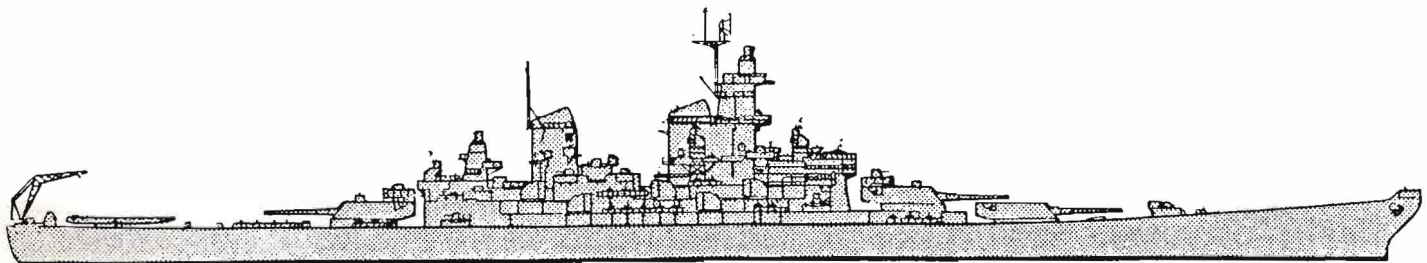
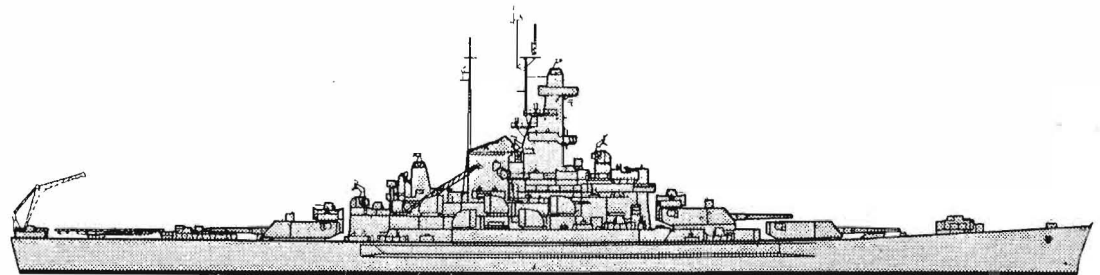
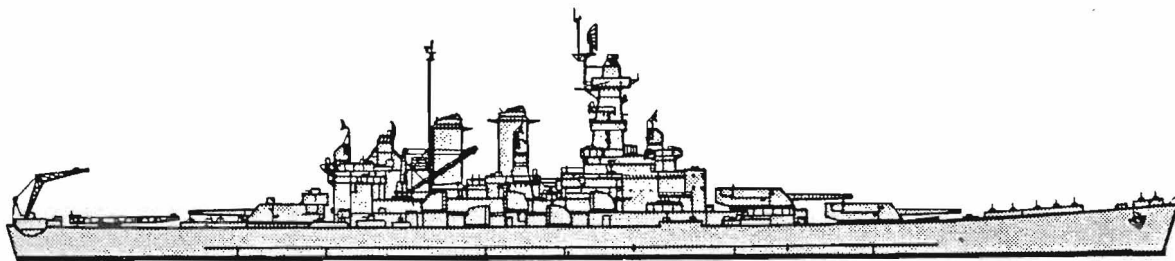


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Operational Experience of Fast Battleships; World War II, Korea, Vietnam

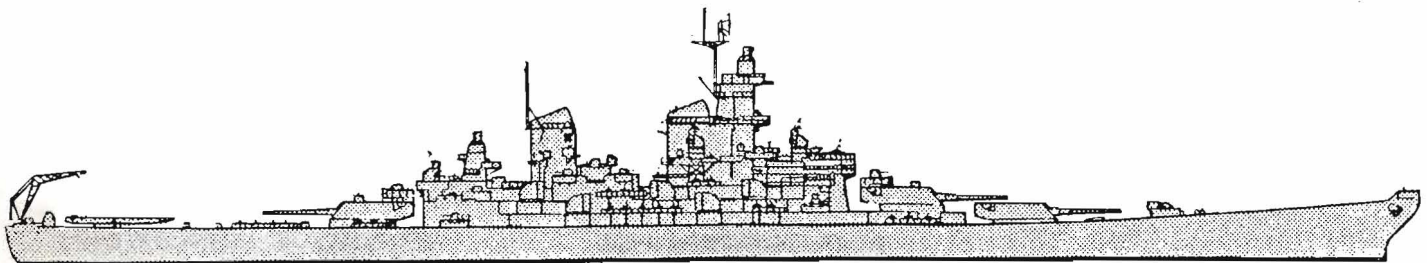
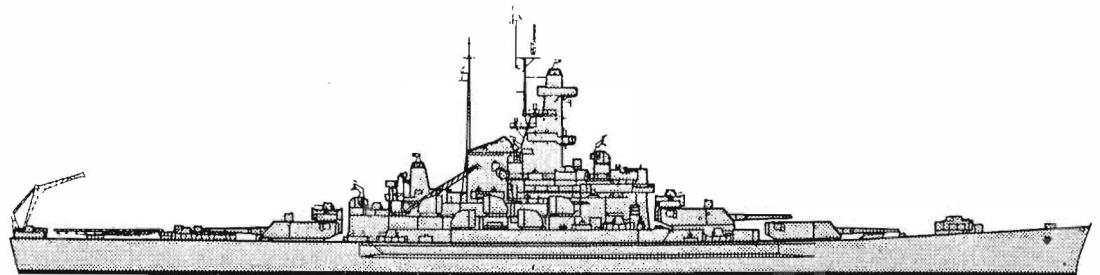
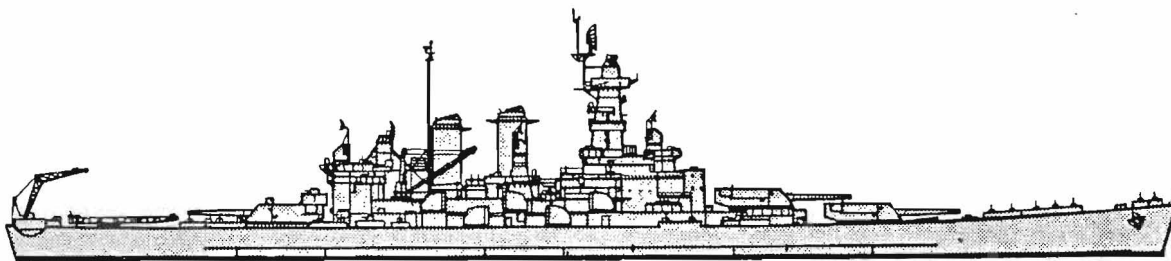


**Naval Historical Center
Washington, DC
1989**

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Department of the Navy**



Operational Experience of Fast Battleships; World War II, Korea, Vietnam



**Naval Historical Center
Washington, DC
1989**

LT

**OPERATIONAL EXPERIENCE OF FAST BATTLESHIPS;
WORLD WAR II, KOREA, VIETNAM**

**Compiled and edited,
with introduction and notes, by
John C. Reilly, Jr.**

Second Edition

**NAVAL HISTORICAL CENTER
Department of the Navy
WASHINGTON: 1989**

Keep them at sea, and they can't help becoming seamen; but attention is needed to make them learn their business with the guns.

--Admiral Sir John Jervis, Earl St. Vincent (1734-1823)

Hits per gun per minute/weapons on target per unit of time is the bottom line in our profession.

--Vice Admiral Isaac C. Kidd, Jr.

The best protection against the enemy's fire is a well directed fire from our own guns.

--Rear Admiral David G. Farragut, 1863.

If you want to win your battles take and work your bloomin' guns!

--Rudyard Kipling, Snarleyow

FOREWORD

The fast battleship has returned to the fleet, not as a tribute to nostalgia, but as a powerful and versatile component of our modern surface Navy. The four ships of the IOWA class, now back on active service, bring with them a rich legacy of experience and accomplishment spanning three wars. This heritage is not only a justifiable source of pride and tradition, but also a valuable repository of practical ideas and lessons for today's battleship Navy.

The idea for this publication originated with my brief visit to IOWA in late 1986. At that time, many members of the ship's company expressed curiosity and interest about the role of the fast battleship in earlier years, and a keen desire to have access to concrete, detailed information about their operational experience in Vietnam, Korea, and World War II. The result was the first edition of this compilation, issued in 1987. It was well received, and produced valuable suggestions for improvement. This second edition includes a considerable amount of new material requested by readers. Although modest in scope, it nevertheless represents the Naval Historical Center's continuing commitment to support the operating forces of the Navy, as well as our larger commitment to increase public and professional awareness of the value of naval history.

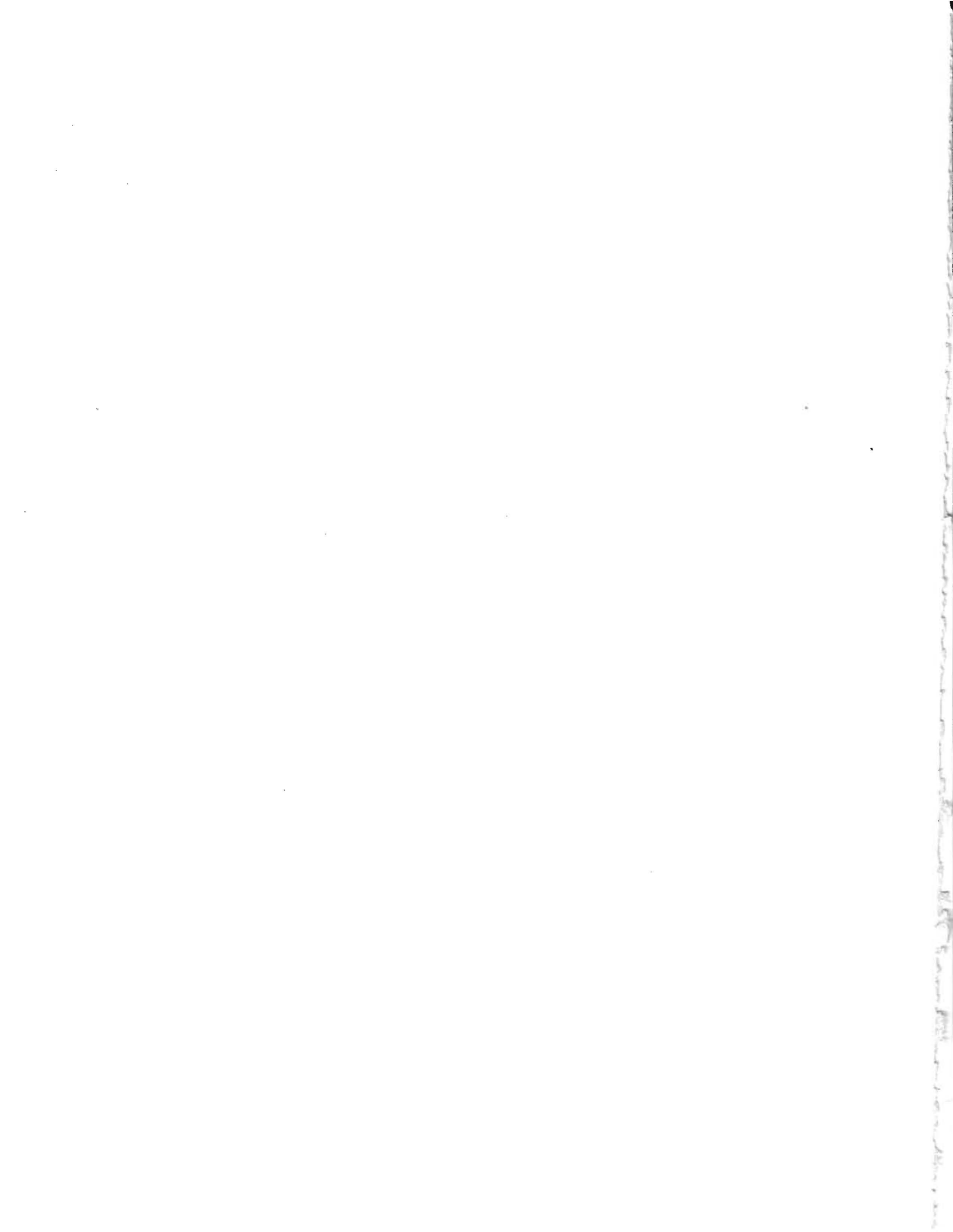
The documents offered here are, in many cases, firsthand accounts by participants in the actions they describe. Recorded soon after the event, they should not be regarded as infallibly accurate and definitive, but rather as guides to the experiences, impressions, and lessons learned of earlier generations of battleship officers and seamen.

It gives me particular pleasure to offer this historical record to a new generation of battleship sailors. May it help them to acquire and enhance that sense of their heritage that is essential to future progress.

Any work of this kind is the product of many heads and hands. The principal editor and author, Mr. John C. Reilly Jr., Head, Ships' History Branch, is a noted authority on ship types. Without the generous assistance of Mr. Richard M. Walker; Mrs. Kathleen Lloyd; YN1 Julie Howells; YN3 Tom West; Mrs. Margaret Wadsworth; Mrs. Theresa M. Schuster; Mr. Raymond A. Mann; and Mrs. Shelley Wallace, it could not have been completed. FCCM(SW) Stephen Skelley, USS IOWA, provided valuable insight. Special appreciation is due to Mr. Claude A. Browne, Jr., of the Navy Publications and Printing Service, for his skillful efforts on our behalf.



RONALD H. SPECTOR
Director of Naval History



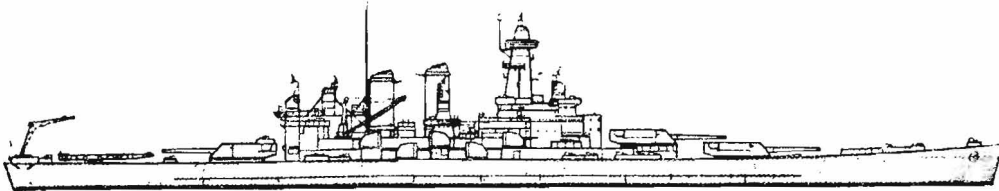
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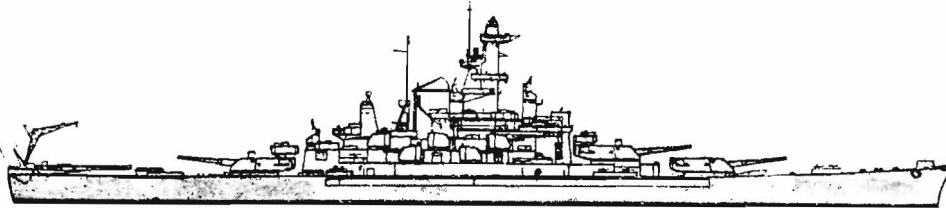
INTRODUCTION

The ships discussed in these pages form the three classes of fast battleships completed for the United States Navy between 1941 and 1944. The IOWA class has rejoined the active fleet as modern surface warships. NORTH CAROLINA, MASSACHUSETTS, and ALABAMA, survivors of the two earlier classes, now serve as memorials to those who built, sailed, and fought them in World War II.



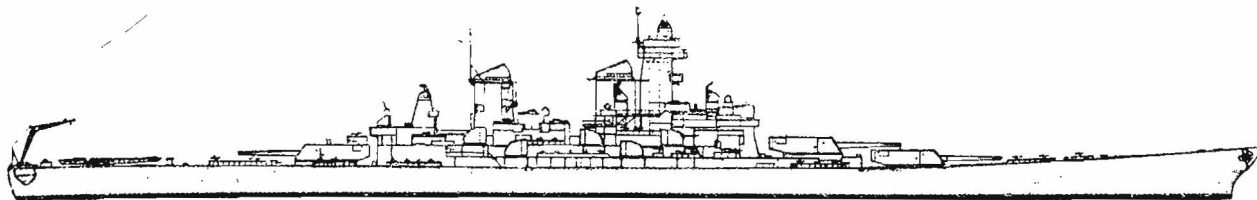
NORTH CAROLINA (BB-55), WASHINGTON (BB-56)

728 feet 9 inches; 46,770 tons at full load; 121,000 SHP; 27.6 knots. Nine 16"/45; 20 5"/38 (10 twin mounts); 1.1" and .50-cal. AA (replaced by 40mm, 20mm AA). Fire control: Main Battery Directors Mk 38 w/Radar Mk 3, later Mk 8, later Mk 13. Secondary Battery Directors Mk 37 w/Radar Mk 4, later Mk 12/22 in combination.



SOUTH DAKOTA (BB-57), INDIANA (BB-58), MASSACHUSETTS (BB-59), ALABAMA (BB-60)

680 feet; 46,200 tons; 130,000 SHP; 27.8 knots. Nine 16"/45; 20 5"/38 (16 in SOUTH DAKOTA, built as Fleet Flagship); 1.1" and .50 AA, later 40mm, 20mm AA. Fire control as in NORTH CAROLINA.



IOWA (BB-61), NEW JERSEY (BB-62), MISSOURI (BB-63), WISCONSIN (BB-64) 887 feet 3 inches; 57,540 tons; 212,000 SHP; 32.5 knots. Nine 16"/50; 20 5"/38; 40mm, 20mm AA. 20mm removed, Korea; 40mm removed from NEW JERSEY, Vietnam. Fire control as in NORTH CAROLINA; Radar Mk 25 on Directors Mk 37 after WW II. ILLINOIS (BB-65), KENTUCKY (BB-66) begun, but never completed.

Five ships of the MONTANA (BB-67) class (925 feet; 70,500 tons; 172,000 SHP; 28 knots. Twelve 16"/50; 20 5"/54; 40mm, 20mm AA) were authorized in 1940, but canceled in 1943. These would have been enlarged IOWAs, sacrificing some speed for firepower and protection.

A Note on Sources

The documents, and extracts from documents, which make up the body of this work were selected from the holdings of the Ships' History Branch and Operational Archives Branch of the Naval Historical Center. Since the Office of Library and Naval War Records was originally established in 1884, the Navy has sought to collect and preserve the historical record of its operating forces and to make it usable to new generations. We hope that this publication will contribute to that end.

Notes, comments, and interpolations appear in boldface.

Acknowledgements

Without the strong help of the individuals mentioned by Dr. Spector in his foreword, this work could hardly have been begun, let alone finished. My special thanks go to my wife, Anna, who put up with the whole process from beginning to end.

Errors, whether of commission, omission, or interpretation, are solely mine.

I. WORLD WAR II

A. NAVAL GUNFIRE

Although shore bombardment became a principal task of older battleships in World War II, fast battleships were also called on to take their share of this mission. The new MASSACHUSETTS supported landings in North Africa in 1942 and, through the end of the war in the Pacific, fast battleships conducted gun strikes and furnished fire support for amphibious landings.

Landing at Casablanca

November 1942

On 8 November 1942 the new and the old--MASSACHUSETTS and TEXAS (BB 35)--supported American landings in North Africa. MASSACHUSETTS, off Casablanca, dropped 5 hits on the unfinished French battleship JEAN BART and put her one operational 15-inch turret out of action. She later engaged French destroyers, dodged torpedoes and sank two of the attackers. MASSACHUSETTS scored hits on a powerful battery at El Hank, but she lacked HC bombardment ammunition and her AP shells did little damage.

MASSACHUSETTS ACTION REPORT:

It is the consensus of opinion on this ship that JEAN BART only fired five or six salvos during the engagement. We know she was hit at least once as the aviator observed it. Before we commenced firing on her she put up a smoke screen...and kept it over her throughout the day, so that all fire was indirect, and spotting from aircraft was difficult.

Toward the end of the first run I was informed that El Hank had not replied for...four or five minutes, and the consensus appeared to be that El Hank was out of commission. This...proved totally in error. El Hank was also covered by a large dust cloud or used a smoke screen. We believe that shells from this force probably temporarily disabled El Hank, causing the crew...to seek shelter. After we had ceased firing, they repaired whatever damage took place and, through the remainder of the day, continued to fire spasmodically whenever we were in range.

This vessel ceased firing with 16" shells at JEAN BART and El Hank when the...number remaining was approximately 40%. Later we engaged enemy cruisers and destroyers and used up another 8%.

The final 7 rounds fired at El Hank from...about 33,000 yards were fired...to unload the guns through the muzzle. This salvo apparently caused a large explosion and it is possible that it destroyed one of the ammunition dumps.

In the future, if it is intended for men of war to bombard land fortifications, the ships...must be equipped with bombardment ammunition as armor piercing shells apparently do not accomplish extensive damage unless they make a direct hit.

DAMAGE INFLICTED BY ENEMY GUNFIRE

1000: Hit at frame 48, port, by an estimated 240mm shell. Angle of penetration about 70°. Shell pierced wooden deck and 60# STS deck and detonated after gouging a hole about one inch deep in the protective (second) deck. "Sail"* coil of Degaussing System ruptured, causing small electric fire which was readily extinguished with CO2. Also, wooden deck at hole started to blaze up, but was brought under control by fog from below and a stream from above. No personnel casualties..., and only a small amount of structural damage....

1057: Hit at frame 107, starboard, by what appeared to be a 240mm shell, striking at an angle of about 40° with the horizontal. The... shell... came from the starboard quarter, ...hit the deck, bounced up at an angle of about 40°, ...and detonated about 10 feet beyond. The shell did not penetrate the 60# STS deck..., but knocked out several rivets and made a dent about two inches deep. The shell detonated about six feet above the deck and about eight feet from the bulkhead. Fragments pierced stanchions, 20mm ready service boxes, 25# STS bulkheads Smoke from the detonation was sucked down in the engine room but was quickly dissipated.

DAMAGE ESTIMATED TO HAVE BEEN INFLICTED BY THE MAIN BATTERY

(1) JEAN BART - A six-gun salvo landed on the stern of this ship but had no visible effect on her main battery. Numerous near misses were observed, and her main battery was silenced after it had fired four to six salvos.

(4) EL HANK - An ammunition dump...about 1000 yards southeast of El Hank lighthouse appeared to blow up as a result of a direct hit.

MASSACHUSETTS also claimed hits on the Mole de Commerce, alongside which JEAN BART was moored; on ammunition dumps and moored submarines; on a cargo ship in Casablanca harbor; and on CL PRIMAUGUET and four destroyers. Action reports are contradictory; S.E. Morison credits **MASSACHUSETTS** and CA TUSCALOOSA with sharing the sinking of DD FOUGEUX, and **MASSACHUSETTS** with later sinking DD BOULONNAIS. **MASSACHUSETTS** landed five hits on JEAN BART. Two exploded belowdecks; two others penetrated unprotected portions of the hull, but did not meet enough resistance to trigger their fuzes. The fifth round, a dud, hit JEAN BART's turret and glanced against its barbette, jamming the turret in train and, for practical purposes, putting it out of action.

MAIN BATTERY FIRE CONTROL

Preparing for the battle, the fire control installation was checked and rechecked many times to insure that all possible removable errors were taken out of the system for the purpose of obtaining the smallest possible pattern with the minimum shift in MPI. All reports indicate that, with a few exceptions, the salvos had a pattern of about 2 mils in deflection and...200 to 300 yards in range. While engaging...light for-

*Phonetic alphabet.

ces numerous salvos were reported as straddling the target. In deflection the salvo would cover one-third of the ship and extend not over one hundred yards on either side. ...only one salvo...had an abnormal spread in deflection. This...was due to one turret not being matched in train. Several salvos ...reported as having excessive range patterns were also traced to mismatching by the gun layers. Nearly all of these salvos came near the end of the engagement and the crew was becoming fatigued. In these instances we had two guns match low. Firing was checked for several minutes, as all targets had been lost in the smoke. ...gun layers were again cautioned about matching pointers. When...fire was resumed...salvos then returned to...normal pattern size.

From this ...we have learned that, during prolonged engagements, the operating crews become fatigued and are, more than ever, subject to ...errors and ...casualties. The turret train layers are not under as great a physical strain as the gun layers,* as they steadily follow the pointer. The errors in matching pointers by the train layers can be expected to be normally very small. On occasions where the turrets were not matched at the instant of firing, they were offset by the same amount, which indicated the lag in personal reaction to a rapidly-moving problem. The gun layers have a more difficult problem, in that they are continually bringing their gun to the firing position and, then, back to the loading position. As they tire during the day their reactions become slower and it required a greater time for them to match their pointers. Also, in some instances, their matching was not too accurate. As these salvos are very powerful when they hit, this engagement clearly demonstrates the desirability...of...installation of full automatic features in train and elevation in all turrets.

