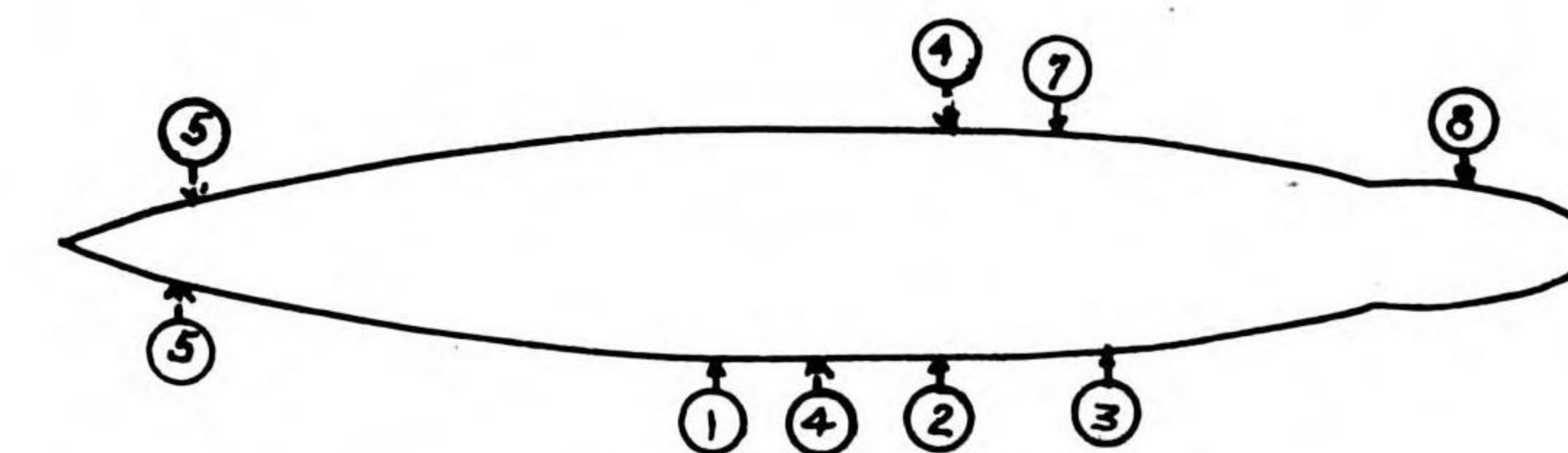
\* Vulnerability values for torpedo hits in reference (b) are deliberately pessimistic, being based on torpedoes striking almost simultaneously along one side of the ship. If the interval between hits is appreciable, there will be time for counterflooding to reduce the trim and list. Also, hits on opposite sides of the ship will tend to counteract each other as far as list is concerned. Reduction or elimination of list and trim automatically reduces the danger of capsizing or plunging and improves the ability of the ship to absorb the effects of succeeding torpedo hits.

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If all the torpedoes hit on the same side, the probability of sinking the BB is about 99 per cent if it is assumed that torpex is twice as effective as TNT, and approximately 70 per cent if it is assumed that torpex is  $1\frac{1}{2}$  times as effective as TNT. If, on the other hand, it is assumed that the two torpedoes not located as to side, hit on the port side, the probability of sinking the vessel is greatly reduced. The extent of this reduction will depend upon whether or not the holding bulkhead was pierced and upon the effectiveness of the damage control measures. If damage control is effectively used, the result of hits on opposite sides of the vessel is to counteract their effects with regard to producing sufficient list to overturn the ship. In this situation the probability of sinking with this number of torpedoes may be reduced to considerably below 40%, depending largely on the material condition of the ship with respect to its watertight integrity. During the second strike (approximately two hours later) the ISE was hit by a torpedo set at 12 feet. If it is assumed that the flooding effects of the earlier hits were under control, which seems reasonable since the reports do not indicate that the ISE was in difficulties, it is not to be expected that this hit, if it were in close proximity to previous hits, would add greatly to the likelihood of the ISE's sinking. If the location of this hit, however, had been favorable, its effect might have been very serious.

The ISE was not hit during the third or fourth strike. However, two torpedoes set at 15 feet struck the port beam and bow during the fifth strike (approximately four hours after the earlier hits). Figure 3 shows the final distribution of hits.

Figure 3.



Hits 4 and 5 were not located as to side.

Because of the length of time elapsing between the successive hits and because of the possible overlapping of the hits the damage control problem is not severe, and therefore, depending on location, the probability of sinking as the result of torpedo attacks again may be considered to be low.

During this strike, the ISE was also hit by three 500# GP, two 2000# GP and eight 1000# AP bombs. The 500# GP bombs were instantaneously fuzed and could damage only main deck installations. The 2000# GP bombs were fuzed .025 seconds delay and as a result probably exploded between the main deck and the armored deck. Because the AP bombs were dropped in a dive from only 1500 feet, they would penetrate only 3" of armor plate and consequently would not pierce the armored deck. Hence, none of the bombs would be expected to do serious damage in terms of sinking the vessel.

Based on the above, the ISE had a reasonable chance of survival. However, it does not seem at all likely that the ISE could have received as many torpedo and bomb hits as the ACA-1 reports indicate and still be able to continue under way at 20 knots as it was reported to have done at the end of the fifth strike.

## B. Aircraft Carriers

### 1. CV ZUIKAKU

Nothing is known about the defensive armor or underwater protective system of the ZUIKAKU. It seems reasonable to assume that its underwater protection is similar to that of the Japanese BB's and patterned after the British underwater protection system. BuShips believes that there is a total of at least 4 inches of armor plus 2 or 3 additional inches of medium steel



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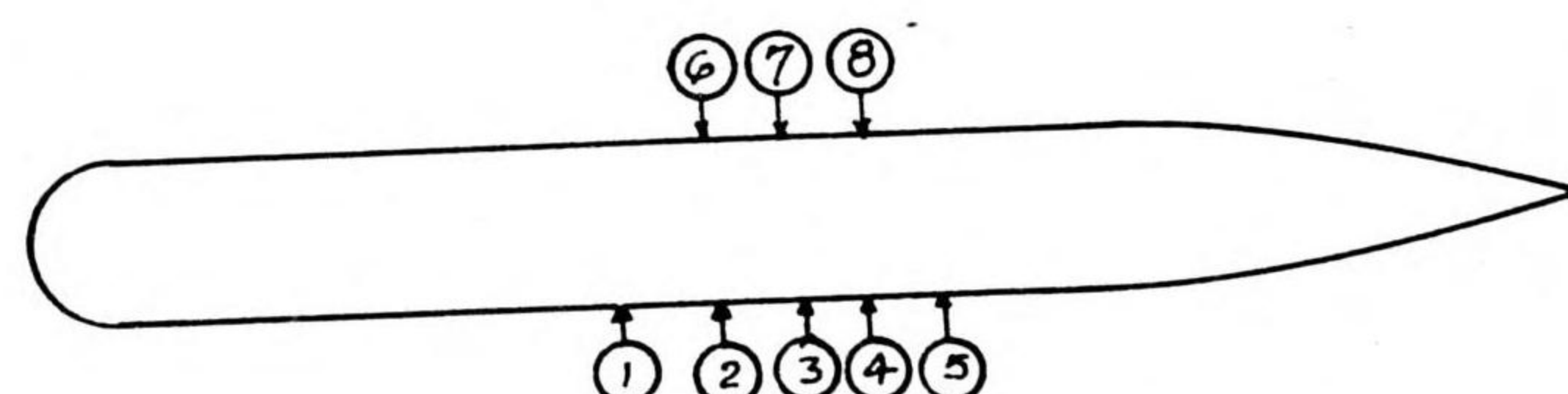
structure over the vitals.

ZUIKAKU was reported hit as follows:

Strike No.	No. of Hits	Weapon	Fuzing or Depth Setting
1	1	500# GP	Inst.
1	7	1000# SAP	.025 sec.
1	7	1000# AP	.08 sec.
1	7	torpedoes	16'
1	1	torpedo	12'
1	3	torpedoes	12'
2	3	torpedoes	12'
3	6	torpedoes	12'
3	3	500# SAP	.025 sec.
3	3	1000# SAP	.025 sec.
3	9	1000# AP	.08 sec.
3	2	2000 GP	.025 sec.

During the first strike the ZUIKAKU was hit by one torpedo set at 12', launched by VT-51, and about one half hour later by seven torpedoes set at 16', launched by VT-20. All the torpedoes hit amidships, three on the port side and five on the starboard.

Figure 4.



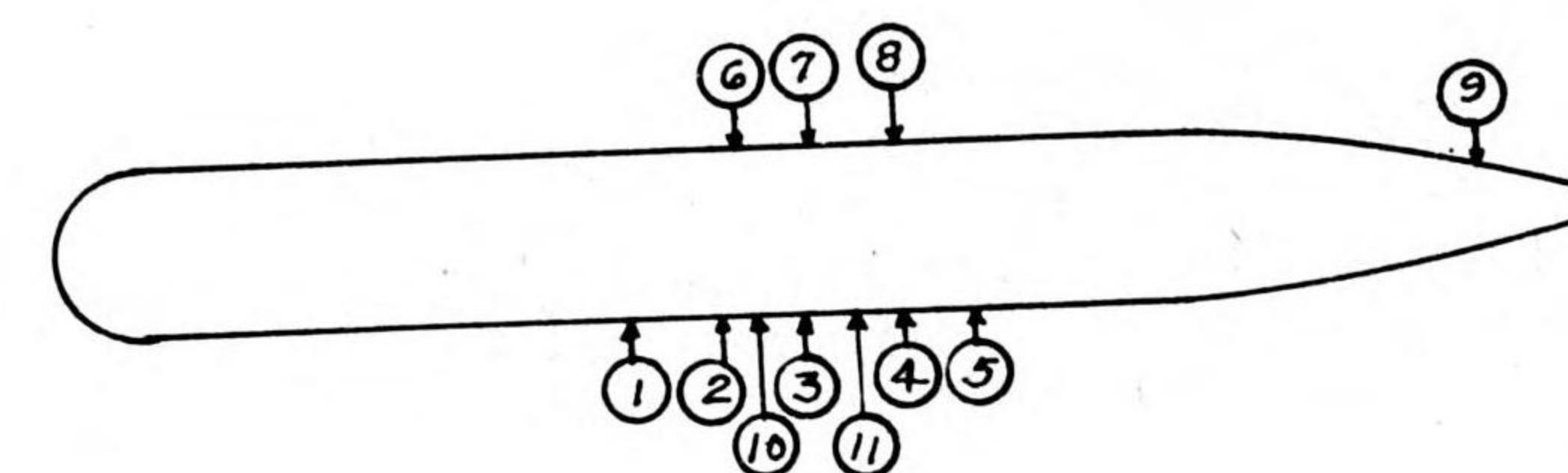
Inasmuch as five of the hits were on one side amidships there is a fair probability that overlapping of flooded areas arose. In addition, the fact that three torpedoes struck on the other side would serve to counterflood and thus aid in maintaining the ship upright. This reasoning is valid if the holding bulkhead was not ruptured. It also may be valid even if the holding bulkhead were ruptured by some of the torpedoes, because of the many longitudinal bulkheads present in ships of British design. The conclusion therefore, is that the ZUIKAKU had a reasonable chance of surviving the reported eight torpedo hits.

In addition to the torpedo hits, the ZUIKAKU was hit by one 500# GP bomb, instantaneously fuzed, and fourteen 1000# bombs, either SAP or AP. It is assumed that seven were SAP and seven AP. The former were fuzed .025 seconds delay and the latter .08 seconds delay. The 500# GP bomb could damage only installations on the flight deck. The 1000# bombs were released in a dive from about 2000 feet. Both the AP and SAP bombs would penetrate the flight deck. Because of the short delay fuze (.025 seconds) used on the SAP bombs they probably exploded in the upper portion of the hangar deck while the AP bombs probably exploded in the lower portion of the hangar adjacent to the main deck. These bombs (both AP and SAP) would therefore not necessarily do fatal damage particularly in view of the fact that there were few, if any, planes aboard. Planes on the hangar deck comprise the most serious fire hazard above the waterline.

During the second strike the ZUIKAKU was claimed hit by three more torpedoes set at 12 feet. One hit on port bow and two amidships on the starboard side. Figure 5 shows the reported distribution of these hits.

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Figure 5.



It is the opinion of BuShips that if these hits were scored, no matter what their distribution, the ZUIKAKU would have sunk. Since the carrier did not sink prior to the next strike, three to three and one half hours later, it seems likely that there was duplication in torpedo hits claimed.

During the third strike the ZUIKAKU was reported to have been hit by six torpedoes set at 12 feet, nine 1000# AP, three 1000# SAP, three 500# SAP and two 2000# GP bombs. The ZUIKAKU was seen to sink about one hour after the last torpedo struck. As in the previous strike none of the bombs were released high enough to have sufficient terminal velocity to penetrate to the vitals of the vessel. The location of only one torpedo hit is known. It hit on the port side approximately amidships. It was the last torpedo to hit. According to an ACA-1 report, the port vessel was seen "... to take on an additional list of ten to fifteen degrees to port. The port catwalk and the edge of the flight deck were awash when the planes retired." If the ZUIKAKU had been hit by six torpedoes after having been hit by several others previously, it would not have been likely to survive for an hour after the final attack, as it was reported to have done. It seems probable here also, that the five hits claimed by one squadron involve duplicate claims.

## 2. CVL ZUIHO

Nothing definite is known about the armor or underwater protection of the ZUIHO. However, she was converted from a submarine tender and oiler. It is BuShip's opinion that  $1\frac{1}{2}$  to  $2\frac{1}{2}$  inches of STS armor covers the mid-section of the ship over the region of the magazines, machinery, and gasoline storage areas. The ends of the ship are unprotected.

ZUIHO was reported hit as follows:

Strike No.	No. of Hits	Weapon	Fuzing or Depth Setting
1	1	torpedo	10'
1	1	torpedo	15'
1	3	500# SAP	.025 sec.
3	3	500# SAP	.025 sec.
3	2	500# SAP	unreported (prob..025 sec.)
3	3	1000# SAP	.025 sec.
3	4	1000# AP	.08 sec.
3	4	torpedoes	12'
3	1	torpedo	15'
3	2	torpedoes	16'
4	2	torpedoes	.025 sec.
4	1	500# SAP	.025 sec.
4	4	1000# SAP	.08 sec.
4	4	1000# AP	.08 sec.

