ESCORT CARRIERS

GUNFIRE, BOMB AND KAMIKAZE

DAMAGE AND LOSSES

DURING WORLD WAR II

31 JULY 1948

APPROVED

C. L. BRAND
Rear Admiral, USN
Ass't. Chief of Bureau for Ships

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CONTENTS

CONTENTS (CONT.)

TABLE

PHOTOGRAPHS

Appropriate views of damage and repairs are included in Sections III, IV, V and VI.

PLATES

At the end of Sections III IV, V, and VI, plates are included to show the damage. These plates were prepared by this Bureau and usually were based on drawings forwarded by the ship or the repair activities.

SECTION I

FOREWORD

1-1. During the war against Japan the spectacular exploits of our fast carrier task forces tended to detract attention from the important part played in other phases of the conflict by our escort carriers. The CVE, like the LST and the DE, constituted a new ship type designed primarily to perform a particular function, and the exigencies of war made it necessary to dispense with many desirable features common to standard combatant types. To meet urgent strategic commitments, mass production, one of the greatest advantages possessed by this country, immediately was utilized. The period for developing the design was not only reduced to a minimum, but simplicity of construction, including the use of standard commercial materials, became a more important design consideration than resistance to damage, speed, maneuverability, or efficiency of the hull and engineering plant. However, the performance of the escort carriers was so creditable that there has been a tendency to overlook several of the basic handicaps under which these ships operated.

1-2. The primary deficiencies of the wartime escort carriers, as compared to the CVL's, were their low speed, short flight deck and lower damage resistance due to less adequate compartmentation and less extensive duplication of systems and equipment. These disadvantages did not prevent CVE's from successfully providing local air support for amphibious operations nor did they seriously lessen their effectiveness in conducting an agressive anti-submarine war. In addition to these two combat functions, CVE's performed highly essential logistic services by transporting a steady flow of aviation materiel to the forward area, provided air cover for hazardous convoys and served as training craft for new air groups.

1-3. Prior to the construction of the CVE55 Class, all the escort carriers were merchant ship conversions. About 45 of these were built on the C-3 hull designed originally by the Maritime Commission as a large, single screw, fast, cargo type. Of these 45 carriers, all but 12 were transferred to the United Kingdom. Four others, CVE26-29, were converted from 19 knot, twin screw, "National Defense" tankers of the CIMARRON Class. The first group of vessels built from the keel up specifically as escort carriers was the CVE55 Class, numbering 50 ships. The latter were designed for the Navy by the Maritime Commission and were built by the Kaiser Shipbuilding Company. Before the end of the war, several vessels of the COMMENCEMENT BAY (CVE105) Class were commissioned.

The design of CVE105 to 123 was adapted from that of the CVE26-29 Class, using the conventional type tanker hull with longitudinal framing and two main longitudinal bulkheads. Since only a few ships of this Class saw service prior to the end of hostilities, none received any battle damage.

1-4. Two CVE torpedo damage cases, LISCOME BAY (CVE56) and BLOCK ISLAND (CVE21), were covered in BuShips War Damage Reports Nos. 45 and 49. These two CVE's are the only ones in our Navy which are definitely known to have been torpedoed by the enemy. HMS AVENGER, manned by the Royal Navy but indentical to BLOCK ISLAND, also was torpedoed. In both LISCOME BAY and AVENGER the torpedo hit was followed immediately by a magazine explosion. All three torpedoed vessels were lost. SANTEE (CVE29), a tanker conversion, survived a reported but doubtful torpedo hit. The latter case has been taken up in some detail in Section V of this report.

1-5. It is the primary purpose of this report to indicate, through a discussion of battle damage incurred by CVE's as a result of gunfire, bomb and Kamikaze attack, the damage resistance of these and similar ships and the damage control problems which they may encounter. Out of a total of 25 instances of battle damage to CVE's, ten have been taken up in some detail in this report. TABLE I below is a list of the 25 instances of battle damage to this type of vessel.

TABLE I

ESCORT CARRIERS DAMAGED AND SUNK IN ENEMY ACTION

SUNK

	Name	No.	Basic Design	Date	Damaged By	Locale
1	LISCOME BAY	56	Carrier	24 Nov. '43	Torpedo	Gilbert Is.
2	BLOCK ISLAND	21	Cargo	29 May '44	Torpedoes	West Atlantic
*	GAMBIER BAY	73	Carrier	25 Oct. '44	Gunfire	Off Samar
*	ST. LO	63	Carrier	25 Oct. '44	Kamikaze	Off Samar
*	OMMANEY BAY	79	Carrier	4 Jan. '45	Kamikaze	Off Mindoro
*	BISMARCK SEA	95	Carrier	21 Feb. '45	Kamikaze	Off Iwo Jima

TABLE I (CONT.)

SURVIVED

Name	No.	Basic Design	Date	Damaged By	Locale
† FANSHAW BAY	70	Carrier	17 June '44	Bomb	Off Saipan
† FANSHAW BAY	70	Carrier	25 Oct. '44	Gunfire	Off Samar
* KALININ BAY	68	Carrier	25 Oct. '44	Gunfire and Kamikaze	Off Samar
† KITKUN BAY	71	Carrier	25 Oct. '44	Kamikaze	Off Samar
† SANGAMON	26	Tanker	25 Oct. '44	Bomb	Off Samar
* SANTEE	29	Tanker	25 Oct. '44	Kamikaze and Underwater Explosion	Off Samar
* SUWANEE	27	Tanker	25 Oct. '44	Kamikaze	Off Samar
* SUWANEE	27	Tanker	26 Oct. '44	Kamikaze	Off Samar
† WHITE PLAINS	66	Carrier	25 Oct. '44	Gunfire and Kamikaze	Off Samar
† MARCUS ISLAND	77	Carrier	15 Dec.'44	Kamikaze	Mindoro
* MANILA BAY	61	Carrier	5 Jan. '45	Kamikaze	Lingayen
† SAVO ISLAND	78	Carrier	5 Jan. '45	Kamikaze	Lingayen
† KADASHAN BAY	76	Carrier	8 Jan. '45	Kamikaze	Lingayen
† KITKUN BAY	71	Carrier	8 Jan. '45	Kamikaze	Lingayen
† SALAMAUA	96	Carrier	13 Jan. '45	Kamikaze	Lingayen
† LUNGA POINT	94	Carrier	21 Feb.'45	Kamikaze	Iwo Jima
† WAKE ISLAND	65	Carrier	3 Apr.'45	Kamikaze	Okinawa
* SANGAMON	26	Tanker	4 May'45	Kamikaze	Okinawa
† NATOMA BAY	62	Carrier	7 June'45	Kamikaze	Okinawa

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1 BuShips War Damage Report No. 45
2 BuShips War Damage Report No. 49
* Detailed in subsequent Sections of this Report
† Briefed in Section VII of this Report

SECTION II

SUMMARY AND CONCLUSION

2-1. From a design standpoint, the CVE is now classed as a combatant vessel. This is in contrast to the wartime CVE's which were built as ACV's, an auxiliary classification, and subsequently adapted to combatant service. Up to CVE105, therefore, these ships were essentially of improvised design and lacked the degree of compartmentation and the duplication of services desirable in combatant operations. It is of these ships that the detailed damage accounts in this report have been written. Their successors, the ships of CVE105 Class, were built to a considerably higher standard and are comparable in damage resistance to CVL's, although their construction is simplified to facilitate quantity production, and their maximum speed, 19 knots, limits their usefulness. It will be noted, therefore, in the several case histories which follow in Sections III, IV, V and VI, that there is frequent reiteration of the superiority of CVE105 Class vessels as compared to their predecessors.