Experiments...at the Naval Gun Factory in automatic operation versus personal operation clearly demonstrate the fact that men, watching the movements of a dial, fatigue rapidly. It was definitely proven that a man cannot match a moving pointer, within the limits of error required for automatic gun control equipment, for... much in excess of ten minutes. He will follow accurately for a few minutes, make a break, and then match up again and follow for a short period of time.

During the firing we had some difficulty with...weave in deflection. The cause of this...has not...yet been determined. When firing on...JEAN BART at times, by indirect fire, it was sufficient to move the salvos from just one side of the target to the other. We are hoping that the trouble is entirely within the Stable Vertical and can be corrected in the near future. The only pieces of Main Battery fire control equipment that have given us any trouble at all are the stable verticals.

Automatic Control in Elevation and Train for Main Battery Turrets

During the first phase of the battle...our primary target was... JEAN BART. She was lying...on a bearing...nearly normal to our mean firing course, which gave us a very narrow target in deflection. In or-

***MASSACHUSETTS' turrets had not yet been fitted for automatic control.**

der to hit, the turrets had to be very closely matched in train. With the existing conditions of yaw, crosslevel, and...necessary changes in course to maintain the desired firing ranges, we had a most difficult set of circumstances for hand-matching in train. An error in matching of 5 minutes* would probably mean a complete miss in deflection for an entire salvo. This happened several times. The need for train receiver regulators** is acute, and they should be installed in the turrets at once.

To reduce salvo intervals, continuous level and crosslevel fire is used by this ship. The range pattern, in most cases, is small, and errors of 5 to 10 minutes in matching in elevation have caused salvos not to straddle. Elevation receiver regulators are, thus, a crying need for the 16"/45...turrets, as hand matching in continuous level is not adequate.

Setting of Erosion during Battle

The battle was fought in three main phases. During each phase, all guns did not fire on every salvo. In the lulls between phases, it was thus necessary to correct initial velocity for the fastest gun*** and to correct the individual guns to the fastest gun by means of the initial velocity loss correctors in the gun elevation indicators. The turret officers kept track of the shots fired by each gun so that this procedure was possible. The...shots fired per gun varied from 66 to 115 for the engagement. Pattern size in range was, thus, kept normal even though erosion varied from gun to gun. This procedure is novel, and is mentioned only as a matter to be kept in mind by plotting room officers so that it will not be forgotten in the heat of battle. All guns should be star-gauged at first opportunity if a considerable number of rounds have been fired.

Indirect Fire

The entire first phase of the engagement was indirect fire on...-JEAN BART. ...BART was seen indistinctly for only a few seconds some time before tracking was begun. The haze and smoke in the harbor made it necessary to open fire with a range and bearing taken from the plotting table in Main Battery Plot. The only means of correcting the set-up in an hour and a half of rangekeeping and shooting was by means of Air Spot. During this time the ship maneuvered radically at speeds above 20 knots, closing and opening the range from 23,200 to 32,400 and reversing course. The rangekeepers were subjected to a test in indirect firing as, probably, never before.

The ship spotters never saw a single salvo fall because of haze and smoke. The air spotters were thus required to spot in range and deflec-

*Minutes of angle, 60 to a degree.

**Device which controls hydraulic train or elevation gear in response to electrical orders from the fire-control system.

***Gun with the highest initial velocity.

tion. The range spots were good but, during the early salvos, the air spotter had trouble with deflection spots. These deflection spots were all too meager. The usual difficulty of establishing the line of fire was a problem, but the selection of a position from which to make his spots was a far greater one for the air spotter. He was constantly beset by difficulties, including...hostile aircraft, antiaircraft fire, smoke, and sun glare. The position finally selected did not afford a good opportunity for estimating deflection during the early salvos. The range problem during the first phase was not troublesome but the deflection problem was critical.

RADAR

One of the great advancements in the last few years in Naval gunnery has been Radar. By constant practice, we have reached such a degree of perfection with the use of our radars that we depend greatly upon them for ranges during an approach in any kind of weather. If it is hazy, or the weather conditions are such that the target cannot be distinctly seen by the director trainers, we are able to stay on the target with...high...accuracy by following the Radar in train. Our radars have held up beautifully..., even during target practices with reduced velocity charges. But, when we commenced to shoot service velocity charges, ...the radars failed. FC Radar #1, used by Spot One, failed early in the day and was not back in operation until...practically all of the firing had been completed. FC Radar #2, used by Spot Two, was in and out all day and, at times when both optical and Radar ranges could be obtained, they varied so greatly that the spotter feared the Radar was not reliable for use. During the part of the battle in which we were engaging enemy light forces, neither Main Battery Radar was performing properly. We were set back...in that we had to operate entirely optically and could only bring a target under fire when it became visible through the smoke. This loss was felt very keenly and was costly in that many more salvos were required...than would have been necessary if we could have ranged, trained, and spotted by Radar through the smoke. It is urgently recommended that an immediate study be commenced of the effect of shock on all our Radars and equipment.

RANGEFINDERS

All rangefinders...functioned satisfactorily when it was possible for them to see a target through the haze and smoke, which was seldom. Considerable difficulty was experienced by the rangefinder levellers in keeping their rangefinders level or on the target with the present levelling equipment. The levelling drive installation should be redesigned to remove the excessive lost motion now present. The installation of...rangefinder stabilizers will greatly improve ranging. It is recommended that these stabilizers be gotten into the ship at the earliest practicable date.

MAIN BATTERY

Armor-piercing projectiles are not suitable ammunition for shore bombardment. When firing at...shore batteries, time and again we silenced the battery, apparently by driving the crews to cover. If we

would cease firing or shift to another target for...10 to 15 minutes, the battery would again come to life. To do a satisfactory job on a shore installation, high-capacity shells with instantaneously-acting fuzes are required. With such ammunition, these ships can be used effectively for bombarding shore installations in that their range, speed, and maneuverability are such that they can avoid enemy fire while, at the same time, delivering a high rate of fire on the enemy's fortifications. Unless it is possible to close the range sufficiently to insure direct hitting of a shore fortification, the objective should be to neutralize the battery instead of to destroy it as the necessary rates of fire for neutralization are very much less....

CONCLUSIONS DRAWN FROM EXPERIENCE OF AIR SPOT....

The two most difficult things about spotting a shore bombardment are (1) seeing the fall of shot, and (2) keeping in mind the line of fire between ship and target, especially when one or the other is out of vision.

Use of Bombardment Ammunition - It was virtually impossible to observe the impacts of AP projectiles which landed on the beach, the docks, or in the city. Water splashes were easy to see, but when the fall of shot was any other place it usually went unseen. I estimate that the action against...El Hank would have been about fifty percent more efficient, as far as expenditure of ammunition is concerned, had bombardment shells been used.

COMMANDER AMPHIBIOUS FORCE, ATLANTIC FLEET, COMMENTS:

Material Performance. The TORCH operation served as a severe material test for the heavy armaments of the capital ships engaged. Turret crews were called upon to serve their guns for long periods of actual firing time. The performance of turrets of battleships and heavy cruisers was excellent. The few casualties that occurred were...soon restored. Powder and shell supply was fast, and loading crews performed without casualty. It may be said, in general, that naval gunfire...gave substantial assistance to the landing forces and aided materially in overcoming enemy opposition.

Fire Control Information. Shore fire control parties and spotting planes should amplify their requests for fire support by including such information as location of own front line, type of target, type of fire required, proposed movements of own troops, and any other pertinent data that will be of service to the ship furnishing fire support. All shore fire control parties should keep the Attack Force Commander informed of targets under fire.

Bombardment of Nauru Island

December 1943

To prevent Nauru from being used as a base for attacks on our forces, a task group including two carriers and the battleships WASHINGTON, NORTH CAROLINA, MASSACHUSETTS, INDIANA, SOUTH DAKOTA, and ALABAMA bombarded the island. Since this was the first Pacific gunfire strike carried out by the fast battleships, the firing ships reported their methods and results in detail.

WASHINGTON ACTION REPORT:

The ship was informed of the probability of the bombardment of Nauru about ten days ahead of the actual bombardment. Preliminary studies of the problem were made during this period. The film on Nauru and the model of Nauru furnished by JICPOA were studied, as were the intelligence folders and current intelligence on the Island. When the Task Force Commander's bombardment plan was received, the Gunnery Department studied the target assignment and prepared a bombardment and salvo plan to cover the assigned areas. The Navigation Department prepared track charts of the proposed targets. By conference between the Navigation Department and the Gunnery Department, the best possible visual and radar targets for navigation were selected and given letter designations in the middle of the alphabet which facilitated identification. The X3JW* and the 3JW* circuits were crossed, with the intention that visual bearings would be available to the Navigator, Flag Plot, Combat, and Main and Secondary Plot. However, due to unforeseen personnel difficulties, none of these visual bearings were put on this circuit. The various plots were kept independently, the Navigator's plot by visual bearings, the Gunnery plots by combination of optical bearings and radar ranges, and Combat plot by radar ranges and bearings. Under the visibility conditions which obtained, it is believed that better plots would have resulted in some stations if visual bearings had been disseminated as planned.

A conference was held during the afternoon of D-2 day, ...attended by the Captain, all Heads of Departments, all senior officers down to the fourth lieutenant in seniority, plus key officers in each department. At this conference, the Navigator presented and discussed the Navigation Plan. The Gunnery Officer presented and discussed the Fire Plan to be used by both batteries, referring frequently to the track chart of the Navigation Plan to point out the expected position of the ship during various phases of the Fire Plan. Each officer present...was given an opportunity to stress important matters under his cognizance and their relationships to fire control, ship control, and damage control. Care was taken that these discussions brought out clearly the following points:

Own surface forces: in the bombardment formation (Task Group 50.8.1) and the nearby carrier formation (Task Group 50.8.5). Officers present were fully informed as to...our own forces they might see or pick up on the radar screen, and what their probable formations might be.

*Ship's internal fire-control telephone circuits.

Where our own forces might be seen at various times during the bombardment. What our own forces were supposed to be doing at various times.

Time, with relation to H-hour, that such observations might be expected in the various sectors.

As the separation of the forces developed, the carrier force (Task Group 50.8.5)(which, the conference was informed, would probably be within visual and radar range, and on the disengaged side of the bombardment formation to the west and northwest) was widely separated from the bombardment formation (Task Group 50.8.1), and was not encountered, visually or by radar, during the bombardment.

The officers present were informed as to probable enemy forces to be expected: surface, none; and air, moderate, if any enemy planes at all would be airborne. Information was disseminated as to the air plan of our own forces and the probable location of our own aircraft.

The conference was then thrown open to discussion as to various contingencies which might arise, with the warning that comments must be specific and well-prepared, and that a general conversation was not desired.

This conference occupied 51 minutes. After this conference, an instruction period was scheduled for all divisions on D-1 day, at which time officers present at the conference disseminated information to the lower echelons concerned, particularly to junior officers and key enlisted personnel. Special attention was devoted to assuring that all lookouts, particularly sky lookouts in Condition ONE, were thoroughly instructed. As a result of this conference, and the subsequent instruction period, all fire control, ship control, and damage control personnel had a clear and complete picture of the prospective operations.

Comment should be made on the great value of the model of Nauru Island furnished by JICPOA. This was used for familiarization of all key officers and enlisted personnel. Lookouts were given an opportunity to examine it through reversed binoculars from the directions from which it might be sighted and approached, and from the relative height of eye which they would be using. This model was also used for familiarization of aircraft spotters with the target areas and the targets assigned to the ship. Air spotting drills were effectively conducted, using this model and white cotton splashes in conjunction with bombardment rehearsal of the main battery.

ALABAMA ACTION REPORT:

First contact was made on the Island by the various radar equipments as follows:

Mark 8 #1	48,000 yards, bearing 196° T. - 0605
SG #2	45,000 yards, bearing 192° T. - 0631
SG #1	41,000 yards, bearing 189° T. - 0638
Mark 4 #1 & 2	40,000 yards, bearing 189° T. - 0639

Comment by Radar Officer on Performance of Mark 8:

At 47,000 yards the outline of the cliffs of the Northern end of the Island was quite distinct on high speed scan, and as had been previously planned, was used as reference point for finding on the screen the signal corresponding to Point Able. The following procedure was used in identifying Point Able on radar screen:

(a) Predicted pictures of the Mk. 8 screen had been drawn previously for points along the predicted approach course and firing course. From a study of the Relief Model it has been predicted that the Cantilever* would be picked up bearing 195° T., distance 43,000 yards, so a radar view of the Island to exact scale was prepared of this point for use with high speed precision sweep. It had also been predicted that on this bearing Point Able would be 4,700 yards farther in range than the nearest land and would be on the right tangent to the Island.

(b) With the aid of this information the tracking point was identified earlier than it would otherwise have been. When the Island bore 195° T. a range was taken to the nearest point of land. 4,700 yards was immediately added to this reading, and the range step was then cranked to the resulting range. The Cantilever was tentatively identified at once on the screen by its relatively strong signal, and by its location with respect to other predicted signals.

Tracking was commenced at 43,000 yards, as had been planned, using optical bearings and radar ranges. It is believed, however, that full radar control would have been feasible throughout most of the bombardment. As it was, radar bearing was used intermittently during periods of poor visibility resulting from smoke.

Comment by Spot One:

After initial contact and establishment of bluffs at the NW end of the Island, no tracking points were immediately observed so director was kept trained on right tangent. What was believed to be the Cantilever was picked up by rangefinder at about 44,000 yards. Shortly thereafter, from a comparison of the Mk 8 screen with scaled pictures which had been prepared the tracking point was tentatively identified on the screen and tracking was commenced. At 40,000 yards radar the rangefinder range was 39,900, and the two instruments agreed exactly on the angle of train. This and immediately succeeding comparisons made possible the early and certain identification of the tracking point. Still early in the approach period three pips coming onto the screen were identified as the phosphate plants.

The Mk. 4's were able, chiefly by means of prior instruction of the operators in what to look for, to provide fairly consistent ranges throughout. Secondary battery fired Mk. 8 range line, but checked Mk. 4's continuously and could have used the latter ranges with reasonable success.

*A prominent pier, used as a radar reference point.

Main Battery

Firing was done in accordance with the fire schedule. Cantilever pier was tracked using forward FH radar and optical bearings and positions plotted each minute on a chart 1,000 yards to the inch. These positions were used to determine ranges and bearings to tracking points in the respective areas. Tracking errors were negligible.

Control spots for coverage were computed using an overlay grid oriented to the line of fire on a large scale chart. These often varied appreciably from tentative control spots listed on the fire schedule. Control spots were chosen to give coverage of assigned targets in accordance with information from plane and top spotters.

Salvo one was fired on "commence firing" from the OTC, and thereafter salvos were fired on time as indicated on the fire schedule. On salvos 2 and 3, turret 3 could not bear, but caught up by firing 3 guns on salvo 4. On salvo 30, turret 2 and 3 each failed to fire one gun necessitating the firing of salvo 32.

Salvo 1 was fired with a total deflection pattern of 400 yards by use of horizontal parallax correctors. The MPI of this salvo was in the center of the assigned area and coverage was almost complete. Subsequent salvos were fired with a 100-yard deflection pattern.

ACTH in range was used as determined for AP projectiles, and was very close to correct. A left ACTH of about 4 mils was used on the basis of reports from other ships, and an additional left ACTH of 5 mils was required throughout.

High order detonation was obtained on all impacts observed.

Secondary Battery

Bombardment was conducted in accordance with prepared procedure and fire schedule, with the following exceptions:

(1) Fire was opened at +20 minutes of Main Battery commence-fire instead of at +17. This...was necessitated by the fact that the target area was beyond maximum range at +17 minutes.

(2) Computer was shifted to LOCAL, indirect control, twice during firing when Point Able (Cantilever Pier), the tracking point, became obscured to Sky 2* by smoke. In each instance of returning to SEMI-AUTO, no change in bearing solution was evident.

(3) Commencing after 23rd salvo, salvo interval was decreased to 10 seconds. This was done to bring completion of firing to within time allowed.

(4) A 41st salvo was fired...to expend two remnants resulting from 2 guns having missed a salvo in the shift to a 10-second interval.

***Sky 4: After secondary-battery director. Main 2: after main-battery director. Sky 2: port secondary-battery director.**

ALABAMA secondary battery bombardment doctrine and procedure provides for direct type, indirect type, and offset type control. The doctrine and procedure for offset-type control were selected in advance for the Nauru bombardment after consideration of the factors involved, and were not departed from.

Tracking errors are considered negligible. Mark 8 radar ranges with secondary battery optical bearings were used. Secondary battery optical ranges were transmitted in standby, and were accurate and consistent enough to have been used successfully for the periods in which the tracking point was visible to rangefinder operators. Mark 4 radar operators had been prepared in advance to cope with the problem of ranging on the Cantilever, and were able to provide continuous, though slightly inconsistent ranges throughout. It is believed they obtained the maximum possible performance of the Mark 4 in a problem of this nature.

Control spots were determined from a grid overlay used in conjunction with a large scale plot of the tracking point and target area. Grid was oriented to true bearing of line of sight to Point Able by setting to the bearing obtained from advancing ship's position one minute along the track. Since course was steady throughout firing this was very accurate. No difficulty was encountered in the employment of this method and accuracy obtained is believed to have been satisfactorily high. Post-firing check of ranges, bearings, computation errors and errors of application indicates that the seven subdivisions of the target area were properly covered. This, of course, is not conclusive proof of success, since, under the circumstance of almost no fall-of-shot observations, the accuracy of the gun ballistic and arbitrary ballistic remain unverified. However, in connection with these latter ballistics, past performance leaves no reason to believe the gun ballistic was not accurate, since it was obtained as heretofore. An extremely successful calibration practice, conducted just before the operation with this eventuality in mind, was fired at precisely the range at which bombardment fire was opened. The ACTH then determined was IN 278 yards. IN 250 yards was used on bombardment.

NORTH CAROLINA ACTION REPORT:

Control

Main Battery

The control procedure followed the standard bombardment procedure used by this ship. The position of the ship relative to the target area was continuously and accurately plotted in CIC by means of information obtained from radar and optical ranges and bearings to prominent landmarks. The rangekeeper continuously tracked the seaward end of the cantilever pier. Spots were applied to the rangekeeper...to hit the assigned targets. Immediately after firing a salvo, the control spot plus ...arbitrary corrections to hit determined from previous salvos was applied for the next salvo. As aircraft spots were received, they were applied in addition to the already-calculated offset. This system was simple and effective. Invariably, salvos had to be held for the time

schedule rather than for "Plot Ready". A salvo interval of 20 seconds greater than the time of flight would have been possible had it been desirable.

Secondary Battery

The secondary battery control procedure followed in general that outlined above for the main battery. While firing in the first target area directors and computers tracked the seaward end of the cantilever pier, offsetting gun train order and gun elevation order by means of control spots in order to hit the desired targets. When fire was shifted to grid areas G1 and G2, it was necessary to shift the point being tracked to a point closer to the target area. A radio tower on top of the hill was selected. At this time heavy smoke obscured the entire target area so that no points were visible, nor were any satisfactory radar targets observed. Combat Information Center furnished the controlling computer with continuous ranges and bearings to the radio tower and firing at the second target area was accomplished in complete indirect fire.

Post firing analysis does not explain the large ACTH in the deflection in main battery firing. The average ACTH in deflection was left 30 mils and in range was Zero. The only possible explanation is that the position of the target area relative to the seaward end of the cantilever pier may have been in error on the charts. A discrepancy of about 400 yards in the chart would have caused this error in deflection. Fortunately, the deflection error was observed, both by the air spotter and by Spot One,* on early partial salvos, fired specifically as spotting salvos, so that few projectiles were wasted.

The aviator reported that secondary battery salvos landed within the main battery area during the early phase. He was unable to accurately determine the positions of fall of shot of the secondary battery projectiles after shift in targets because of the confusion existing in determining own salvos. Other battleships and several destroyers were firing at the landing strip immediately adjacent to our assigned area.

Battery performance was excellent. The main battery fired salvos as planned without variation. Loading times were shorter than those obtained in drill. Secondary battery salvo intervals were originally 15 salvos were fired. Due to misfires, partial salvos were fired upon the completion of the 40 planned salvos to complete ammunition expenditure.

WASHINGTON ACTION REPORT:

Fire Control for Bombardment

The fire control installations of these vessels are well designed for firing against surface craft and aircraft, but no adequate facilities have been provided for the handling of the problems of shore bombardment. In this connection almost every ship has designed equipment of

***Gunfire spotting station in forward main-battery director.**

its own. It is felt that better results would be obtained if a few standard items, such as drafting machine scales, were furnished by the Bureau of Ordnance for the control of bombardment. Many action reports on shore bombardments have emphasized the need for charts of uniform scale to be issued in advance of a scheduled bombardment. In view of the many amphibious operations which will be required in this war, it is believed that each battleship and cruiser should be furnished, immediately, a set of charts to this standard scale of all probable early objectives, followed, as soon as possible, by a set of charts for all probable future objectives. Similar charts should be available in the advanced areas for issue to destroyers as required. This ship recommends contour charts of 1,000 yards to the inch and detailed target intelligence charts of 500 yards to the inch.

In connection with the equipment problem, the Pearl Harbor Navy Yard built bombardment tables for both main and secondary battery plot in accordance with designs of this ship. The table in Main Battery Plot, which also serves as a navigational plotting table for Auxiliary C.I.C., has a space allotted for a dead reckoning tracer. With the addition of such a dead reckoning tracer, preferably of the destroyer type, the problem of firing a shore bombardment while the ship is maneuvering would be greatly simplified. The systems used by the Main and Secondary Batteries in this bombardment are described below:

Main Battery

All Main Battery salvos were by indirect fire. A description of the methods used follows: Ship's track was plotted on the bombardment table in Auxiliary CIC (Main Battery Plot) using a scale of one inch to one thousand yards. An exact scale photograph of an Army terrain map of the island, showing previously selected radar and optical points of aim, was used in conjunction with this track. A large drafting machine scale, manufactured by ship's force, enabled the plotter to extend his track to a range of 36,000 yards. Initially the track was plotted using optical bearings of tangents and both optical and radar observations of peaks of the island. When the Cantilever Pier was definitely identified optically and on the Mark 8 Radar scope, Director Two* was placed on the pier and all further tracking was done using optical bearings and radar ranges measured to the pier. The controlling rangekeeper was set up to generate a solution on a reference point near the center of the target area assigned this ship. Prior to the time of opening fire, several setups on this point were given to the controlling rangekeeper, the later ones serving as a check on the accuracy of the earlier information. From the time of commence firing, the controlling rangekeeper was allowed to generate without correction, it being felt that any error which might develop would be rectified by spots.

Target points were selected prior to the bombardment in an attempt to cover the target area thoroughly and at the same time concentrate on primary enemy installations within the area. The target for each salvo was prearranged, and a new range and deflection offset was applied to

***After main-battery director.**

the controlling rangefinder before each salvo using the predicted bearing of the reference point for the time of the salvo. Spots received were plotted on the chart in such a way that the measured offsets for later salvos included corrections for error of previous fall of shot. Responsibility for properly covering the targets rested with the Spot Coordinator, who had full authority to depart from the schedule.

Spots from...aircraft...and spots necessitated by the shifting of targets were handled by the Spot Coordinator, using a plexiglass grid. The horizontal scale along the central line, which is the 20,000 yard line of the scale (other range lines run from the origin at various angles to this one) is graduated in 100 yard increments; the scale along the bottom is divided into mils. Deflection spots in yards may be converted to mils by running parallel to the diagonal lines under the range line corresponding to present range is reached and then travelling along a vertical line to the mil scale. The grid is aligned in bearing by a drafting machine. A range scale on the drafting machine arm permits the grid to be positioned in range.

An illustration represents the following situation: The rangekeeper is tracking in generated a reference point "R". Two salvos have been fired in a target "T₁". The first fall of shot resulted in a spot of approximately Up 120 yards, left 50 yards and a point "A" was plotted in this position relative to "T₁". The second salvo was fired at Point A and resulted in a spot which when plotted from A located Point B. The mid-point between points A and B give the location of a fictitious target. The distance from T₁ to this mid-point is the spot to be applied as the result of the two salvos. In shifting to a second target T₂, a fictitious target C is plotted in relation to T₂, separated by the previously determined spot. The necessary correction from the reference point (R) to point (C) is obtained by placing the zero point of the range scale at the reference point. The grid is then positioned with the central scale line over C. Then the range spot is picked off of the range scale at the central line (in this case Up 1100). By following the proper lines, the deflection spot is seen to be 5 mils right (at a range of 22,000 yards).

Ballistic corrections for height of target and for difference between high-capacity range table values and the values generated by the computer were applied to the spot knobs in such a way that the difference between the total spot counter and the partial spot counter represented the ballistic spot. In this way, a new ballistic could be entered at any time by merely setting it on the dial and pushing the knob in, thereby returning the partial spot dial to zero. The spot for offsetting a target point from the reference point was then set on the partial spot dial without pushing in the knob.