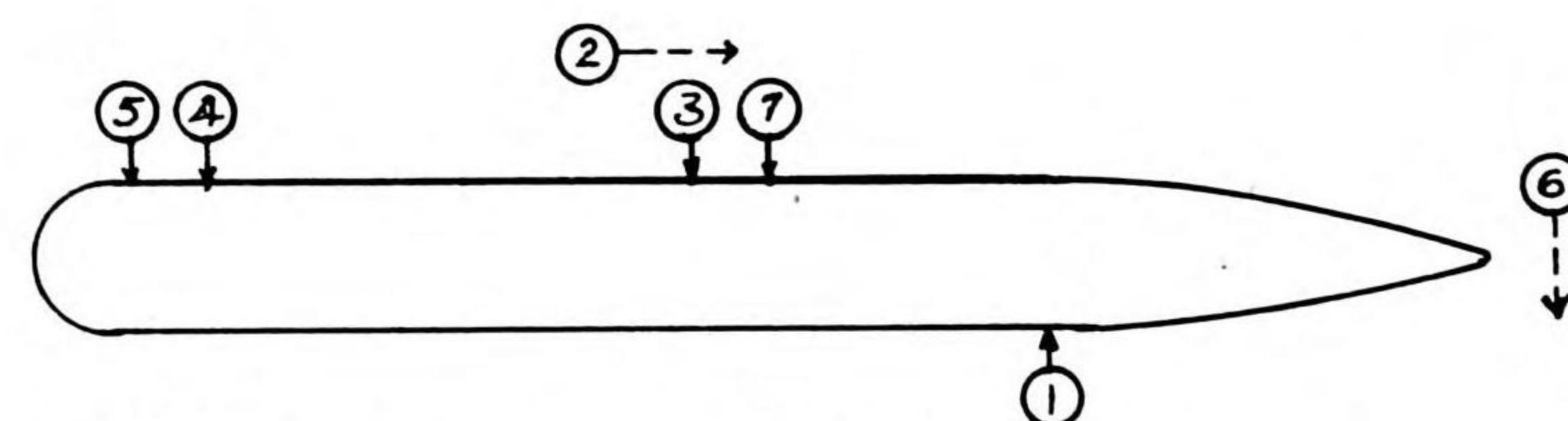
During the first strike the ZUIHO was hit by two torpedoes, one set at 15 feet and one at ten feet, and three 500# SAP bombs fuzed .025 delay. The bombs hit the central portion of the flight deck over the armored region. They were dropped in a dive from 2500 to 3000 feet. It is highly likely that the bombs exploded in the hangar space and hence were unlikely to do serious damage in terms of sinking. One torpedo hit forward of amidships on the starboard side, the other hit at an unspecified point on the port side. Reference (b) indicates that a CVL of



the U.S. Fleet has an 82 per cent chance of surviving two torpedo hits.

The ZUIHO was not hit again until the third strike, about five hours later. During this strike the vessel was reported to have been hit by five torpedoes, five 500# SAP, three 1000# SAP and four 1000# AP bombs. The AP bombs, fuzed .08 second delay, were dropped in a dive from 2000 feet and therefore would very likely have penetrated into the vitals of the ship before exploding. Three hit toward the stern; the fourth was not located. The SAP bombs, because of the relatively short delay fuzing (.025 sec.), probably all exploded in the region of the hangar deck. All five torpedoes struck within a period of ten minutes. Three, set at 12 feet, struck on the port side, one amidships and two on the stern. The fourth, set at 12', struck at an unspecified point, and the fifth, set at 15', hit on the port side amidships. Figure 6 shows the distribution of the torpedo hits.

Figure 6.



2- hit on port side at unspecified point.

6- not located at all.

Reference (b) estimates that a CVL has only about one chance in a hundred of surviving four torpedo hits, if the warhead contains 660 lbs. of TNT.

The ZUIHO by this time was reported to have been struck by seven torpedoes and at least four 1000# AP bombs which penetrated to its vitals before exploding. Had all these hits occurred it is practically certain that the ZUIHO would not have remained afloat for another one to two hours to be struck again during the fourth strike. It must be assumed that the reported number of hits obtained against the ZUIHO is in excess of that actually obtained.

During the fourth strike the ZUIHO was reported to have been hit by two torpedoes, four 1000# AP, four 1000# SAP and one 500# SAP bombs. All these hits were reported to have occurred at about 1415. The locations of the bomb hits are unknown. The AP bombs, fuzed .08 sec. delay, probably penetrated into the vitals of the ship before exploding. The SAP bombs, fuzed .025 sec. delay, probably exploded above the hangar deck. Both the torpedoes, set at 16', struck the starboard quarter. The ZUIHO was seen to sink at 1530.

In view of the amount of punishment the ZUIHO was reported to have sustained before the fourth strike and assuming that the reports were accurate, it seems likely that there was a great deal of overhitting in the attack. However, the fact that the ZUIHO remained afloat for approximately one hour after the final attack on it makes it likely that the reported number of hits is excessive.

### 3. CVL CHITOSE

The same assumptions regarding the CHITOSE's protection against bombs and torpedoes may be made as were made for the ZUIHO. Before conversion, both the CHITOSE and the CHIYODA were seaplane tenders.

The CHITOSE was struck by bombs and aircraft torpedoes only during the first strike when it was hit by three torpedoes, one 1000# AP and two 100# GP bombs. The bombs were released in a dive from 2500 feet. The AP bomb, fuzed .08 sec. delay, hit at the stern end of the flight deck and although it undoubtedly penetrated well into the ship before exploding it probably did not hit in the way of the magazines or gasoline storage and hence would not have caused sinking

damage, but undoubtedly would have damaged the propellers and rudder, stopping her. The three torpedoes, all set at 18', probably the maximum depth that could have been used without passing under the vessel, hit on the starboard side in the midships region. While the probability of a CVL surviving after being hit as the CHITOSE is reported to have been is low, possibly five chances in one hundred, it is not beyond the realm of possibility. Hence, it is not necessary to assume that there was any inaccuracy in the reports of the number of hits obtained. The CHITOSE remained dead in the water throughout the remainder of the day until it was sunk by surface forces at 1647.

### 4. CVL CHIYODA

It is assumed that the CHIYODA's protection was essentially the same as that of the ZUIHO.

The CHIYODA sank shortly after the first strike when it is reported to have been hit with nine torpedoes, sixteen 1000# SAP and four 1000# AP bombs. It does not seem necessary to enter into an extended discussion to establish that a considerable amount of overhitting of the CHIYODA was done.

### C. Cruisers

As previously noted the cruiser strength of the Northern Japanese Force consisted of one CA and 4 CL's. To the best of our knowledge the CA was not damaged in any of the air attacks. Each of the CL's sustained some hits by a major weapon.

#### 1. CL No. 1 - Chart A.

This CL was reported to have been sunk by a torpedo set at 12 feet, during the second strike after being left dead in the water by damage done during the first strike. However, during the first strike it appears to have been hit by only "several rockets" (44 were aimed at the vessel). It does not seem likely that several 5" rockets could do sufficient damage to leave a CL dead in the water. It is possible that bombs or torpedoes from planes based on the FRANKLIN or BELLEAU WOOD, for which no ACA-1 forms have been received, struck the CL.

#### 2. CL No. 2 - Chart A.

This CL was hit by a torpedo during the first strike. It seems not to have gotten under way again until about 1010. It proceeded north at 5 to 6 knots without being hit again until the fifth strike when a 500# SAP bomb fuzed .01 sec. delay hit it on the stern. There is no reason to suppose that the CL would have any great difficulty in surviving these hits.

#### 3. CL No. 3 - Chart A.

This cruiser was hit by a torpedo, set at 12', on the port side forward of amidships, during the first strike. It was not hit again during any of the remaining strikes. The reports indicate that it proceeded north at 10-12 knots throughout the remainder of the day.

#### 4. CL No. 4 - Chart A.

This cruiser was not hit until the fifth strike when it was hit by five 1000# bombs either AP fuzed .08 sec. delay or SAP fuzed .025 sec. delay. One bomb hit near the stack, the others forward of the bridge. The ACA-1 report stated that the cruiser was left dead in the water and burning furiously. This assessment of the damage is reasonable for the number of hits claimed, regardless of the combination of AP and SAP bombs which hit.

### 11. Damage to the Central Force.

The Central Force was composed of 5 BB's, 10 CA's, 2 CL's and 3 DD's. An attempt was made to identify the vessel under attack in each of the attacks made against this force. However, there were several factors present during the course of these attacks which served to make complete identification impossible, particularly the virtual impossibility of using the position



of the ship in the disposition of the fleet as a guide to its identification, necessitating complete reliance on the pilot's identification.

#### A. Battleships

Because there was only one NAGATO Class BB present it was possible to identify all attacks against it, again by assuming that the identification given in the ACA-1 reports is accurate. Furthermore, it is known that the MUSASHI was sunk on 24 October, hence, all subsequent attacks on ships of this class must have been made on the YAMATO.

An attempt was made to separate the attacks made on 24 October against the two YAMATO Class BB's in order to determine how many hits were claimed against the MUSASHI. Unfortunately the action reports were not detailed enough to permit such a separation. It is possible, however, to estimate the minimum number of hits which it may have sustained. A detailed discussion will be given below.

#### 1. YAMATO Class

Reference (a) lists only the following information concerning this class:

Displacement	45,000 tons
Length	857' 0"
Beam	125' 0"

It seems reasonable to assume that the armor and underwater protection of these BB's are comparable to that of the newer U.S. and British BB's. This would give a total of approximately 8½ inches of STS over the vitals of the vessel and a torpedo defense system capable of defeating a warhead of 1000 lbs. of TNT.

#### (a) Attacks on 24 October.

During the first strike (approximately 1030) one of the two YAMATO Class BB's was hit as follows:

No.	Bomb	Fuzes	Location of Hit(s)
2	1000# AP	.08 sec. delay	Amidships
3	1000# SAP	.025 sec. delay	Port Quarter
1	1000# GP	.1 sec. delay (nose)	Stern

It is probable that the GP bomb had a .025 tail fuze as well as the .1 nose fuze although this was not reported. This vessel was hit in addition by two torpedoes set at 8 feet. Both torpedoes hit on the starboard side, one amidships, the other approximately midway between the forward turret and the bow.

The bombs were dropped in a dive from 2500 feet. Reference (d) indicates that a 1000# GP bomb will break up and possibly give a low order detonation if it hits armor thicker than 1.5 inches; reference (e) places this thickness at 1.8 inches. In any event if the GP bomb was fuzed .1 sec. delay it would have penetrated to the armor deck and probably given at least a low order detonation. If fuzed .025 sec. delay it would have detonated between the main deck and the armor deck and thus resulted in little or no serious sinking damage. The AP bombs hit over the region of the heavy armor. They could penetrate only about 3.25 inches of armor (references (d) and (e)) and hence would be defeated by the deck armor and do no serious sinking damage. The SAP bomb fuzed .025 sec. delay should have penetrated the main deck and exploded between it and the second deck. It, therefore, would not be expected to do much damage in terms of sinking the vessel.

The two torpedoes which hit this BB during the first strike were set at the shallow depth of 8 feet. Therefore, they probably hit well up in the region protected by the armor belt. If so, it is unlikely that the holding bulkhead incurred any damage. Consequently the vessel had about a 98% chance of surviving (reference (e)).

During the second strike, at approximately 1210, a YAMATO Class BB was reported to have been hit amidships, with two 1000# AP bombs fuzed .08 sec. delay and two 1000# SAP bombs fuzed .025 sec. delay and two torpedoes set at 12 feet. By the same line of reasoning as in the previous strike, it may be concluded that these bombs contributed little toward the sinking of the vessel.

The two torpedoes struck on the port side, one amidships, the other well forward of amidships. These torpedoes were set at 12 feet.

If it is assumed that this YAMATO Class BB is the same one attacked during the first strike, the damage done to it would be of such a nature as to give an expectancy of survival of approximately 90 per cent. If it was not the same vessel attacked during the first strike its expectancy of survival is about 98 per cent.

At the end of this strike the possible distributions of torpedo hits is as follows: Figure 7 - All hits on the same vessel. Figure 8 - Hits of first and second strikes on different vessels.

Figure 7.

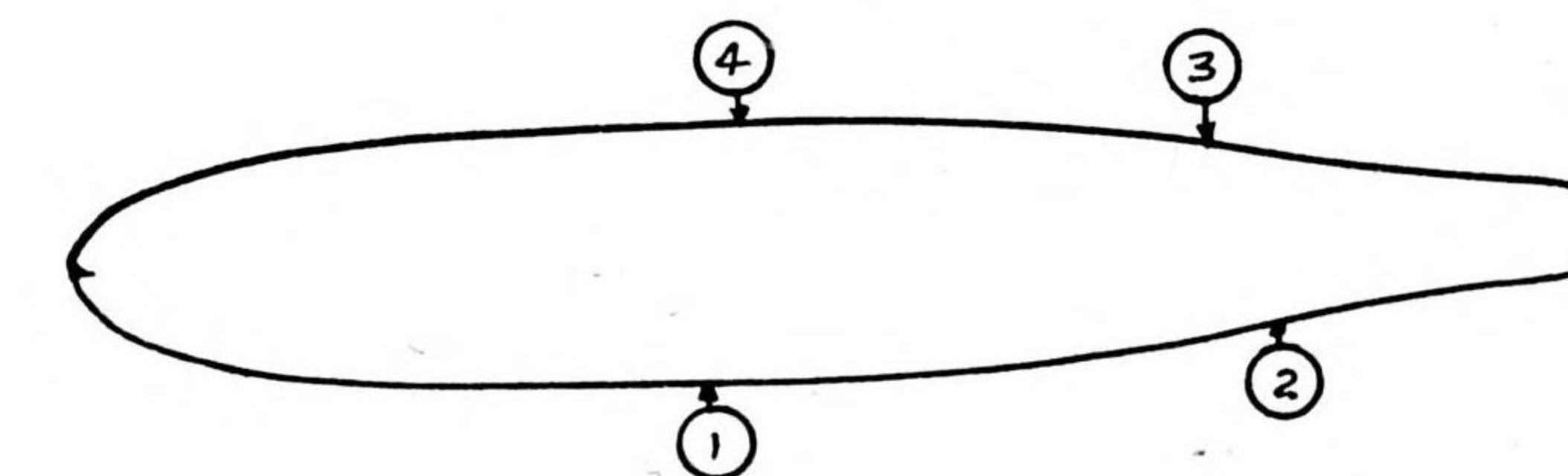
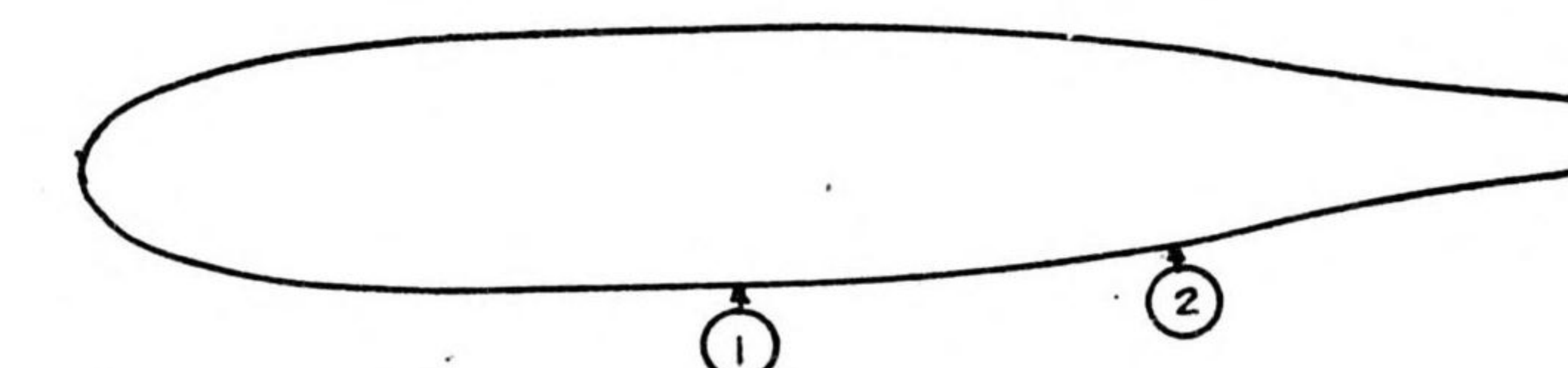
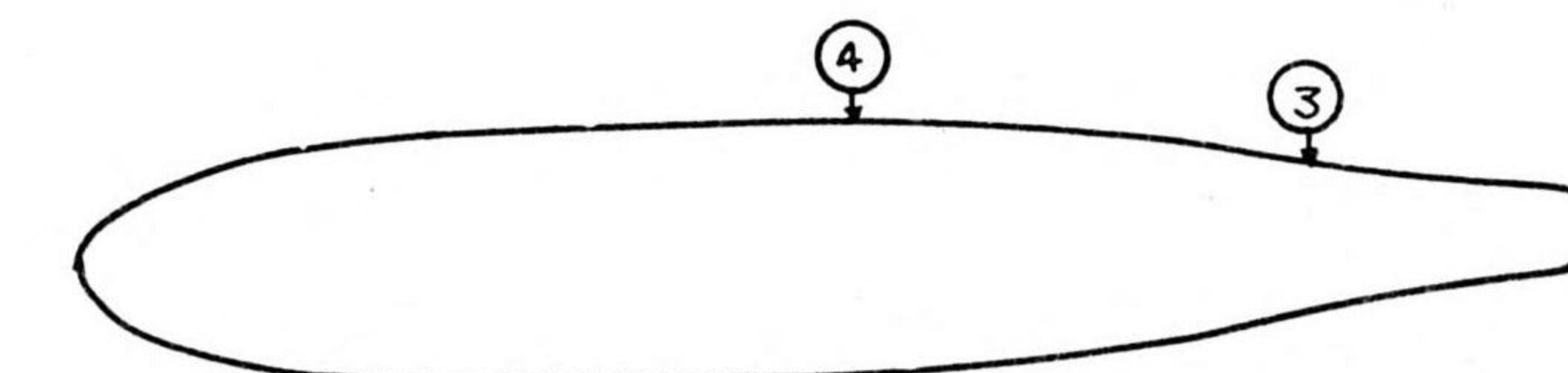


Figure 8.