2-2. The major damage control problem in carriers of all types has been fire protection. Concern with the potential hazard presented by fire has transcended consideration by carrier damage control personnel of problems of stability, casualty control, personnel casualty and structural strength after damage. It is appropriate, therefore, that over half of this report is devoted to descriptions and discussions of fire protection problems. The most important discussion of fire protection is contained in the paragraphs on "Preventative measures against hangar conflagrations" in Section IV, which describe various measures that have been considered and those that have been adopted to diminish the hazard of conflagrations, particularly in hangars. Since the referenced paragraphs are in themselves a condensation, no further effort to summarize them is made elsewhere in this report. In Section V, the paragraphs on SUWANEE (CVE27) and SANGAMON (CVE26), both of which experienced severe fires among parked aircraft, illustrate the scope of the medical problem in caring for personnel casualties, the importance of training all hands in fire fighting, the need for a means of jettisoning aircraft from the hangar, and the value of prompt and rapid degassing of aircraft after recovery. The paragraphs on ST. LO (CVE63) and BISMARCK SEA (CVE95) in Section VI illustrate the extreme hazard of hangar deck fires among gassed aircraft and in the presence of exposed munitions.

2-3. The problem of establishing control of progressive flooding in CVE's is extensively discussed in Section III and is summarized

in paragraphs 3-58 and 3-59. The stability characteristics of the CVE55 Class after appreciable flooding, either from underwater damage or from the collection of fire fighting water high in the ship, offered only a very small margin of safety. Under such conditions the ships became extremely tender, taking marked lists with small shifts of load athwartships. Fortunately this dangerous condition did not cause the loss of any CVE's. In the case of KALININ BAY, as explained in Section III, the low statical stability even proved a considerable advantage in that it enabled the ship to maintain full power despite the loss of watertight integrity throughout the machinery spaces. In the CVE105 Class, as indicated in Section V on SANTEE (CVE29), the maintenance of seaworthiness after extensive flooding is much more readily accomplished than on the CVE55 Class. The size of the ship and the extent of the ballast system make its stability characteristics far less sensitive to damage.

2-4. While the employment of gunfire against carriers is generally considered an unlikely contingency, a fairly complete picture of its effect is given in Section III. Widely dispersed fires, slow flooding with serious effect on stability, and very extensive electrical damage were the primary effects of gunfire attack on CVE's.

2-5. Very little valuable information on engineering casualty control is contributed by this report. The main propulsion plants of the CVE's with damage experience were largely made up of units infrequently found in combatant ships and now considered obsolete. Only scanty data on engineering casualties due to battle damage were provided in the reports of individual ships. One notable exception was MANILA BAY (CVE61) in which extensive electrical repairs were accomplished underway in the operating area. The work undertaken by this ship on radio, radar and I.C. installations was highly essential to the accomplishment of her mission and is described in paragraph 4-22. This very important phase of damage control undoubtedly will receive more emphasis as increasing dependence is placed on radar and external communications. Too frequently, repair work undertaken on such installations is not described in damage reports. As a result, valuable data on the training and tools required are lost. A small amount of effort properly applied in such repairs frequently has restored the services of essential equipment which, on superficial examination, appeared permanently disabled.

2-6. Difficulty was experienced by SANGAMON in maintaining uninterrupted propulsion power after momentary loss of electric power while employing electric auxiliary machinery almost exclusively. As described in Secion VII (D), this case raises an interesting point in view of the tendency in contemporary merchant con-

struction to put increasing dependence on electric-driven auxiliary machinery. Undoubtedly it is possible to make electrical units and power systems markedly more resistant to shock damage than those installed in SANGAMON, but the direction of improvement in the CVE105 Class was in the adoption of a larger proportion of steam-driven auxiliaries.

2-7. From a structural standpoint, the major damage control problem in CVE's was the rapid repair of damaged flight decks, as demonstrated in the performances of MANILA BAY, SUWANEE and SANTEE. There was no case of CVE battle damage in which the possibility of structural failure of the hull girder was an important consideration in damage control. WAKE ISLAND (Section VII L) is the only CVE which was reported to have experienced dishing or buckling of the shell as a result of severe flexural vibrations. OMMANEY BAY, which broke up after torpedoing by a friendly vessel, had been abandoned over an hour before due to fire. In view of the very slender margin of safety of ships of CVE55 Class in longitudinal strength, this record is somewhat surprising and probably would have been different had more such ships been subjected to damage from underwater explosions. The infrequency of attack on CVE's by underwater explosions leaves open the question of extent of damage to be anticipated therefrom. Hence, it is suggested that reference be made on this subject to BuShips War Damage Reports No. 23 on YORKTOWN (CV5), No 30 on HORNET (CV8) and No. 39 on WASP (CV7).

2-8. The effect of major damage in way of gasoline tanks is not covered in this report because of the absence of CVE experience therewith. While some data are included on this topic in the discussion of the loss of MISSISSINEWA (AO59) in paragraph 5-23, this experience is not applicable to CVE105 Class vessels since the latter employ a greatly improved gasoline stowage arrangement consisting of saddle-type tanks protected by wing ballast tanks, which gives protection comparable to that afforded later ships of the CV9 Class. BuShips War Damage Report No. 39 on WASP contains a comprehensive discussion on the damage resistance of gasoline stowage arrangements. The only data in this report which add to that fund of information are given in paragraph 4-33 on degassing arrangements.

2-9. The exposed position and severe service given important aircraft handling devices, e.g. elevators, catapults, barriers, arresting gear, night landing lights, bullhorns, etc., make it inevitable that casualties thereto will be frequent and that ship's force accomplishment of many repairs will be required. This phase of damage control was a highlight of MANILA BAY's performance and is described in some detail in Section IV. A very important damage control

asset is the ability to restore moderately damaged plane handling gear to operation in order to maintain an effective flight schedule. Paragraphs 4-22 and 4-23 described a successful undertaking of this nature.

2-10. The Damage Control organization in ships of the CVE105 Class was based on the outline in Chapter VI of F.T.P.170 (B), "Damage Control Instructions." It consisted of six repair parties, as listed below, whose repair areas are indicated on the inboard profile in Plate V-5:

(a) Repair I, Air Department, responsible for an area including the forward halves of the flight, hangar, and gallery decks, and the forward part of the gasoline system.

(b) Repair Ia, Air Department, responsible for the after halves of the flight, hangar, and gallery decks, and the after part of the gasoline system.

(c) Repair II, Hull Department, responsible for the forward part of the ship not under Repair I.

(d) Repair III, Hull Department, responsible for the after part of the ship not under Repair Ia and exclusive of the enginerooms. This party is headed by the First Lieutenant.

(e) Repair IV, Hull Department, responsible for the amidships part of the ship below the hangar and outside the engineering spaces.

(f) Repair V, Engineering Department, responsible for the engineering spaces.

2-11. Each party consisted, with the full war complement, of from 15 to 20 men including one officer. Similar organizations in earlier CVE's proved very satisfactory. In all carriers, however, the need for numerous additional personnel in repair activities in the event of major damage was demonstrated repeatedly in the recent war. Fortunately, there were usually large numbers of personnel available since flight operations normally could not be carried on simultaneously with damage control. The successful coordination of such part-time repair personnel requires more than usual care in the training of the regular repair organization in order that each of its members can direct several temporary assistants as well as perform his own duties. It is probably more important in carriers than in any other type of ship that damage control be recognized as an all hands evolution.