As previously mentioned, Director Two remained on the Cantilever Pier throughout the firing. Director One received designation from the controlling rangekeeper and, hence, was trained on the target area. The field of view from both directors was sufficiently large to enable personnel to see the entire target area as well as the Cantilever, but the blanket of smoke prevented either director from furnishing any usable information regarding the fall of shot. As expected from the experience

gained in drills, the Mark 8 radar in the plotting room proved itself invaluable for bombardment. When the Mark 8 went out of commission, tracking continued with optical ranges.

The use of a universal drafting machine with a scale sufficiently long to allow plotting at the maximum ranges of the main battery has many disadvantages. The machine is clumsy to handle and lost motion inherent in the instrument becomes magnified when the longer arm is used. Unless some better means is found, it is believed that the method used by the secondary battery to determine offsets, i.e. moving the target area and leaving the ship at the center of a large compass rose, will be adopted.

Secondary Battery

Except for the extra salvos fired at the barracks area, the Secondary Battery used indirect fire from the plotting room (stable element key). Verbal orders to the mounts originated at the controlling director, which was trained on the specific targets during firing. Another director stood by to fire on targets of opportunity. The latter director fired the extra salvos by direct fire on the barracks area upon completion of the scheduled bombardment.

The grid used in Secondary Battery Plot proved effective in simplifying the bombardment problem. This grid, constructed of a sheet of heavy cellulose acetate, is ruled off in accurate one-inch squares and has a wedge for attaching it to a standard drafting machine. The chart of the bombardment target was drawn in ink on the under side of the grid with target locations, possible tracking points, and tangents indicated for ready reference and use. In the center of the grid, a set of circles indicate by their radii the distance the ship travels at speeds of 10, 15, 20 and 25 knots. A small hole is placed at the center of the circles to enable the making of a pencil mark on the paper beneath. The grid is used in conjunction with a large-scale mooring board which has divisions of one degree and 200 yards (to a scale of one thousand yards per inch).

Employment of the grid is as follows: Using the best available source of range and bearing, the grid point is placed over the mooring board in the proper location. These values of range and bearing are obtained by phone from the Main Battery Plot following a "Mark". At the "Mark", a stop watch is started, the point on the chart placed over the range and bearing on the mooring board, and a pencil mark made below the hole in the center of the speed circles. The cellulose sheet is then moved in the direction of the ship's movement until the pencil mark is seen to lie on the circle of the ship's speed. The range and bearing of the target is then read under the target's position on the cellulose sheet and set on the controlling computer. When the stop watch indicates 45 seconds the computer time motor is started, thus commencing generation of range and bearing of the target. Repetitions of this procedure are used for checking. In these checks, at the end of the 45 second period the value sent to the computer should appear under pointers of the range and bearing dials. If...not..., a small adjustment is made.

After opening fire, the cellulose sheet is moved along over the mooring board as ranges and bearings are received from the Ship's Position Talker. When spots are received, they are marked in ink on the surface of the grid to indicate the location of the fall of shot and provide a reference for the application of spots. Using this method, it is easiest to set spots by the present-range and generated-bearing knobs.

The east end of the runway was used as a reference point for air spots, since this was the only clear reference in the assigned target area. As the location of the fall of shot was marked on the surface of the cellulose sheet, the spots required at the computer to move the fall of shot to the next target was immediately apparent.

NORTH CAROLINA ACTION REPORT:

Detailed information on the target area made possible careful planning and successful execution of this bombardment.

The ability to fire complete indirect fire with no visible point of aim made possible the firing of the secondary battery at the assigned targets in grid Areas G1 and G2.

The performance of material and personnel was up to the standards set in previous actions by this ship and was all that could be expected.

All 5" projectiles were loaded in the upper hoists with their bases down, thereby preventing setting time fuzes off "Safe". There were no prematures from this ship. This procedure is considered sound and is recommended for all future bombardments.

There were no material casualties affecting gunfire. The concussion due to main battery gunfire caused minor damage to certain hull fittings and equipment around the turrets.

WASHINGTON ACTION REPORT:

Although plane spot was maintained, the heavy clouds of dust and smoke covering the target area, and the interference caused by many ships firing at near or adjacent targets, precluded efficient spotting. In spite of this, however, a careful examination of many excellent photographs taken by the planes of the USS BUNKER HILL, during and after the bombardment firing, show that the targets assigned to this vessel were very effectively covered. I attribute full credit for this to the excellent preparation of the Gunnery Department.

MASSACHUSETTS ACTION REPORT:

Although the use of these heavy ships for such a mission might be questioned, it is desired to point out that the action herein reported did more to raise the spirits of the crew of this ship than all the efforts put forth in other ways. It is perhaps true that more rounds were fired than were necessary to accomplish the obtainable physical results at the target, but the fact that firing was done at a Jap was enough to renew the men's feeling that they were actually in the war. Perhaps fewer rounds and slower firing would have accomplished as much. It is

SOUTH DAKOTA ACTION REPORT:

The following specific tasks were assigned to SOUTH DAKOTA...

- (a) Fire one 9-gun 16-inch salvo into a designated area.
- (b) Cover two 500-yard squares with 63 16-inch HC projectiles over a 15-minute period.
- (c) At the end of the first 15-minute period, ...take an additional area, 500 yards square, under fire. ...63 projectiles and...15 minutes were provided....
- (d) Cover one 500-yard square with 400 5-inch projectiles.
- (e) Destroy all targets of opportunity.

The nine-gun 16-inch salvo was fired with a deflection spread of 300 yards between turrets and a range spread of 600 yards between the high and low guns of each turret. The basis for the size of the spread was the information contained in BuOrd conf. circular letter A47-43.* An examination of the assigned area indicated that sufficient saturation and the effect desired would be obtained by the use of this spread.

The few air spots received indicate that the areas assigned were properly covered. When the main battery was shifted to the second target area in which a structure identified as a radio installation was seen, the air spotter reported that the second salvo in this area demolished everything at that point. No targets of opportunity were fired upon. If the information from the aircraft spotter concerning buildings on the shore remaining intact had been received, the 5-inch battery could have been used to better advantage on these targets.

The following conclusions are drawn from the results of this action:

(a) Lacking an enemy surface target, this bombardment is believed to have been an extremely valuable influence in drawing the units of the fast battleship type of combatant vessel together as a mutual supporting and effective fighting group. The intangible effect on the temperament and morale of personnel is equally important. It is expected it will manifest itself in a greatly increased interest in the individual's job, an increased desire to do damage to the enemy and increased fighting efficiency.

(b) In future bombardments, where the opposition is light, the fire plan should be much more deliberate. Fire should be checked to allow the smoke and dust to clear away if found necessary. With good spotting from the air spotter it should be possible to demolish any target. It is believed that three-gun salvos are sufficient for any type of target to be encountered.

NARRATIVES

MAIN PLOT:

At 0645 the turrets were trained out to a general relative bearing line and told to get up High Capacity ammunition. At 0648 Main Battery

Director One identified the cantilever by radar, and both rangekeepers commenced tracking this target. At 0650 watches were synchronized with Combat, and the ship's track was started on our plotting table, using ranges and bearings off rangekeeper #2, which was still tracking the cantilever. At 0653 Director One identified their target, optically, as being the cantilever. ...we were ready for spotting. At 0655 order was given to turrets to load and lay. Range was about 30,000 yards at this time. At 0658 rangekeeper #1 was shifted to regenerative setup, and corrections applied to correct solution to point of aim of first salvo. At 0659 turrets...matched pointers in hand, as previously instructed for the opening salvo. At 0702...the first salvo was fired. As soon as possible, salvo #2 was fired, aiming at a point in the water 400 yards short of the target area. Our planes reported salvos...landing on the beach, and the third salvo went out aimed at the gun emplacement on top of cliff in our area.

About this time, the ship came left and turret #3 was forced into the stops. Turrets #1 and #2 continued firing, using 2-gun salvos, and Conn was asked to come right, if possible, to bring turret #3 to bear. Turret #3 was told to stand by to fire two guns per salvo, as soon as she could bear, ...to catch up with the fire schedule. No good spots were received, and we had to assume we were somewhere in the area during the next four salvos. After four salvos, the ship came right and turret #3 was able to reopen fire. The following four salvos were 4-gun salvos, with turret #3 firing two guns per salvo. The 6th salvo was spotted as falling in the water, short of the target area, and an up spot was introduced to cover the building and town area. Fire was laddered across this area without subsequent spots until the supply dump was reached, where about three more salvos were fired. The 19th salvo was shifted, still without any further spots, to the buildings on...top of the bluff, which were in our area.

After the 22nd salvo, fire was checked while the turrets reset their IV loss, and the rangekeeper was shifted to set up for the Radio Station.... Fire was resumed in about 40 seconds, and a spot of R030 was received on the 24th salvo. Corrections were applied and, after the 26th salvo, our planes reported the target covered with smoke and dust. The gunnery officer...believed the target destroyed. Three more salvos were fired at this target, after which fire was shifted to...possible fuel dump, ...which seemed worth taking under fire. Fire was laddered, after about 3 salvos, into this target.... The firing was completed at 0733....

Throughout the bombardment the spots received were very few and far between, and it was necessary to assume where our fall of shot occurred ...to carry out our time schedule. As best we could, we took all targets under fire, and our shifts were corroborated by some spots and not with others. It seems to me that the poor position of our spotting planes, and ...poor communications with...overlapping frequencies were largely the cause of so much blind firing.

MAIN BATTERY PERFORMANCE

In general battery performance was excellent. A salvo interval of 46.2 seconds was maintained through the first twenty-two salvos and for the last twenty-three; an interval of thirty-seven seconds was maintain-

ed. On the whole, gun crews and turret officers had no difficulty in maintaining this interval. From salvo twenty-five through salvo thirty-seven, the salvo interval averaged 29.5 seconds, and in some cases was as low as 15 seconds. Despite the reduction of time between salvos, gun crews had ample time to make good smooth loads, and there were no gun room or loading casualties which caused a gun to miss a salvo.

SECONDARY BATTERY PERFORMANCE

The 5" battery was scheduled to open fire at H+1 time, with point "Able"* at 17,000 yards. Actually, the battery commenced firing at H+20, with point "Able" at 16,000 yards. Eight-gun salvos at 15 second intervals were used.

The first salvo was offset to hit in the water in grid square Option* One, and the splash was sighted in this square. Thenceforth the MPI was shifted continuously to cover the assigned area. Spotting plane observations confirm the fact that the area was covered, with no stray salvos except near the end of the bombardment when several bursts were seen on the bluff in areas Prep* and Queen* Five.

Observation from Air Defense and Directors was limited by smoke and dust over the target. However, the cantilever pier and the cleared area along the northwest landing ship were usually visible and were used to judge the location of the bombardment area. Tracers could be followed until lost in the smoke of the target, and they seemed to be headed the right direction.

After approximately 30 salvos, the interval was reduced to 12 seconds and after salvo #36 rapid continuous fire was used to complete the bombardment on schedule. Because of the difficulties of keeping a check of rounds fired during rapid fire, the ammunition allowance was exceeded by 82 rounds before "cease firing" was given.

At the beginning of the rapid firing phase, several splashes were sighted in the area Jig* One, northwest of the cantilever, 1,000 yards short of the 5" area. At this period the only 5" firing was from this ship and the three destroyers astern. The splashes were probably ranging salvos from one of the destroyers, but were erroneously spotted as an error in this ship's 5" fire. The resulting up-spot was late in being applied and probably accounts for the bursts sighted on the bluff beyond the 5" area as reported by plane spotters near the end of the 5" bombardment.

SPOT I

The island was sighted at about 50,000 yards and, shortly thereafter, Hill #9 was identified. Tracking by optics was begun at ranges above 45,000 yards. The island could be seen on the radar screen, but the pips were very weak and no definite point on the island could be identified at ranges above 45,000 [yards] by radar. At about 45,000 yards the cantilever structure was picked up optically, and the point of aim was

*Phonetic alphabet.

shifted to it. Almost immediately thereafter the cantilever was identified on the radar screen, and tracking proceeded using optical bearings and radar ranges. At about 40,000 yards the cantilever was giving a stronger pip than is normally given by a battleship at the same range.

Director One was the controlling director until just before fire was opened, at which time Director Two took control and Director One followed designation from Plot..to observe the fall of shot. Shortly after opening fire, Director Two reported...they had lost the target. Director One trained on the cantilever, and took control for about two salvos until Director Two reported being on the target. Director One then again followed designation from Plot. About the middle of the firing period Director Two reported...a fuse...blown in the radar, and Director One again trained on the cantilever but, at about the same time, Director Two reported...they were again in commission, and Director One trained back and matched designation from Plot for the rest of the firing.

Accurate spotting from Director One would have been impossible, but ...by...a few salvos, placed in the water at intervals during the firing, it would have been possible to cover the area fairly well if no plane spots had been available.

SPOT II

In future bombardments, where the opposition is as scarce as it was here at Nauru, the fire plan could be slowed up letting the smoke clear and enabling spotting from directors. With excellent points of aim, such as we had here..., many more buildings could have been destroyed had we used director fire from Director I.

MAIN BATTERY PROCEDURE

Prior to D-Day, all director and spotting personnel were thoroughly indoctrinated with general information on the target area.... The areas to be fired upon, and all possible radar targets, were marked on... large terrain maps..., and each director and...control station was furnished with one copy. Large-scale copies of an aerial photograph...were made up with a superimposed grid for...aircraft spotters and spot conversion in Plot. All...reference points were numbered, and all targets lettered, for ease in designation. A family of curves was drawn up for use in determining IV corrections for various target heights at various ranges. A...grid, used for conversion of grid spots to range and deflection spots, ...was available for use. The tentative ship's track...was laid down on the plotting table in Plot and on the DRT in Combat for a check on ship's position. A...target outline, with all possible tracking points marked, was also drawn in on these plots, so...position relative to any reference point or target might be taken off these plots. Drills were held, and the entire bombardment rehearsed, several times prior to actual firing.

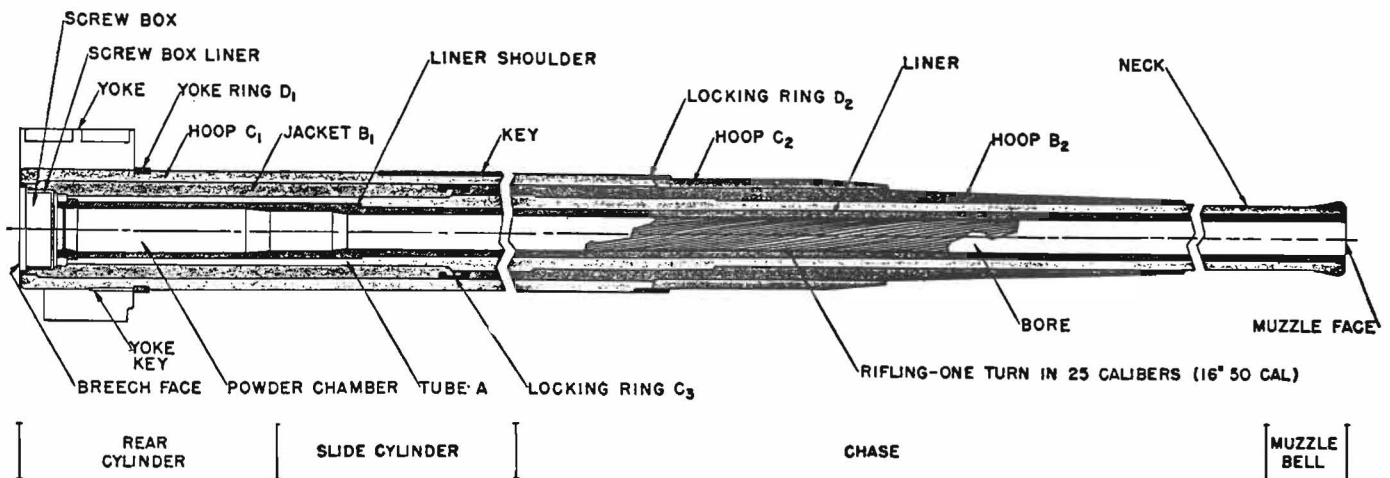
Main Battery Directors One and Two pick up reference points...and transmit range and bearing...to Plot and Combat, where they are used to plot...ship's position and determine ship's track. As soon as a good reference point is picked up...and positively identified, both rangekeepers begin tracking it...to determine any...current and...provide a basis for a firing setup on the controlling rangekeeper. If a good reference

point is not available, the setup for the controlling rangekeeper is taken off the plot of ship's track in Plot. In such a case, data for this track is received from Combat, using information available. If a good reference point for tracking is available, the rangekeeper is controlled by the director until just prior to opening fire, when it is shifted...to become regenerative, leaving the same problem running. A range and bearing correction is then introduced to shift the theoretical tracking point from the reference point to the point of aim for the first salvo. If no such reference point...is available, the control rangekeeper is set up using range and true bearing to the target...taken from the plotting board.

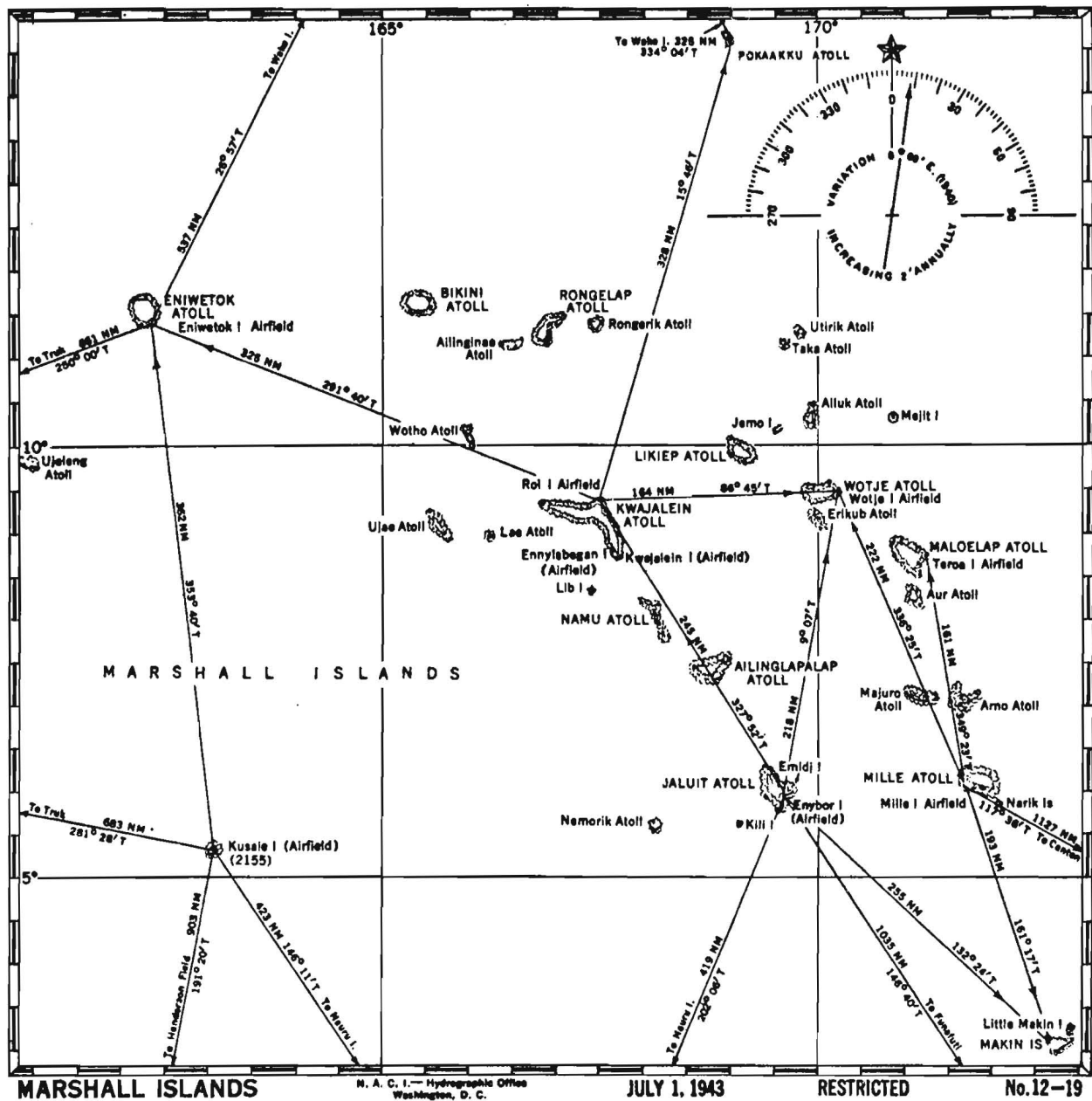
Range and deflection spots are applied to correct for range-table differences between HC and Service [AP] ammunition, and an IV correction is applied to correct for target height. Level and crosslevel are continuously received from the Mark 43 Stable Vertical, and all firing is done using the indirect method.... Throughout the firing, Director Two remains on the reference point, which is continuously tracked by the standby rangekeeper. This solution is used to furnish range and bearing to secondary battery plot..., and also to check the setup on the controlling rangekeeper. The plot of the ship's position is continued throughout, using information [from the] standby rangekeeper. Director One is controlled, in train, in "Automatic" by the controlling rangekeeper...to be able to augment air spots by optical spots.

Master Chief Fire Controlman (SW) Stephen Skelly (Fire Control Gunner, USS IOWA) comments on SOUTH DAKOTA action report:

- Fire plan should be much more deliberate.
- Fire should be checked when target is obscured.
- With good air spot, it should be possible to demolish any target.
- 3-gun salvos are sufficient for any target.
- SOUTH DAKOTA was on the right track long before Saipan [see p. 43]!



Cross-section of a 16"/50 gun. A series of concentric outer cylinders, called hoops, are heated and shrunk around an inner cylinder, the A tube. As the hoops shrink, they tightly grip the cylinders within them. Locking rings hold the hoops in place. The entire gun is then heated and shrunk onto a rifled liner. The assembled gun forms a reinforced cylinder capable of withstanding the enormous pressures of firing.



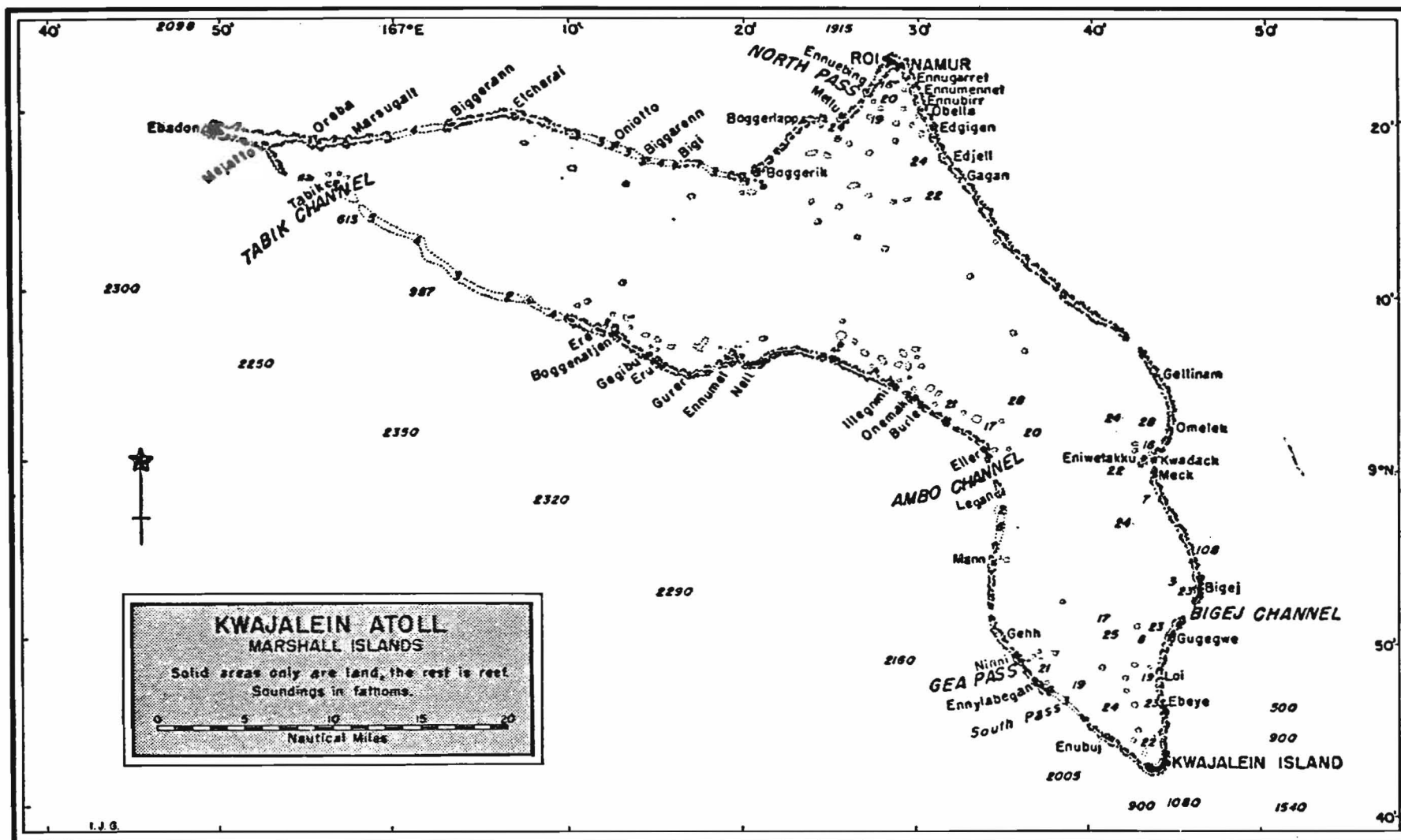
Bombardment of Kwajalein, Marshall Islands

January 1944

Battleships conduct a pre-invasion strike at Kwajalein Atoll. WASHINGTON's report refers to individual islands by code names; Porcelain, for instance, is Kwajalein Island, the principal island of the atoll; Ebeye Island is Burton. MASSACHUSETTS, on the other hand, uses actual geographic names, and mentions her use of previous combat experience.