Vessel 1.



Vessel 2.

Strike No.	Hit No.	Depth Setting
I	1	8'
	2	8'
II	3	12'
	4	12'



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During the third strike, at about 1400, a BB of this class was reported hit with three 1000# bombs, probably one AP fuzed .08 sec. delay and two SAP fuzed .025 sec. delay and three torpedoes. Two of the torpedoes were set at 22 feet, the third at 10 feet.

It is not reported where the bombs hit; but because they were dropped from only 2000 feet they would not be expected to put the vessel in danger of sinking. The torpedo set at 10 feet hit on the starboard side aft; the other two, set at 22 feet, hit unspecified points on the port side. As a result of these torpedo hits the distributions illustrated in figures 9 and 10 may have resulted. Figure 9 - All hits on one vessel. Figure 10, (a) and (b) - Hits distributed between the two vessels; those of third strike all hitting either vessel 1 or vessel 2.

Figure 9.

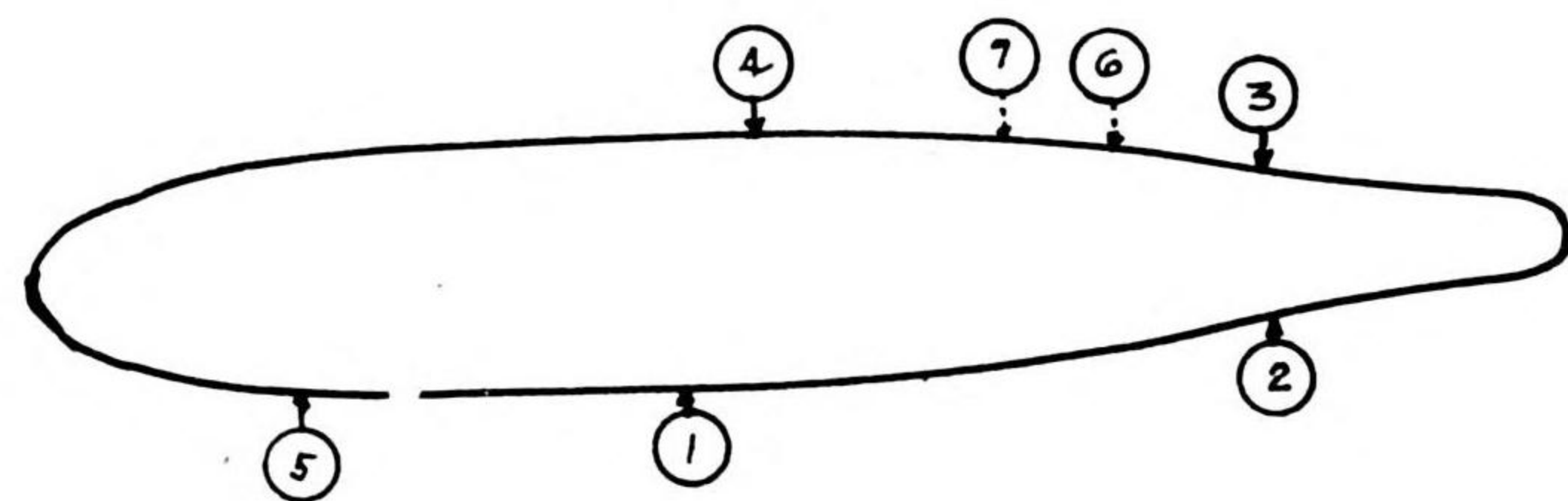
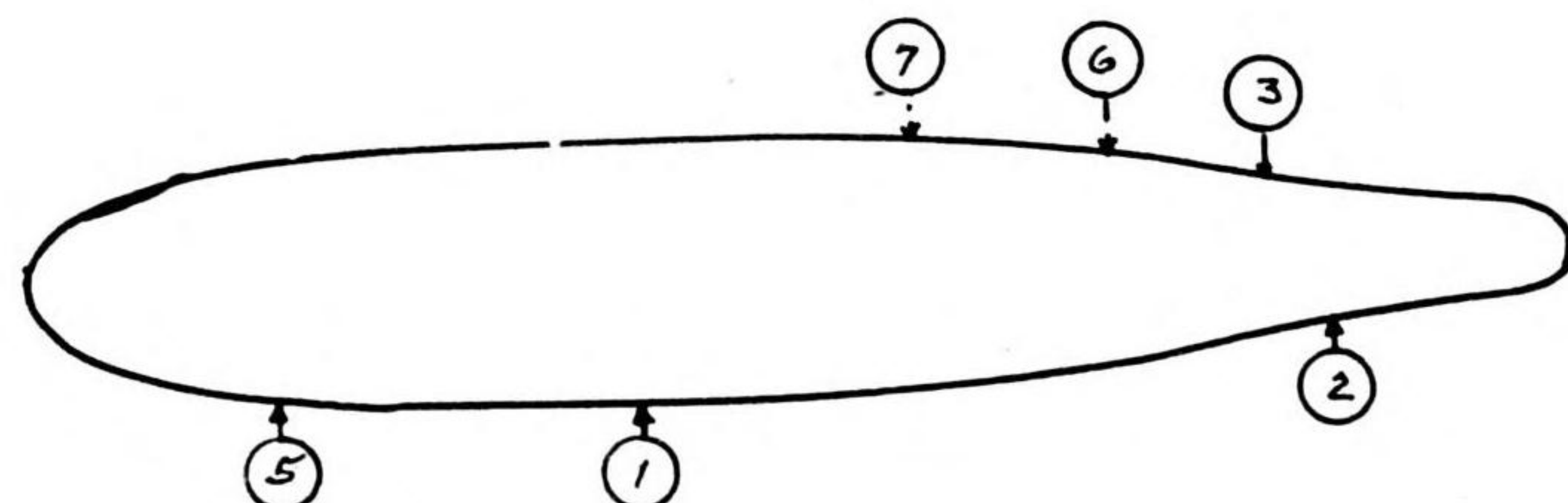
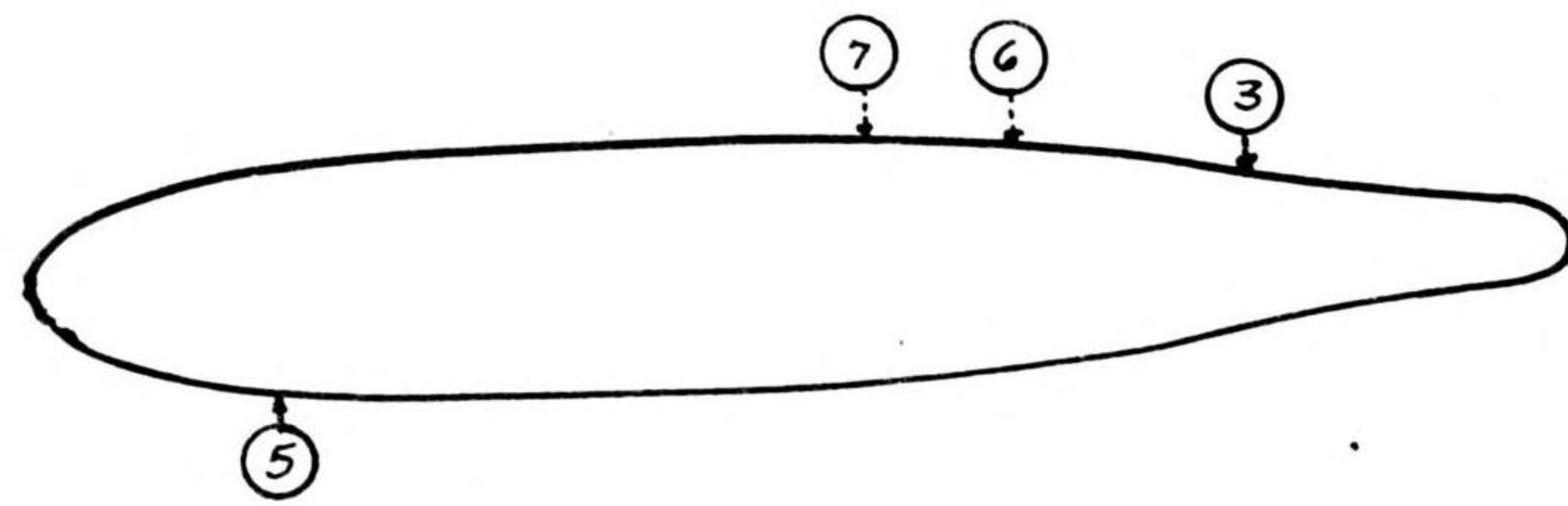


Figure 10a.

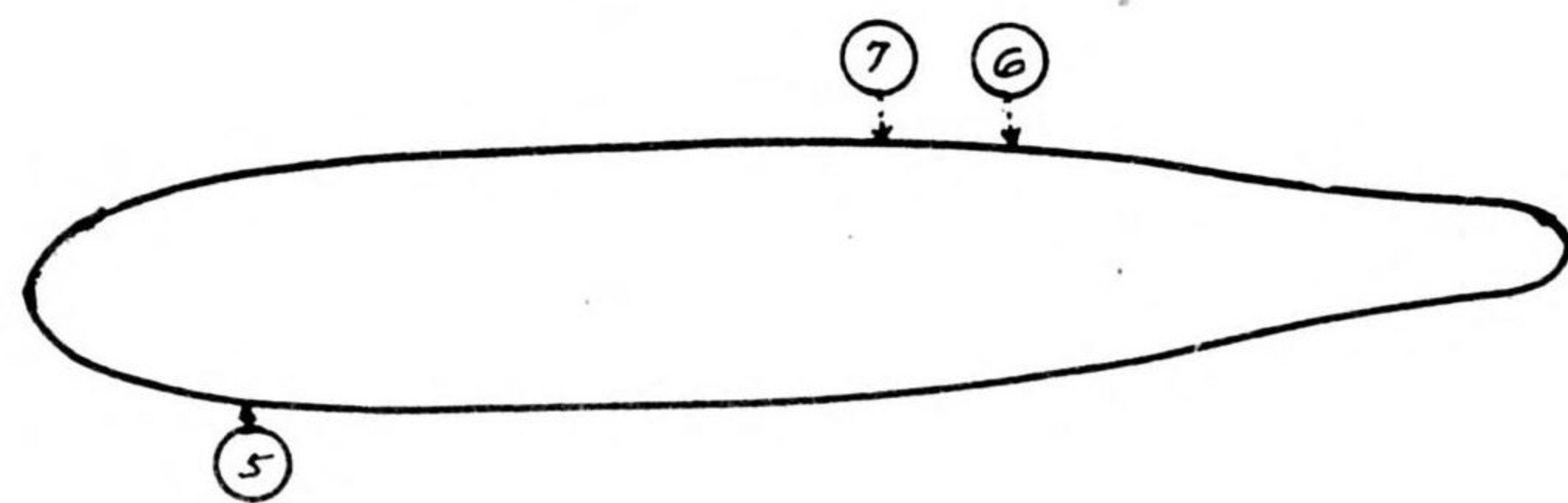


Vessel 1.



Vessel 2.

Figure 10b.



The dotted arrows indicate uncertainty as to location.

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Strike No.	Hit No.	Depth Setting
I	1	8'
	2	8'
II	3	12'
	4	12'
III	5	10'
	6	22'
	7	22'

Because it was reported that the BB hit during the third strike was down at the bow and streaming oil after this strike, the sixth and seventh hits are indicated as having occurred forward of amidships. Figure 9 shows the distribution of the torpedo hits if all attacks had been made against the same BB.

Analysis by BuShips shows that in U.S. BB's of the 61 class it is possible to flood the entire length of the torpedo protection system outboard of the holding bulkhead and do no more than raise the water line by approximately 5 feet, provided the armored deck is not ruptured. The torpedo protection system covers 470' amidships of the 860' length of the vessel. One torpedo hit will flood approximately 80 feet of the torpedo defense system.

In view of the above discussion, the distribution of hits in figure 9 would result in flooding approximately 320 feet of the torpedo defense system and would therefore not be likely to put the vessel in any serious danger of sinking. This holds true even if the holding bulkhead were ruptured by some of the torpedoes. This would be all the more true if it is assumed that the Japanese follow British ship design.

Figures 10a and b show the possible distribution of torpedo hits after the third strike if the second attack was not made against the same vessel hit in the first attack. Neither of the vessels would be in serious jeopardy under these circumstances. Vessel 1 would require less counterflooding than vessel 2 to remain on even keel. But, as stated above, neither would ship sufficient water to be in danger of plunging.

During the fourth strike, at approximately 1440 a YAMATO Class BB was hit by seven 1000# bombs. These were in an unknown combination of AP bombs, fuzed .08 sec. delay, and SAP bombs, fuzed .025 sec. delay. In addition, it was hit by two 500# GP bombs fuzed instantaneously. This attack was by the same air group which hit a YAMATO Class BB during the third strike. They believe that the YAMATO hit during the fourth strike was the same one. As in the previous cases of bomb hits, all damage done by them would be above the armored deck because of the fuzing and altitude of release used. Therefore, it is not likely that the bombs would have seriously endangered the vessel in terms of likelihood of sinking.

At about 1515, during the fifth strike, a YAMATO Class BB was reported hit dead astern by a torpedo set at 8 feet. It was also hit by three 1000# bombs: one a GP fuzed .01 sec. delay, one an AP fuzed .08 sec. delay, and the third a SAP fuzed .025 sec. delay.