2-12. The enemy weapons which caused most of the damage in CVE's are described briefly in the detailed cases which follow. The most important by far was the Kamikaze plane and its bomb load. Kamikaze planes varied from the 6,000-pound ZEKE to the 29,000-

pound FRANCES and bomb loads varied from 63 Kg to 1000 Kg. Normally several hundred gallons of gasoline were carried by the plane in its attack, and resultant shipboard fires caused a considerable portion of the ensuing damage. The standard Japanese bombs used against CVE's appear to have been the 63Kg GP and the 250 Kg GP. These bombs were fuzed to detonate within about 20 feet of impact so that the vulnerable hangar was usually the center of damage. In several cases, dud bombs of the above types were recovered intact after penetrating deep into the ship. Charge-weight ratios in the Japanese bombs described as GP approximated 50 %. Japanese projectiles were of orthodox design and their primary effects, as indicated in paragraph 2-4, were the disruption of watertight integrity, the initiation of widely dispersed fires and the extensive dislocation of electrical systems.

2-13. The behavior of munitions in damaged CVE's was in line with that experienced in other classes of carriers and extensively reported in previous War Damage Reports, notably that of FRANKLIN. Torpex-loaded torpedo warheads appear to have contributed to the loss of ST. LO (CVE63), BISMARCK SEA (CVE95) and OMMANEY BAY (CVE79), in each of which, warheads are believed to have detonated due to roasting for a considerable period in severe fires. Torpex-loaded depth bombs in SUWANEE and SANTEE, although split open, ignited and subjected to prolonged roasting, did not detonate high order. Bomb fragments attacked and penetrated three torpex-loaded torpedo warheads on FANSHAW BAY without igniting or detonating the warheads. The low order, single detonations of 20mm and 40mm ammunition in clipping rooms adjacent to the hangar and of machine gun ammunition in burning aircraft frequently constituted a considerable hazard to personnel combatting hangar fires. There is no case, however, of a mass detonation of such ammunition on any type of ship.

2-14. The conclusions to be drawn from this report may be summed up by stating that the numerous materiel disadvantages of the CVE's as compared to CVL's have been largely eradicated in the CVE105 Class, except for their low speed. The advent of pilotless aircraft as a naval weapon suggests that the CVE is a logical prototype of carriers intended for their employment. The value of a powerfully armed ship suitable for mass production is obvious. The proven ruggedness of the SANGAMON Class and the flexibility of space and weight limitations in similar ships of the COMMENCEMENT BAY Class indicate considerable future usefulness of the CVE type.

SECTION III

U.S.S. GAMBIER BAY (CVE73)

and

U.S.S. KALININ BAY (CVE68)

Gunfire and Kamikaze Damage

Off Samar

25 October 1944

Class.....CASABLANCA (CVE55)	Length (O.A.).....512 Ft. 3 In.
Commissioned-CVE68 November 1943	Beam (O.A.).....108 Ft. 1 In.
CVE73 December 1943	Draft (Estimated Mean,
Displacement (Full Load).....10,400 Tons	Before Damage).19 Ft. 0 In.

References:

(a) C.O. GAMBIER BAY ltr. A16-3 (3)/L11-1, Serial 001, of 6 November 1944 (Loss Report).
(b) C.O. GAMBIER BAY ltr. CVE73/A16-3, Serial 002, of 27 November 1944 (Action Report).
(c) C.O. KALININ BAY ltr. CVE68/A4/95/thg, Serial 094, of 30 October 1944 (Action Report).
(d) C.O. KALININ BAY ltr. CVE68/L11-1/50/wgl, Serial 0011, of 6 November 1944 (Battle Damage Report).
(e) C.O. KALININ BAY ltr. CVE68/L11-1/50/kk, Serial 0013, of 12 December 1944 (Battle Damage Report).
(f) U.S. Naval Technical Mission to Japan Target Report, Index No. 0-19 "Japanese Projectiles - General Types".

Plates III-1 - CVE55 Class - Layout of Machinery Spaces
III-2 - GAMBIER BAY - Gunfire Damage
III-3 - KALININ BAY - Gunfire and Kamikaze Damage

Photographs 3-1 to 3-10 (Furnished by C.O. KALININ BAY)

NARRATIVE

3-1. GAMBIER BAY and KALININ BAY were two of the six CVE's in the Seventh Fleet Task Unit 77.4.3 which came under gunfire attack from the central Japanese force during the Battle for Leyte Gulf. The other CVE's were FANSHAW BAY (CVE70), ST. LO (CVE63), WHITE PLAINS (CVE66) and KITKUN BAY (CVE71). This well-known action took place off Samar soon after daylight on the morning of 25 October 1944 after a surprise contact between the northern escort carrier group and the Japanese battleships and cruisers which had sortied through the San Bernadino Straits during the night and were proceeding southwestward to harass the landing forces in San Pedro Bay. The weather at the time of the action was intermittently squally with a 10-knot wind from east-northeast and a slightly choppy sea. Immediately on sighting the U.S. force, the Japanese, with four BB's, six CA's and three divisions of DD's deployed on an overtaking course and bore down from the northwest, their battleships opening fire about 0700 at 35,000 yards. The carriers, in circular disposition, took an easterly course to launch planes, then about 0730 executed a ships right to a new southwesterly course which left GAMBIER BAY and KALININ BAY on the exposed windward flank where smoke offered little protection. A division of enemy heavy cruisers, overtaking on the port quarter, maintained a slow but steady fire on the exposed ships.

3-2. GAMBIER BAY successfully chased salvoes for over an hour before a major caliber near-miss opened the forward engineroom to the sea. Thereafter it was not possible to keep up with the rest of the Task Unit. Enemy cruisers closed to point-blank range and riddled the hull with gunfire. Enemy destroyers also attacked from the starboard quarter with torpedoes and gunfire. By 0845, GAMBIER BAY had lost all power and lay dead in the water, unable to combat the numerous fires throughout the length of the ship. The decision to abandon ship had to be made. About 0907, with at least four main compartments flooded from the sea, she rolled over to port and sank rapidly.

3-3. KALININ BAY was more fortunate. She was able to maintain full speed throughout the engagement despite partial flooding in five main compartments which reduced GM to virtually zero and introduced an appreciable list, but left sufficient freeboard to prevent the list from seriously hampering the operation of the ship. When the Japanese broke off the surface engagement about 0930, KALININ BAY had suffered damage from about 14 shell hits or near-misses. Some two hours later, land-based Kamikazes attacked the ship, scoring two glancing hits with relatively superficial damage. After the battle, KALININ BAY retired to Manus and thence to Terminal Island for permanent repairs.

3-4. The ineffectiveness of the Japanese force was remarkable in view of its decisively superior speed, numbers and offensive power. The failure of enemy intelligence and communications prevented them from perceiving how close they were to wiping out the U.S. force, and how readily they might have done so, had the chase been driven home. Undoubtedly the skillful tactics of the U.S. Task Unit Commander and the courageously delivered attacks of the screen and of the CVE air groups contributed much to the successful escape. However, it seems incredible that five* out of six,19-knot,unarmored CVE's could escape from a fast battleship and cruiser force in broad daylight after being within gun range for over two hours. As in the battle of the Komandor skies, survival of the inferior U.S. force can be largely attributed to the ignoble failure of the greatly superior enemy force to press home the attack. From the standpoint of damage control, a comparative analysis of the experiences of both GAMBIER BAY and KALININ BAY is worthy of attention.

DISCUSSION OF DAMAGE IN GAMBIER BAY

3-5. In GAMBIER BAY approximately 15 hits were fairly well identified and 11 others were reported before the ship was abandoned. The tabulation below has been developed from data contained in reference (b).