WASHINGTON ACTION REPORT:

Porcelain was picked up first by Director One's Mark 3 Radar at 0907 at a range of 42,500 yards, but a suitable visual point of aim could not be picked up until 0944. Visibility up to this time had been very poor due to heavy squalls. At 0950 WASHINGTON reported having a



satisfactory solution. On orders from the Commander Task Unit, one 6-gun and one 3-gun salvo were fired at areas 101, 102, 103, and 104 between 0956 and 1007 by WASHINGTON. Neither of these salvos was effective.

Before the completion of the approach firing several patrol craft were sighted off the north tip of Porcelain. Between 1008 and 1015 the Secondary Battery fired on three of these, sinking one and obtaining hits in two others. On arrival at Point Baker at 1016, the Secondary Battery ceased fire on the patrol craft and commenced bombardment of Burton.

Phase I

Secondary Battery fire against Burton was conducted according to plan. Only a poor coverage of the target resulted due to normal shift of the MPI and lost motion in the elevation system, as the stable element was used as the source of level in this and the following firing. However, several of the beach defenses were straddled, and a small fire was started in the hangar area.

The Main Battery opened fire on Berlin at 1038 with an excellent setup on the small tower in area 307. Despite this, the run on Berlin Island was not satisfactory. The narrow target area combined with shifts of the MPI and the often-stressed doctrine of boldness in spot application caused many salvos to land partially or fully in the water. Hits on the island caused the directors to lose their point of aim from time to time, including the entire period of a 150° turn to the southward leg. Shortly after this turn, one 16-inch salvo was fired at a 4,000-ton tanker behind the northern tip of Berlin but missed. Fire was resumed on Berlin after this salvo and the remainder of the allowed ammunition was effectively expended.

The starboard 5-inch battery had opened fire on the tanker as soon as the turn was completed, obtaining a straddle on the third salvo. Fire was continued at the tanker while the set-up for bombardment of Bennett Island was made. At 1052 the starboard battery was divided to allow fire on Bennett Island. At 1052 the starboard battery was divided to allow fire on Bennett Island. The tanker was seen to be hit and smoking when it was lost to sight about 1056 and all starboard mounts resumed fire on Bennett Island, firing a total of eight salvos.

During the latter part of the firing on Berlin, the off Main Battery Director picked up a large concentration of buildings on Beverly Island. Fire was opened on this island immediately after ceasing on Berlin, as the ship was rapidly moving southward out of the firing area affording best enfilade. The other director and rangekeeper were put on Burton. Some delay occurred while Director One searched for a point of aim on Burton, and effective fire was continued on Beverly even after getting set up on Burton, as considerable damage was being done. A total of 36 rounds were fired on Beverly in rapid fire.

At 1100 the 5-inch battery commenced firing on Berlin without air spot, but with considerably better opportunity for enfilading fire. The target was obscured by smoke from fires started by the Main Battery, however, and the true effectiveness could not be observed.

At 1109, the Main Battery fire was shifted to Burton Island, concentrating on the area surrounding the seaplane service apron. The firing on Beverly had consumed both ammunition and time originally allotted to Burton, and only 24 of the allowed 54 rounds were fired. A

large fire was started in what is believed to have been a fuel storehouse south of the hangar, which continued to burn throughout the day. Direct hits were observed on buildings surrounding the seaplane apron and on what appeared to be gun emplacements near the ramps. A few overs landed among a group of small vessels anchored near the pier.

By 1110 the 5-inch battery had completed firing on Berlin Island, and another director, which had been tracking its point of aim on Burton Island was given control of the starboard mounts and commenced firing a minute later. The first salvos fell in the assigned area along the northern beach of the island. Fire was then shifted to the hangar area, where fires were started. This firing was considered effective.

Phase II

Because of delays occurring prior to the scheduled bombardment and during the period between phases, the runs to the south of Porcelain were made at a speed of 20 knots instead of 12 knots as planned, and the salvo interval was decreased to one minute. The Main Battery opened fire at 1226 on the target areas on the western end of Porcelain. Salvos were fired in accordance with the fire plan and are believed to have been highly effective. All shoreline target areas from 196 around to 152 were covered. In the attempt to put the MPI of the salvos in the installations near the water's edge many shots fell in the water, but most salvos were at least partially effective, and many were completely so. All strong points as indicated on the intelligence charts are believed to have been hit. Fire was ceased at 1250, having fired 66 rounds. Fires were started in areas 175 and 196 which continued to burn throughout the bombardment.

From 1240 to 1250 the port 5-inch battery fired on beach defenses on the southwestern beach of Porcelain Island, and inland...where batteries were believed to be located. A large fire was started in the latter area, and beach defenses were well covered. At 1251 course was changed to 240° T. and the starboard 5-inch mounts opened fire on beach defenses on the western end of Porcelain Island. Again the effectiveness was good; fires and explosions were seen in this vicinity by both ship and plane observers. This fire was maintained until 1317.

Burton Island was picked up by the Main Battery Directors immediately after ceasing fire on Porcelain. Fire was opened at 1256, and a quick run was made with almost perfect conditions of enfilade. The fire schedule was carried out, and two additional three-gun salvos were fired to partially make up for the small number of rounds fired on the island in the first phase. After initially concentrating on the seaplane apron and adjacent areas, salvos were landed on the southern portion of the island which had not been previously covered. A total of 36 rounds was fired in this phase, 32 of which hit assigned areas. Hangars and shops were set afire, and an antiaircraft battery on the north end of the island was silenced.

A report, now believed to have been erroneous, had been received of a heavy gun emplacement on the southeastern tip of Carlson Island, and Main Battery fire was commenced on this point at 1320. Much difficulty was experienced during this firing due to lack of a definite point of aim in train and range and the narrow width of the target area.

At 1327 the Secondary Battery opened fire for four minutes on an LST type vessel anchored north of the western tip of Porcelain. A hit

was obtained on the second salvo, starting a small fire and buckling the craft amidships.

Main Battery fire was shifted from the southern tip to the central part of Carlson Island at 1330. Again difficulties were experienced against the narrow island,* but great damage was inflicted on the radio station and adjacent buildings. One large radio tower was knocked down, and buildings were left in flames.

Fire was interrupted on Carlson at 1351 to take under fire active batteries on Porcelain. The batteries were quickly silenced by 5-inch and 16-inch fire. Fire was then divided, the forward turrets resuming bombardment of Carlson while Turret 3 and the 5-inch battery continued shooting in the west beach areas on Porcelain until 1407. After the ship completed its run to the northwest and started south again, the Secondary Battery took the northern half of Carlson under fire. After six 5-gun salvos had been fired, the air spotter reported no further suitable targets in this area and, at 1426, the port mounts opened fire on targets in the center of the island, starting several fires and explosions. The fire was continued for three minutes. At 1426, 16-inch fire on Carlson was ceased and the Main Battery was again trained on the west end of Porcelain. The remaining 14 rounds were expended against the shore installations with very gratifying effect.

After completion of 5-inch firing on Carlson, fire was shifted to the west end of Porcelain. After minutes of firing, the after two ports mounts shifted fire to undamaged buildings...on the lagoon side of Porcelain. This fire was very effective and explosions and fires were seen. Fire was ceased when the target became obscured. Two 5-inch remnant salvos were then fired at the center of Carlson, both of which hit among buildings in the target area.

Because of the many target areas required to be covered by both batteries, fire could not be diverted to ships for any length of time. During the action, the following targets were taken under fire: six islands (bombardment and counterbattery), three patrol craft, two tankers, and one barge. Counterbattery fire was ordered on three occasions and the enemy batteries were promptly silenced. Divided fire in both batteries was employed several times, in order to provide counterbattery fire or to take targets of opportunity under fire, while still continuing the scheduled bombardment. The rapid shift of targets, points of aim, and change of type of fire were ably handled by the plotting room and director personnel because of the careful preparation and realistic drill of the Gunnery Department in the bombardment problem.

This problem not only tested the Gunnery, Fire Control, Radar and CIC equipment to their fullest capacity but also tested the skill and efficiency of the operating personnel of the above equipment. The difficulties at first encountered were readily overcome. The entire performance was most satisfactory.

As had been expected from reports of other vessels having fired the 16" reduced charges, large amounts of unburned 16" powder littered the decks after the firing. This was cause of a small fire on main deck aft.

***Pattern sizes of salvos are small in deflection, about 10 times longer in range.**

MASSACHUSETTS ACTION REPORT:

Gunnery Officer's Comments

Training for the bombardment had initial impetus from previous battle experience at Casablanca and Nauru. Every effort was made to utilize the experience of other ships in similar problems. The actual training began when the ship's force constructed relief maps of ROI, NAMUR, KWAJALEIN, and EBEYE Islands enroute from Efate to Funafuti. The details of the bombardment and the target areas were learned during the sojourn at Funafuti. Enroute to the Marshalls ammunition was allotted to the various targets and salvo plans were evolved. The salvo plan for each battery and each phase was then tested at General Quarters, with Plot running a solution based on the track charts provided by Commander Battleships, Pacific. After such testing the firing schedules were incorporated in the Bombardment Plan. Considerable time was spent in studying relief maps, photographs, and charts to identify target areas and points of aim for both batteries. All pilots, lookouts, spotters, and director personnel were included in this familiarizing program. In spite of this training, trouble was experienced in identifying the proper point of aim twice during the bombardment. It should be noted that, although this ship was assigned the task of destroying emplacements, pillboxes, and machine guns on EBEYE Island, no chart was ever received showing these specific targets. The targets fired upon were selected from photographs and air target charts.

The Secondary Battery was adequate to the task and provided all the counterbattery fire required. In the bombardment, itself, some of the Main Battery salvos had range patterns of 600 yards. This may have been caused by different initial velocities of the various indices of reduced powder charges. The battery was carefully boresighted and director-checked just prior to the bombardment. All turrets were fired in full automatic train and elevation. Matching errors of any magnitude are therefore unlikely. The most spectacular salvo was the one which caused the explosion of an ammunition dump.

As a recommendation for future bombardments it is suggested that more time be allowed. In the case of EBEYE ISLAND, the firing period was only 30 minutes. In this phase 63 main battery rounds had to be fired at targets B1 to B57 and the seaplane base. In most instances, therefore, only sufficient time was available to fire one three-gun salvo at any particular target or area. The target assignments were such that 63 deliberate single-gun salvos would have been more effective.

EFFECTIVENESS OF GUNNERY - SURFACE

From the standpoint of bombardment, the results of this vessel's main battery fire are considered satisfactory, Phase 2 on Kwajalein Island being considered particularly effective. The north ends of Kwajalein and Ebeye Islands...were especially well covered. To a lesser degree, [other] areas were well covered [or] partially covered. At least four large fires were started and the ammunition dump was destroyed in this general area. The ammunition storage...must have been a large one. One of the computers, when the associated director line of sight was elevated to the peak of the explosion and a range taken on the same point, registered an altitude of 3100 feet. Another lesser explosion was also reported resulting from this fire. Concentrated fire at specific defense installations...on Kwajalein and...on Ebeye, was reported to have attained hits on guns and pillboxes. In other strong points assigned as targets for this battery direct hits were likewise reported.

Smoke from earlier firing obscured much of the fall of shot of the secondary battery precluding a specific appraisal of the results of the fire delivered by that battery. It is established, however, that a concentration of 5" projectiles were landed in [seven] areas....

The port 5" battery succeeded, by counter battery fire, in silencing a shore defense battery.... This battery fired at this ship during Phase 1 and was silenced after four salvos from this vessel and no further interference from these beach installations was observed. Other specific targets...were hit. The secondary battery also fired at small boats at anchor or on a reef.

In many instances, especially during the bombardment of Ebeye Island, main battery fire would have proved considerably more effective had the range pattern been smaller than it was. The reason for this large pattern probably lies in the fact that different indices of reduced charges were used in this bombardment. The three powder indices used were made up of 8", 14", and 16" grains. It was suspected that these indices would produce variations in initial velocities could be expected: 1710 f.s., 1745 f.s., and 1770 f.s. There is no available I.V. data on firing these indices with 1900 lb. projectiles, but there are undoubtedly variations in initial velocity of magnitude comparable to those quoted in this despatch. A 60 f.s. variation in I.V. would produce a 600-yard variation in the fall of shot of H.C. projectiles fired with reduced charge at 14,000 yards. These data are submitted to account for the large range patterns reported from time to time. Since most of the salvos on Ebeye Island were across the width of the island, and since the average width of this island is 300 yards, it must be expected that salvos with accurately placed M.P.I.'s would at times result in overs and shorts which would not hit the island. These shots are referred to as "wild" shots since they missed the target area.

MAIN BATTERY

<u>Rounds fired in bombardment</u>	- 362
Hits in areas assigned	86%
Hits in adjacent areas	2%
Wild shots in other than adjacent land areas and in the water	12%

Capture of Kwajalein Atoll

February 1944

The invasion of the Marshall islands was supported and protected by the Fast Carrier Force, its task groups including eight fast battleships. The newest of these were the recently-added IOWA and NEW JERSEY. The naval bombardment which immediately preceded the landing on Kwajalein featured the 16-inch and 5-inch batteries of six of Task Force 58's new battleships.

INDIANA ACTION REPORT:

All gunnery machinery was shut down when the other battery (main or secondary) was firing, in order to avoid overheating of motors. This paid dividends as no trouble was experienced with any machinery other than the minor casualties.

SOUTH DAKOTA ACTION REPORT:

The first approach of the fast battleships followed three aircraft bombings of the previous day. At this stage low speed cannot be used generally due to the probable counter battery fire and submarine threat. In the later runs, the low speeds recommended should be used. Low speed with a proper anti-submarine screen, identification of the individual blockhouses, gun installations, pillboxes, control posts, etc., and subsequent destruction is ensured provided adequate and timely photographs are furnished the bombarding ships.

ALABAMA ACTION REPORT:

The aids to preparation and conduct of the bombardment were extensive, and it is strongly recommended that this service be continued, since the success of the enterprise will be directly proportional to the amount of preparation and training preceding it, which in turn depends on this pre-bombardment intelligence. Photographs taken 29 January from altitudes as low as 500 feet by ESSEX planes were delivered to ALABAMA that afternoon by message drop and were most helpful. Continuance of this procedure whenever practicable is recommended.

NORTH CAROLINA ACTION REPORT:

Preparations Preliminary to Bombardment.

This ship took advantage of regular entry and departure from various ports to conduct simulated bombardment. These drills involved Ship Control and Combat Information Center in addition to the Main and Secondary Battery fire control organizations. Procedures, methods of control, types of fire, and battery and ammunition setups had been organized and tested during drills, during firing of bombardment practices, and in the battleship bombardment of Nauru on December 8, 1943. No major departure from these procedures was found necessary to carry out either the scheduled bombardment of Roi and Namur or the special bombardment of ROI. As soon as security measures permitted their release, orders and intelligence data pertaining to the scheduled ROI-NAMUR bombardment were carefully studied by all officers and men whose duties required knowledge of these. Classes were held for rangefinder, director and all control station crews on the general plan of attack, objectives, intended salvo plan, characteristics of ROI and NAMUR and adjacent islands, location and appearance of all known landmarks, targets and target areas, methods of fire planned to be used, bearings on which to obtain best enfilade effect on target areas, and possible enemy countermeasures. Radar personnel were particularly instructed as to probable good lands for tracking.

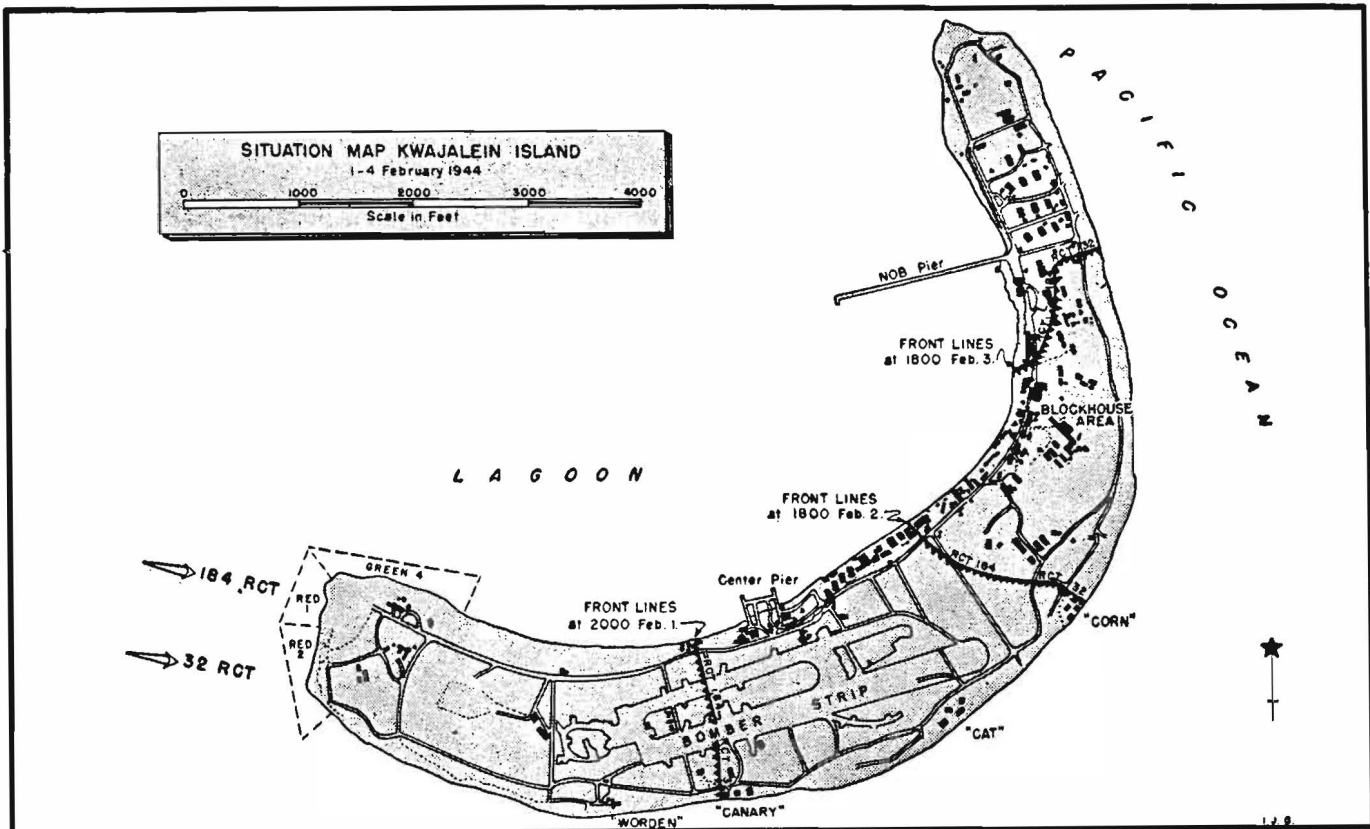
A thorough knowledge of the objectives, plans, and all available information by everyone concerned is essential; and is mandatory to obtain optimum results in the event of enemy counter measures requiring a sudden departure from previously-laid out schedules. Spotting drills were held for aviators and top spotters* making use of the excellent scale model of the islands that was provided. These drills were of great benefit, particularly in training airplane and top spotters in estimating distances on the land, and in their learning, in detail, landmarks, target areas, etc.

*Gunfire spotters stationed in the elevated main-battery directors.

Methods of Gunnery Control.

The gunnery control procedure followed the standard bombardment procedures used by this ship for the Main and Secondary Batteries. Except when in direct fire, the rangekeeper tracked prominent landmarks upon which a director could obtain ranges and bearings, either by optics or by radar. Spots were applied in range and deflection...to hit assigned target areas. Points on which the directors trained were shifted, keeping the director point of aim as close as possible to the target area being fired on. Spotting during the daylight phase of the special bombardment was by top spotters, assisted by Mark 8 radar spots when splashes of shells hitting the water were seen in the scope. Deflection spots were generally accurate. Good range spots were obtained optically on salvos intended for beach areas and areas close to the beach. Little trouble was caused by smoke and dust from explosions on the island. At times, targets were obscured momentarily, but except where large continuous fires were burning, the visibility rapidly cleared. During Phase 2 on January 30, direct fire was employed on targets such as blockhouses, runways, pillboxes, beach defenses, etc., with excellent results.

Firing by radar control during the night was not difficult because of the excellent performance of the Mark 8 radars in picking up landmarks. Flashes of bursts from the projectiles could easily be seen and made optical spotting possible. The spotter could determine the position of the bursts relative to persistent fires on the island. The Mark 8 radars observed the bursting on land of projectiles from one salvo only and gave a "no change" spot on that salvo. Optical spotting in deflection at night is considered to have been accurate. The top spotter made range spots which were probably fairly reliable. Many explosions on the island were seen during the night bombardment.



SUMMARY OF ROUNDS FIRED BY VESSELS
AGAINST KWAJALEIN ATOLL OBJECTIVES

<u>Vessel</u>	<u>16"</u>	<u>14"</u>	<u>5"</u>
SOUTH DAKOTA (a)	294		
NORTH CAROLINA (a)	21		2,237
ALABAMA (a)	330		1,562
COLORADO (b)	319		2,042
MARYLAND (b)	563		2,378
TENNESSEE (b)		783	2,482
WASHINGTON (a)	354		1,715
INDIANA (a)	306		2,099
MASSACHUSETTS (a)	362		1,852
NEW MEXICO (b)		816	962
MISSISSIPPI (b)		897	2,637
IDAHO (b)		928	780
PENNSYLVANIA (b)		836	3,061

Bombardment of Mili (Mille) Atoll

March 1944

On 18 March 1944, IOWA, NEW JERSEY, and two destroyers attacked bypassed Mili Atoll. Two hits from Mili's coast defense guns caused IOWA minor damage; the scar from one hit can still be seen on the side plate of Turret II.