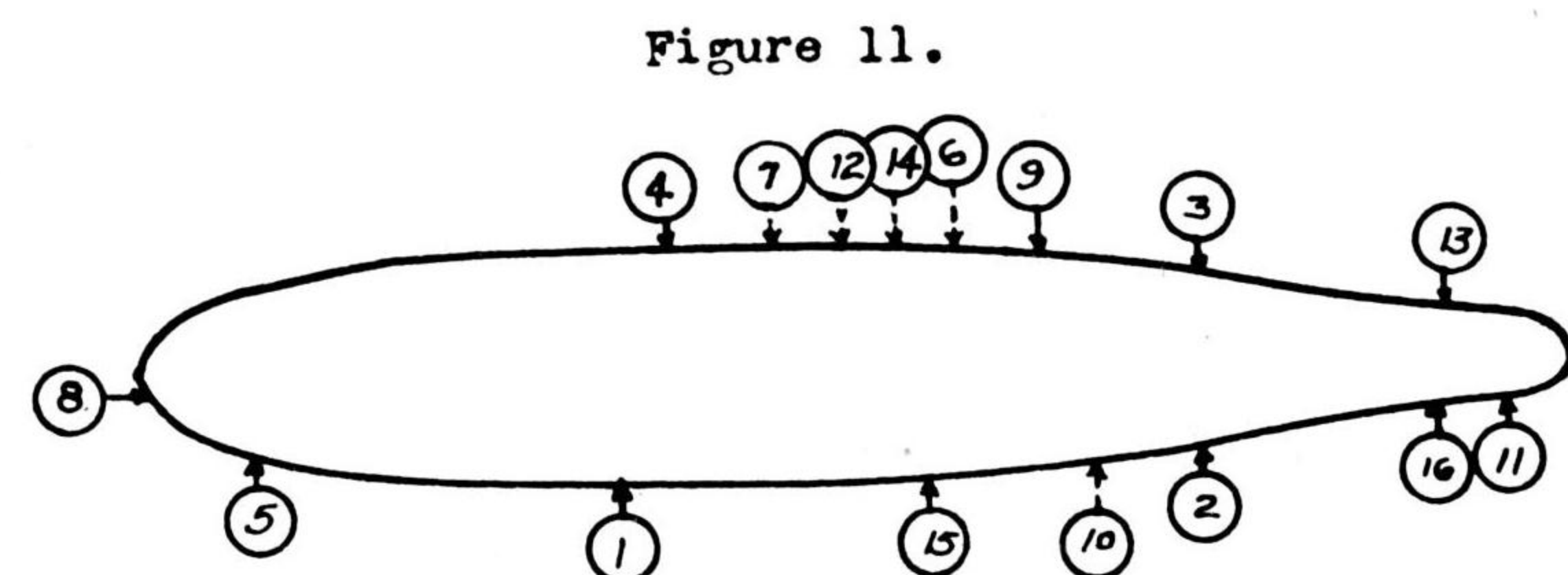
In the latter phase of this strike this same vessel was hit by eleven 1000# SAP bombs fuzed .025 sec. delay and eight torpedoes set at 12 feet. All of the torpedoes hit forward of amidships, four on the port and four on the starboard side.

The damage resulting from the bomb hits scored during this strike probably occurred above the armored deck for reasons already given. It would seem, however, that the region above the armored deck would have been pretty well destroyed by this time.

Figures 11 and 12a thru f show the possible combinations of all torpedo hits on YAMATO Class BB's 24 October, distributed according to the descriptions of the locations of the hits given in the action reports.



Figure 11 - Distribution of torpedo hits if all attacks were made on the same vessel.



Figures 12a thru f - Distribution of torpedo hits if all the attacks were not made on the same vessel.

Figure 12a - Vessel if attacks 1, 3 and 5 were made against it.

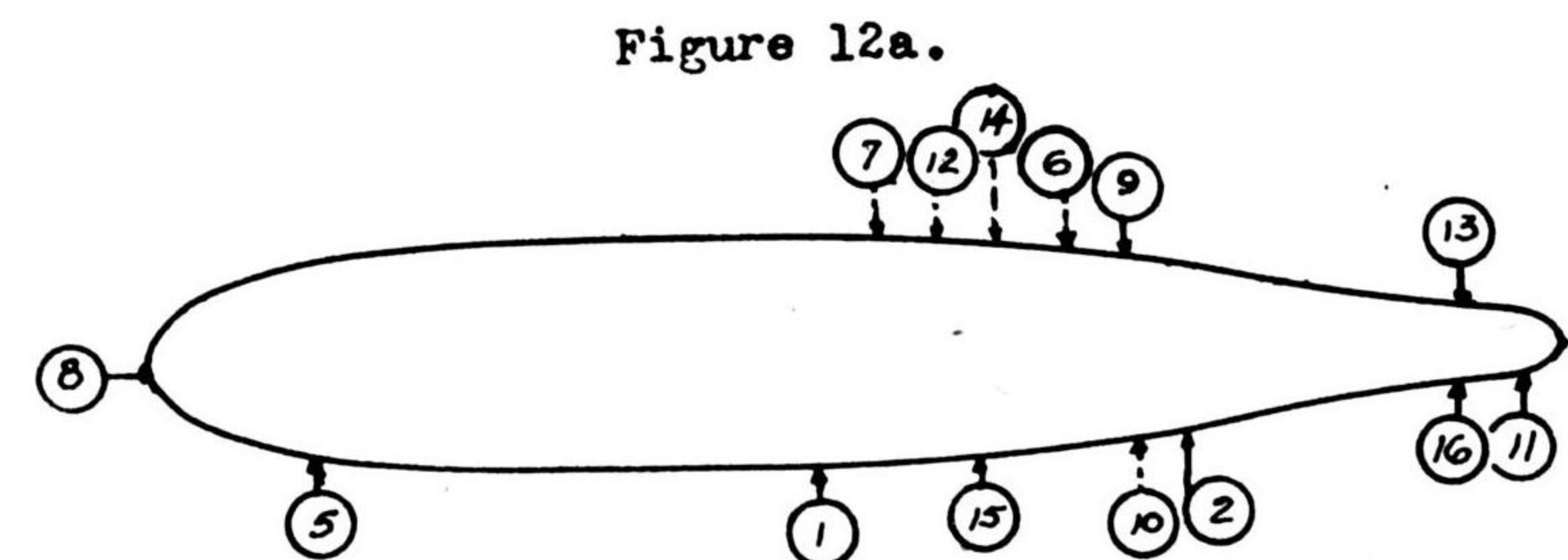
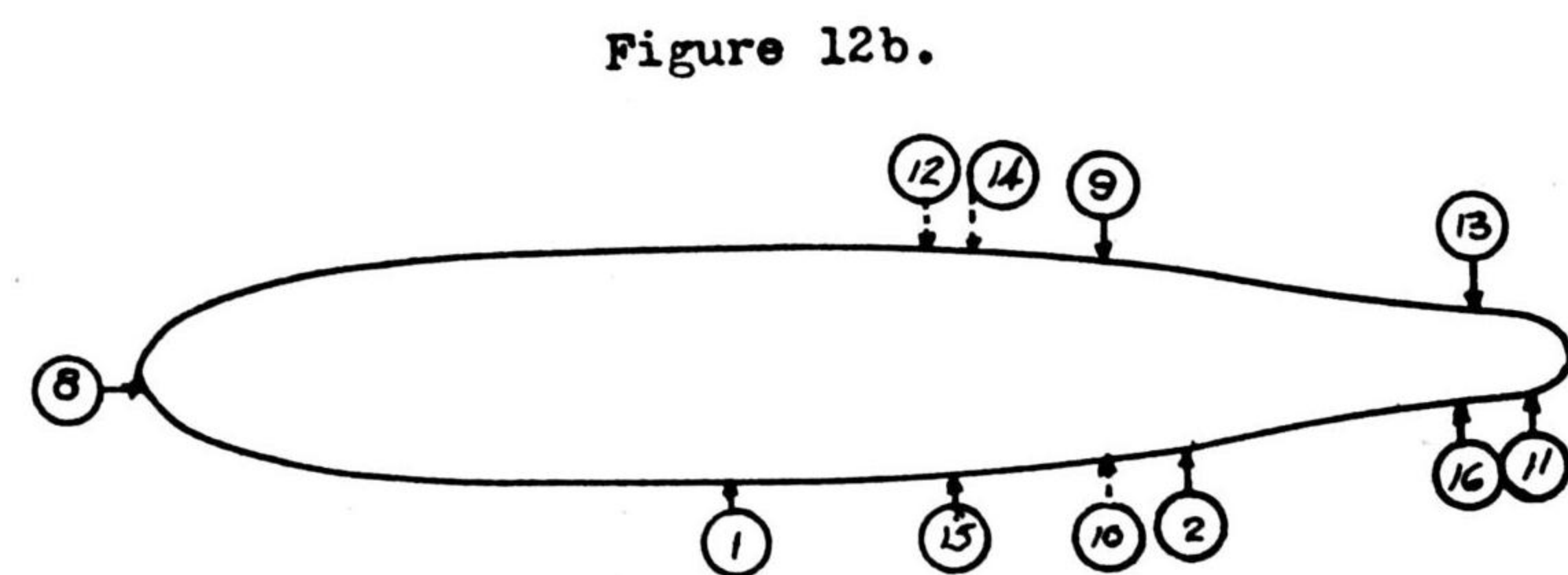


Figure 12b - Vessel if attacks 1, and 5 were made against it.



The dotted arrows indicate hits which are located as to side only (Nos. 6 and 7) or only as to side and region forward of amidships (Nos. 10, 12 and 14).

Figure 12c - Vessel if attacks 2, 3 and 5 were against it.

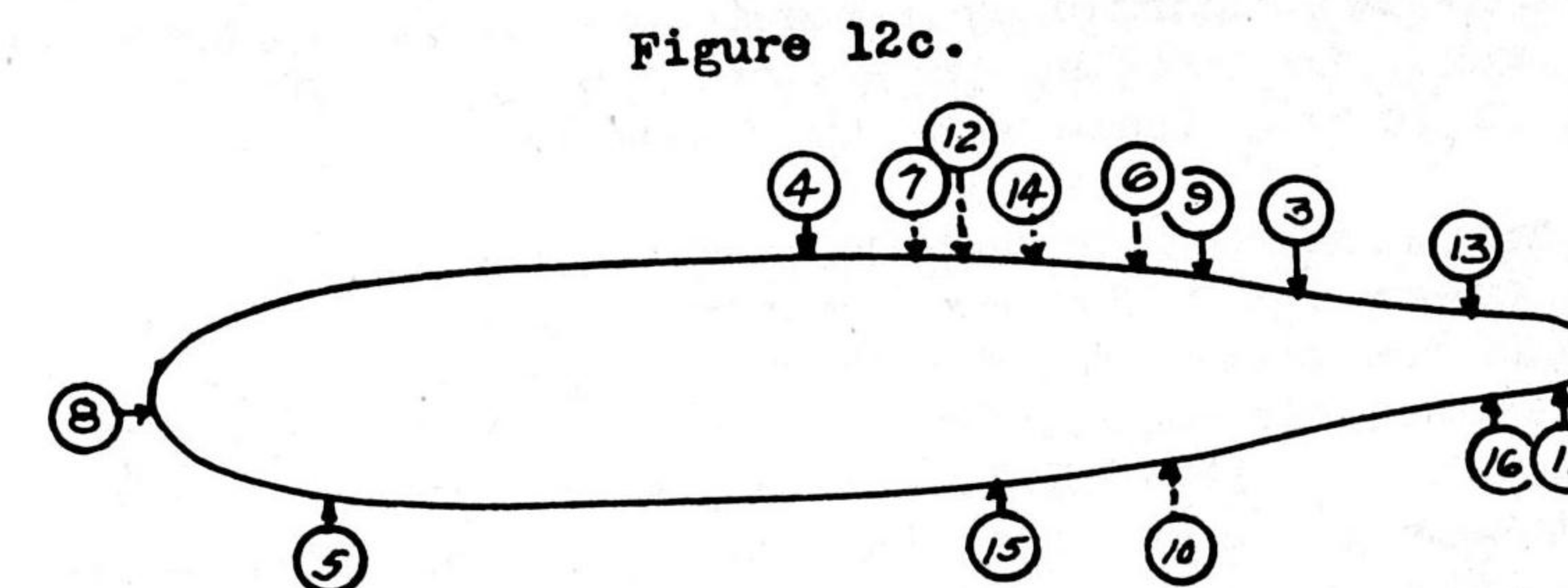


Figure 12d - Vessel if attacks 2 and 5 were made against it.

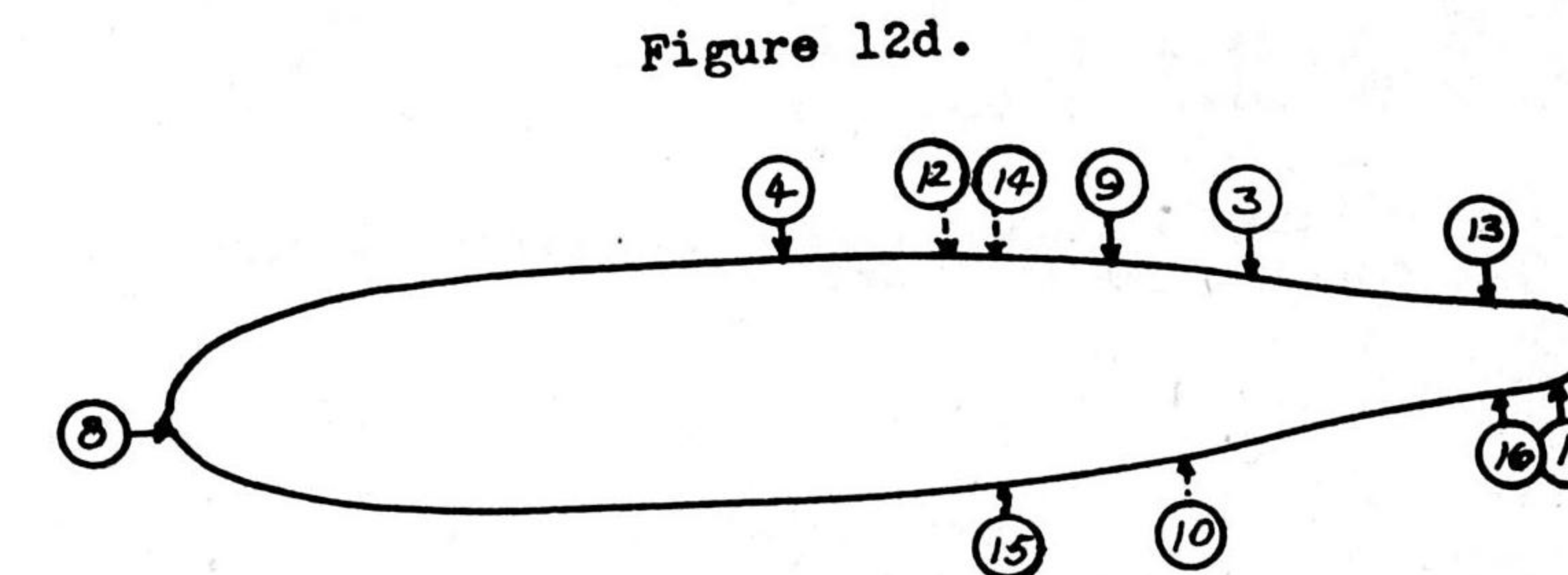


Figure 12e - Vessel if attacks 3 and 5 were made against it.