Projectile Hits in GAMBIER BAY, 25 October 1944

Time	Hit No.	Estimated Proj. Dia.	Entry Level	Entry Frame	Whether Detonated	Blast Location	Compts. Flooded	Location of Fires
0810	1	8"	Flight Dk.	186	Yes	Gallery Dk.	--	Flight Dk.
0817	2	8"	Forecastle	30	Yes	Chain Locker	--	--
0820	3	14"	Second Plat.	97	Yes	Shell	Fwd. Eng. Rm.	--
0824	4	8"	First Plat.	110	Yes	B-406W	Mach. Shop	--
0824	5	8"	Second Dk.	33	No	--	--	--
0828	6	5.1"	Hangar	66	Yes	Shell	--	--
0828	7	8"	Flight Dk.	75	Yes	Flight Deck	--	Flight Dk.
0830	8	4"	Main Dk.	112	Yes	CPO Galley	--	--

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* ST. LO (CVE63) survived the gunfire action but later in the day, after the Japanese surface force had retired, suffered a Kamikaze hit. Fires and explosions followed which quickly got out of control and resulted in the loss of the ship. See Section VI.

Time	Hit No.	Estimated Proj. Dia.	Entry Level	Entry Frame	Whether Detonated	Blast Location	Compts. Flooded	Location of Fires
0832	9	4"	Second Dk.	124	Yes	Crew's Mess	--	--
0837	10	5.1"	Second Dk.	180	Yes	C-203-2L	--	--
0837	11	5.1"	Second Dk.	162	Yes	Shell	C-202L	--
0837	12	8"	Second Plat.	124	No	--	Aft Eng.Rm.	--
0843	13	8"	First Plat.	134	?	--	Aft Eng.Rm.	--
0850	14	8"	First Plat.	79	Yes	GSK Stores	GSK Stores	--
0850	15	8"	Hangar	70	Yes	Parked Aircr.	--	Plane
?	X-1	?	Gallery	92	?	Condit. Rm.	--	---
?	X-2	?	Flight Dk.	35	?	Catapult Track	--	--
?	X-3	?	Gallery	23	Yes	Radar Rm.Stbd.	--	--
?	X-4	?	Gallery	49	Yes	Exec.Off.S.R.	--	--
?	X-5	?	Gallery	38	Yes	J.O.Bunkroom	--	--
?	X-6	?	Gallery	125	No	--	--	--
?	X-7	?	Flight Dk.	5	No	--	--	--
?	X-8	?	Island	57	No	--	--	--
?	X-9	?	Mast	67	No	--	--	--
?	X-10	?	Upper Dk.	48	Yes	Elev.Mach.Rm.	--	--
?	X-11	?	Gallery	58	?	Clipping Rm.	--	--

3-6. In the interest of brevity, a further amplification of the damage caused by each hit has been undertaken only for Hits 1, 3, 4, and 10 through 13 since these were the more serious.

3-7. At 0810, a projectile (Hit No. 1), estimated to have been 8-inch common, struck the flight deck about 6 feet aft of the after elevator near the centerline. It tore up flight deck planking and detonated in passageway C-0212T on the gallery deck. It left a jagged hole about 6 feet by 8 feet in the flight deck. The detonation caused fires on the flight deck and in the passageway. Hangar deck personnel noted smoke and flame through the after bulkhead of the elevator well (the forward bulkhead of the passageway) at the gallery deck level which indicated that the bulkhead was ruptured.

3-8. Aggressive fire fighting by repair parties extinguished these fires in about five minutes, during which time the sprinkling systems for the after part of the hangar, the after elevator pit and the after clipping rooms were turned on. Inspection of the area after the fires were extinguished showed a considerable amount of wreckage and debris. Damage to an electrical panel in the passageway put the 5-inch ammunition hoist out of action. The rudder angle indicator on the open bridge also became inoperative, probably due to a damaged cable.

3-9. About 0820, a near-miss (designated Hit No. 3 in the above table) detonated near frame 97 port about 12 feet below the waterline, in way of the forward machinery space and apparently several feet from the hull since it was reported that the blast opened the shell but no fragments entered. The auxiliary steam line to the main circulator was fractured by the blast and at frame 97 aerofoam tank No. 2, located on the lower gratings outboard, was thrown inboard and forward about 12 feet, against the main condenser. In view of the severity of the shock, absence of fragments and the size of the rupture in the plating, it was estimated that a 14-inch, 16-inch or 18-inch AP shell from an enemy battleship then nearly astern caused the damage. Rapid flooding took place through the hole which was reported to be about 4 feet square; subsequent calculations based on the rate at which the water rose in the compartment indicated an opening about 21 inches in diameter. The head of water behind the inflow and the inaccessibility of the hole made plugging impossible. Two electric submersible pumps were promptly lowered down the escape trunk in an attempt to control the flooding. Both had trouble maintaining a suction owing to momentary interruptions in the power supply. The electrical load was therefore promptly shifted to the after generators. An effort to take suction on the flood water with the main circulator was thwarted by loss of steam supply to the pump. Two bilge pumps in the after engineroom were connected to the main drain, but their capacity of 1200 GPM was totally inadequate against an estimated 19,000 GPM inflow. In five minutes the water level was five feet above the tank top in the forward machinery space and water began to enter the fire boxes of the boilers (Plate III-1). Both boilers and the main engine in that space were secured about 0825 and all personnel abandoned the machinery space soon afterwards.

3-10. Personnel of Repair V, who investigated damage in the machine shop, B-407E, abaft bulkhead 100 immediately after Hit No. 3, reported leaks around the port shaft and steam lines, and weeping seams in the bulkhead which had been distorted. About 0824, Hit No. 4, an 8-inch projectile, punctured the port shell at frame 110 about 7 feet below the waterline in the machine shop, B-407E, and detonated near fresh water tank B-406W. Most of the repair party personnel who were engaged in plugging the leaks in bulkhead 100 were killed or seriously wounded. Shock damage to the distribution switchboard in the generator room immediately above the machine shop threw out the bus tie circuit breakers so that power was temporarily lost in the forward part of the ship. B-407E, an off-center compartment, flooded slowly from leaks in the forward bulkhead and the entry hole of Hit No. 4 (Plate III-2). A port list, which undoubtedly was due to this flooding, was noted soon afterward.

3-11. As a consequence of the hit in the forward machinery space and the resultant loss of power on No. 1 shaft, GAMBIER BAY slowed to 11 knots and gradually dropped astern of the Task Unit. The enemy cruisers, broad on the port beam at this time, concentrated their fire on GAMBIER BAY and the frequency of hits began to increase rapidly.

3-12. About 0837, an enemy cruiser salvo, including apparently both 5.1-inch and 8-inch projectiles, produced Hits 10, 11 and 12 on the port side. These hits resulted in the loss of all remaining power. Hit No. 10, probably 5.1-inch, detonated in the steward mates' compartment, C-203-2L. Bunks and lockers were wrecked and lights went out. The compartment filled with smoke but no fires were observed. Hit No. 11, also probably 5.1-inch, detonated upon impact with the port shell in way of the after messing compartment, C-202L. A large hole was opened in the shell between frames 159 and 165. The after distribution board was damaged by fragments. This caused the loss of electrical power in the after half of the ship. Hit No. 12, probably 8-inch AP, entered the after machinery space through the port shell about 10 feet below the waterline. The projectile passed through the casing of No. 3 boiler and lodged in the boiler. It is doubtful that this hit detonated. The after machinery space began to flood slowly through the projectile entry hole which was slightly less than one foot in diameter. In addition, the port shell plating was split vertically close to bulkhead 118, between the bulkhead and frame 119. The split was about 10 feet long by 1/2 inch wide and was entirely below the waterline. The cause of this rupture was not reported. It may have been the detonation of a short from the same salvo or the impact of a projectile which ricocheted from the side without penetrating. Water poured in against the boiler and within seven minutes rose above the floor plates. The only remaining boiler, No. 4, was then secured and the after plant was abandoned about 0845.