IOWA ACTION REPORT:

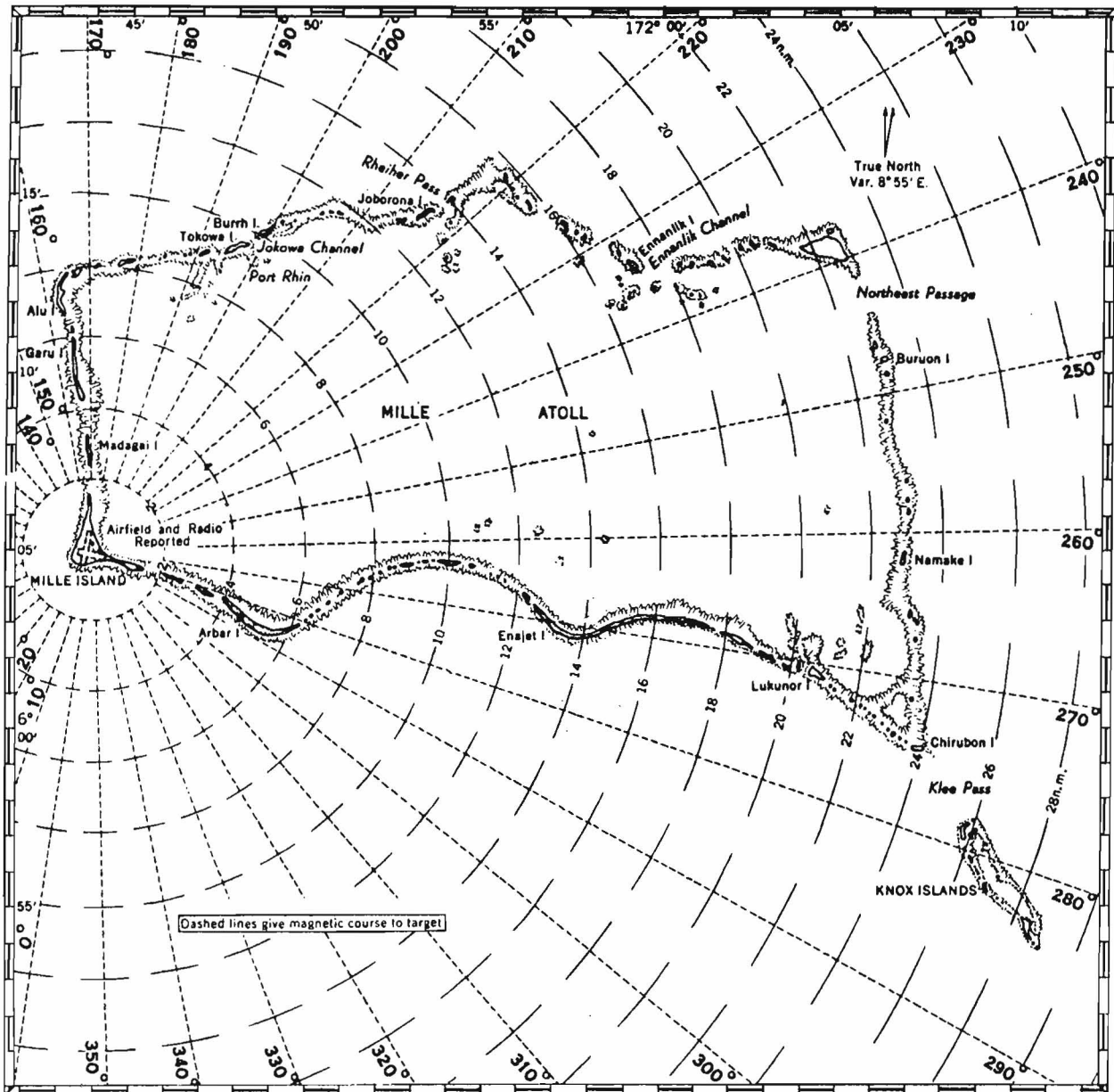
It was planned that the bombardment group conduct a slow and methodical bombardment of Mille in coordination with...air strikes by LEXINGTON groups in order to afford training to BatDiv 7, to destroy and damage enemy coastal installations, antiaircraft guns and coastal stations, ammunition, stores, fuel and personnel; and to cooperate in training LEXINGTON air group in gunnery observation and spotting procedure.

Upon arrival off Mille on morning of 18 March, bombardment commenced according to plan. Effective counterfire from shore batteries was experienced after closing to the 15,000 yard track line. As a result, the original bombardment plan, which contemplated final phase on the 10,000 yard track line, was abandoned. The final phase was fired outside 20,000 yards. Task group returned to base on 19 March 1944.

At 0704 IOWA opened fire on enemy installations on Mille Island with main battery, distance approximately 20,000 yards. During the period 0704 to 0906, NEW JERSEY and IOWA alternately bombarded in accordance with Commander Task Unit 50.10.1 Bombardment Plan. The range was then closed to approximately 15,000 yards, and firing resumed with both 16" yards and firing resumed with both 16" and 5" batteries according to the Bombardment Plan. At 0907 enemy coast defense guns commenced firing at the screen and battleships. Counter battery fire, employing full main battery and five inch battery salvos, was immediately started. At 0940 IOWA received a hit about 18" above the top of barbette on the left side plate of No. 2 turret, believed to be of about 6" caliber. At 0951

(a) Fast battleships of TF 58

(b) Older battleships, operating with the amphibious forces.



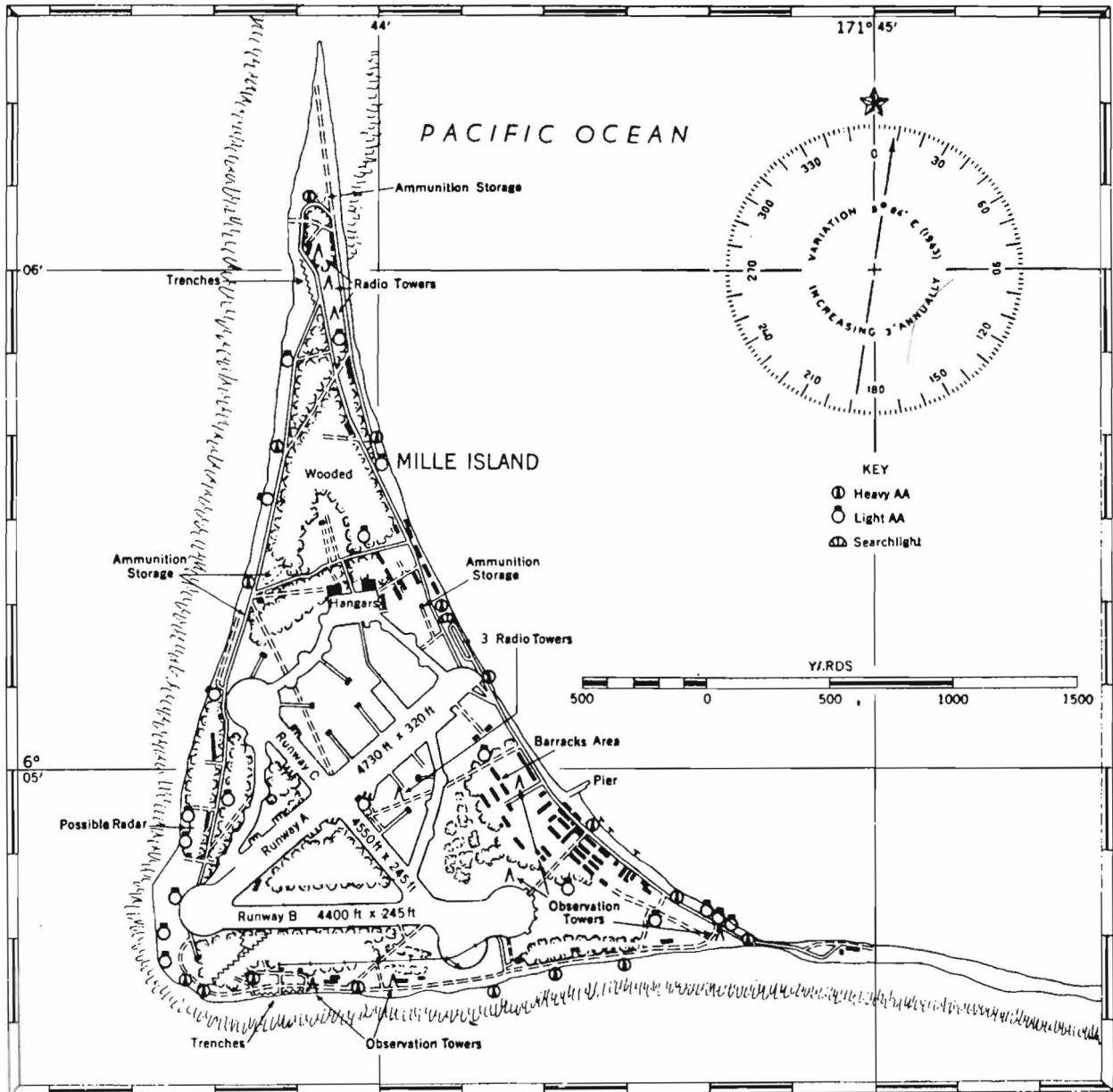
MILLE ISLAND - APPROACH

N.A.C.I. - Hydrographic Office
Washington, D. C.

MAY 20, 1943

RESTRICTED

No. 12-19-22-14-1A



MILLE I., MARSHALL IS

N.A.C.I.—Hydrographic Office
Washington, D. C.

10 NOV 1943

RESTRICTED

No. 12-19-22-14-IT REV

Commander Task Unit 50.10.1 gave verbal orders to fire the main battery only at the times prescribed by the Bombardment Plan, but to continue using the 5" battery for counter battery fire. At about 0956, IOWA took another medium caliber hit in the hull, port side, frame 134, about four feet below the main deck. No fires resulted from either hit. Moderate damage was sustained. At 1000 cease firing with all batteries was executed according to plan, and air groups commenced first strike. During the period 0929 to 1007, approximately 20 shells were reported to have hit the water within a radius of 300 yards from IOWA, both shorts and overs. The last two of these shells landed close aboard to starboard when IOWA was retiring, distant some 20,000 yards from the nearest land.

IOWA still had her planned allowance of main battery bombardment ammunition remaining for use during the second firing period. NEW JERSEY was directed to leave formation and operate independently while IOWA resumed bombardment. At 1315, opened fire with main battery on enemy shore installations, range 20,000 yards. During this last phase of the bombardment no activity by shore batteries was observed. At 1359, ceased firing and hauled off to the west, NEW JERSEY rejoining formation at this time. At 1400 LEXINGTON air group commenced its second strike according to schedule. During this strike, two particularly violent explosions were observed on Mille Island.

Performance of Own Ordnance Material and Equipment.

Tracking. Reference points in the target area were tracked by the rangekeeper in plot aft* and Director 2. Current was determined by solving for target course and speed, these values being set on the firing rangekeeper in plot forward. A navigational plot was maintained in plot forward using ranges and bearings of the tracking point as supplied by the after rangekeeper. Since the island had been under almost daily air bombardment for a period of several weeks, it was anticipated that difficulty would be experienced in identifying tracking points. This proved to be the case. Throughout the whole operation only two tracking points could be even partially identified. One was a major tower apparently located about 500 yards east of the intersection of runways A and C. This tower was used as a point of aim several times during the bombardment, but could not be located by the air spotters even though one carrier spotter made several low passes over the area in an effort to identify the tower. The other point was an aircraft revetment at the western intersection of runways A and C. This was visible from the ship for only a short time when the ship was to the southwest of the island.

Control Procedure and Spotting. When direct fire was possible, air spot was used for range and top spot for deflection. When using indirect fire, air spotters report of fall of shot was used to determine the spot to be applied to generated range and bearing on the controlling rangekeeper. Planes were authorized to use either direct spotting to visible targets or to report grid coordinates of fall of shot, at their own discretion. Spotting by own Kingfishers and carrier Hellcats was excellent. At one time, when firing at coastal batteries with planes spotting direct, there was some confusion between Up and Down, Right and Left.

*IOWA-class battleships have two main-battery plotting rooms.

The situation was cleared up by directing the plane to spot North or South and East or West. Communications with spotting planes were excellent. Air spots were received in the plotting room over a loudspeaker so that all concerned could clearly hear the spotter. The plotting room officer used the radio transmitter at intervals to talk directly to the air spotter. At other times the plotting room radioman controlled the spotting circuit as directed by the plotting room officer.

Rangefinder. Mark 8 radar ranges to nearest land were compared with optical ranges to assist radar operators in determining the range to reference point. Casualties to the Mark 8 radar due to shock of gunfire made it necessary to rely entirely on optical ranges during the latter part of the 15,000 yard run.

Performance of enemy ordnance.

Enemy gunfire was well controlled and accurate. When the battleships turned away to haul off for the first air strike, the enemy guns quickly went to rapid fire and continued in rapid fire until the ships were out of range. This ship was straddled at least 10 times at a range of about 13,000 yards, and many shells landed from 200 yards over to 1,000 yards short. The foremost tower structure was apparently used as a point of aim since most of the near misses were from 10 to 50 yards on either side of the tower in deflection. Two hits were received.... The hit on the left side plate of Turret 2 did not affect operation of the turret which continued to fire until the phase was completed. There were 10 shots that landed less than 50 yards from the ship's side.

Own battle damage.

Gunnery. The projectiles which struck the left side plate of Turret 2 about 18" above the barbette, detonated on impact. Fragments entered the left pointer's night port, demolishing the pointer's telescope, Mark 66. Another fragment entered the left rangefinder port, breaking the glass in the left end window of the Mark 52 rangefinder.* About 20 feet of the watershed and gas seal on the left side of the turret was torn off. The STS splinter shield around 40 MM Mount #1 on the starboard side of the first superstructure deck was heavily sprayed by fragments, but the shield was not pierced and none of the crew was injured.

Construction Department. One shell, estimated to have been 6" caliber, struck the port side plate of #2 turret while the turret was trained on the port beam. This shell apparently came from slightly abaft the port beam. It marked the plate and is believed to have detonated upon impact. The point of impact was about 18" above the top of barbette and about 5' below the left trainer's sight port. Fragments broke through glass of left pointer's sight port and injured two men inside the turret. Fragments tore off completely some 20 feet of the watershed and gas seal on the left side of the turret. Other fragments tore up sections of the first superstructure deck planking, gouging it out. Three fragments were driven down through the planking and steel deck (10 lb. plate) into officers' rooms below. The largest of these holes through plating was about 4" in diameter. Another hole, about 1" in diameter,

*Long-base turret rangefinder.

permitted passage of a fragment that was driven through the upper half of writing desk in stateroom 103. Other fragments hit against the conning tower foundation at frame 84 (25 lb. STS) but only scarred the surface. A fragment also deflected top of davit stop. Damage to turret did not interfere with operation, but exposed roller path to effects of weather. Pointer's telescope in the turret was ruined.

A shell having base plug measuring 4.5" struck and penetrated through "P" strake (25 lb. STS) at frame 134 on port side. Exploding on impact, or soon thereafter, this shell tore a jagged hole inward, roughly 30" by 50" in size. Many fragments, including base plate, were found in the space inboard of the shell in the second deck void B-228V, which runs from frame 127 to 135. The void is 5' wide at the second deck level. The top of this hole was about 1' below the main deck level, and the bottom limits cleared the waterline by some 13 feet. Several fragments struck and marked the next bulkhead inboard, torpedo defense bulkhead, #3 (40 lb. STS), but did not penetrate. At one point a small bulge in this bulkhead is noticeable from the inboard side in the Engineering Log Room. Fragments tore away a 3' section of air escape line from fuel oil overflow line, but did not damage the latter line appreciably. Several holes were made in a small drain line going through the void. The "M" and "Q" degaussing coils running through the void were cut, 12 strands being severed. No damage was done to 20 lb. STS deck, or to other limits of the space.

Battleship Bombardment of Ponape, Caroline Islands

May 1944

Part of the preliminaries to the invasion of the Marianas consisted of an attack on the large island of Ponape, site of a Japanese airfield and seaplane base. While a carrier task group provided air cover IOWA, NEW JERSEY, MASSACHUSETTS, NORTH CAROLINA, ALABAMA, and SOUTH DAKOTA shelled the island for 70 minutes.

ALABAMA ACTION REPORT:

The bombardment was conducted in a leisurely manner and was scheduled so that there was no confusion between the fire of different ships. The approach and firing navigation tracks were highly satisfactory and operated to simplify what could easily have been a very difficult gunnery problem. It is recommended that surface ship bombardment be conducted in similar fashion whenever practicable.

Control was relatively easy and merits little comment. The main battery used indirect fire throughout; the secondary battery used offset control. The secondary battery also was set up for indirect fire and maintained a track during the bombardment. Main battery control against Langar and Japutik Islands, in particular, was extremely accurate.

Exact knowledge of results obtained would benefit gunnery personnel greatly in the determination of accuracy of fire and improvement of future performance. It is recommended that post bombardment pictures be distributed whenever possible.

MASSACHUSETTS ACTION REPORT:

Include low altitude pictures of area to be bombarded taken from altitude of approximately 100'-150' at ranges of 25,000, 20,000 and 15,000 yards along the prospective lines of fire. These would be of inestimable aid to top spotters in picking out points of aim and targets.

NEW JERSEY ACTION REPORT:

Air spots were provided by ship's planes. Voice radio communication between ship and plane was excellent. The radio receiver in the controlling spotter's plane was apparently jarred off frequency by the force of catapulting, but this trouble was remedied by returning prior to commencement fire.

The C.I.C. maintained a navigational track of the ship throughout the action. The position of the ship was determined by Director 2 Radar bearings and ranges on Mant Island of Pakin Atoll. The use of high peaks on PONAPE, as radar navigational targets, was not attempted as it would have involved the identification of one of several high peaks and could easily have resulted in confusion.

The navigational track obtained was plotted on a chart containing an expanded section of the island with grid areas designated, and was used to furnish bearings and ranges on any desired point to the Main and Secondary Battery Plotting Rooms.

IOWA ACTION REPORT:

Prior to the bombardment, a relief map of the target area was constructed which was of great value in preparing aloft personnel for the actual appearance of the island from the firing area. However, photographs taken from low altitudes from seaward would have been of much more benefit, and it is recommended that future photo reconnaissance of target areas which may be bombarded include such photographs. An object which, in a vertical photograph appears to offer a good point of aim, usually turns out to be invisible or unrecognizable from the foretop of a ship 20,000 yards away.

Control Procedure and Spotting -- When firing direct, Director One was in control of train, level, and firing circuits. Top spots were used in deflection and air spot in range. When firing indirect fire, Director One controlled train to the reference point, and director 4 (stable vertical) controlled level and firing circuits. Necessary range and deflection spots to correct for the difference between the reference point and the target area were computed in the plotting room. Air spots in range and deflection were used.

Tracking - Numerous well defined reference points were available on Ponape Island and no difficulty was experienced in maintaining an accurate navigational track in plot forward. Except for the two salvos fired at Tolen Palikir and the three at Jokaj Ridge, all fire was indirect, using some visible object near the target area as a reference point for director train and rangefinder ranges. Except for the five salvos mentioned above, the target areas were not visible from the ship. During

the second phase the top of a hangar near number one airfield was used as a reference point. This hangar became hidden behind a ridge at 1548 and the range keeper was allowed to generate range and bearing on this reference point while the ship made a 180-degree course change and closed the range 1,700 yards. At 1557, with the reference point still hidden, fire was reopened on generated range and bearing and four salvos were fired obtaining hits in the barracks area and starting fires. At 1603 the reference point came into view from behind the ridge, and the trainer's crosswire of director one, which had remained matched in automatic in train, was found to be one mil to the right. The rangefinder range was 100 yards low on generated present range. The accuracy of own ship's course and speed inputs and of the range and bearing integrators in the Mark 8 range-keeper, as evidenced by this small cumulative error over a fifteen minute period, was most gratifying, and speaks well for the high quality of IOWA's fire control equipment.

Air spotter reported that IOWA salvos started fires in Ponape Town and in the stores and barracks areas southeast of airfield number one. Salvos fired at airfield number two did no apparent damage aside from digging up the runways and adjacent areas.

NORTH CAROLINA ACTION REPORT:

In view of the great amount of detailed planning and instruction necessary in preparing for bombardment, intelligence data should be provided as far in advance as possible. Late photographs showing remaining targets and target areas after air bombing, as were furnished by CTF 57 for the bombardment of Ponape, are most valuable.

The gunnery control procedure followed the standard bombardment procedures previously used by this ship for main and secondary batteries. Except when direct fire was employed, the rangekeeper tracked prominent landmarks upon which optical bearings, and radar and optical ranges were obtained. Level was controlled in phase 1 by Spot 1, with the top of the hill as point of aim. In phases 2 and 4 level was controlled by the stable vertical. Spots were applied in range and deflection to hit specific targets or areas. During phase 1 the controlling secondary battery computer received train and radar range from the controlling main battery director for firing on Japutik Island. (This was the initial use made of a recent alteration to the switchboard wiring making provision for the control of the secondary battery from a main battery director.) Shift of the main battery MPI to hit specific targets in the town of Ponape, during phase 2, was done by application of spots from the spotting aviator with excellent results. Provisions were made to shift to indirect-fire method of bombardment in the event that tracking points close to the target area became obscured.

Coordination and flow of information between CIC, flag plot, gunnery department, ship control and communications were smoothly and efficiently handled. Control of fighter aircraft in the Combat Air Patrol, assigned this ship during the bombardment, functioned in excellent fashion.

Marianas Operation; Fast Battleship Bombardment of Saipan and Tinian

June 1944

Two days before D-Day the fast battleships of Task Force 58--IOWA, NEW JERSEY, WASHINGTON, NORTH CAROLINA, SOUTH DAKOTA, INDIANA, and ALABAMA -- began the pre-landing bombardment of Saipan and Tinian. Though this attack appeared successful to shipboard observers at the time, it proved a failure due to a lack of the specialized training and experience required for successful shore bombardment.

COMMANDER, TG 51, ACTION REPORT:

The following essential features were incorporated in basic plans:

(a) Major air strikes by aircraft of fast Carrier Task Forces (TF 58) commencing on D-3. (Actually the first strike, a fighter sweep, was made on D-4). These strikes were to gain complete control of the air and to soften the islands for the landings.

(b) An extensive bombardment on Dog minus TWO by Battleships of Task Force 58. This bombardment was designed to knock out major enemy defenses and to support initial minesweeping activities in accordance with requirements specified by CTF 52.

IOWA ACTION REPORT:

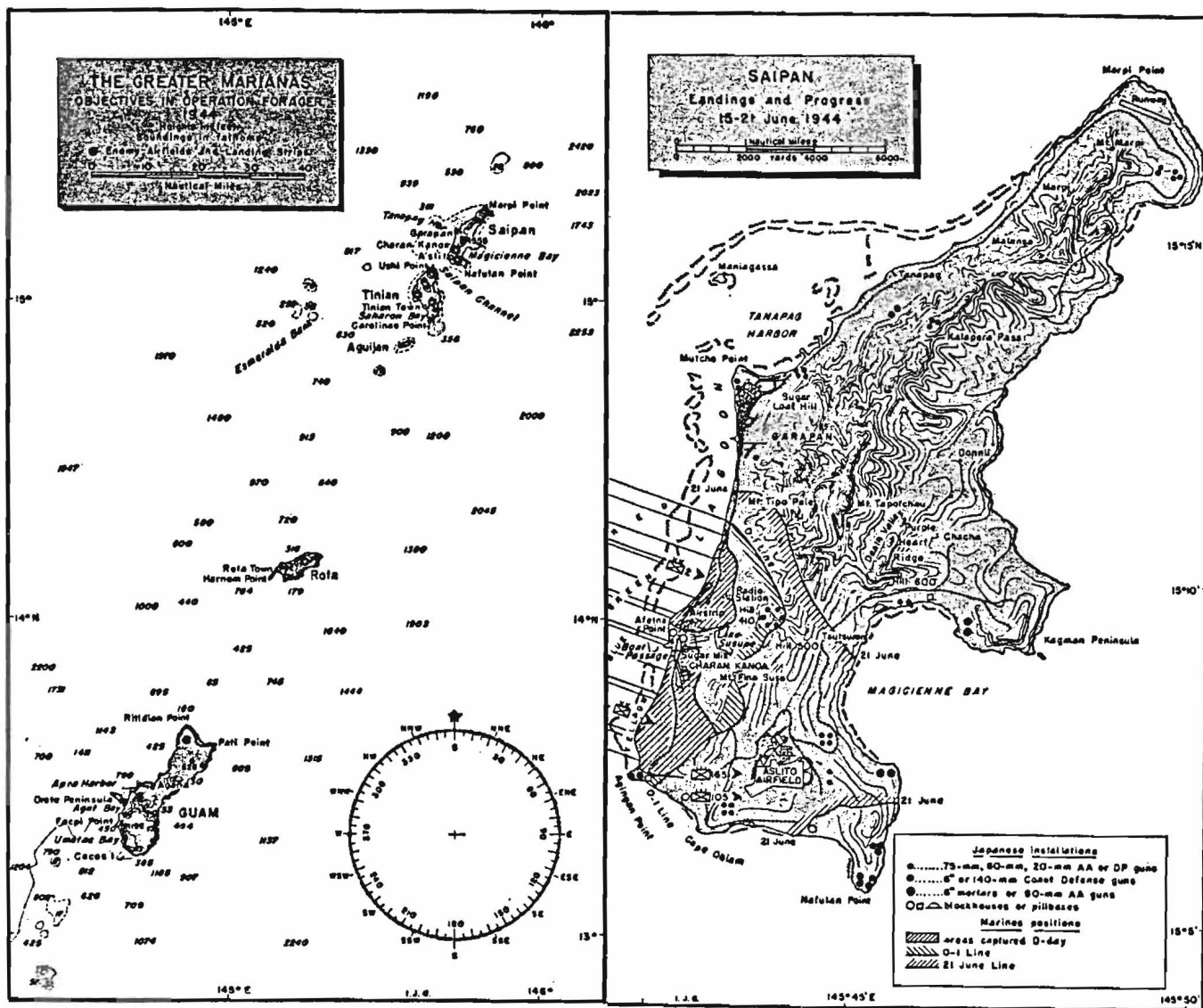
1. Performance of...ordnance material was satisfactory in all respects. Tracking presented no difficulties and plane and top spots were coordinated in the plotting room. Numerous fires were started among buildings adjacent to the Ushi Point airfields by both 16" and 5" fire. One 16" salvo blew up an ammunition dump in a most spectacular fashion and provided an excellent fireworks display for several minutes afterwards. The procedure used in previous bombardments of Milli and Ponape was found to be satisfactory.