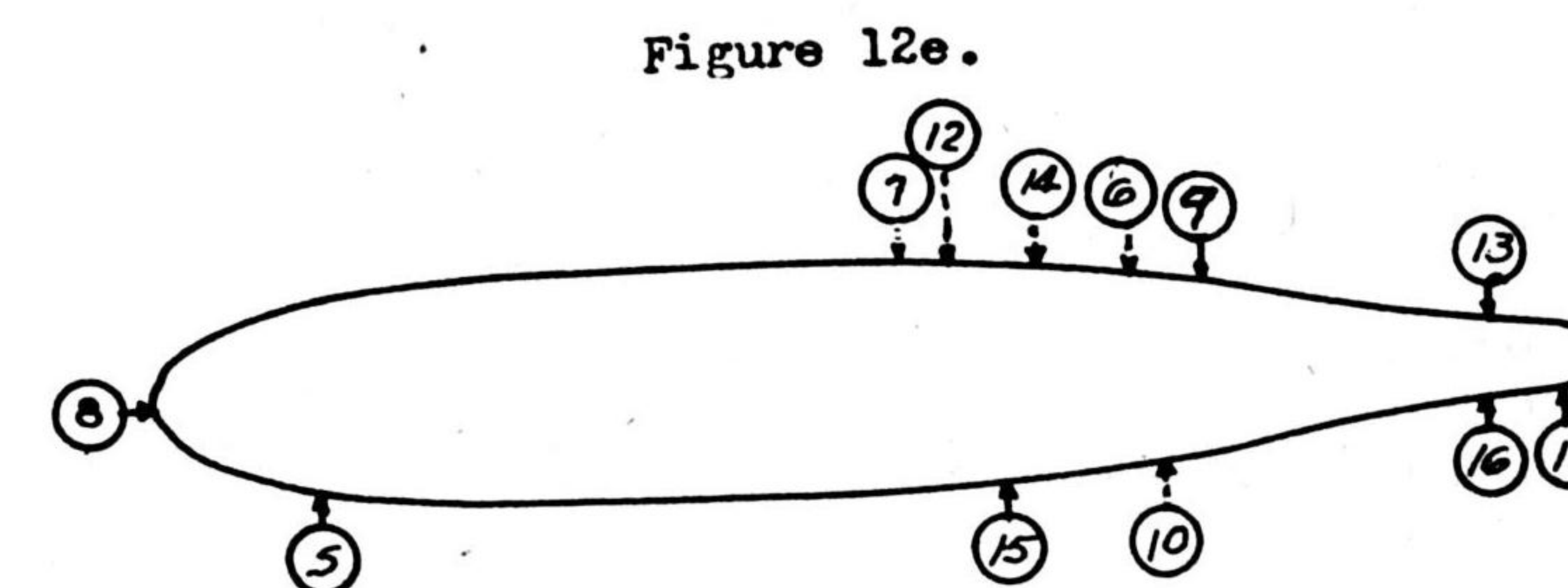
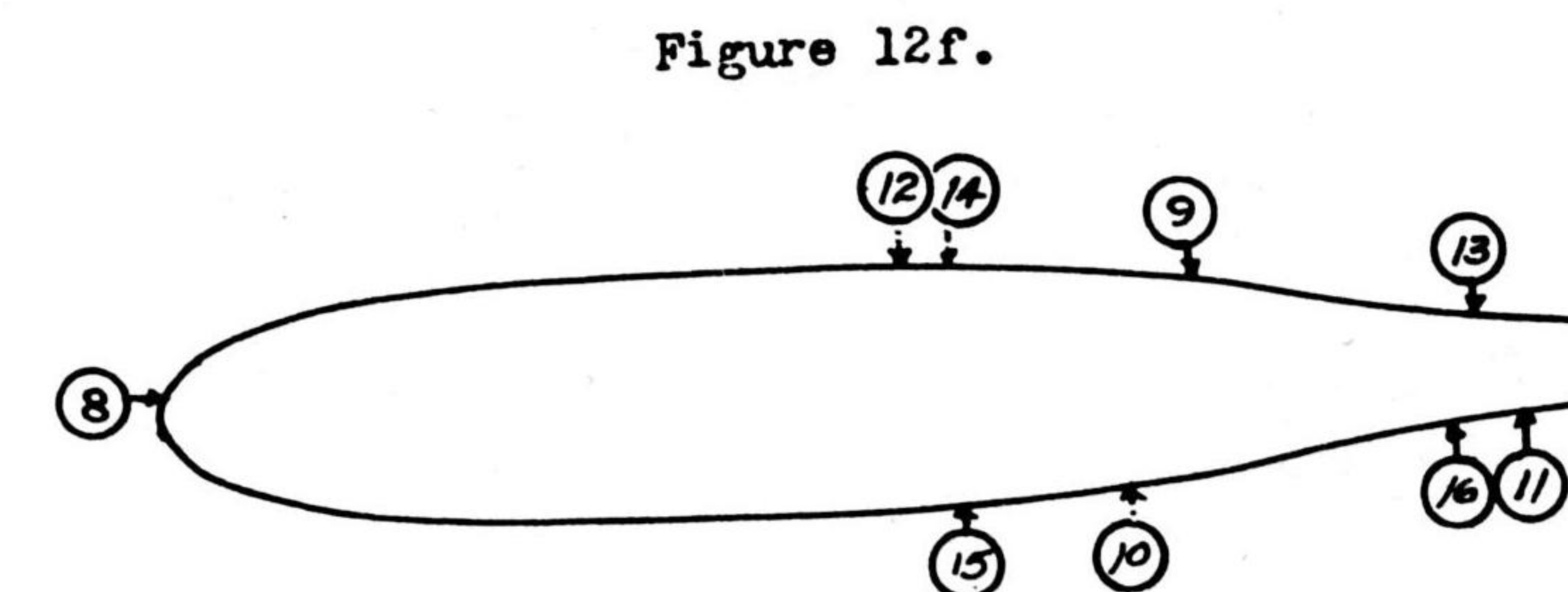


Figure 12f - Only the last attack directed against vessel that sank (MUSASHI).



The dotted arrows indicate hits which are located as to side only (Nos. 6 and 7) or only as to side and region forward of amidships (Nos. 10, 12 and 14).



The MUSASHI was reported by a POW to have sunk at approximately 1800, about three hours after the last attack. The problem arises as to which if any of the six possible distributions of torpedo hits is in accordance with the above report of the sinking of the MUSASHI.

The minimum number of torpedo hits which the MUSASHI may have sustained is nine, distributed as shown in Figure 12e. The maximum number is sixteen distributed as shown in Figure 11. In either case the vessel would have been expected to sink by plunging bow first, and in either case it had a reasonable expectancy of remaining afloat for three hours before sinking. It is considered possible for the MUSASHI to have survived sixteen hits for three hours because of the peculiarly unfortunate circumstances that the first two torpedoes which struck her were set at 8 feet, and because of the way the remaining hits were spaced in time and in location about the vessel. It is assumed that the eight hits which struck forward of amidships in the last strike flooded the bow completely, and in addition flooded one or more compartments inboard of the torpedo defense system forward of amidships.

This assumption is reasonable; (1) because at least four torpedoes hit the bow forward of the torpedo defense system and (2) because at least one torpedo struck in the region forward of amidships aft of the bow.

From the foregoing it follows that all torpedoes other than the last nine were in excess of those required to sink the MUSASHI.

(b) Attacks on 25 and 26 October.

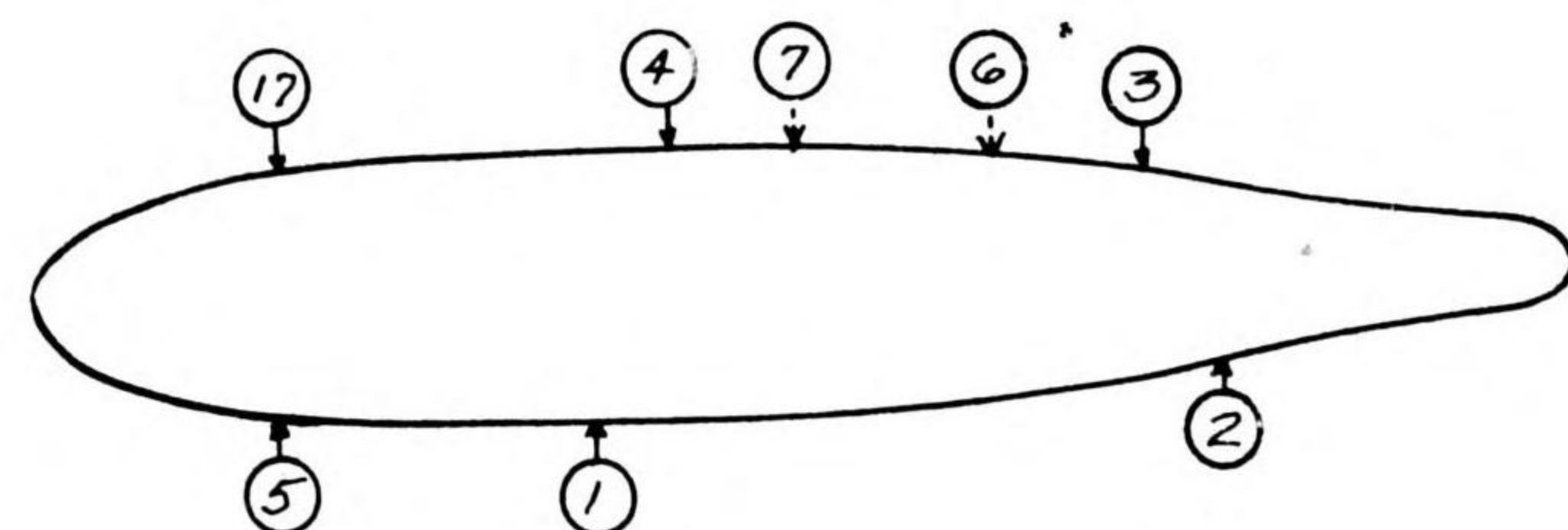
All the attacks made against a YAMATO Class BB on 25 and 26 October must have been made against the YAMATO itself because the MUSASHI was sunk on 24 October. The maximum number of bomb and torpedo hits which the YAMATO may have received on the 24th is eight 1000# AP, eleven 1000# SAP, one 1000# GP and two 500# GP bombs and seven torpedoes. This is on the assumption that all except the last attack was directed against this vessel. It already has been pointed out that the bombs would not be expected seriously to endanger the ship in terms of sinking, and that the torpedoes, distributed as they were, (see Figure 10) would also not put the YAMATO in serious danger.

On 25 October the YAMATO was struck with four 1000# GP bombs and one 250# GP bomb all instantaneously fuzed. These could do only superficial damage.

On the morning of the 26th the YAMATO was hit with six 5" H.E. rockets, two 1000# SAP bombs fuzed .025 sec. delay, one 500# GP bomb fuzed .025 sec. delay, one 250# GP bomb instantaneously fuzed and one torpedo set at 10 feet.

Again the bombs would not penetrate into the vitals of the vessel. The torpedo was reported to have hit on the port side well aft of amidships. Figure 13 shows the resulting distribution of hits.

Figure 13.



Because it is not claimed that the torpedo hit the stern it is likely to have hit in the region protected by the torpedo protection system. If so, it would not have seriously handicapped the vessel. If it had hit farther astern the flooding would have been more extensive. But because of the fine compartmentation in this region, by means of transverse bulkheads, the

flooding would not be extensive enough to cause plunging by the stern nor to induce bodily sinking. In brief, the torpedoes probably succeeded in flooding most of the torpedo defense system but none of the areas inboard, forward or astern of it.

As a result the YAMATO would be expected to have settled lower in the water but not to have sunk.

2. KONGO Class

Reference (a) lists the following for vessels of this class.

Hull	Armor
Displacement 30,000 tons	Deck 4" - 5" (The armor deck is the third deck.)
Dimensions 704' x 98'	Belt 8" amidships 3" ends
Mean Draft 27' 6"	Watertight integrity - very good (bulges)
Speed 26K	Damage control - good

This class is British designed.

Two members of this class, the KONGO and the HARUNA, were present throughout the course of the attacks. It is not possible with the information at hand to determine the distribution of the attacks between these two ships. The number of bombs and torpedoes which were reported to have struck them is listed below.

Time	No. of Hits	24 October	
		Weapon	Fuzing or Depth Setting
1030	1	1000# SAP	.025 sec.
1030	2	1000# GP	.025 sec.
1315	2	Torpedoes	22'
1400	1	1000# SAP	4-5 secs.
25 October			
0800	4	100# GP	Instant.
0900	1	Torpedo	Unreported
1100	1	Torpedo	10'
1215	1	Torpedo	10'
1240	3	500# SAP	.025 sec.
1300	1	500# SAP	.025 sec.
1610	2	500# GP	.01 sec.
1610	8	H.E. rockets	Unreported
1615	2	500# SAP	.025 sec.
1615	1	1000# GP	.01 sec.
26 October			
0830	5	1000# SAP	.025 sec.
0830	1	500# GP	.025 sec.
0830	1	Torpedo	18'

Because of the uncertainty of the distribution of the hits a detailed discussion of the attacks will not be undertaken; instead an overall estimation of the efficacy of the bombs and torpedoes will be made.

Six of the seven 1000# SAP bombs which hit vessels of this class were fuzed .025 sec. delay. They were dropped in a dive from 2500 feet. A 1000# SAP dropped under the above conditions can penetrate a maximum of 3 inches of STS, insufficient to penetrate the armor deck. Furthermore,

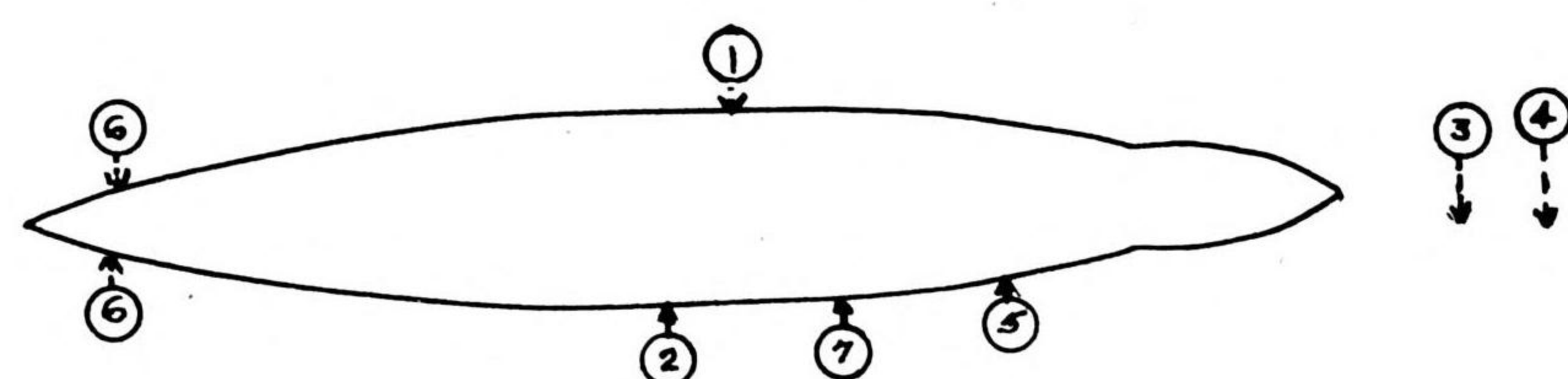


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the impact may have been great enough to result in a low order detonation. Hence at best these SAP's would do damage above the armor deck. The seventh 1000# SAP bomb was fuzed 4-5 sec. delay and released in a glide from 750 feet. The 500# SAP bombs were all fuzed .025 sec. delay. They were all dropped in a glide from about 3000 feet. It is unlikely that they would do any damage by way of sinking the vessel hit.

Figure 14 shows the distribution of torpedo hits claimed against KONGO Class BB's during the course of the 3 day battle. Figure 14 - Distribution of Torpedo Hits on KONGO Class BB's.

Figure 14.



Hit No.	Depth Setting in Feet	Location	Time
1	22	Amidships starboard	1400/24 Oct.
2	22	Port at unspecified point	1400/24 Oct.
3	unreported	unreported	0900/25 Oct.
4	10	unreported	1100/25 Oct.
5	10	Starboard, abaft main battery	1215/25 Oct.
6	unreported	Stern - side not specified	1215/25 Oct.
7	18	Starboard as indicated	0830/26 Oct.