3-13. About 0843, Hit No. 13 punctured the port shell in way of the after engineroom near the overhead, demolished the forced draft blower on the first platform and increased the rate of flooding. A few minutes later the shock from the detonation of a large projectile was felt in the vicinity of the GSK storeroom, A-407A, a large compartment just forward of the forward engineroom. The CO2 system was wrecked and CO2 filled the storeroom. Flooding undoubtedly followed although no investigation could be made to confirm this.

3-14. At 0850, the order to abandon ship was given. GAMBIER BAY at this time was under fire from three enemy cruisers at point-blank range. Numerous fires were burning, the port list was steadily increasing and progressive flooding was taking place in way of compartments holed above the initial waterline. Numerous projectiles

continued to strike the ship as she was abandoned and survivors in the water noted a large explosion in the forward elevator pit which blew the forward elevator out of the ship. At 0907, the ship capsized to port and sank in four minutes.

3-15. Interrogation of survivors indicated that Hit No. 15 struck the sole remaining plane aboard, a fully gassed TBM armed with a torpedo and parked near the forward elevator in the hangar. The sharp blast which accompanied the hit initiated a gasoline fire and injured a large number of men who were proceeding to abandon-ship stations in the vicinity. A hose was led out to combat the blaze, but no pressure was available. It is probable, therefore, that the later blast which blew the forward elevator out of the ship was caused either by the detonation of the torpedo carried by the burning plane, or by a gasoline vapor explosion.

3-16. Structural damage from the projectiles was moderate and the strength of the hull was not seriously impaired. The cruisers on the port beam are known to have been employing both their 5.1-inch and 8-inch batteries against the CVE's. Most of the hits are believed to have been made by 8-inch,armor-piercing projectiles. Several 8-inch shells passed entirely through GAMBIER BAY without detonating. These produced holes approximately 10 inches in diameter where they passed through the side plating and bulkheads. The average distance of penetration after impact was about 30 feet. The blast effect of the 8-inch projectile detonations was sufficient to produce holes about 6 to 8 feet in diameter in adjacent bulkheads and decks. The 5.1-inch shells usually detonated on impact and produced holes in the shell about 4 feet in diameter. Several hits were registered on the starboard side of GAMBIER BAY by destroyers reported to be of the TERUTSUKI Class which mounted a 4-inch main battery. These projectiles also detonated on impact and opened holes in the shell about 3 or 4 feet in diameter.

3-17. The report on Japanese projectiles made by the Naval Technical Mission to Japan, reference (f), stated that in the design of AP projectiles the Japanese concentrated on the possibility of striking the enemy ship below the waterline and therefore possibly below the armor belt. To achieve this, the projectiles were designed with a flat nose and an easily dislodged cap-head and windshield. Upon striking the water, the cap-head and windshield broke off the flat-nosed projectile body and permitted the latter to continue an uninterrupted trajectory under water. The fuze delay was adjusted to give satisfactory functioning after initiation upon impact with the water, passage through the water and penetration of the ship's side. Their fire control doctrine stressed the desirability of getting short-misses and the Japanese claimed that even projectiles which missed the ship would have a certain mining effect.

3-18. With the exception of flooding, damage to the main machinery plant in GAMBIER BAY was not severe. Hit No. 12, which caused the flooding of the after machinery space, also disabled No. 3 boiler. Electrical cable and equipment suffered considerable damage from shock, blast and fragments. When the forward machinery space was abandoned and the entire electrical load shifted aft, high ammeter readings at the main power panel indicated many grounds. The breakers on various distribution boards and electrical panels were thrown open frequently by shock. There was no report of damage to the main generators. Steering control was lost at the time the salvo containing Hits 10, 11 and 12 landed aft, and could not be shifted to either Batt. II or the trick wheel because fragments from Hit No. 11 disabled the after distribution panel. Three minutes later all power was lost due to flooding of the after machinery space. Emergency Diesel generators were not installed in ships of the CVE55-104 Class because of space and weight limitations.

DISCUSSION OF DAMAGE CONTROL IN GAMBIER BAY

3-19. Fire fighting measures were prompt and effective during the early part of the action. Fires on the gallery and flight decks caused by Hit No. 1 were extinguished in five minutes. Hit No. 2 ruptured the fire main riser to the gallery deck at frame 23, but this break was promptly isolated. Additional fragment damage, however, resulted in loss of fire main pressure in the forward part of the ship within fifteen minutes after the first hit. The flight deck fire produced by Hit No. 7 could not be controlled because of this loss of pressure. Repair I ran a jumper from the after portion of the flight deck. By the time this was accomplished, all pressure had been lost due to the damage in the machinery spaces. Subsequent fires could not be controlled. The intensity of the attack and the short interval between the time critical damage was sustained and the time the ship sank prevented rigging handy-billies or other portable fire pumps. No report was made on the use of foam or CO_2.

3-20. The fire fighting efforts produced considerable free water in hangar deck spaces. This water collected from the operation of the after hangar sprinklers and the sprinklers in the after elevator pit following Hit No. 1 at 0810. It was not reported when these sprinklers were secured although presumably they were on about five minutes, the duration of the fire. Elevator pit drainage on this class of CVE was poor. An alteration to improve this condition had been authorized, but had not been accomplished on GAMBIER BAY by the time of the action. As a result, the after elevator pit was probably partially full of water from 0810 until the ship capsized. In addition to the sprinkling water accumulated in the hangar, sprinklers were employed in the after magazines for about 15 minutes, which permitted several feet of

water to collect in C-402M, C-401-1/2M, C-302-1A and C-302-1M. At the time of abandonment of the forward machinery space at about 0825, calculations indicate that flooding in the after elevator pit, forward machinery space and machine shop had reduced the GM of GAMBIER BAY from 3.3 feet to about 0.5 foot positive.

3-21. The incurrence of damage after 0820 was so rapid that little chance to control flooding was offered. About 0820, Repair II and Repair V were directed to inspect the forward and after bulkheads of the forward machinery space for ruptures or leakage into the adjoining spaces. Repair V reported leaks in bulkhead 100, into the machine shop, B-407E, around steam lines and the port shaft, and through fractured seams. These leaks were in the process of being stopped with mattresses and shoring when, about 0824, Hit No. 4 detonated in the machine shop, and killed or seriously wounded a majority of the Repair V personnel. Another projectile in the same salvo passed through compartment, A-203L, the battle station of Repair II. Some minutes later, a projectile detonated in the after messing compartment, C-202L, the battle station of Repair III, also in use as a battle dressing station. Although it was not so reported, these spaces undoubtedly began to take water later when the port list neared 15 degrees. Thus, constant and punishing gunfire interfered greatly with damage control efforts. After 0837, GAMBIER BAY's stability rapidly diminished. By 0840, GM is estimated to have been reduced to minus 1.5 feet. The loss of all power at about 0845 destroyed any slight remaining chance of pumping out flooded compartments and the Commanding Officer then reported a "decided list to port". Flooding took place in the GSK storeroom at about 0850 and the abandon ship evolution began at that time. Until then, other than in the machine shop, no appreciable off-center flooding was reported although such may have occurred as a result of damage from near-misses in way of C-908F. After the vessel was abandoned, numerous additional hits accelerated the flooding.