Samuel Eliot Morison, HISTORY OF UNITED STATES NAVAL OPERATIONS IN WORLD WAR II, Volume VIII:

On the morning of 13 June (D minus 2 day) the seven new battleships under Admiral Lee's command, together with a number of destroyers, were detached from the fast carrier groups to deliver the first scheduled bombardment of Saipan and Tinian. reports of land-based reconnaissance planes on 29 May had shown intense activity in the strengthening of the Saipan defenses. The fringe of the island was well provided with coast defense and antiaircraft guns, but very few blockhouses. Miles of new trenches had been dug. Admiral Turner's fire support groups were not due to arrive until the 14th, hence the big ships of the carrier groups were given the assignment to start bombardment a day earlier.

Sad to relate, the bombardment of 13 June was a failure. These fast battleships simply did not know the technique. They had been too busy steaming around with carriers to practice bombardment, a type of firing that requires slow and patient adjustment on specific targets, differing widely from main battery fire in a naval engagement. Pilots of the battleships' spotter planes had not learned to distinguish targets. And the battlegroups were required to shoot from ranges between 10,000 and

16,000 yards because they were considered too valuable to risk in the unswept shoal area which extends about six miles to leeward of Saipan. The result was that most of the 16-inch and 5-inch shells went completely wild, and the only targets destroyed were large, conspicuous, and of no military value, such as farmhouses and the Charan Kanoa sugar mill. Actually 2432 high-capacity 16-inch and 12,544 five-inch shells were expended in all this sound and fury. There was much truth in a humorous bluejacket's description of this bombardment as "a Navy-sponsored farm project that simultaneously plows the fields, prunes the trees, harvests the crops, and adds iron to the soil."



Capture of Iwo Jima

February 1945

Preinvasion bombardment of Iwo Jima was carried out, for three days, by fire support ships of the amphibious force. These warships were joined, on the morning of D-Day, by the fast battleships WASHINGTON and NORTH CAROLINA for what Samuel Eliot Morison called "the heaviest pre-H-Hour bombardment of World War II."

COMMANDER, AMPHIBIOUS GROUP 1, ACTION REPORT:

This operation clearly demonstrated that previous high altitude bombings and long range bombardment of Iwo Jima directed only into "target areas" achieved negligible damage to the very numerous defenses of the island, which were stout, comparatively small, and well dispersed. Photographic interpretation shows, on the contrary, that the defenses were substantially increased in number during December, January, and early February. The bombardment by this force on 16 and 17 February also had less than the desired effect, due to interference by weather, to the need for giving way to minesweeping and UDT operations, and by lack of thorough familiarity with the actual important targets, as distinguished from a mark on a map, or a photograph. It was not until after fire support ships, their spotting planes, and support aircraft had worked at the objective for 2 days, had become familiar with the location and appearance of the defenses, and had accurately attacked them with close-range gunfire and low altitude air strikes, that substantial results were achieved. This experience emphasizes once again the need for ample time as well as ample ships, aircraft, and ammunition, for preliminary reduction of defenses of a strongly defended position. At the same time it is realized that certain defenses will never be destroyed or even discovered until after the troops land.

NORTH CAROLINA ACTION REPORT:

19 February (D-Day)

0530, special task group consisting of NORTH CAROLINA (BB55), WASHINGTON (BB56), [3 cruisers and screening destroyers] arrived vicinity Iwo Jima. 0545, sounded general quarters for scheduled bombardment of Iwo Jima.

Took station..., later maneuvering to maintain line of fire north of 270° True after H-Hour. 0640, launched two spotting planes. 0701, commenced firing main battery. 0705, sunrise. First targets were coast defense guns..., ..antiaircraft guns and dual-purpose battery.... 0744, main battery commenced firing area coverage fire over assigned areas. 0827, secondary battery commenced firing.... 1243, main battery shifted to direct fire on pillboxes and caves containing antiaircraft guns.... 1258, main battery shifted to 155mm gun or mortar installation.... 1343, main battery shifted fire to...engage gun installations reported by WASHINGTON's spotting planes. 1435, took antiaircraft guns ...under fire of main battery. 1542, main battery fire was shifted to gun installations.... From 1605 to 1712 secondary battery fire was concentrated...to destroy small caliber guns which were firing at this ship. 1649, gun installations...again taken under fire by the main battery. 1712, secondary battery ceased firing. 1738, main battery ceas-

ed firing. 1842, recovered one aircraft, other being recovered by WASHINGTON. Proceeded to join TG 54.9 (Covering Force Night Deployment Group)....

20 February

0615, arrived off Iwo Jima.... 0717, launched one spotting plane, other of this ship's planes being launched by WASHINGTON. 0759, commenced firing with main battery on coast defense guns...and with secondary battery.... Secondary battery continued firing...until 0948. 0931, main battery ceased firing. 1100, recovered two aircraft....

21 February

1140, commenced firing secondary battery.... 1650, secondary battery ceased fire.

22 February

1407, commenced firing secondary battery.... Entire firing was close support fire for our troops, as directed by shore fire control party. 1641, secondary battery ceased fire. 1840, joined TG 58.12...and departed Iwo Jima area.

Personnel Performance and Casualties

.... Personnel maintained a high degree of efficiency throughout four days of bombardment and one night AA action, this period having been preceded, and being followed, by the ship's operations with Task Force 58 in connection with the Tokyo air strikes.

Lessons Learned...

Additional oblique photographs should be provided which indicate the appearance of the target from a height of approximately 100 feet at ranges of 6,000 - 10,000 yards.

Bombardment tracking drill, as a matter of routine in entering port, is recommended for the development of a well-trained team for bombardment actions.

Great care must be used in ramming 16" reduced charges, particularly at low gun elevations, to preclude the possibility of primers' flames failing to ignite these short bags at an excessive distance from the primer vent.

Auxiliary CIC, capable of tracking the ship's position in the main plotting room, is an effective aid to fire control in bombardment actions.

The accuracy demonstrated by the 5" battery in blind, close-support fire on D-plus-3 indicates that, with present equipment and methods of indirect fire, the 16" battery also warrants consideration for such a role if deemed necessary.

NAVAL GUNFIRE OFFICER REPORT TO COMMANDING GENERAL, V AMPHIBIOUS CORPS:

TRAINING: CONCLUSIONS. That the successful coordination of Naval Gunfire, Air and Artillery was largely due to the indoctrination of all command levels of the Corps, as a result of extensive command post exercises.

DOG DAY BOMBARDMENT. A squadron of specially trained air spotters made its first appearance controlling fires in the PACIFIC in this operation. The squadron was a veteran of EUROPEAN operations. Thirty-two pilots, equipped with 24 FM-2 fighter...aircraft and 6 TBFs, were available. The FM-2s were equipped with a two-channel MF* radio and a ten-channel VHF* set. The unit trained with ships and SFCPs in the HAWAIIAN area. Their workmanlike performance during this training period indicated that the squadron would be a valuable asset during an operation. The squadron was capable of maintaining 8 VOF on station throughout Dog-Day and Dog-plus-1. Thereafter, 6 planes would be kept in the air for spotting missions.

BRIEFING. The plan, as finally drawn, was the product of virtually all echelons of command. The gunnery officers...worked in close coordination. Questions were fully discussed and completely considered before they were incorporated into the plan. The plan itself was closely studied by all echelons and, in its final form, represented the efforts of all organizations, and three months of work. It was realized that all hands had to know the plan completely. The assault troops who were to follow the barrage, and the firing ships which had to maintain a complicated schedule of fire while keeping station in the midst of [landing] boats, had to be thoroughly familiar with all phases.

CONCLUSIONS. That the Dog-Day bombardment, in conjunction with the destruction accomplished in the preliminary firing, enabled a successful landing to be made against one of the enemy's most heavily and skillfully defended possessions, with acceptable casualties.

GENERAL SUPPORT MISSIONS. A large amount of destruction of targets visible from seaward was accomplished by general support ships. This was particularly true in the 5thMarDiv zone on the northwest side of island, and in the northern part of the 3dMarDiv zone. In addition many targets invisible from seaward were damaged or neutralized. Five-inch fire cleared away camouflage and exposed new targets repeatedly, some of which were engaged by gunfire, others by air or artillery. The result of this destruction and damage substantially reduced the task of our infantry. Adequate photographic coverage immediately following such fires... would do much to increase the value of deep-support fires by naval gunfire, artillery and aerial bombing.

*MF: medium frequency. VHF: very high frequency.

Third Fleet Operations off Japan, July-August 1945:
Fast Battleship Bombardments of Honshu, Hokkaido

- 14 July: SOUTH DAKOTA, INDIANA, MASSACHUSETTS bombard Kamaishi, Honshu.
15 July: IOWA, MISSOURI, WISCONSIN bombard Muroran, Hokkaido.
18 July: NORTH CAROLINA, ALABAMA, IOWA, MISSOURI, WISCONSIN bombard Hitachi, Honshu. British fast BB KING GEORGE V attacks nearby target.
29-30 July: SOUTH DAKOTA, INDIANA, MASSACHUSETTS night bombardment of Hamamatsu, Honshu.
9 August: SOUTH DAKOTA, INDIANA, MASSACHUSETTS bombard Kamaishi.

SOUTH DAKOTA ACTION REPORT (Kamaishi, 14 July):

Fire discipline was excellent throughout. The methods used by CIC and Main Plot, employing both fire control and search radars for determining the ship's position, proved extremely satisfactory; little difficulty had been expected in view of the rugged and distinctive nature of the terrain. Gunnery communications, with the exception of the radio communications with the air spotters, were excellent.

Kamaishi proved to be an excellent bombardment target from the standpoint of radar tracking. Tracking points which appeared to be good targets were predesignated, similar to the procedure employed in SOUTH DAKOTA's previous bombardments; the ship's position was accurately fixed at all times. At close ranges the ship's track in CIC was maintained with the VF PPI almost entirely. For the early stages of the approach a plexiglass overlay with 10° bearing lines and concentric range circles was used with some success. Once the range had closed to 25 miles it was of little use, and normal tracking proved to be speedier and much more accurate. It is believed the overlay would work well at short ranges where radar is confronted with a low unbroken coast line and where sharp, distinct echoes cannot be found.

Land was first picked up on the SK at 0214...and identified as Rakko Take (4,800 feet) bearing 343°, 77 miles; no difficulty was experienced thereafter, and land contacts were made at expected ranges and times.

Director control officers and radar operators should make a complete analysis of radar tracking points from all available photos and charts and should sketch appearance of these points as they will appear on fire control radar scopes from several different bearings and ranges. It would be of material value if the OTC were to lay down the bombardment approach track in the operation order and endeavor to follow that track as closely as possible. This would facilitate the analysis and identification of tracking points by radar.

CTU 34.8.2 (COMBATDIV 7) ACTION REPORT (Muroran, 15 July):

On 15 July 1945 Commander Battleship Division 7 conducted the day bombardment of industrial targets in Muroran, Hokkaido. The timing of this bombardment was an important factor because as the bombardment progressed weather and visibility closed in and upon completion the ceiling was 1,000 feet. Spotters were hampered throughout by the reduced visibility, the low ceiling, and flames and smoke in the target area. Under these circumstances the successful control of fire was enhanced by the expeditious completion of the bombardment.

Reports of spotters immediately upon completion of the bombardment disclosed the following: In the Nihon Plant a terrific explosion, followed by fires to 300 feet in large shops, was observed in addition to considerable damage along the waterfront. In the Wanishi Iron Works, of 8 buildings with stacks observed from ships on arrival, 4 were seen to be demolished. The entire area was covered by fires, with damage to 4 blast furnaces, a storehouse, and many other buildings. Heavy smoke was also observed from what appeared to be a chemical plant. The coal liquefaction plant was heavily hit and gas tanks and all coke furnaces but one were damaged.

CTU 34.1.2 6 COMBATDIV 6) ACTION REPORT (Hitachi, 18 July):

This (bombardment of HITACHI-MITO Area, HONSHU, 17-18 July) is the first experience on a large scale, so far as is known, with night bombardment of enemy industrial targets. Conditions for accurate gunnery were about as difficult as might ever be expected. There was not complete control of the air, it was raining, and visibility was about 2 miles. It was impossible to spot, so the bombardment was completely blind and any hits obtained were entirely dependent upon an accurate fixing of the ship's position. The range was extreme, so that even had the fix been perfect the errors of ordnance and gunnery which make spotting necessary might well have caused all projectiles to miss. The speed had to be high and the duration of the bombardment short with consequent high rate of fire. None of the elements of successful destructive bombardment was present--slow speed, close range, deliberate fire, accurate fixing of the ship's position, and the spotting of each salvo. From the standpoint of maintaining pressure on the enemy it was a success. In terms of gun wear and hits per round fired it was expensive. Material damage to the enemy, as judged from the photo interpretation report and as expected, was small. In fact the damage was considerably greater than might be expected under the conditions.

Five rounds per gun--5 salvos--were fired at each of 4 targets. None of these targets was hit. Although, in this case, it was necessary to take these targets under fire, it appears that where it is not necessary, such a small number of salvos is unproductive of material damage in a night bombardment and these rounds would be more effective if added to other targets.

It is felt that the results of this bombardment were encouraging in forecasting substantial success for a night bombardment where spotting is possible. The destruction should be directly proportional to the accuracy of the spotting.

MASSACHUSETTS ACTION REPORT:

When salvos are being directed in a large area blanketed by smoke, with observations impossible, it is believed that better control of the salvos in hitting definite targets can be gained by shifting the point of aim for one or two salvos to a target that is visible to the spotter and, having checked the hitting range, returning to the blanketed area.

MISSOURI ACTION REPORT:

The bombardment of HITACHI, HONSHU, 17/18 July apparently was another

very successful bombardment. The Japanese were taken completely by surprise. The bombardment problem was a most difficult one. The coast was relatively unknown and the charts varied in presentation of the navigational points and soundings. The coast was also quite smooth, and there were practically no distinctive tracking points throughout the approach and bombardment run.

Main reliance for obtaining a fix was placed on DRT position and soundings, plus occasional radar cuts on peaks or small points along the coastline. The position was checked between ships using the interplotting-room frequency.* This was the first time this frequency was used and it proved to be of great assistance to this ship. The coordination between the navigator, Combat and Plot was satisfactory and at all times Plot had the latest and best navigational position form whence to shoot. To make the problem more difficult, the visibility was very limited and a steady drizzle of rain was present during the approach and firing. At no time was the fall of shot or land visible to the ship.

In order to check the firing data the following procedure was used: The center of the target on the second phase was about 1,000 yards from the water's edge. The forward Mark 8 radar (Spot I) was placed in automatic to track the target following the rangekeeper setup** just before opening fire on this target. The range line indicated a fall of shot 1,000 yards in from the beach on the first salvo. A down spot of 500 yards was placed on the second salvo and the range line indicated a fall of shot 500 yards from the beach. Another down 500 was placed on the third salvo and three splashes were observed on the Mark 8 scope at all stations indicating the accuracy of the original range to the target. This procedure was carried out again on the eighth and ninth salvos with the same results. It is believed that this is a good procedure to follow under similar bombardment circumstances on targets near the beach.

MASSACHUSETTS ACTION REPORT:

The success or failure of a bombardment depends entirely on the air spotter's observations. Therefore, every consideration should be given to the factors which affect the ability of the spotter to make accurate observations. First, he must be thoroughly familiar with the area, which can be brought about only through the study of low oblique and colored photographs in addition to high verticals. Second, he must be assigned a type plane or position in a plane which permits observations with ease. The rear seat of the Helldiver and Avenger is not suitable for this assignment. Third, due consideration must be given to the adverse effect of smoke in obscuring an area.

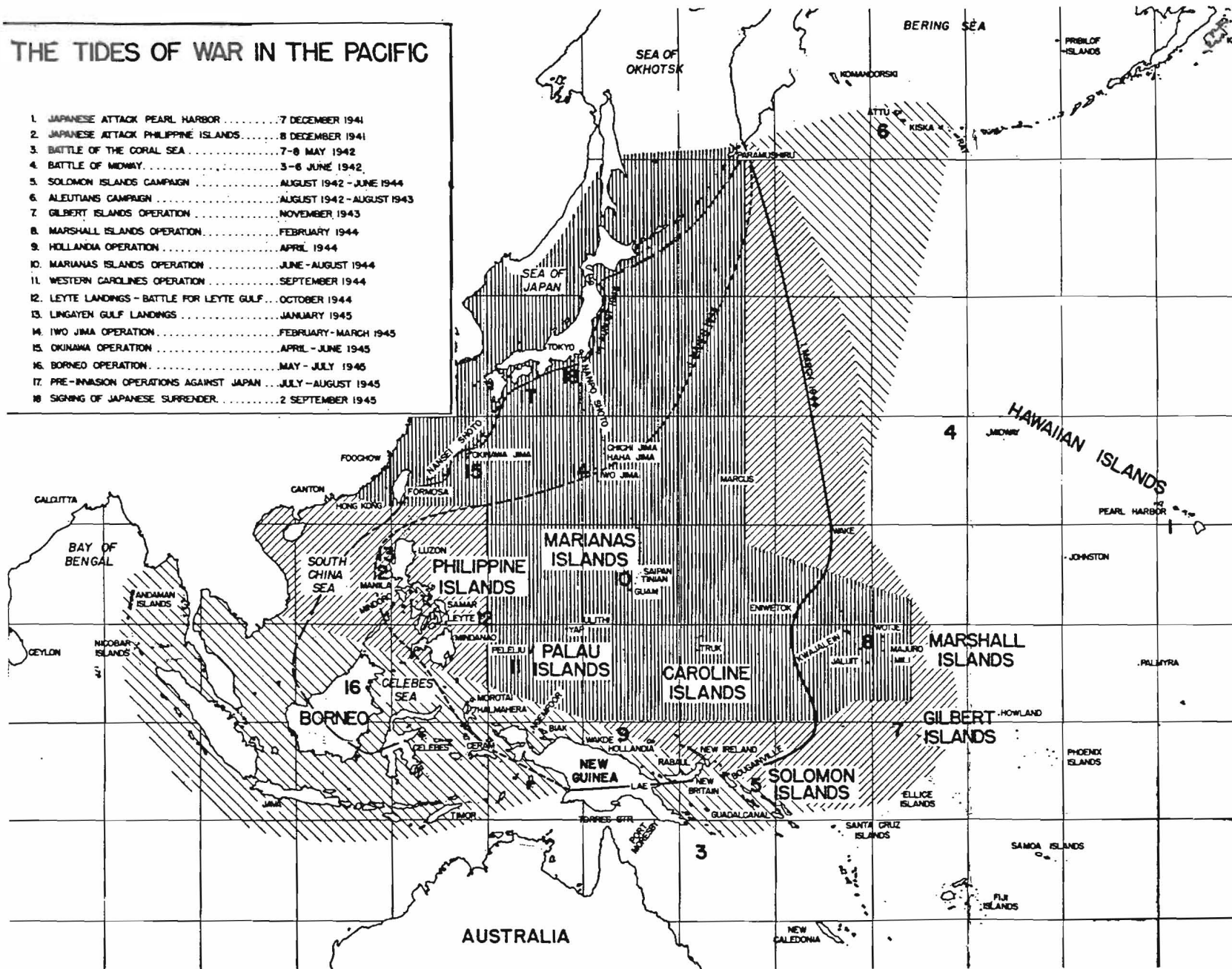
It is believed that carrier fighter pilots, after proper briefing and instructing from the firing ship, are capable of performing all the duties of a spotter, and that the slight advantage of having VOS squadrons on battleships no longer justifies the acceptance of the numerous disadvantages.

*Voice radio net connecting ships' plotting rooms.

**According to the solution generated by the rangekeeper.

THE TIDES OF WAR IN THE PACIFIC

1. JAPANESE ATTACK PEARL HARBOR 7 DECEMBER 1941
2. JAPANESE ATTACK PHILIPPINE ISLANDS 8 DECEMBER 1941
3. BATTLE OF THE CORAL SEA 7-8 MAY 1942
4. BATTLE OF MIDWAY 3-6 JUNE 1942
5. SOLOMON ISLANDS CAMPAIGN AUGUST 1942 - JUNE 1944
6. ALEUTIANS CAMPAIGN AUGUST 1942 - AUGUST 1943
7. GILBERT ISLANDS OPERATION NOVEMBER 1943
8. MARSHALL ISLANDS OPERATION FEBRUARY 1944
9. HOLLANDIA OPERATION APRIL 1944
10. MARIANAS ISLANDS OPERATION JUNE - AUGUST 1944
11. WESTERN CAROLINES OPERATION SEPTEMBER 1944
12. LEYTE LANDINGS - BATTLE FOR LEYTE GULF OCTOBER 1944
13. LINGAYEN GULF LANDINGS JANUARY 1945
14. IWO JIMA OPERATION FEBRUARY - MARCH 1945
15. OKINAWA OPERATION APRIL - JUNE 1945
16. BORNEO OPERATION MAY - JULY 1946
17. PRE-INVASION OPERATIONS AGAINST JAPAN JULY - AUGUST 1945
18. SIGNING OF JAPANESE SURRENDER 2 SEPTEMBER 1945



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Photographs of the coast line taken from seaward, at masthead height on the probable approach bearings, distributed for study, would greatly assist the problem of identifying landmarks for fixing the ship's position.

Every effort should be made to obtain low altitude photographs of a target area after the bombardment, with copies forwarded to the firing ships for study.

The use of smoke for deception and concealment by the Japanese is a definite possibility, and may be encountered in future bombardments. Spotters must be on the alert to detect this and must avoid making false reports on the extent of damage based on the quantity of smoke or fires observed.

FROM: CTU 34.8.2		DATE: 15 JULY 1945			
ACTION	TO: TU 34.8.2	INFORMATION	TO: COMGRD FLEET	CLASSIFICATION	
			CTF 38	PLAIN	
			CTG 38.4	*RESTRICTED	
			BON HOMME RICHARD	*CONFIDENTIAL	
				*SECRET	
			*TOP SECRET	XXX	
Special Instructions				RELEASE	
+ If not encrypted by originator do not transmit by radio without thorough paraphrasing and encrypting.					

151046

PRESENT INTENTION TO MAKE FOLLOWING MODIFICATIONS TO MY OP-ORDER 11-45 FOR 17 JULY BOMBARDMENT BASED ON EXPERIENCE OF 15 JULY X DISPOSITION 8BC6 ALL STATION

ASSIGNMENTS SAME AS 8BC1 EXCEPT ATLANTA AND DAYTON ASSIGNED STATIONS 5.5070 AND 5.5290 RESPECTIVELY X BOMBARDMENT AXIS RECIPROCAL OF GENERAL BEARING LINE X

SCREEN ORIENT TO GENERAL BEARING LINE X TARGET ASSIGNMENTS PARA 5 PAREN BAKER PAREN ANNEX BAKER MODIFIED AS FOLLOWS X PHASE ONE 5 ROUNDS PER GUN WISCONSIN

MISSOURI TARGET 2099 CMA IOWA NORTH CAROLINA TARGET 812 CMA ALABAMA TARGET P582 X PHASE TWO UNCHANGED EXCEPT ALMO ALLOWANCE TARGET 1476 INCREASED TO 5 ROUNDS PER

MUN X PHASE THREE EIGHT ROUNDS PER GUN WISCONSIN MISSOURI IOWA TARGET P458 CMA NORTH CAROLINA ALABAMA TARGET P459 CMA ATLANTA DAYTON INTERCHANGE ASSIGNMENTS X

WISCONSIN BE PREPARED TO COVER TARGET 1468 X ALL PHASES SERVICE CHARGES X COUNTER BATTERY RESPONSIBILITY MISSOURI SECTOR BETWEEN COURSE AND GENERAL BEARING LINE

ALABAMA SECTOR BETWEEN GENERAL BEARING LINE AND RECIPROCAL OF COURSE XXX

I. G. Seeger
Authenticated I. G. SEEGER, Lt., USNR.
(Signature, Name & Rank)

**U.S. STRATEGIC BOMBARDMENT SURVEY: SHIPS' BOMBARDMENT OF JAPAN, 1945.
REPORT OF SHIPS' BOMBARDMENT SURVEY PARTY:**

Surface bombardments of Japan proper took place shortly before the Japanese surrender. It is not probable that the economic consequences...were felt on the fighting fronts before the war ended, but there is evidence...that the attacks, in combination with other pressures..., had considerable influence in lowering the will to continue the war of the local populations which were subjected to gunfire from heavy ships.