There is no reason to believe that all the torpedoes hit the same BB. But even if they did, it can be shown that they were not likely to sink the vessel.

In the first place, there is very little likelihood that the hits would have caused the vessel to plunge or turn over, because the long time interval between the successive hits would have permitted ample time for counterflooding. There remains the possibility of bodily sinking. This is unlikely even if the holding bulkhead was ruptured by all the torpedoes. This is due to the presence of longitudinal bulkheads inboard of the holding bulkhead in vessels of British design.

Since all the attacks, if delivered against one BB, would not have sunk it, it follows that any division of the attacks between the two BB's would have been insufficient to sink either one.

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### 3. NAGATO Class

Reference (a) lists the following for vessels of this class.

Hull	Armor
Displacement 34,000 tons	Deck - 7"
Dimensions 700' x 95'	Belt - 14" amidships, 8" - 4" ends
Mean Draft 30'	Watertight integrity - very good (bulges)
Speed 23K	Damage control - good.

The design of this class is similar to the British Queen Elizabeth Class.

There was only one NAGATO Class BB present in the Central Japanese Fleet. The action reports show that it was hit on the 24th with three 1000# AP bombs fuzed .08 sec. delay and one 1000# SAP bomb fuzed .025 sec. delay. These bombs were dropped in a dive from 2000 feet. They would not be able to penetrate the deck armor under these conditions and hence may be expected to have done only superficial damage in terms of sinking.

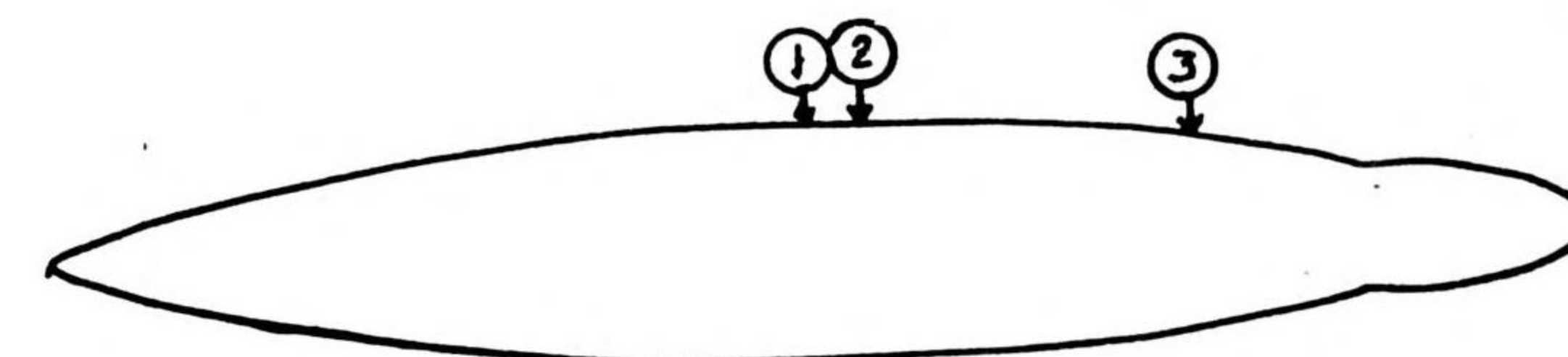
The NAGATO was reported to have been hit on the 25th with the following bombs:

No. of Hits	Bomb	Fuze
4	500# SAP	.025 sec. delay
1	500# SAP	.01 sec. delay
3	250# GP	.01 sec. delay
5	500# GP	.01 sec. delay

It was also hit by three torpedoes.

Figure 15 shows the distribution of the torpedo hits obtained on the 25th.

Figure 15.



Hit No.	Depth Setting in Feet	Time
1	22	0920
2	15	1015
3	Not reported	1225

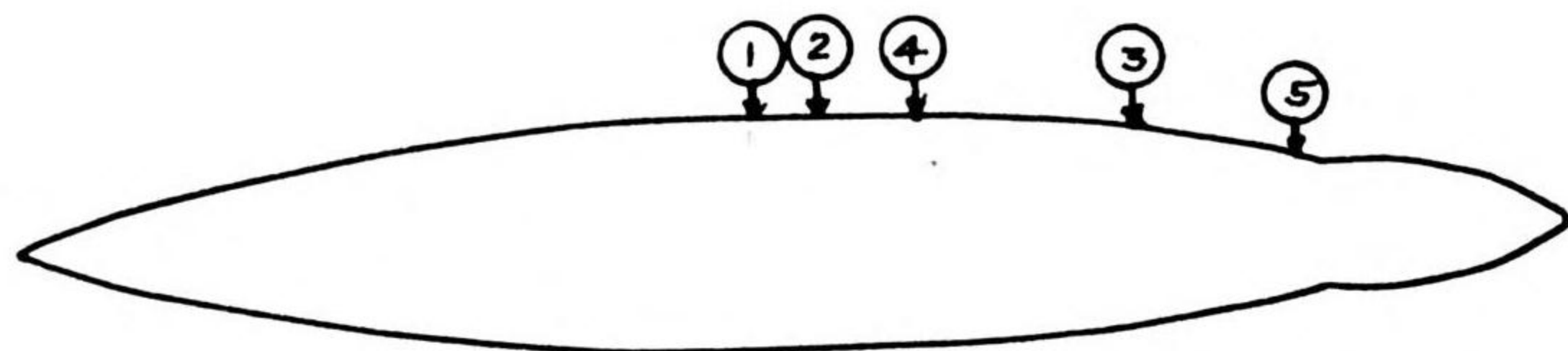
Reference (b) estimates that three hits spaced along one side so as to cause maximum flooding would have a 40 per cent probability of sinking an old U.S. BB if they occurred almost simultaneously. It is likely that the NAGATO would have had considerable better than a 60 per cent chance of survival in the present circumstances primarily because of the appreciable period of time between successive hits and because flooding would be limited inboard of the holding bulkhead by the longitudinal bulkheads. It should be pointed out that there is a probability that the holding bulkhead would not be ruptured because of the depth of the torpedo defense system after modernization. The NAGATO's chance of survival may have been as high as 90 per cent under these circumstances. (Reference (b)).



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On the 26th the NAGATO was hit by two torpedoes set at 18 feet and no bombs. Figure 16 shows the distribution of all the torpedo hits sustained by the NAGATO.

Figure 16.



Hits 1 through 3 were obtained on the 25th and details may be found following figure 15. Hits 4 and 5 were obtained at 0830, on the 26th. It must be assumed that damage control measures had been taken previous to this attack and that the vessel was on an even keel and under control. It took evasive action during the course of the attack on the 26th.

The hits on the 26th would not have seriously endangered the vessel because at most they would have caused flooding of only two compartments outboard of the holding bulkhead in a stable ship. In brief there is little reason to believe that the NAGATO would have been sunk as the result of the attacks launched during this battle.

B. Cruisers

The ten CA's originally present in the Central Fleet fell into four classes as follows:

<u>ATAGO Class</u>	<u>NACHI Class</u>	<u>TONE Class</u>	<u>MOGAMI Class</u>
ATAGO TAKAO MAYA CHOKAI	HAGURO MYOKO	TONE CHIKUMA	KUMANO SUZUYA

In the following discussion the identification of the CA attacked as given in the action reports is accepted. It is realized that many errors of identification occur. However, since no means of checking these identifications is available they must be accepted as the basis for discussion.

A submarine attack at approximately 0600 on 24 October sank the ATAGO and MAYA and damaged the TAKAO sufficiently to cause it to turn back. Thus at the time the air attacks began only one ATAGO Class CA, the CHOKAI, was present. Attacks against this vessel will be discussed below.

1. CA ATAGO Class - CHOKAI

Reference (a) describes this class as follows:

<u>Hull</u>	<u>Armor</u>
Displacement - 12,500 tons Dimensions - 657' x 64' Mean Draft 18' Speed 33K	Deck - 5"* Belt - 4" amidships Watertight integrity - good Damage control - Unknown

\* BuShips believes 2" - 3" more probable, although no direct evidence is available.

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At 1400 on the 24th this vessel was hit with one 1000# AP bomb fuzed .08 sec. delay and two torpedoes set at 10 feet.

If the deck armor is 3" thick the AP bomb, which was dropped in a dive from 2000 feet, would have penetrated it. The CA would have an 88 per cent chance of surviving such a hit. If the armor were 5", most unlikely, penetration would not have occurred and there would be no appreciable probability of sinking.

Both torpedoes hit the CHOKAI at unspecified points on the starboard side. If they were widely spaced the CHOKAI had a 60 per cent chance of surviving them. If they were close together and amidships the structural damage would be such as to cause sinking almost certainly.

The CHOKAI was not hit again until the morning of the 25th when between 0845 and 0910 it was hit with four more torpedoes as follows:

<u>Time</u>	<u>Depth Setting in Feet</u>	<u>Location of Hit</u>
0845	15	Near stern on port side
0850	Unreported	Near stern, side not reported
0910	Unreported	Near stern on port side
0910	Unreported	Amidships on port side

After the last two torpedoes hit, the ship was dead in the water. The report states it was seen to sink sometime later in the same position. There is every reason to believe that a heavy cruiser would sink rapidly after receiving six torpedo hits regardless of their distribution.

Nevertheless, subsequent to 0910 the CHOKAI is reported to have sustained the following hits:

<u>Time</u>	<u>No.</u>	<u>Weapon</u>	<u>Fuzing or Depth Setting</u>	<u>Location of Hit</u>
1235	3	500# SAP	.025 sec.	Across stern
1300	7	500# SAP	.01 sec.	Uniformly distributed
1300	1	Torpedo	15'	Starboard near stern
1645	2	H.E. rockets	instant.	Near water line on port bow
1710	1	250# GP	instant.	Port side just forward of bridge

The action report states that CA was seen to stop and then get underway slowly. By this time the cruiser was reported to have sustained at least 4 hits near the stern.

It is clear that either extensive misidentification of the target attacked or over-estimation of hits obtained or both occurred.

2. CA NACHI Class

Reference (a) lists the following characteristics for this class:

<u>Hull</u>	<u>Armor</u>
Displacement 11,500 tons Dimensions 656' x 62' Mean Draft 18' Speed 33K	Deck 5"* Belt 4" amidships Watertight integrity - good Damage control - unknown

\* BuShips believes 2" - 3" more probable, although no direct evidence is available.



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On the 24th two vessels of this class, the HAGURO and the MYOKO, were present. At 1030 one of them was hit amidships on the port side by a torpedo set at 8 feet. A CA has about a 97 per cent chance of surviving one torpedo hit (reference (b)). One of these vessels was hit at unspecified points on the port side by two torpedoes set at 10 feet, at 1400 of the same day. This CA, believed to be the HAGURO, lost speed, retired and subsequently sank on 24 October.

There is no way of determining whether all three torpedoes hit this vessel. There is nothing in its behavior to preclude this possibility. No other attacks were made against these vessels on 24 October.

On 25 and 26 October only one MACHI Class CA, presumably the MYOKO, was present. It was attacked throughout the day on the 25th and once early in the morning of the 26th. It was hit with numerous bombs and some rockets. These hits are listed in the following table.

Time	No. of Hits	Weapon	Fuzing or Depth Setting
0800	2	5" H.E. rockets	unreported
0800	6	100# GP	unreported
0800	2	250# GP	unreported
1325	1	1000# SAP	.025 sec.
1325	2	500# SAP	.025 sec.
1330	1	1000# SAP	.025 sec.
1330	2	250# GP	unreported
1335	2	500# SAP	.025 sec.
1340	1	1000# GP	instant.
1615	1	1000# SAP	.025 sec.
1645	1	500# GP	instant.
1715	2	500# SAP	.01 sec.
1730	1	500# SAP	.01 sec.
1730	1	325# DB	instant.

Only the 1000# SAP bombs had sufficient terminal velocity and delay fuzing to permit possible penetration into the vitals of the vessel, provided the armor deck is not more than 2 1/2 inches thick. Even if it is assumed that all three bombs penetrated the armor deck the vessel had a 60 per cent chance of surviving (reference (b)). Hence, there is little reason to believe that the MYOKO would have sunk by virtue of the hits obtained against her.

### 3. CA MOGAMI Class

Reference (a) lists the following for this class:

Hull	Armor
Displacement 14,000 tons	Deck - 2"
Dimensions 660' x 65'	Belt 2 1/2" amidships (may be heavier)
Mean Draft - 19'	Watertight integrity - good (bulges)
Speed 33K	Damage control - unknown

Two vessels of this class, the KUMANO and SUZUYA, were in the Central Japanese Fleet on 24 and 25 October. One of them was hit with thirteen 5" H.E. rockets at 1515 on 24 October. No other hits were reported against either of the MOGAMI Class cruisers on the 24th.

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On the 25th the MOGAMI Class CA's were hit with the following bombs and torpedoes:

Time	No. of Hits	Weapon	Fuzing or Depth Setting
0715	1	500# SAP	instant.
0745	5	100# GP	instant.
0800	1	torpedo	12'
0815	1	500# SAP	.01 sec.
0900	2	100# GP	instant.
0905	9	500# SAP	.025 sec. (The vessel hit sank)
1240	3	500# SAP	.025 sec.
1610	1	500# GP	.01 sec.
1645	2	500# GP	instant.
1730	2	torpedoes	unreported

The nine SAP bombs which struck at 0905 were reported to have hit as follows: five amidships on the stack, one on the stern and three on the bow. The Air Group Commander reported that he "-- observed the CA to go about 500 yards, blow up and sink within five minutes." It is clear that some of the bombs must have penetrated a magazine. Unfortunately the altitude and angle of glide at release were not reported. However, if the TBM's which made the attack, released in a 45° glide at 300K, the altitude of release must have been at least 4000 feet for the bombs to have attained sufficient vertical terminal velocity to permit penetration into the vitals of the vessel. It is worth noting that this altitude of release is considerably greater than that reported in any of the action reports.

Intelligence reports show that it was SUZUYA that sank. It is not known if SUZUYA is the vessel which was struck with a torpedo at 0800.

All the hits occurring after 0905 must have been scored against KUMANO. None of the bombs were dropped from sufficient altitude to permit penetration into the vitals of the vessel. The point of impact of the two torpedoes which hit KUMANO at 1730 was not reported. A CA has a 60 per cent probability of surviving two torpedo hits if they are not adjacent and if the damage control is effective.

At 0830 on 26 October KUMANO was reported hit with seven 1000# bombs (type not reported) and two torpedoes. She was reported to have been travelling 25K at the time of this attack. This makes it appear highly unlikely that KUMANO was hit by two torpedoes at 1730 on 24 October. It is even more unlikely that she could have sustained the hits claimed above and survived as she is reported to have done. There can be little doubt that errors of considerable magnitude were made in reporting the hits obtained against KUMANO.

### 4. CA TONE Class

Reference (a) describes this class as follows:

Hull	Armor
Displacement 14,500 tons	2 1/2" belt amidships
Dimensions 658' x 65'	2" deck
Mean Draft 18'	Watertight integrity - good
Speed 33K	Damage control - unknown

Two vessels of this class, the TONE and the CHIKUMA, were present during the air attacks of 24 and 25 October.



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The hits claimed against them are listed below:

Approx. time	No.	24 October	
		Weapon	Fuzing or Depth Setting
1315	2	500# GP	instant.
1530	1	torpedo	12'
25 October			
0800	3	100# GP	instant.
0800	8	5" H.E. rockets	instant.
0815	2	500# SAP	.01 sec.
0845	2	torpedoes	10'
0850	1	torpedo	unreported
0900	1	torpedo	15'
1100	3	torpedoes	12'
1340	1	1000# GP	instant.
1415	3	torpedoes	15'

As in all the previous attacks against Heavy Cruisers the bombs would not be expected to cause damage which would lead to sinking. An analysis of the distribution of the torpedo hits between the two cruisers follows.