DISCUSSION OF DAMAGE IN KALININ BAY

3-22. In KALININ BAY, owing to preoccupation with more urgent matters, no attempt was made to report the sequence of hits. It is known, however, that at about 0750, after the ship had been under fire some 45 minutes, fragments of major caliber projectiles from a salvo of near-misses flew through the hangar from the starboard side abaft the forward elevator. Shortly thereafter, an 8-inch projectile punctured the port shell below the waterline in way of the storeroom just forward of the engineering spaces. Subsequently, about 12 other hits were suffered, 4 of which caused underwater damage and slow flooding that was largely kept under control. One severe and persistent fire also occurred in the compartments between the two main engineering spaces. Since the chronological order of the hits is unknown, the sequence indicated in the tabulation below is merely po-

sitional from bow to stern below the flight deck and then from bow to stern on the flight deck and above. The last shell hits occurred about 0930 as the Japanese destroyers on the starboard quarter retired from an unsuccessful torpedo attack. Soon thereafter, the whole Japanese force broke off the engagement and made no further effort to attack the CVE Task Unit.

3-23. Fourteen hits were fairly well identified as summarized in the table below:

Projectile Hits in KALININ BAY, 25 October 1944

Time	Hit No.	Estimated Proj. Dia.	Entry Level	Entry Frame	Whether Detonated	Blast Location	Compts. Flooded	Location of Fires
	1	8"	Second Dk.	8P	No	--	--	--
	2	8"	First Plat.	19P	No	--	A-301L A-401A	--
	3	8"	Upper Dk.	51P	No	--	--	--
0750	4*	14"-16"	Hangar	69S	Yes	Short	--	--
0800	5	8"	First Plat.	77P	Yes	A-408 Lub.	A-407A,etc.	--
	6	8"	First Plat.	103P	Yes	B-405W	B-407E	Armory and Mach.Shop
	7*	8"	First Plat	203P	Yes	Short	C-308M	--
	8*	8"	Second Dk.	199	Yes	Short	--	--
	9	8"	Flight Dk.	55-1/2	No	--	--	--
0904	10	8"	Flight Dk.	59-1/2P	Yes	Elevator	--	Acetylene in Hangar
0904	11	8"	Flight Dk.	67	No	--	--	--
	12	8"	Stack		No	--	--	--
	13	8"	Flight Dk.	87P	No	--	--	--
	14	8"	Flight Dk.	119	No	--	--	--

The most serious damage was due to Hits 2, 5, 6, 7 and 10. These hits caused sufficient flooding and fires to have resulted in loss of the ship but for the prompt and effective damage control measures taken.

3-24. Hit No. 2 apparently was made by an 8-inch projectile which went completely through the hull, entering above and exiting below the waterline in the narrow compartments well forward. The shell did not detonate, but apparently the cap-head broke off or the shell broke up since there were one entrance hole and two exit holes. The slow flooding which followed left several feet of water in storeroom A-401A on the tank top level and in living space A-301L above on the first platform level. The narrow beam of these compartments made the free surface effect of this flooding negligible. The holes were plugged as indicated in Photos 3-1 and 3-2 and the compartments were pumped

* Fragments from shorts.

out about six hours later with the secondary drain and several 2-1/2-inch portable submersible pumps.

3-25. Hit No. 5, also apparently 8-inch, caused the first serious damage. The projectile punctured the port side at the waterline, where it left a hole about 8 inches in diameter, slightly forward of the forward bulkhead of the engineering spaces. It then penetrated the first platform in A-305L and entered lube oil tank A-408Lub., where it detonated (Photos 3-4 and 3-6). Large fragments punctured bulkhead 82 so that flood water entered the following compartments amidships: A-407A, A-911F and B-1. Adjacent tanks and voids were also pierced by fragments. The maximum height reached by water in the spaces forward of bulkhead 82 is estimated to have been the 15-foot waterline and in B-1 the 10-foot waterline. The stability of the ship was precarious throughout the balance of the action due to the large free surface introduced by this flooding.

3-26. Hit No. 6, also believed to have been 8-inch, punctured the port side at the waterline at frame 103, leaving a hole in the shell about 10 inches in diameter, passed through the first platform deck over the machine shop, B-407E, and detonated in fresh water tank, B-405W. A fuel oil settling tank was also pierced so that oil spread over the flooded surface and contaminated the fresh water system. Fragments penetrated other adjacent tanks and a stubborn fire broke out in the armory and machine shop which persisted for 1-1/2 hours despite the extensive use of foam by the fire fighting party (Photo 3-8).

3-27. Hit No. 7 was made by a fragment of a short off the stern. The hull was punctured under the counter in way of the pyrotechnic stowage. The sprinkler piping of the pyrotechnic stowage was carried away and the space flooded to a depth of several feet.

3-28. Hit No. 10 penetrated the flight deck abaft the forward elevator and detonated under the after starboard corner of the elevator about 20 feet beyond the point of impact. Fragments severely damaged the radar control room, causing the ship to lose the service of all radars. Another fragment punctured an acetylene bottle in the hangar. Acetylene gas caught fire, but the fire was extinguished with CO_2. The base of the same projectile penetrated the hangar, main and second decks and entered the void surrounding the gasoline tanks. This permitted the protective atmosphere of inert gas to escape (Photo 3-10). Fortunately, however, the gasoline tanks themselves remained intact, and the fire in the hangar was quickly brought under control without serious consequences.

3-29. In addition to the above, damage to electrical cables and to piping throughout the ship was extensive. Hit No. 11 cut 57 circuits

in the cable run at frame 67 on the starboard side of the gallery deck. About 30 other circuits were severed by Hit No. 9. In numerous locations fragment damage disrupted local electrical installations. In A-911F Hit No. 5 ruptured all fuel oil transfer lines which connected the manifold in the forward engineering space with the forward tanks. The same system was also ruptured in way of the machine shop. The 6-inch sprinkler main was cut by Hit No. 13 at frame 87 in the hangar, but fortunately no other important damage to the fire main was received.

3-30. About an hour and a half after the end of the gunfire engagement, land-based Japanese aircraft damaged the CVE's of Task Unit 77.4.3 in one phase of the first large-scale Kamikaze attack in the war. Four of the five remaining carriers were hit in this action. One, ST. LO, subsequently sank, following severe internal explosions (Section VI). KALININ BAY was hit by two of four ZEKES which attempted to crash her.

3-31. The first Kamikaze attack on KALININ BAY occurred about 1050 between frames 120 and 132 to port of the centerline on the flight deck. The plane, hit by anti-aircraft fire and smoking, spiraled in from an angle of about 60 degrees and failed to pass through the flight deck on impact. It gouged out several holes, left a deep indentation about 8 feet wide and skidded forward and overboard on the port bow. Numerous small gasoline and splinter fires were started in its path. The damage was due exclusively to impact and gasoline fires since no bomb was carried. The fires were quickly extinguished.

3-32. The second Kamikaze crashed forward and to port of the first. Anti-aircraft fire had also hit this plane which smoked during its descent and was out of control at the crash. It almost missed the ship, but scored a glancing blow and then plunged into the water close aboard to port. Several life rafts and 20mm mount No. 12 were demolished. The plane's bomb detonated in the water and caused a slight shock.

3-33. Numerous minor but annoying casualties not attributable to any specific hit were reported. The catapult remained out of commission for four hours after the engagement, due to air leaks which bled down the HP air bank. The gasoline line for plane fueling was ruptured at station No. 3 on the gallery deck. The gyro repeater on the open bridge was disabled. The limit switch, designed to automatically halt the after elevator level with the flight deck, was knocked out of adjustment. The steering telemotor failed twice for short intervals, but no cause for the failure was apparent. The entire fresh water system became contaminated with fuel oil, because of the simultaneous rupture of the fresh water and fuel oil settling tanks inboard of the machine shop. After drydocking, a few small dents and holes in the shell were

observed under No. 1-40mm sponson, apparently caused by fragments from a short.