Had the war continued, it is estimated that about 22 per cent of total Japanese pig iron production...would have been lost because of the effects of three attacks against plants of the iron and steel industry.... Other surface bombardments appear to have had little effect on the Japanese economic structure...except to the extent that they contributed to increased...absenteeism and reduced...productivity....

This report demonstrates the vital role which intelligence information plays in shore bombardment, and the necessity for...an organization which, among other functions, is capable of identifying key industries in the enemy's...economy, designating the most vulnerable points of attack, providing detailed information on targets selected for assault, and assessing results.

The Kamaishi Works of Japan Iron Company, ... as a result of two bombardments, incurred very considerable physical damage, and a loss of production equivalent to from eight to twelve months output. Yet no major building...was destroyed because the greatest concentration of hits did not exceed 37 per 200 yard square. In the bombardments generally the density of hits was much lower, possibly because of the technique of aiming at different buildings scattered throughout a target area, or intentionally spreading the fall of shot to cover an entire target, under the assumption that both accuracy of firing and effectiveness of ammunition would be greater than they actually proved to be. Data on the effectiveness of projectiles...indicate that about 42 direct hits by 16-inch high-capacity projectiles would be required to cause 50 per cent structural damage to a heavy steel-framed building approximately 600 feet long and 150 feet wide. ...doctrine and techniques for attacking industrial targets with ships can be considerably improved by further study based on reappraisals of weapon effectiveness and accuracy of firing under varying conditions. It also appears that, although long and medium range attacks by both day and night can inflict considerable damage, destruction of...heavy industry by such attacks is not to be expected unless either a very large amount of ammunition is allotted to the task or much greater accuracy is obtained. Experience has shown that it is possible to raise the level of accuracy at the expense of increasing the hazard to...ships by using shorter ranges and prolonging firing periods. The extent to which these measures can be adopted will therefore usually be governed by the broad strategic aspects of the war as well as the immediate tactical situation.

The Hamamatsu and Hitachi areas were subjected to high explosive and incendiary bombing as well as...surface bombardment, and study... thus permitted a certain...comparison of the relative effectiveness of these forms of attack. Because of the highly combustible nature of the majority of...targets, fires initiated by incendiary bombing clearly

caused the greatest...damage. Although a considerable number of fires were associated with high explosive bombing and gunfire, there were many instances in which detonation...definitely did not initiate fires directly, even when occurring in structures of light wood and paper construction. It therefore seems probable that, in general, fires initiated by...explosives were caused by overturning of cooking fires, striking of volatile and inflammable liquids or gases, short circuits, etc. It appears that development of major caliber incendiary ammunition is warranted, and is a necessity if ships are to be used in the future for large-scale bombardment of industrial plants or urban areas.

It is concluded that...explosive projectiles or bombs are most efficiently used when directed against targets which are highly resistant to burning. Against heavy steel-framed buildings, individual 2,000-pound bombs seem to be approximately eight times as effective as 16-inch high capacity projectiles in producing damage when mean areas of effectiveness are compared. Serious fragment damage from bombs seems to be confined largely to the immediate vicinity of each hit, while the heavy fragments from projectiles proved capable of damaging machines at considerable distances. Both missiles showed themselves...capable of damaging the heaviest...industrial structures. Choice of weapon against such targets would seem to be governed largely by deciding whether, in specific circumstances, sufficient hits can most easily be delivered by ships or planes, and weighing the relative risk involved. Since reports of gunnery exercises indicate that at least 90 per cent of hits on individual large buildings is to be expected at short ranges, as compared to an average of something less than one per cent in these bombardments, it is apparent that this type of attack can be devastating with great economy of ammunition and effort when circumstances permit its use. It is...evident that, considering the enemy economy as a whole, only a small percentage of important targets will usually be within reach of attack by ships.

The damaging effect of individual eight-inch and smaller projectiles appears...too small to make their use profitable against...heavy industry unless a very great number of hits...can be obtained, or unless harassment and not destruction is the result desired. Incendiary ammunition in the smaller calibers, however, should produce results comparable to those obtained by incendiary bombing, if used against...inflammable targets.

GENERAL SUMMARY

Units of the Third Fleet attacked selected targets with gunfire in the areas of Kamaishi, Hamamatsu, Hitachi, Muroran, Shimizu, Shionomizaki and Nojima Saki. The primary task of the first four...attacks was bombardment, and the principal components of task units which executed them were, in general, fast battleships and heavy cruisers. Attacks on [the latter three] were secondary tasks carried out during antishipping sweeps...by light cruisers and destroyers....

The two bombardments of Kamaishi caused damage which, according to Japanese officials, would have required repairs costing about 65 per cent of the total value of physical assets to restore the plant....the equivalent of from eight to 12 months' production...would have been lost, because of the combined effects of gunfire and the critical

condition of the Japanese economy. Fires initiated by gunfire extensively damaged the town of Kamaishi. Refrigeration plants and other facilities of the considerable fishing industry...were destroyed....

Widespread damage had been inflicted on the Hamamatsu area by air attacks prior to the...bombardment. Gunfire damaged surviving buildings and equipment of the...Hamamatsu Locomotive Works and incapacitated [it] for about three months. Projectiles falling in the railway yards caused interruption of through traffic on the Tokaido main line for about three days. Slight damage was also inflicted on [other] plants...and on a naval barracks. Damage to dwellings, gas, electrical attacks, was considerably augmented by gunfire.

In Hitachi...ships' gunfire moderately damaged the Taga Works and Mito Works of Hitachi Manufacturing Company and slightly damaged Yamate Plant...and the copper refining section of Hitachi Mine. In addition, projectiles falling in the urban area caused considerable damage to housing and to telephone, power, water and gas facilities. Some Japanese officials considered that the effectiveness of the incendiary attack was increased by the surface bombardment, because many persons who had fled from the city were not available to fight fires. These officials were impressed by this apparent coordination between our surface and air forces.

Targets for surface bombardment in the Muroran area were the Wani-shi Iron Works...and the Muroran Works of Japan Steel Company.... It is estimated that...damage inflicted on the former...would have resulted in loss of...about two and one half months' output of coke, and a slightly smaller loss of pig iron. Loss in production at the latter...can be roundly stated as about 40 per cent of one month's output. In the city, ...gunfire interrupted railway service for three days, and double track service was not restored for five days. The...water supply was disrupted for about one week, electric power supply for about two days, and damage to the telephone system required about two months for repair.

Effectiveness of ammunition...indicates that the average amount of structural damage caused by a 16-inch high capacity...hit is about 1,400 square feet in heavy steel framed buildings, and about 3,200 square feet in wooden structures. Corresponding figures for eight-inch projectiles are about zero square feet and 400 square feet. The equivalent figure for heavy steel frame buildings calculated in the same manner for the average 2,000 pound GP bomb hit is 8,800 square feet. The mean area of effectiveness of a 16-inch high capacity projectile for serious damage (destroyed plus heavy damage) against machine tools is 4,900 square feet as contrasted to 8,500 square feet for a 1,000 pound bomb.

27...industrial plants or housing areas were fired on by heavy ships. Of these 22 were hit. In daylight firings by battleships the ...average target was about 1.5 million square yards, or 39.6 of the 200-yard squares used on bombardment charts. The average percentage of shots...which fell within target boundaries was 24.9, at an average range of 23,300 yards. The approximate average error of the mean point of impact of shots directed at all targets during daylight was 249 yards in range and 209 yards in deflection. During night firings by battleships, at an average range of 24,740 yards and against targets averaging half a million square yards, or 14.8 200-yard squares, in size, the aver-

age percentage of hits...was 21.6 and the average error of mean point of impact was 280 yards in range and 468 yards in deflection. The average accuracy of heavy cruiser firings was slightly less than the average... obtained by battleships.

Interrogations seemed to indicate that even...officials knew little of what was transpiring away from their own localities. For this reason surface bombardments caused people to wonder what had happened to their own ships and planes, and with the realization that our ships could approach the shores of Japan with impunity they knew..that the progress of the war was even more unfavorable than they had suspected. People... invariably stated...that gunfire was more terrifying than either HE or incendiary bombing. When asked why...the most common answer was that there was normally ample warning before major air attacks, and the duration of the danger could be judged by the arrival and departure of the planes. Surface bombardments, however, usually came without warning, the fall of projectiles was more prolonged, and people were perplexed and confused by the uncertainty of where the attack was coming from and how long they would be forced to endure it.

Commander Edward J. Mathews, USNR (Ret.), "Bombarding Japan." U.S. NAVAL INSTITUTE PROCEEDINGS, Vol. CV (February 1979), 75:

We liked Kamaishi because the main target, a big steel mill, was well removed up a deep bay from the little town. That meant that we could shoot up the mill without killing townspeople and destroying buildings. We were confident (wrongly) that any merchant vessels had by now taken refuge in the Inland Sea or on the west coast. When, in the operation order, we restricted the cruisers and destroyers of the screen to "targets of opportunity," I felt sure, on the basis of aerial reconnaissance, that no such targets would appear.

We picked up the coast of Honshu in the gray dawn of 14 July and bore down at high speed on the unsuspecting little city. Our force constituted a formidable phalanx of gray ships, with spray creaming over our bows and signal flags snapping at the halyards. As we rounded onto the bombardment track, I was surprised to see a large merchant ship... emerge from the...inner bay. She was followed by two others, then by a minuscule gunboat which had the impertinence to poop tiny shells at us that fell half way. They had sneaked in since the last photo reconnaissance.

The screen was screaming for permission to release batteries. None of them had ever encountered so juicy a target. Just then we opened fire on the mill with the 16-inch guns, and either someone cut the screen loose or they just couldn't stand it any longer. At any rate, the air became solid with flying metal. The merchantmen and their escort disappeared behind curtains of spray from concentrated salvos. They were directly in line with the town, and soon red gouts of flame showed where the "overs" had ignited the little frame houses. Smoke from the burning town began to obscure the mill, but the merchantmen continued on their way and finally disappeared behind a headland, seemingly unscathed.

In the meanwhile, the battleships were throwing everything they had in the direction of the mill. Several tiny islands stood across the mouth of the big bay below the mill.

As we bellowed back and forth on our bombardment track, one small island in particular drew our attention. It was close aboard, a particularly charming one, with the conventional white paper house in which dwelt a little white-kimonoed man with a tiny white dog. ...the little dog, ...frightened by the noise, was careering around the island with the man in hot pursuit. Around...they went, and each time we repassed the island we shouted encouragement. Finally...the man caught the dog, gave him a whack, dashed into the paper house and banged the paper door behind him, obviously convinced that therein lay security. A triumphant cheer rose from our formation as we turned away.

Bombardments

	16" Shells (BB)	8" Shells (CA)	6" Shells (CL)	5" Shells (DD)
14 July 1945—KAMAISHI.....	802	728	-----	825
15 July —MURORAN.....	860	-----	-----	-----
17 July —HITACHI.....	1,207	-----	292	-----
29 July —HAMAMATSU.....	810	1,035	-----	-----
9 August —KAMAISHI.....	850	1,440	-----	2,500 Approx.
Total.....	4,529	3,203	292	3,325

B. SURFACE ACTION

World War II was the first truly three-dimensional conflict. Air power, both land- and carrier-based, took a full share of the work in coordination with ground, surface, and undersea forces. In this war the fast battleship's fleet air defense capability became, arguably, its most important characteristic. The fast battleship, though, was still very much a battleship, designed to fight surface actions and to absorb damage while delivering heavy armor-piercing projectiles at ranges up to twenty miles or more. Opportunities for surface combat were relatively scarce but, as long as an enemy surface strike capability existed, had to be anticipated. Through the end of the war in the Pacific operating plans included a contingency plan, to be put into effect if heavy Japanese surface forces should threaten American amphibious units or carriers. When ordered, the fast battleships were to detach themselves from the carrier task groups and form a surface task group with supporting cruisers and destroyers. Backed up by carrier planes, they would then engage the attackers in day or night battle in general accordance with the tactical doctrine which had been developed in years of fleet exercises since World War I. Such a general battleship force surface action never materialized--though it seemed tantalizingly close at Leyte Gulf, when fast battleships steamed north after what proved to be a Japanese decoy force--and the battleship task group was, otherwise, formed only for air defense or shore bombardment.

Engagement with French Surface Force, Casablanca

November 1942

Off Casablanca on 8 November 1942, MASSACHUSETTS fought a brief gunnery action with defending French destroyers, sinking one and sharing a second with cruiser TUSCALOOSA.

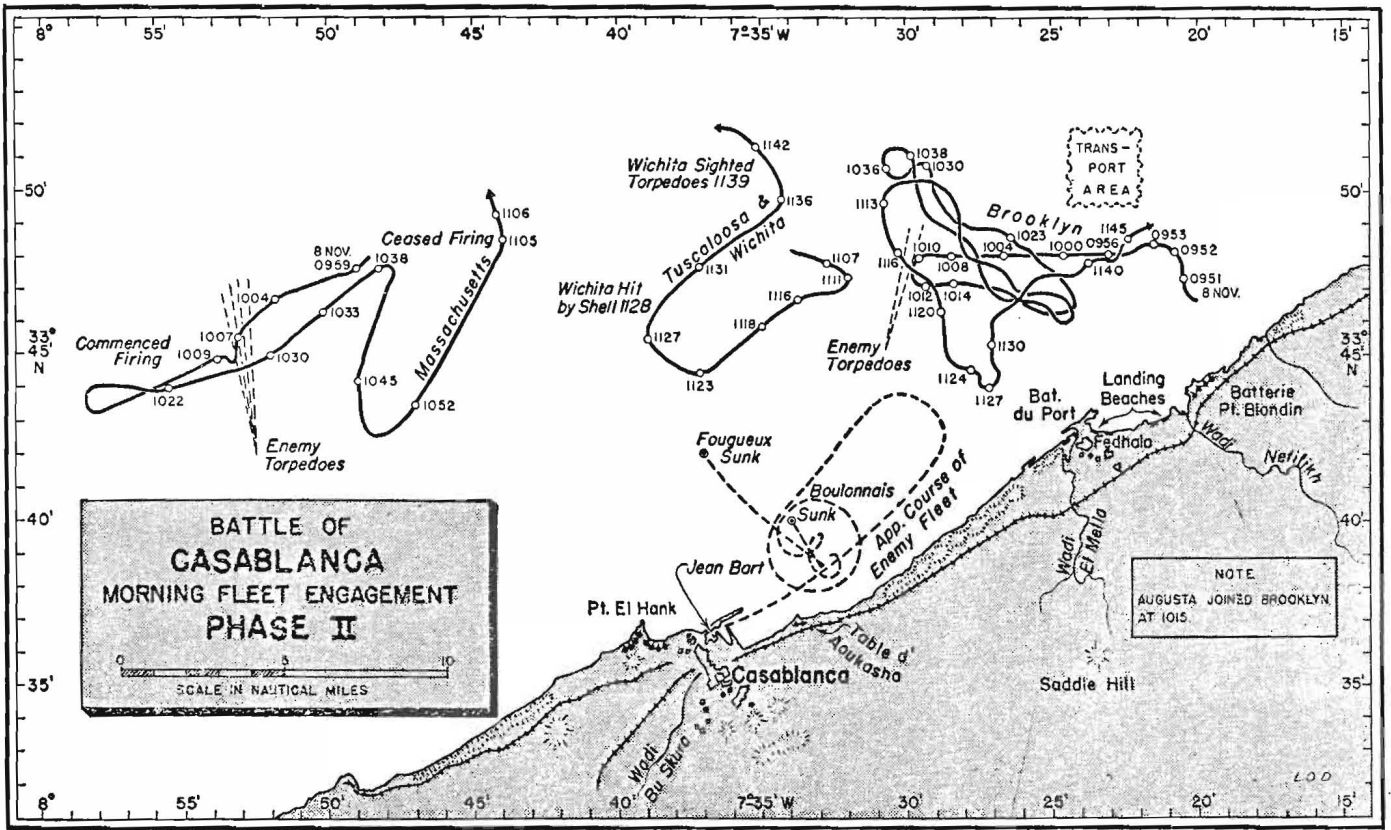
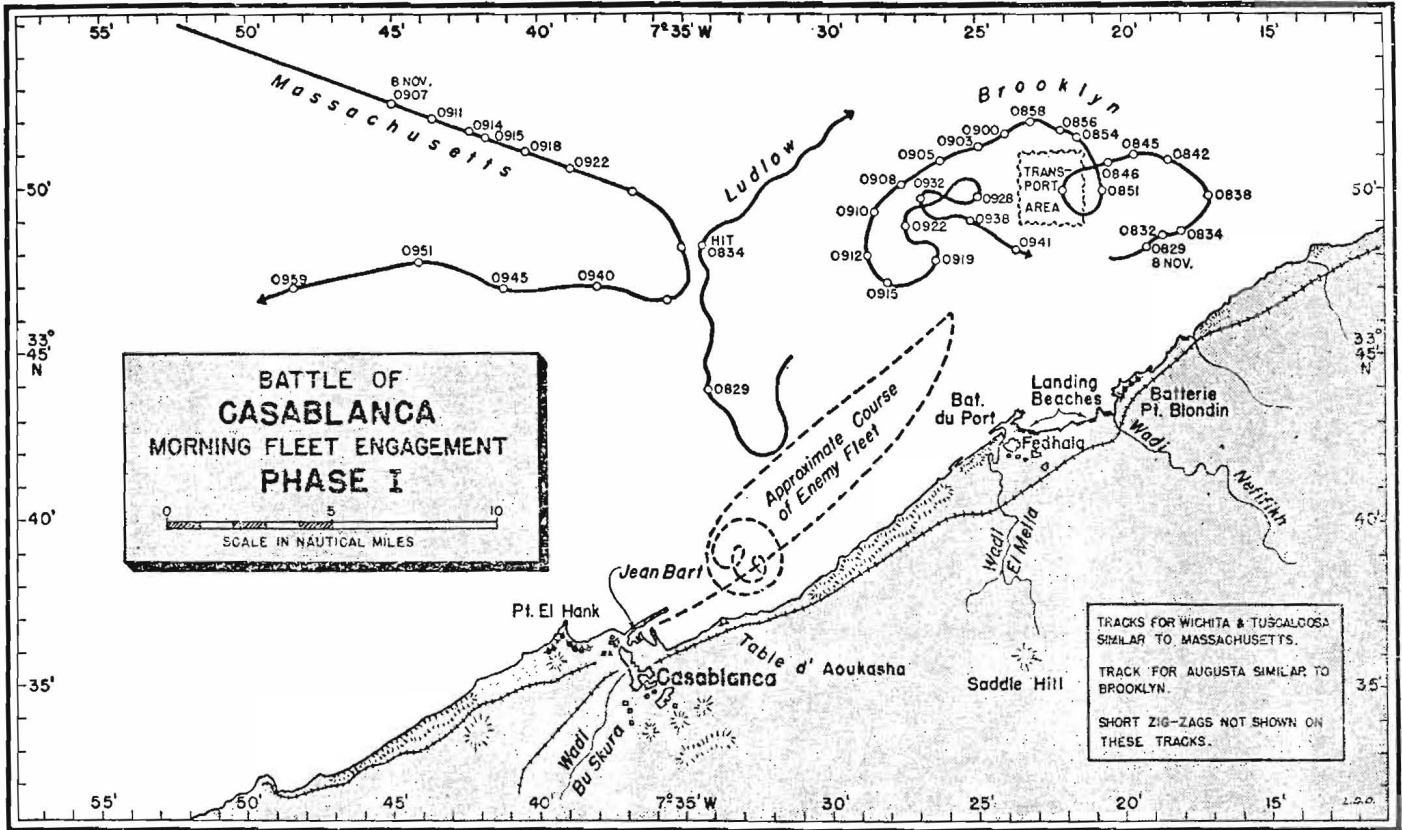
MASSACHUSETTS ACTION REPORT:

Evasive Tactics by the Enemy and Effect on Rangekeeping

During the second phase of the battle, enemy light forces were engaged. The radars were inoperative and the rangefinders were ineffective due to own ship changing course and because of enemy smoke screens. Enemy ships maneuvered in circles, ellipses, figure eights in and out of the smoke screen. Accurate ranges were not possible and range lines on the graphic plotter,* with deduction of range rates, were out of the question. Target angle changed so rapidly that the spotter had trouble keeping up with it. The best range obtainable was set on rangekeeper along with target angle and estimated target speed. Shooting was "from the hip," with application of spots in range and deflection when salvo landed.

When engaging light forces using evasive tactics and smoke screens, radar ranges are vital. Radars must be improved so that they do not

*A graphic plotter, attached to the Mark 8 rangekeeper, automatically registers a graphic time record of advance range, generated present range, and sight deflection. Generated range rate can be checked with an integral protractor.



fail on shock of gunfire. Range lines and rates are unobtainable, and present-range pencil [on plotter] must be matched with best range obtained or, if range cannot be measured, the "shoot and spot" method must be used.

A suggestion for shooting at light forces using evasive tactics is to shoot one turret with existing angle set, shoot a second turret with target angle 45 degrees to the right of present target angle, and a third turret with target angle 45 degrees to the left of present target angle. This procedure will have a good chance to catch the enemy no matter which way he turns.

GENERAL REMARKS

War Watch Officer. The...War Watch Officer is to act for the Captain in case of emergency. For this reason, it is impossible to lay down detailed instructions as to his course of action. He should be guided by the following general principles.

U.S.S. MASSACHUSETTS is a large and valuable unit of the fleet. She was never designed as an offensive unit to be used against submarines and destroyers, nor as a salvage vessel or commerce raider, and should not be used as such. As a general principle MASSACHUSETTS should close anything her size or larger, and keep out of torpedo range of vessels which are, or may be, so armed.

Battleship Night Action, Naval Battle of Guadalcanal

November 1942

In this decisive action WASHINGTON and SOUTH DAKOTA engaged a Japanese force formed around the battleship KIRISHIMA. SOUTH DAKOTA suffered extensive topside damage, but WASHINGTON's accurate fire mortally injured KIRISHIMA. Set aflame and racked by explosions, KIRISHIMA was scuttled by her crew. The last major Japanese naval thrust at Guadalcanal had been turned back, and WASHINGTON had done what she had been designed to do--sink one of her own kind in a gunnery action. WASHINGTON was the only American fast battleship to defeat another capital ship.

WASHINGTON ACTION REPORT:

SUMMARY OF OUTSTANDING EVENTS AND GENERAL COMMENT.

On the night of November 14-15 WASHINGTON was flagship of Commander Task Force 64 (ComBatDiv 6.) In column, with four destroyers ahead and SOUTH DAKOTA astern, she stood north between Russell and Guadalcanal, then east and southeast, passing north of Savo. Standing west from this point, first radar contact was made at 0001 with enemy ships east of Savo. From 0016 to 0019 fired 42 rounds 16", opening at 18,500 yards, at large cruiser or battleship which it is believed was sunk. From 0016 to 0017 fired 100 rounds 5" at ranges 12 to 13,000 yards at enemy cruiser or large destroyer which was also engaged by SOUTH DAKOTA and was left burning. Standing on north-westerly courses fired 133 rounds 5" from 0025 to 0034 at ranges about 10,00 yards at light craft close to south-east shore of Savo which were engaging our destroyers; all were silenced

and one was left burning. From 0100 to 0107 fired 75 rounds 16" and 107 rounds 5" at ranges from 8,400 to 12,650 yards, at battleship northwest of Savo which was firing at SOUTH DAKOTA. This battleship was silenced and was subsequently tracked by radar through a 500-degree turn. From 0100 to 0107, fired 120 rounds 5", at ranges from 7,400 to 9,500 yards, in succession at three enemy cruisers illuminating and engaging SOUTH DAKOTA and also under fire by her; they were silenced.

By the time our 5" fire on light craft close to southeast shore of Savo had ceased one of our destroyers was sunk, one was hopelessly afire (she exploded and sank a few minutes later) and the other two were put out of action (they retired to southward). Subsequently, and before we opened fire on ships northwest of Savo, the SOUTH DAKOTA was seen to the eastward between this ship and Savo on a course to northward of WASHINGTON course. What appeared to be the SOUTH DAKOTA was seen at about 0121 at a considerable distance to the southeastward between this ship and Guadalcanal on a southerly course.