At 1530 on the 24th one of the cruisers was hit at an undetermined point by a torpedo set at 12 feet. This hit would not have been likely to cause it any serious difficulties. Neither of the vessels was hit again by torpedoes until 0845 the next morning. At that time two torpedoes set at 10 feet hit a cruiser of this class and are reported to have blown off a sizable section of the after part of the stern. This vessel could have remained afloat after these two hits (reference (b)) but would have been stationary thereafter. It is not known if this vessel was the one previously hit. Even if it were, it had an appreciable chance of surviving. At 0850 a TONE Class CA which was underway and turning to starboard was hit by a torpedo on the port side forward of amidships. Because this vessel was under way it could not have been the one hit at 0845. The situation at this time was therefore as follows:

Vessel 1

At least 2 hits aft - Dead in Water

The fourth torpedo may have hit either vessel.

At 0900 a TONE CA which was underway was hit near the fantail with a torpedo set at 15 feet. The cruiser was seen dead in the water later in the day. This vessel must have been the one listed as number 2 above.

At 1100 one of these CA's was hit amidships with 3 torpedoes and according to the reports did not sink. There can be no doubt that there is exaggeration in the reports with regard to the number of hits claimed. Neither of these vessels could have survived three more torpedo hits.

At 1415 one of these cruisers was hit on the port side forward of amidships by three torpedoes set at 15 feet. It was seen to sink in 15 minutes. The result of the attacks is therefore, one TONE sunk, the other severely damaged and dead in the water. However, if the vessel were hit with as many torpedoes as claimed it is certain that both would have sunk.

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5. CL AGANO Class

Reference (a) lists the following characteristics for vessels of this class:

Hull	Armor
Displacement 6,000 tons Dimensions 550' x 49' 6" Draft - unknown Speed - 30K	Nothing is known; however, it is assumed that the armor deck is 2" STS (reference (d)).

Two vessels of this class, the NOSHIRO and the YAHAGI were with the Central Fleet. It is not possible on the basis of available information to establish what portion of the hits recorded below were scored against a given vessel. They will therefore, be considered together.

They are reported to have been hit with the following bombs, torpedoes and rockets:

Time	No. of Hits	25 October	
		Weapon	Fuze or Depth Setting
1355	2	500# GP	instant.
1415	2	500# SAP	.025 sec.
1500	2	500# SAP	.025 sec.
1615	1	1000# SAP	.025 sec.
26 October			
0730	4	5" H.E. rockets	instant.
0840	1	500# GP	instant.
0850	3	torpedoes	10'
1035	1	torpedo	unreported
1050	1	torpedo	8'

The only bombs which may have penetrated into the vitals of these vessels on 25 October were two 500# SAP bombs, dropped at 1500, in a 50 degree glide from 2800 feet, and the 1000# SAP dropped in a dive. All the bombs hit the fantail and therefore could not have hit a magazine. Consequently, they could not have done damage leading to sinking (reference (b)).

The first three hits scored on the 26th were distributed on the starboard side of one of these vessels, probably the NOSHIRO, as follows: two very close together and nearly amidships, the third on the quarter. This distribution of hits would certainly have caused the vessel to sink rapidly. Since it did not do so, it appears likely that no more than two hits were obtained-one amidships the other on the quarter. The next hit (1035) was scored on an AGANO Class cruiser which was reported to be underway at 5K. This vessel must have been the same one previously hit, that is the NOSHIRO. The torpedo which hit at 1035, hit on the starboard side in line with the second forward turret. The vessel almost immediately began to list heavily and settle on the starboard bow. Flames were seen issuing from the starboard side. This vessel sank at approximately 1100.

The last torpedo hit was reported to have been made at 1050 against a vessel turning to port. This probably was not the vessel previously hit because the report does not in any way indicate that the vessel attacked was previously damaged. It is probable that the vessel attacked at 1050 was the YAHAGI. A CL would not be likely to sink as the result of a single torpedo hit. The YAHAGI is known not to have sunk.



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12. Damage to the Southern Force.

The Southern Japanese Force was composed of 2 BB's, 1 XCVS-CA, 2 CA's, 1 CL, and 10 DD's.

The air attacks against this force represent only a minor portion of the total weight of attack which it sustained. It is particularly difficult in the present instance to estimate the probability of any individual ship's sinking as a result of the bombing attacks, because all the ships hit by bombs were hit by shells as well. More for the sake of completeness than for any contribution which the data may make to the entire picture an analysis of the data will be made.

A. BB's

1. FUSO Class

Reference (a) describes these vessels as follows:

<u>Hull</u>	<u>Armor</u>
Displacement 30,000 tons Dimensions 673' x 94' Mean Draft 28' 6" Speed 22.5K	Belt - 12" - 8" amidships, 5" - 4" ends Decks - 7" - 4 1/2" Watertight integrity - very good (bulges) Damage control - good

Both members of this class, FUSO and YAMASHIRO, were with the Southern Force and both were sunk. According to the action reports they were hit by air attack as follows:

<u>Time</u>	<u>No. of Hits</u>	<u>Weapon</u>	<u>24 October</u>		<u>Vessel No.</u>
			<u>Fuzing or Depth Setting</u>		
0855	4	H.E. rockets	instant.		1
0855	4	H.E. rockets	instant.		2
0855	4	250# GP	.025 sec.		1
0855	6	250# GP	.025 sec.		2
<u>25 October</u>					
0845	8	100# GP	instant.)	(All on same vessel)	
0845	1	250# GP	instant.)		
0845	2	500# GP	instant.)		
0850	4	torpedoes	10 feet		

It is obvious that the air attacks of 24 October could not have done any serious damage to these BB's. Subsequent to these attacks and prior to the reported air attacks of 25 October the U.S. Surface Units attacked the Japanese Southern Force and inflicted heavy damage. POW information available at this time indicates that both these BB's sank as a result of this attack, at approximately 0400 and in a position well to the north of the position where the air attack of 25 October is reported to have occurred.

If this POW report proves to be reliable it is clear that the air attack of 25 October could not have been made against these BB's. If, on the other hand, the report should prove false the attacks of 25 October might very well have occurred against these vessels.

The four torpedoes which were reported to have hit a FUSO Class BB all hit on the port side. The vessel was observed to stop dead in the water. Four torpedo hits occurring almost simultaneously, as these did, have a 90 per cent probability of capsizing an old BB. Hence the air attack may have been primarily responsible for sinking one of these BB's.

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B. Cruisers

Neither of the CA's was hit by aerial attack. The following discussion concerns itself therefore with the XCVS-CA, the MOGAMI, and the CL, ABUKUMA.

1. XCVS-CA MOGAMI.

Reference (a) describes this class as follows:

<u>Hull</u>	<u>Armor</u>
Displacement 14,000 tons Dimensions 660' x 65' Mean Draft 19' Speed 33K	Belt 2 1/2" amidships Deck 2" - 1 1/2" Watertight integrity - good (bulges) Damage control - unknown

The MOGAMI was hit by air attack as follows:

<u>Time</u>	<u>No. of Hits</u>	<u>Weapon</u>	<u>24 October</u>	
			<u>Fuzing</u>	
0855	4	5" rockets	instant.	
<u>25 October</u>				
0830	5	500# SAP	.025	

The MOGAMI was reported by a POW to have sunk. The sinking was clearly not due to the bomb damage it is reported to have received on 25 October.

2. CL - NATORI - Class - ABUKUMA.

Reference (a) describes this class as follows:

<u>Hull</u>	<u>Armor</u>
Displacement 5,170 tons Dimensions 535' x 47'3" Mean Draft 15' 11" Speed 33K	Belt 2" - 15" (amidships) Deck-unknown, assumed 1 1/4 inches Watertight integrity - good Damage control - unknown

The ABUKUMA was hit by air attack on 26 October only. The reported hits are listed

below:

<u>Time</u>	<u>No. of Hits</u>	<u>Weapons</u>	<u>Fuzing or Depth Setting</u>
1015	2	100# GP	instant.
1020	7	500# GP	.01 sec.
1030	1	torpedo	10 feet
1030	1	500# GP	instant.
1100	2	500# GP	.025 sec.
1100	1	500# SAP	.025 sec.
1100	3	5" rockets	instant.
1130	1	500# GP	.01 sec.

The seven 500# GP bombs which struck the ABUKUMA at 1020 traveled only 5 feet after impact before exploding. The damage done by them would not, therefore, have been of a type likely to lead to sinking.

The 500# SAP and GP bombs which struck at 1100 were fuzed .025 sec. delay. They would have had sufficient vertical terminal velocity to permit 13 feet of vertical travel between



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impact and detonation. This is sufficient to penetrate well below the armor deck into the vitals of the vessel. The SAP bomb hit amidships "abaft the bridge." The GP bombs hit "just abaft amidships." Because of the relatively small explosive charge in these bombs the danger to the vessel in terms of sinking arises almost entirely from the chance of hitting the magazine. From the description of the locations of the hits it is probable that none of these bombs hit in way of the magazines. It is more probable that they hit in way of the engines, crippling the vessel. The action report stated that "when last seen the ship was turning in a tight circle at about 5K".

13. Accuracy of Reporting.

1. Identification of vessel attacked.

There were many instances in which it could be definitely established that there was gross misidentification of the vessel attacked. This was found by reference to photographs. There were many instances, however, in which no check on the pilot's identification could be made. Because accurate identification of the target attacked is essential to any study involving bombing accuracy and damage, it is suggested that more complete photographic coverage of Naval Air attacks be obtained.

2. Accuracy Obtained.

In several instances it was evident that the number of hits claimed was in excess of that obtained. This was true for example in the case of ZUIKAKU and ZUIHO. There were several other instances, ISE and HYUGA, for example, in which it was possible to reconcile the claimed number of hits with the fact that the vessel survived only by assuming in every instance that the distribution of torpedo hits was most unfortunate and that the Japanese damage control was always thoroughly efficient - never having been disrupted by bombing or strafing.

The alternative to the assumption of exaggerated claims of hitting is gross malfunctioning of ordnance. This seems unlikely in view of the fact that ordnance appears to function satisfactorily in small scale attacks in which there is less likelihood of duplicate claims of a hit.

Reliable information concerning accuracy is essential for several different problems. Among these are (a) the determination of the relative effectiveness of various weapons in sinking vessels, (b) the evaluation of the efficiency of various tactics and (c) the estimation of force requirements. The only completely reliable source for such information is a photographic record of the attack.

14. Weapons Selection.

1. Against Battleships.

A discussion of the bombs, fuzes and torpedo depth settings selected for use in attacks on the various vessels in the Japanese Fleet is presented in Section II. It was pointed out there that the 1000# AP bomb when dropped below 4000 feet, will not penetrate the armor deck of a BB and that its use is not essential for penetration of the armor of a CV or CA. Furthermore it is clear that no bomb, with the possible exception of the 1600# AP, presently in use is capable of penetrating the armor deck of a BB when dropped below 4000 feet. The 1600# AP, if dropped in a 70° dive at 300K from 4000', will penetrate approximately 4 1/2 inches of STS. It is possible that armor decks of old Japanese BB's total less than 4 1/2 inches of STS.

It appears unlikely, in the light of the above discussion, that Naval bombing can succeed in penetrating to the vitals of a BB. There remains, then, to consider the damage which can be done above the armor deck.

The armor above the armor deck is usually 1 1/2" of STS. The 1000# GP, 2000# GP, and 1000# SAP bombs can penetrate this armor when dropped at 300K in a glide or dive from as low as 1000 feet. It is doubtful that the 500# GP bomb can and certain that the 250# GP bomb cannot penetrate 1 1/2" of STS.

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The approximate weight of explosive carried by each of the bombs which can penetrate the first deck is as follows:

1000# AP	150 lbs.
1000# SAP	300 lbs.
1000# GP	550 lbs.
2000# GP	1100 lbs.

The damage is roughly proportional to the weight of explosive. Therefore, the 2000# GP, the 1000# GP and the 1000# SAP are to be preferred, in that order, to the 1000# AP for attacks on BB's. This conclusion is in agreement with FTP 224.

It is of interest to compare the weight of explosive actually delivered on the Japanese BB's by 1000# AP bombs in the Battle for Leyte Gulf with that which would have been delivered had the same weight of 1000# SAP, or 1000 or 2000# GP bombs been used. Such a comparison is made below.

No.	1000# AP bomb hits Weight of Explosive	Weight of Explosive in same weight of 1000# SAP bombs / 1000 or 2000# GP bombs	
		9600 lbs.	17,600 lbs. 35,200 lbs.
32	4800 lbs.		

It has already been shown in Section II that the torpedo depth settings used against BB's were too shallow in at least 60% of the cases and that in no case was an optimum depth setting used. This served to reduce the effectiveness of the torpedoes. Another and perhaps more important factor was the considerable time interval between successive hits, and the unfortunate distribution of the hits about the hull of the BB's. The most feasible method of sinking a battleship is to cause it to capsize or plunge. Capsizing may be caused by obtaining at least 5 hits, essentially simultaneously, on one side of the vessel (reference (b)). Plunging may be caused by flooding either the entire bow and at least one main compartment close astern of the bow, or by flooding the stern and one main compartment just forward of the stern (BuShips). To cause plunging, therefore, it is necessary to secure many hits essentially simultaneously, all concentrated well forward of amidships or well astern of amidships.

It may not be feasible to design torpedo attack tactics which would ensure a proper distribution of hits to cause plunging. It does, however, appear feasible to design tactics which would ensure the scoring of hits on one side rather than on both sides of a BB during a given strike. The potential value of such tactics is well illustrated by considering that ISE would almost certainly have sunk if the 5 torpedoes which were reported to have struck her during the first strike had all hit on one side, rather than 2 on one and 3 on the other.

2. Against CV's and CVL's.

The 1000# SAP is capable of penetrating the armor of CV's and CVL's when dropped in the usual Naval bombing attack. It is probable that the 2000# GP is not. In the Battle for Leyte Gulf the Japanese aircraft carriers were struck with thirty-three 1000# SAP bombs. Although all, or very nearly all, of these bombs had sufficient terminal velocity to penetrate the armor of the carriers, none of them penetrated to the vitals of the vessels. This is so because the bombs were fuzed .025 sec. delay instead of the more desirable .1 sec. delay.

The following table illustrates the effect of fuzing upon depth of penetration. It is assumed that the bombs are released in a 70° dive at 300K.

Fuze	Approximate vertical distance traveled between impact and detonation. Altitude of Release		
	2000'	3000'	4000'
.025	15'	16'	17'
.08	47'	52'	55'
.1	59'	64'	69'



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It requires approximately 55' of vertical travel to reach the upper portions of the vitals of a CV and approximately 45' for a CVL.

The 1000# AP bomb which can be fuze .08 sec. delay only, appears to be undesirable for attacks against aircraft carriers. There are two reasons for this:

- (a) it carries a relatively small charge of explosive;
- (b) it may, as shown by the table, explode before penetrating into the vitals of the vessel.

The torpedo protection system of CV's is similar to that of BB's. For this reason it is desirable that torpedo tactics against CV's be the same as those against BB's, i.e., the tactics should be such as to score 5 or more hits on one side during a single attack. If the torpedo hits reported to have been made against ZUIKAKU during the first strike had been all on one side, rather than two on one side and three on the other, there is no doubt that she would have sunk before the second strike.

The distribution of the torpedo hits on CVL's is not as important as on CV's and BB's. Three or four hits wherever they occur (reference (b)) are almost certain to sink a CVL.