DISCUSSION OF DAMAGE CONTROL IN KALININ BAY

3-34. The primary objectives in KALININ BAY's damage control problem were to maintain full power and to control flooding. Slowing down meant sure disaster, as GAMBIER BAY's experience proved. Also, any extension of flooding past bulkheads 66 or 118, in addition to that in the three major compartments between, would have placed the ship in imminent danger of capsizing.

3-35. KALININ BAY was exceptionally fortunate in that no essential part of her propulsion plant was damaged. After receipt of damage, survival depended on the successful control of flooding in the forward engineroom. This flooding took place through holes in the forward bulkhead which had been punctured by fragments of Hit No. 5 just above the level of the floor plates (Photo 3-5). The GSK storeroom just forward of bulkhead 82 flooded to a depth of 4 feet, to about the 15-foot waterline, and water in the forward engineroom rose almost to the floor plates before these holes could be plugged and the flooding controlled by the use of several portable submersible pumps and the main drain.

3-36. In way of the flooded machine shop, No. 4 spring bearing on the port shaft was later found to have completely wiped without interfering with the operation of the shaft. The bearing failure may have been caused by operation at full speed for several hours with the bearing submerged or by a slight deflection in the bearing foundation as a result of impact or blast damage from Hit No. 6.

3-37. The most notable feature of the flooding problem was the list. Soon after hits began to occur, the ship developed a 7 degree list to port, probably due to the tendency of the flood water entering from the port side to collect to port of the centerline in way of the machine shop where amidships tanks confined athwartships access to a narrow passage. Since the list made it difficult to plug the various shell holes along the port side, about 150 tons of ballast were shifted some 20 feet to starboard from C-908F to C-907F in an effort to right the ship. This, however, brought the ship through the upright over to an 8 degree list to starboard, although the change in moment was only enough to have heeled the ship in the undamaged condition through an angle of about 5 degrees. Apparently the ship lurched from port to starboard. The depths and locations of flooding at the time this occurred were not recorded so it is not possible to compute with accuracy whether any positive GM remained. It was immediately obvious, however, that the stability characteristics of the ship had been critically reduced so that there was little

margin of safety. After this sudden indication of negative GM in the upright condition, efforts to halt further ingress of flood water and to reduce the collection of fire fighting water, particularly in way of the hangar, were given proper emphasis.

3-38. The marked starboard list after the transfer of ballast was of great advantage since with less water coming in through the holes in the port side it was much easier both to secure plugs in the holes and to reduce the internal water level by pumping. Plugging of projectile holes and fragment holes was aided by the availability of an assortment of wooden plugs and wedges, a supply of which had been placed in many watertight compartments prior to the action. Three emergency oxy-acetylene cutting outfits on board were also used effectively to cut away obstructions around waterline holes.

3-39. Most of the flooded compartments were unwatered within a few hours of the termination of the action. A-301L and A-401A were unwatered in six hours using the secondary drain in A-401A and five submersible pumps. Flooding in A-407A and in the forward machinery space, B-1, was brought under control by plugging holes and using submersible pumps and the main drain. The level in A-407A never exceeded a depth of four feet, while flooding in the machinery space was held below the fire box level. No record was made of the time these spaces were unwatered. The serious fire in B-407E complicated the damage control problem. This space flooded to a depth of 10 feet before the inflow of water was brought under control. No flooding was reported in the after machinery space, although a small fragment hole in bulkhead 118 as a result of Hit No. 6 was observed. Flooding in pyrotechnic stowage C-308M reached a depth of several feet before the break in the sprinkler line was isolated. In reference (c), the Commanding Officer reported that submersible pumps functioned perfectly despite the tendency of the pump suctions to become clogged with debris. A man at each pump kept the suction clean. Handy-billy pumps were not used because of the lack of ventilation below decks due to damage to blower power leads in the flooded area. It was stated that P-500 pumps would have been extremely helpful, but none of the allowance had been received on board prior to the engagement.

3-40. The damage control organization took considerable pains to limit the amount of fire fighting water used, since hangar deck and elevator pit drainage on the CVE55 Class vessels was very poor. Only ten small freeing parts drained the hangar. Elevator pit drainage was similarly inadequate. An alteration to install two additional drains in the forward end of each elevator pit had been authorized, but not yet accomplished. This and other drainage alterations were completed during the ensuing repair period.

3-41. The persistent fire in the ship's armory, aviation armory, generator room and upper part of the machine shop rekindled three times before it was finally blanketed with foam and extinguished after 90 minutes of fire fighting. In order to isolate this fire, a thick layer of liquid foam was maintained over the oily water which flooded the machine shop as well as the adjacent forward machinery space. In addition, bulkhead 100 was cooled by fog spray to prevent the ignition of oil vapor in the forward machinery space.

3-42. As stated in paragraph 3-28, a minor but intense fire was initiated in the forward end of the hangar when a fragment from Hit No. 10 pierced a shatterproof acetylene bottle just aft of the carpenter shop. CO2 was found to be effective against the burning acetylene and the fire was extinguished in about five minutes. The problem of extinguishing an actylene fire presents an unusual hazard which deserves mention. Acetylene mixed with air in any concentration between about 3% and 82% constitutes an explosive mixture. If a small leak in an acetylene bottle is evidenced by a local flame, the flame eliminates the likelihood of formation of an explosive concentration and should not be extinguished; instead, the leaking bottle should be jettisoned as quickly as possible. For this reason, acetylene containers should be stowed in a position topside, from which they may be jettisoned readily, and extreme care should be exercised in extinguishing burning acetylene in way of damaged cylinders. Profuse use of CO2 appreciably reduces the explosion hazard under such conditions.

3-43. The first Kamikaze crash on the flight deck spread burning gasoline the full length of the deck. Wood deck splinters were ignited, but the deck itself did not burn. The fire was extinguished in approximately five minutes by the use of fog spray and portable CO2 extinguishers. It was fortunate that the flight deck was clear of aircraft when this occurred. The Commanding Officer, in reference (c), stated: "It cannot be emphasized too strongly how essential speed is in combating fires. This was especially true with regard to this vessel's hangar and flight deck fires where four to six men were stationed at every fire station." Other damage experience throughout the recent war repeatedly bore out the vital necessity for speed in combating fires.

COMPARATIVE ANALYSIS

3-44. The damage control problems in GAMBIER BAY and in KALININ BAY were largely parallel, although a few contrasting phases may be noted. The major points of similarity were:

(a) Tenderness of stability characteristics
(b) Absence of major structural damage
(c) Prevalence of electrical casualties
(d) Impairment of ability to handle planes

(e) Adequacy of fire fighting equipment in the absence of aircraft
(f) Absence of gasoline vapor explosions

Notable contrasts included the following:

(a) Ability to control flooding
(b) Employment of sprinkling systems
(c) Employment of lifesaving equipment

3-45. Vessels of the CVE55 Class had very little margin of safety of either stability or longitudinal strength under wartime loading. The circumstances under which the ships had been designed and built forced acceptance of lower standards than existed in other combatant types. In view of this condition and at the direction of the Chief of Naval Operations, the Bureau of Ships promulgated, early in 1944, special precautions to be observed in loading CVE's of this Class. These precautions included the restriction of the mean draft to 20 feet or 10,380 tons displacement, the establishment of total load limits for the hangar and flight decks and a recommendation for prompt ballasting to replace the weight of consumed fuel.

3-46. Inclining data for this Class indicated considerable variation in the position of G in Condition II, but the average computed value of GM in Condition II was approximately zero. The most recent inclining experiment available gave a negative GM in the light condition of 0.3 foot. Data from the same booklet indicated a full load positive GM of about 3.0 feet. The launching of all aircraft increased GM about 0.3 foot in the full load condition.

3-47. The mean draft of 19 feet before damage in KALININ BAY may be assumed approximately that of GAMBIER BAY, which was not reported. This draft and the length of time the ships had operated since their last replenishment period indicate that at the time of the action the reduction in weights of consumable stores, provisions, and ammunition carried deep in the ship approximately offset the gain in GM due to the removal of high weight when planes were launched. Hence before damage, GM in both ships should have been approximately the same as that for Condition VI; that is 3.0 feet. This is to be compared with 5.5 feet in the CVL 22 Class and 4.0 feet in the CVE105 Class for the same condition of loading. The previously mentioned low safety factor in longitudinal strength in the CVE55 Class made it undesirable to fill all ballast tanks. To prevent overloads in the hogging condition, Bureau instructions recommended that tanks in the ends of the ships be kept empty. These tanks were A-901F, A-902F, C-907F, C-908F and C-909F which had been designated for emergency use only.

3-48. The Condition VI static stability curve for GAMBIER BAY and KALININ BAY, considered applicable to these ships just prior to damage, indicates a range of stability of about 60 degrees, a maximum righting

arm of 2.4 feet at 35 degrees and a GM of 3.0 feet. No chronological record of the height of water after damage in the various flooded compartments is available from either ship. However, for purposes of an approximate stability analysis, it is believed reasonable to assume that, at the time of the 7 degree port list in KALININ BAY and at the time of abandoning the after engineroom in GAMBIER BAY, each ship had flooding in three of the four main compartments in the mid-length of the ship, the depths varying from the eight-foot waterline to the external waterline. Under these conditions calculations indicate that the loss of GM due to the free surface exceeded the gain in GM due to the added low weight in each case by more than 3.0 feet. In view of the estimated pre-damage GM of only 3.0 feet, both ships appear to have been in a lolling condition with negative GM in the upright position throughout the latter part of the action.

3-49. KALININ BAY, apparently to counteract an initial starboard list, entered the engagement with an unsymmetrical ballast loading. C-908F, normally required to be empty, was full. As stated in paragraph 3-37, the ballast in this tank was pumped into C-907F when the 7 degree port list developed and the ship swung through the upright to an 8 degree starboard list. This raised several shell holes in the port side clear of the water and permitted repair parties to insert plugs and gain headway in pumping out. In this case the tenderness of the ship due to very low or negative metacentric height served to advantage in KALININ BAY. No attempt to shift ballast in GAMBIER BAY was reported. Possibly in the latter ship none was being carried on the side to which she listed when flooding began.

3-50. The Bureau's concern as to the adequacy of the structural strength in the CVE55 Class was based upon the high tensile stresses* calculated in the hangar deck for hogging condition with end tanks filled. This resulted in the restrictions on draft and restrictions on the filling of tanks in the ends of the ship. As bending moments in the sagging condition were only half the bending moments in the hogging condition, stresses in the sagging condition were not critical. The effect of the weight of flood water amidships tended to lessen rather than increase the tensile stresses in the main deck and no evidence of structural failure was reported by either ship.

3-51. In the matter of electrical casualties the experience of

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* The calculated stress is approximately 10 tons per square inch which is roughly 1 1/2 tons per square inch greater than the maximum stress considered good practice for this type of construction.

both carriers was typical of any unarmored ship subjected to gunfire attack. Extensive disruption of radar, radio, fire control and IC circuits was experienced, but power remained available at the generators until machinery spaces were abandoned. Neither ship reported employment of the casualty power system. This is believed to be due to an omission in the reports rather than to failure of the system to prove its value.

3-52. When the engagement opened, the Unit Commander ordered the launching of all available aircraft. Therefore, both ships were able to launch virtually all planes before serious damage was incurred.

3-53. GAMBIER BAY launched 10 VF's and 8 VTB's in the first twenty minutes. This left only 3 TBM's aboard. The latter had to be armed and gassed and brought to the flight deck from the hangar. Although the gasoline system had been secured when contact was made, the last three planes were gassed about 0730 and the system again purged and secured. The first of these planes was soon afterward catapulted with only a 15-knot wind over the flight deck. This was the minimum which would permit a satisfactory launching of a fully loaded TBM. A necessary evasive change of course further reduced the relative wind before the next plane could be launched and the latter was therefore jettisoned by catapult to eliminate the fire hazard. The third TBM was still in the hangar when both elevators became disabled and remained aboard throughout the engagement.

3-54. KALININ BAY's experience was similar. Twenty-six aircraft were aboard when the action commenced and by 0725 only five remained. About 0750, the last three fighters were launched leaving only 2 TBM's aboard. These two were armed with torpedoes but were temporarily stranded by loss of air pressure on the catapult. One was later launched; the other remained on the hangar deck because of engine trouble.

3-55. Both ships suffered damage to elevators, catapults and arresting gear which left them unable to launch or land planes. Repairs in KALININ BAY were effected in time for a fighter to land aboard at 1745, at which time the ship still had a 7 or 8 degree starboard list.

3-56. The fire protection system permitted effective control of fires throughout the action in KALININ BAY and up to the time that loss of the ship by progressive flooding was imminent in GAMBIER BAY. The absence of severe conflagrations in both ships was largely due to the fact that there were so few planes aboard when the hits occurred. The adequacy of the fire protection system was not tested against blazes involving the primary fire hazards in a carrier; that is,

gassed aircraft, the ship's gasoline system and exposed bombs, torpedoes and aircraft ammunition.

3-57. The inert atmosphere of the cofferdam surrounding the gasoline tanks was effective in preventing a gasoline vapor explosion in KALININ BAY when the base of Hit No. 10 entered the void. The source of the explosion noted by survivors of GAMBIER BAY after their ship was abandoned is not certain but it is unlikely that the ship's gasoline system was involved.

3-58. The effectiveness of KALININ BAY in establishing flooding boundaries and regaining flooded compartments was remarkable. Her accomplishment was singular in that the work was accomplished largely during an action and while underway at undiminished maximum speed. In GAMBIER BAY there was little opportunity to regain control of the situation after the forward engineroom had been holed. A rupture more than one foot in diameter with a 12-foot head behind the inflow was virtually impossible to plug underway with the tools at hand.

3-59. The critical nature of stability was apparently better appreciated by KALININ BAY personnel than by those in her sister ship. The very extensive use of sprinkling systems in GAMBIER BAY markedly reduced her GM whereas KALININ BAY deliberately avoided the use of sprinklers insofar as possible and succeeded in extinguishing fires with a minimum amount of water.

3-60. Lifesaving equipment was not needed by KALININ BAY, but the survivors of GAMBIER BAY made several valuable observations with regard to this material. Approximately 700 survivors of the latter ship were recovered after more than forty hours in the water. The shortcomings of the wooden water breakers were remarked upon. Despite the fact that all breakers had been refilled two days before the battle, it was reported that the drinking water in every breaker was contaminated with sea water, apparently due to accidental damage to the spigots. The laminated construction of the floats in the floater nets caused extreme discomfort to personnel lying in the nets for such a long period. It was recommended that the nets be made of solid football-shaped floats replacing the cylindrical laminated units. Lastly, the impracticability of carrying the emergency rations and first aid kits inside the rafts was pointed out. It was recommended that this material be rigged to tow from the raft to afford full use of the raft to survivors.