3. Against Cruisers.

Because of the light armor of these vessels (2 to 2 1/2 inches) it is unnecessary to use 1000# AP bombs against them. The more heavily charged 1000# SAP bomb, dropped in a 70° dive at 3000 and 2000', will have sufficient terminal velocity to penetrate the armor of a CA. If fuze .1 sec. delay the bomb will explode deep in the vessel even if the fuze is initiated by the superstructure. It is probable that a .05 sec. delay fuze would be more desirable than a .1 sec. delay fuze for attacks against CA's and CL's. However, because no such fuze exists the .1 sec. delay fuze appears to be the most desirable one.

The torpedo protection system of cruisers is such that three or four hits, regardless of location are almost certain to sink them.

4. General.

It has been shown above that the 1000# AP bomb appears to be not a suitable weapon for Naval air attack against any warship. It is not desirable as a weapon against merchant vessels. FTP 224 (reference (d)) does not recommend its use against any land targets. In view of the above, the question as to whether it is advisable for U.S. aircraft carriers to carry any 1000# AP bombs merits consideration.

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SECTION IV - STATISTICAL SUMMARY OF AIR EFFORT

SORTIES FLOWN  
BATTLE FOR LEYTE GULF

	Strikes Against Jap Forces	Search	Fighter Sweep	Defensive Over Task Force			Support Leyte Operations	Abor- tive	Total
				Engag- ing Enemy	Not Engag- ing Enemy	ASP			
<b>24 Oct. 1944</b>									
Task Force 38	259	170	18	116	177	64	-	19	823
Total VF	102	94	18	116	177	1	-	9	517
Total VB	84	72	-	-	-	4	-	5	165
Total VT	73	4	-	-	-	59	-	5	141
Task Group 77.4	-	-	-	1	96	50	309	3	459
Total VF	-	-	-	1	96	-	225	1	323
Total VT	-	-	-	-	-	50	84	2	136
<b>25 Oct. 1944</b>									
Task Force 38	674	86	-	6	294	59	-	33	1,152
Total VF	267	55	-	6	294	4	-	13	639
Total VB	226	13	-	-	-	18	-	7	264
Total VT	181	18	-	-	-	37	-	13	249
Task Group 77.4	441	6	-	27	120	16	102	21	733
Total VF	209	-	-	27	120	-	86	6	448
Total VT	232	6	-	-	-	16	16	15	285
<b>26 Oct. 1944</b>									
Task Force 38	257	61	19	2	235	63	-	17	654
Total VF	109	33	19	2	235	4	-	9	411
Total VB	72	14	-	-	-	8	-	2	96
Total VT	76	14	-	-	-	51	-	6	147
Task Force 77.4	55	49	-	9	106	37	91	1	348
Total VF	33	20	-	9	106	-	62	-	230
Total VT	22	29	-	-	-	37	29	1	118
<b>24-26 Oct. 1944</b>									
Task Force 38	1,190	317	37	124	706	186	-	69	2,629
Task Group 77.4	496	55	-	37	-	103	502	25	1,540
Total	1,686	372	37	161	706	289	502	94	4,169

NOTE: "Support Leyte Operations" includes Target Combat Air Patrols and Target Anti-Sub Patrols.

SORTIES FLOWN IN STRIKES AGAINST JAP FORCES

BATTLE FOR LEYTE GULF

24-26 October, 1944  
(East Longitude Time)

	Southern Force			Central Force			Northern Force			Total		
	October* 24	25	26	24	25	26	24	25	26	24	25	26
Task Force 38	-	-	-	259	147	257	-	527	-	259	674	257
Total VF	-	-	-	102	66	109	-	201	-	102	267	109
Total VB	-	-	-	84	51	72	-	175	-	84	226	72
Total VT	-	-	-	73	30	76	-	151	-	73	181	76
Task Force 77.4	-	41	55	-	400	-	-	-	-	-	441	55
Total VF	-	19	33	-	190	-	-	-	-	-	209	33
Total VT	-	22	22	-	210	-	-	-	-	-	232	22
Sub Total	-	41	55	259	547	257	-	527	-	259	1,115	312
GRAND TOTAL	-	96	-	-	1,063	-	-	527	-	-	1,686	-

\* The enemy Southern Force was taken under observation and attacked by search planes on the morning of the 24th. Search Plane Sorties have not been included in the "Strike Sortie" tabulation above.



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NUMBER OF BOMBS EXPENDED  
BATTLE FOR LEYTE GULF

24-26 October, 1944  
(East Longitude Time)

	TASK FORCE 38								All Others							
	Strikes Against Jap Forces								GP SAP					Depth Bomb		
	GP		SAP		AP		Torp.	Rock.	500	1000	500	1000	Rock.			
Total VF	-	-	86	-	-	55			15	8	-	368	34	-	-	-
Total VB	94	64	-	50	-	29	165	175	-	-	-	5	70	13	-	-
Total VT	-	-	57	7	18	127	10	12	205	-	-	-	-	-	-	1
TOTAL	94	64	143	57	18	211	190	195	205	368	34	5	70	13	80	4

	TASK GROUP 77.4						All Others					
	Strikes Against Jap Forces						GP SAP					Depth Bomb
	GP		SAP		Torp.		500	1000	500	1000	Rockets	
Total VF	-	24	1	22	-	-	110	4	89	1	115	
Total VB	121	9	168	207	89	289	110	4	89	1	115	
TOTAL	121	33	169	229	89	289						

TONNAGE OF BOMBS EXPENDED  
IN STRIKES AGAINST JAP FORCES  
BATTLE FOR LEYTE GULF

24-26 October, 1944  
(East Longitude Time)

	Task Force 38	Task Group 77.4	Total
100# GP	4.7	6.1	10.8
250# GP	8.0	4.1	12.1
500# GP	35.8	42.2	78.0
1000# GP	28.5	-	28.5
2000# GP	18.0	-	18.0
Total GP	95.0	52.4	147.4
500# SAP	52.7	57.3	110.0
1000# SAP	95.0	-	95.0
Total SAP	147.7	57.3	205.0
1000# AP	97.5	-	97.5
350# Depth Bomb	-	3.0	3.0
TOTAL TONNAGE BOMBS EXPENDED	340.2	112.7	452.9
Torpedoes (number)	205	89	294
Rockets (number)	368	289	659

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AIRBORNE ENEMY AIRCRAFT ENGAGED AND DESTROYED  
BATTLE FOR LEYTE GULF

24-26 October, 1944  
(East Longitude Time)

	Enemy A/C Engaged and Destroyed by USN A/C			
	Enemy A/C Engaged		Enemy A/C Destroyed	
	VB	VF	VB	VF
24 Oct. 1944				
Task Force 38	121	210	70	109
Task Group 77.4	120	58	52	25
Total	241	268	122	134
25 Oct. 1944				
Task Force 38	4	44	4	15
Task Group 77.4	38	92	14	42
Total	42	136	18	57
26 Oct. 1944				
Task Force 38	3	15	3	13
Task Group 77.4	11	34	6	23
Total	14	49	9	36
24-26 Oct. 1944				
Task Force 38	128	269	77	137
Task Group 77.4	169	184	72	90
Total	297	453	149	227
24-26 Oct. 1944				
Task Force 38	120	247	71	132
VF	7	9	6	3
VB	1	13	-	2
VT	-	-	-	-
Task Group 77.4	169	167	72	86
VF	-	17	-	4
VT	-	-	-	-
Total 38, 77.4	289	414	143	218
VF	7	9	6	3
VB	1	30	-	6
VT	-	-	-	-
Total by Plane Type	297	453	149	227
Sub Total	750		376	
Enemy Aircraft Destroyed by Ships AA	-		14	
Enemy Aircraft Self-Destroyed in Suicide Attacks	-		7	
GRAND TOTAL	-		397	



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OWN PLANE LOSSES  
BATTLE FOR LEYTE GULF

24-26 October, 1944  
(East Longitude Time)

	Total	Losses in Strikes Against Jap Fleet				Losses in Other Action Sorties				On Other Flights	Not in Flight	
		Total A/A	A/C	Op.		Total A/A	A/C	Op.			Own Action	Enemy Action
24 Oct. 1944												
Task Force 38	54	20	17	1	2	10	2	7	1	-	-	24
Task Group 77.4	7	-	-	-	-	6	-	1	5	1	-	-
Total	61	20	17	1	2	16	2	8	6	1	-	24
25 Oct. 1944												
Task Force 38	44	39	24	4	11	3	-	-	3	2	-	-
Task Group 77.4	74	48	24	-	24	14	2	5	7	4	2	6
Total	118	87	48	4	35	17	2	5	10	6	2	6
26 Oct. 1944												
Task Force 38	22	18	9	1	8	3	1	-	2	1	-	-
Task Group 77.4	24	5	4	-	1	5	-	1	4	2	2	10
Total	46	23	13	1	9	8	1	1	6	3	2	10
24-26 Oct. 1944												
Task Force 38	120	77	50	6	21	16	3	7	6	3	-	24
Task Group 77.4	105	53	28	-	25	25	2	7	16	7	4	15
Total	225	130	78	6	46	41	5	14	22	10	4	40
24-26 Oct. 1944												
Task Force 38	44	14	7	4	3	11	1	7	3	3	-	16
VF	37	33	18	2	13	4	2	-	2	-	-	-
VB	39	30	25	-	5	1	-	-	1	-	-	8
VT												
Task Group 77.4	64	27	11	-	16	24	2	7	15	3	3	7
VF	41	26	17	-	9	1	-	-	1	4	1	9
VT												
Total 38, 77.4	108	41	18	4	19	35	3	14	18	6	3	23
VF	37	33	18	2	13	4	2	-	2	-	-	-
VB	80	66	42	-	14	2	-	-	2	4	1	17
VT												
Total	225	130	78	6	46	41	5	14	22	10	4	40

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OWN AIRCRAFT LOST OR DAMAGED IN FLIGHT BY CAUSE  
BATTLE FOR LEYTE GULF

24-26 October, 1944  
(East Longitude Time)

	Sorties Encoun- tering Enemy A/A	Sorties Engag- ing Enemy A/C	* Aircraft in Flight							
			Damaged				Lost			
			A/A	A/C	Op.	Tot.	A/A	A/C	Op.	Tot.
Task Force 38	1320	216	91	23	2	116	53	13	30	96
Total VF F6F	558	191	10	22	-	32	8	11	9	28
Total VB SB2C	439	12	33	-	-	33	20	2	15	37
Total VT TBF/TBM	323	13	48	1	2	51	25	-	6	31
38.1	354	44	17	2	1	20	13	1	17	31
VF F6F	163	35	2	1	-	3	3	1	5	9
VB SB2C	101	4	7	-	-	7	7	-	9	16
VT TBF/TBM	90	5	8	1	1	10	3	-	3	6
38.2	186	17	17	1	-	18	14	1	8	23
VF F6F	74	16	2	1	-	3	1	-	2	3
VB SB2C	66	-	7	-	-	7	6	1	4	11
VT TBM	46	1	8	-	-	8	7	-	2	9
38.3	414	138	35	20	1	56	15	9	2	26
VF F6F	164	126	5	20	-	25	1	8	-	9
VB SB2C	152	8	9	-	-	9	4	1	1	6
VT TBF/TBM	98	4	21	-	1	22	10	-	1	11
38.4	366	17	22	-	-	22	11	2	3	16
VF F6F	157	14	1	-	-	1	3	2	2	7
VB SB2C	120	-	10	-	-	10	3	-	1	4
VT TBM	89	3	11	-	-	11	5	-	-	5
Task Group 77.4	520	219	35	13	16	64	30	7	48	85
Total VF F6F	38	41	-	1	-	1	5	1	8	14
FM	216	156	5	7	13	25	8	6	26	40
Total VT TBF/TBM	266	22	30	5	3	38	17	-	14	31
77.4.1	92	76	3	1	1	5	7	1	18	26
VF F6F	38	41	-	1	-	1	5	1	8	14
FM	20	30	1	-	-	1	1	-	2	3
VT TBF/TBM	34	5	2	-	1	3	1	-	8	9
77.4.2	279	87	18	9	10	37	12	4	16	32
VF FM	120	71	3	5	10	18	4	4	13	21
VT TBM	159	16	15	4	-	19	8	-	3	11
77.4.3	149	56	14	3	5	22	11	2	14	27
VF FM	76	55	1	2	3	6	3	2	11	16
VT TBM	73	1	13	1	2	16	8	-	3	11
Task Force 38	1320	216	91	23	2	116	53	13	30	96
Task Group 77.4	520	219	35	13	16	64	30	7	48	85
Total	1840	435	126	36	18	180	83	20	78	181

\* 44 Additional aircraft were lost while not in flight of which 40 were the result of enemy action, 4 the result of own action.



PILOT AND AIRCREWMEN CASUALTIES  
BATTLE FOR LEYTE GULF

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24-26 October, 1944  
(East Longitude Time)

	Personnel Aboard				Personnel Aboard				Personnel Aboard				Total Casualties			
	A/C Lost Due to Enemy A/A				A/C Lost Due to Enemy A/C				A/C Lost Operationally				Mis- Wound- Survived			
	Dead	Mis- Wound- Sing ed	Survived	Unwounded	Dead	Mis- Wound- Sing ed	Survived	Unwounded	Dead	Mis- Wound- Sing ed	Survived	Unwounded	Dead	Mis- Wound- Sing ed	Survived	
Task Force 38	7	71	2	35	-	4	5	4	2	4	1	38	9	79	8	77
F6F Pilots	2	5	-	1	-	4	3	4	-	-	-	4	2	9	3	9
SB2C Pilots	1	9	-	9	-	-	1	-	1	-	1	11	2	9	2	20
SB2C Aircrewmn	1	10	-	8	-	-	1	-	1	-	-	11	2	11	1	19
TBF/TBM Pilots	1	15	1	6	-	-	-	-	-	2	-	4	2	16	1	10
TBF/TBM Aircrewmn	2	32	1	11	-	-	-	-	-	-	-	8	2	34	1	19
Task Group 77.4	3	26	3	26	1	1	-	5	4	8	6	50	8	35	9	81
FM Pilots	-	3	-	5	1	1	-	4	3	1	2	20	4	5	2	29
F6F Pilots	-	2	1	2	-	-	-	1	-	-	-	8	-	2	1	11
TBF/TBM Pilots	1	7	1	6	-	-	-	-	-	3	2	7	1	10	3	13
TBF/TBM Aircrewmn	2	14	1	13	-	-	-	-	1	4	2	15	3	18	3	28
<u>Total 38, 77.4</u>	-	3	-	5	1	1	-	4	3	1	2	20	4	5	2	29
FM Pilots	-	7	1	3	-	4	3	5	-	-	-	12	2	11	4	20
F6F Pilots	2	9	-	9	-	-	1	-	1	-	1	11	2	9	2	20
SB2C Pilots	1	10	-	8	-	-	1	-	1	1	2	11	2	11	1	19
SB2C Aircrewmn	1	22	2	12	-	-	-	-	-	4	2	11	2	26	4	23
TBF/TBM Pilots	2	46	2	24	-	-	-	-	1	6	2	23	5	52	4	47
TBF/TBM Aircrewmn	4	46	2	24	-	-	-	-	-	-	-	54	10	51	12	92
Total Pilots	5	41	3	29	1	5	4	9	4	5	5	34	7	63	5	66
Total Aircrewmn	5	56	2	32	-	-	1	-	2	7	2	34	7	63	5	66

NOTE: Above does not include personnel aboard 5 F6F, 4 SB2C, 8 TBM lost but condition of personnel is unknown.

NOTE: Above does not include 6 pilots, 12 aircrewmn wounded aboard planes not lost.

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