From radar tracking and visual observation of enemy ships, there were:

- (1) Fired upon by this ship and apparently sunk:
 - 1 large cruiser or BB (WASHINGTON only.)
 - 2 large cruisers (SOUTH DAKOTA plus WASH 5".)
 - 1 destroyer (our DD's plus WASH 5".)
- (2) Fired upon by this ship and apparently damaged:
 - 1 - 14" BB silenced and out of control (WASH. only.)
 - 1 DD burning (WASH. 5".)
 - 5-9 light craft silenced (our DD's plus WASH. 5" plus S.D.)

There was no melee. This ship was undamaged.

COMMENT.

The following comments are submitted:

- (1) Our radar is effective for accurate gunfire at long ranges at night. Japanese radar aboard ships present, if any, is not effective for surface targets.
- (2) Japanese are sufficiently familiar with radar and aware of our use of it to make full use of land cover both between them and ourselves and closely backing them up.
- (3) Our optical vision is superior to Japanese.
- (4) Our fire control and the effectiveness of our projectiles meet or exceed our expectations.

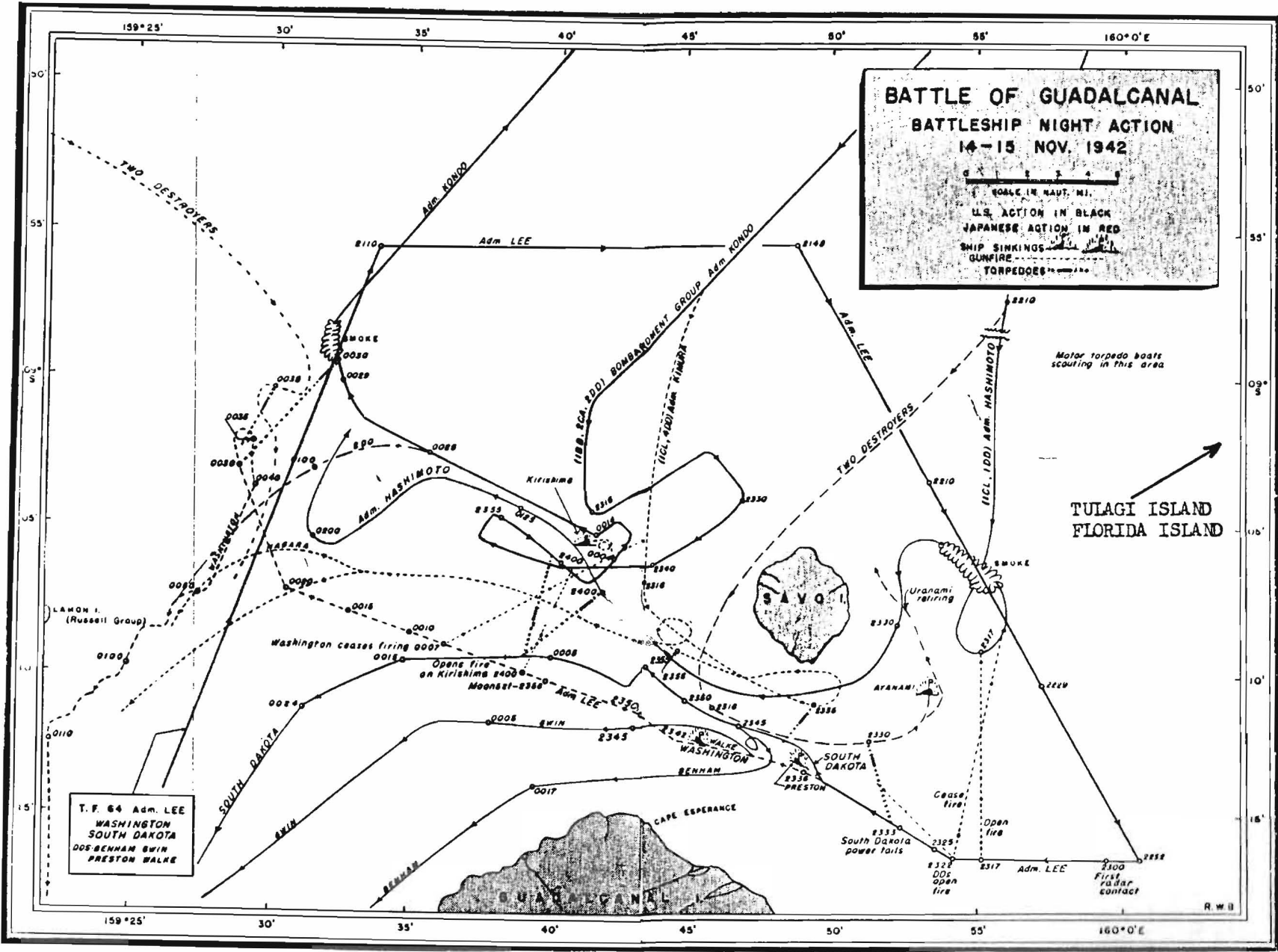
Accordingly,

- (5) We should seek rather than avoid night action, opening at ranges as great as satisfactory solutions can be obtained.

EFFECTIVENESS OF GUNNERY.

This ship was fired on only sporadically. She was not illuminated. No hits were sustained and the nearest miss noted was the splash, apparent-

1-69-1



ly of a major-calibre shell about 200 yards on the port quarter. Observers who witnessed other ships of our force under concentrated fire reported the Japanese gunnery to be accurate. Enemy ships close to Savo fired automatic weapons accurately at our destroyers. The Japanese ships were, apparently, not equipped with radar. Their searchlights provided excellent illumination of SOUTH DAKOTA, but attracted our fire and provided a point of aim.

MAIN BATTERY.

This ship's gunnery appeared highly effective. Fire was opened with a gun range of 18,500 yards initially by this vessel using radar ranges and optical train and hits were definitely obtained by the third salvo. It is believed target was stopped and sinking after third salvo. 42 rounds were fired.

In the second phase target had been tracked by radar ranges and bearing and later by optical train. Fire was opened at 8,400 yards and a hit was probably obtained on first salvo and certainly on the second. Fire was rapid, on one turret ready light, for about 2 minutes 39 seconds, firing about 39 rounds. It was interrupted for 1 1/2 minutes due to an erroneous report that target was sunk, and resumed for 2 minutes and 45 seconds, during which time 36 rounds were fired. A total of 75 rounds was fired on this target which was believed to be an old type battleship.* Starshell illumination was used on this phase after about the second salvo, 62 rounds being fired.

According to the best data available, overall SPGPM was 1.30 and 5 guns had 1.8 average. Fire discipline was excellent.

The normal fire control set-up of this vessel was used throughout, namely:

Collective fire, Director I** controlling in train.
Group I controlling in Plot.
Director IV (Stable Vertical I)*** controlling in continuous level and crosslevel.
Director IV controlling firing circuit (Plot.)
Radar ranges by indicating and voice.

Turret pointers were matched during phases in which the director was being trained on the visual target. During the time when the visual target was obscured, whether training by radar or generated,**** a turret spread in deflection was fired.

The selected train firing key was used in plot to insure that the firing pointer could see the light that indicates when the director

***KIRISHIMA.**

****Forward main-battery director.**

*****Stable-vertical director located in plotting room (plot).**

******Using rate of train derived from previously-observed relative motion of firing ship and target.**

train is on target. It has been standard practice for this vessel to use that key at night when visual or radar train indications are accurate, shifting to generated bearing only in case of poor train indication or obscured target.

Against the first main battery target, 18,500 yards, radar range was used in conjunction with visual train. The target became obscured after the second salvo. The target was lost by all radars after this salvo. As a result the last salvos went out in what amounted to generated. That is, the present range was let ride and the director being in automatic remained on the generated train. On the second main battery target the tracking was done entirely by radar for at least five minutes. When the target finally came into view optically, checks given by the pointer indicated that the radar was exactly on. In this connection it is noted that a considerable period of time is taken to adapt the trainer's eyes to the telescope at either night or day after looking at the radar scope (train indicator.) The reverse is also true. As a result of this difficulty, main battery Director II found it desirable to let the trainer keep track by radar and the pointer observe by telescope. Such a system is made possible by the fact that the director is trained automatically by generated bearing. Therefore small corrections only are necessary and such corrections can be made by coaching from a pointer's station.

Radar spots were used against the first target while the target echo was present. It is of interest to note that against the second target (BB) "overs" as well as "shorts" could be seen optically. Salvos were walked back and forth across the target.

The fire control switchboards on this ship provide for a secondary battery director to furnish target bearing to a main battery rangekeeper. Thus it can also be used to designate to a main battery director. At the time of first contact both main battery directors lost the target and the shift was made for designation, but the secondary battery director had not yet settled down and its designation was not used. In the meantime main-battery Director I had again picked up the target and target bearing was shifted back to it.

SECONDARY BATTERY.

Secondary battery fire control used radar ranges throughout. During Phase 1 radar train was used. In Phases 1A and 2 optical train was used. Level for the basis of gun elevation order was obtained from the Stable Element with dip-range being set on the synchronized elevation knob in accordance with advance range. Firing circuits were controlled by director pointers. Group I used rapid continuous fire. On the other hand, Group III soon shifted to salvo fire, 4 second interval, to facilitate spotting.

In the first phase effectiveness of the Secondary Battery was undetermined. Group I and Group III each controlled two mounts in firing at surface targets at ranges between 13,000 and 15,000 yards. The control of the groups was by radar, range and training. Group III used 400-yard rocking ladder in 200-yard steps. No radar spots were obtained and there was no observation of the fall of shot.

Phase 1A consisted of shooting at what at first appeared to be shore batteries on Savo Island but later identified as surface craft. Initially both groups opened fire on these targets. In view of the fact that Group I appeared to be shooting "over," Mounts 1 and 3 were switched over to Director III which continued the fire. Group III opened fire initially at the target near the right tangent of the island, aiming at the gun flashes, using a 200-yard rocking ladder based on the closest radar range with target speed set on zero. The first target was set on fire, many observers reporting that a stream of 5" tracers poured into the target which immediately burst into flames. A range of 10,200 yards on the burning ship from the main battery coincidence rangefinder was within 100 yards of the range set on the computer. Fire was shifted successively to the left using gunfire flashes as points of aim, and was continued against gunfire flashes until each gun ceased firing. Apparently another target on bearing near the center of Savo Island was set on fire. These targets may have been destroyers or large MTB's.

In Phase 2 (the third secondary battery phase) the secondary battery again opened with divided fire. Group I fired on main battery target and Group III on target whose searchlights were illuminating SOUTH DAKOTA. Twice during the firing Group I was hitting, apparently starting fires in the upper works. When searchlights on another ship were seen to be turned on, secondary battery Director III used them as a point of aim. On this target, which was apparently a heavy cruiser, also engaged by the SOUTH DAKOTA's 5", Group III fired with a 200-yard rocking ladder. The first salvo landed short and was spotted "up 400." Fires were started. At about the 4th salvo the searchlights went out. Director III continued with about eight or ten more salvos, at which time another group of searchlights was seen to come on. The point of aim was shifted to these searchlights and fire continued until they went out. Another set of searchlights came on and fire was again shifted to them. The last searchlights were turned off about the time of cease firing. No hits were definitely observed on the last two targets.

The tactical situation was greatly affected by the presence of islands and the necessity of fighting in comparatively restricted waters. As noted previously the radar screens had many land echoes. For a surface engagement under reduced visibility, and especially in restricted waters, a navigational plot should be maintained in radar plot for fully effective use of the radar. If this vessel were to keep such a plot more space would be required. An expansion of radar plot appears justified.

The picture presented by the SG radar is not a true plan view. Radar operators must be given concentrated training in areas surrounded by land in distinguishing between land and ships. During a previous sweep by this vessel around Russell Island at night, numerous false reports of surface targets were received from the fire control radars that turned out to be land more than 100,000 yards away. During the night of the engagement only one such report was received.

LESSONS LEARNED AND RECOMMENDATIONS.

Radar has forced the Captain or OTC to base a greater part of his actions in a night engagement on what he is told, rather than what he can

see. This ship was not hit but examination of SOUTH DAKOTA revealed completeness with which bridge structure may be riddled by shells and splinters which penetrate 1" STS bulkheads. The enemy may be counted upon to hit foremast superstructure.

The captain and navigator should be in Conn. An experienced officer, other than the navigator, should be OOD and should filter for the Captain the tremendously numerous reports received at the conning station over the various telephone circuits.

COMBATDIV 6 ACTION REPORT:

This action demonstrated the tremendous value of radar in a night action. Battleships obtained excellent fire control results using radar range and radar spots, combined with optical instruments.

Strong signals from enemy ships permitted quick and accurate solution and spots.

First phase opening ranges 16,000 - 18,000 yards, illumination by setting moon. Hit with second salvo. Second phase opening range 6,000 - 9,000 yards; illumination by starshells...did not add to accuracy of fire.

No indication that enemy used radar. Enemy apparently ranged on gun flashes, but inaccurately. SOUTH DAKOTA hit after enemy searchlight illuminated her.

Own gunfire superior to Japs, particularly as range increased.

SG radar invaluable in locating surface targets and coaching fire control radars on.

Samuel Eliot Morison, HISTORY OF UNITED STATES NAVAL OPERATIONS IN WORLD WAR II, Volume V:

The battleship action of November 14-15 was vastly better fought by the United States Navy than the unorganized brawl of two nights earlier. Admiral Lee had a positive doctrine that he maintained, despite the absence of his entire destroyer screen. An able and original scientist as well as a flag officer, he appreciated the value of radar, used it to keep himself informed of enemy movements and tactics, and made quick, accurate analyses from the information on the screens. Yet some mistakes of earlier night battles were repeated. Lee's task force was a scratch team, destroyer and battleships captains alike being unfamiliar with each other and with their commander. Apparently the recurring urgencies in the South Pacific imposed a haphazard composition for every task force thrown together to meet the enemy. Again, and not for the last time, the Japanese taught the American a lesson in the use of torpedoes. SOUTH DAKOTA was lucky to escape alive. WASHINGTON, conned by Captain Glenn Davis and directed by Admiral Lee with a skill and imperturbability worthy of her eponym, saved the day for the United States.

Surface Sweep Around Truk

February 1944

While the Fast Carrier Force carried out air strikes at Japanese installations and shipping, IOWA and NEW JERSEY conducted an anti-ship sweep around the atoll.

CINCPACFLT ACTION REPORT:

At 1118, 16 February, Commander Task Force 50 (Vice Admiral R.A. Spruance) ordered that Task Group 50.9, composed of NEW JERSEY, IOWA, MINNEAPOLIS,* NEW ORLEANS,* BURNS,** BRADFORD,** IZARD** and CHARRETTE** be formed for the purpose of making a sweep around TRUK, counterclockwise, to destroy any enemy ships encountered. Commander Task Force 58 was directed to provide air cover and to provide the O.T.C. with information of the location of targets.

When approximately 13 miles north of NORTH PASS, TRUK Atoll, lookouts on several of our ships observed smoke dead ahead on the horizon, and radars commenced to pick up surface targets ahead of the formation, bearing from 250° to 270° True. Reports from the air observer, other planes, lookouts, and radar were inconsistent; however, it is believed that enemy ships present at the time were:

- (1) 1 KATORI Class light cruiser.
- (2) 1 ASASHIO Class destroyer.
- (3) 1 Trawler or mine vessel carrying a considerable quantity of explosives. This ship was approaching TRUK from the north, apparently unaware of the presence of our ships.
- (4) 1 Large fast destroyer.

By 1509, range to the trawler had been reduced to 15,000 yards and our destroyers opened fire. The trawler maneuvered and returned ineffective fire with its anti-aircraft battery. By 1520, the trawler was drifting toward the head of the column, and burning. Shortly thereafter NEW JERSEY opened fire with its port 5-inch battery at 800 yards. The trawler blew up, with a violent explosion, and disappeared.

The next ship engaged was the light cruiser of the KATORI Class which at 1515 was distant at 17,400 yards. Hit by both the cruisers and IOWA, the enemy CL took a heavy list to port, capsized, and about a minute later sank by the stern.

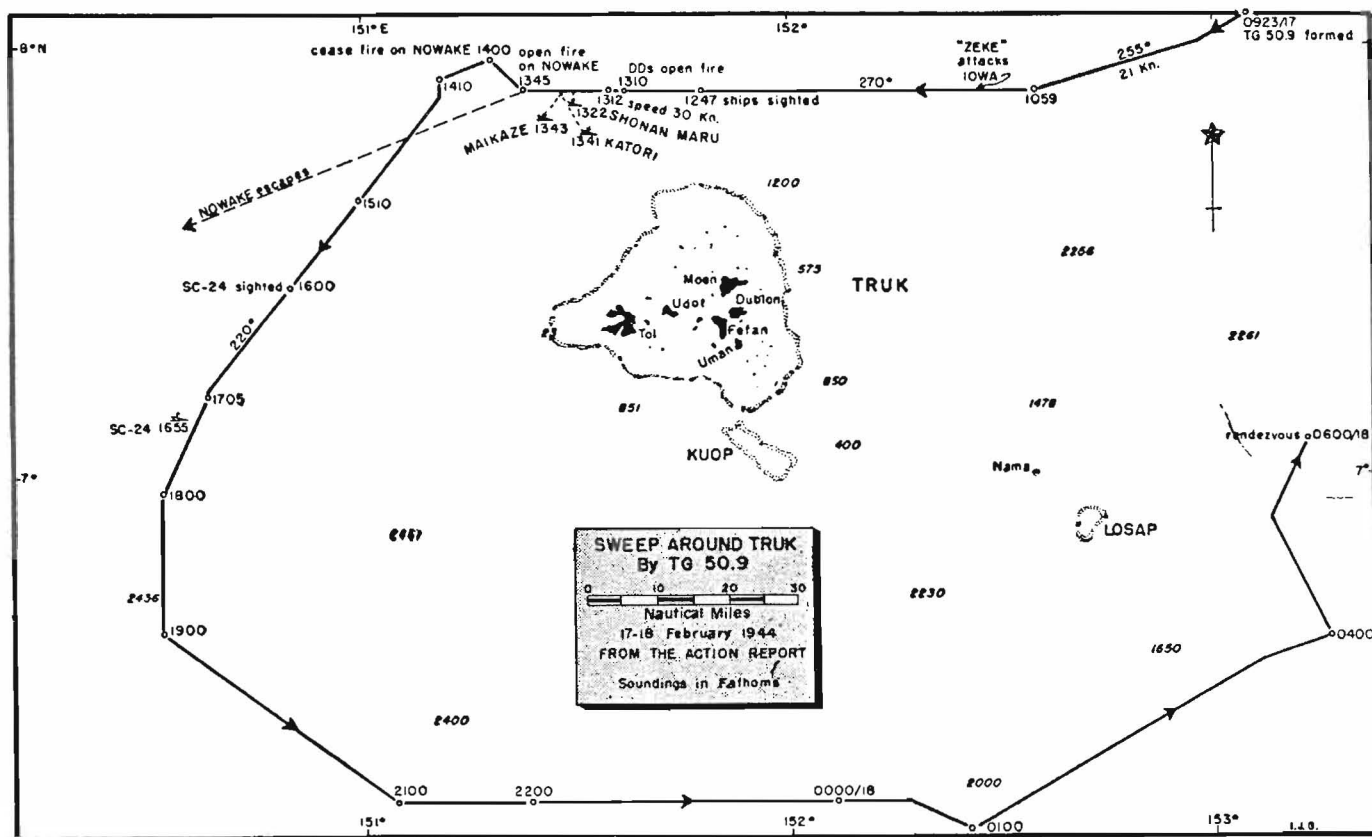
Concurrently with the firing on the light cruiser, the ASASHIO Class destroyer, burning and dead in the water, was engaged. Firing was opened at 1522, when IZARD was distant 13,000 yards from this vessel. From this time until 1540, when this enemy destroyer capsized and sank, an increasingly heavy fire was concentrated on it. IZARD, CHARRETTE, BURNS, BRADFORD, NEW JERSEY with her secondary battery, and MINNEAPOLIS and NEW ORLEANS commenced firing in that order. All ships claimed straddles or hits.

*Heavy cruisers.

**Destroyers.

During the foregoing, the fourth enemy ship, an undamaged destroyer, had been standing away to the westward at high speed. By 1546, the range of this vessel from IOWA had opened to 34,000 yards despite the fact that Task Group 50.9 was steaming at 30 knots. At 1547, both IOWA and NEW JERSEY opened fire and continued to fire until 1558. IOWA fired 40 projectiles and NEW JERSEY fired 18 at ranges from 32,000-39,000 yards. The Air Observer reported straddles, but it is believed that no hits were made. An increase of speed to 31 knots at 1601 failed to close the range. The enemy continuing to draw away and finally escaped.

From 1300 to 1500 Task Group 50.9 was subjected to 3 air attacks. The first attack made by one fighter bomber came as a surprise. The plane dropped one bomb which exploded harmlessly off the starboard bow of IOWA. A second attack by a dive-bomber was driven off by anti-aircraft fire, and a third plane was shot down by the Combat Air Patrol.



IOWA ACTION REPORT:

By 1500 three targets were visible to IOWA: a cruiser* bearing 245, range 33,000 yards; a cruiser (or destroyer) bearing 260; and a small ship bearing 270, range 22,000. Our planes were bombing the two largest ships and splashes were observed near them. These two enemy ships were firing at our planes. When the cruiser bore 243, range 30,000 yards, Spot One reported he considered it to be an AOBA class cruiser, dead in the water, with her after stack blown off.

At 1512 began to build up speed to 30 knots in obedience to signal. At 1516 the light cruiser (destroyer) ahead, now bearing 267 true at... 28,800 yards, was observed to stand away to the westward at high speed. The main battery was trained on her and ready to open fire. She was tracked as making 24 knots on course 318 true. NEW JERSEY was nearly in the line of fire and, further, no orders had been received regarding target designation or opening fire. A fourth target...was later identified as a FUBUKI class destroyer, dead in the water and smoking.

Some concern was felt in this ship due to the fact that it appeared that the course of 270 would cause the ship to pass within torpedo range of the cruiser and very close aboard the small vessel under fire by NEW JERSEY and our destroyers. It was feared that this small vessel might be carrying mines.

The ship which was retiring to the westward was still well within range of the main battery but had increased speed to 32 knots and by 1525 the range had opened to 31,500. Her course was then 267. IOWA was on course 270, speed 30.

At 1527 NEW JERSEY was seen to open fire with her port 5" battery on the minelayer. The minelayer blew up and disintegrated.

Following...this...NEW JERSEY shifted her secondary battery fire to the FUBUKI class destroyer lying dead in the water and now bearing 270 true. At 1526 the enemy cruiser on the port bow appeared to be firing.

No fire signals had been received, but Commander Battleship Division 7 gave oral permission to IOWA to open fire on the enemy ships. At 1530 IOWA opened fire with both the main and 5" batteries on the AOBA class cruiser. The main battery fired...eight salvos, 46 16" high capacity shells, and the 5-inch battery a total of 124 projectiles. At the time the IOWA batteries opened on the...cruiser, she had been under fire for some time by our 8" cruisers. All eight of IOWA's salvos were spotted as being straddles. Just after IOWA's fourth salvo fell, the cruiser took a sudden and heavy list to port. At about 1541 her bow rose about 30 feet out of the water and she sank stern first.

As IOWA's first salvos were being fired, three torpedo wakes were observed heading for, and close aboard, the ship. One...passed close

***Recognition of ships and planes has always been a problem. The "cruiser" cited here was the training cruiser KATORI. The "cruiser (or destroyer)" was the KAGERO-class DD NOWAKI; the "small ship" was the converted trawler SHONAN MARU. The "FUBUKI class destroyer" was the KAGERO-class MAIKAZE.**

down the port side side from ahead. A second...passed close under the stern. The third...passed about 100-200 yards ahead.... The starboard 5", 40mm and 20mm batteries, which had been trained to open fire, without orders, on any torpedo wake sighted, opened fire on the torpedo.

At 1539 the FUBUKI class destroyer, still under fire by NEW JERSEY's 5" port battery, was on port beam of IOWA, range 7,000 yards, and smoking so heavily that she could not be seen clearly. Permission had just been given for IOWA's 5" battery to open fire..., when she rolled toward IOWA and sank rapidly.... Her after gun had been firing all the time and continued to do so until there was an explosion near the stern of the vessel just before she sank. The destroyer running to the westward continued to draw away, despite the fact that own speed was not 30 knots, and by 1542 her range was 34,000 yards.

At 1546 NEW JERSEY, without signal, changed course to the right and IOWA followed, in column, steadying on course 310 true. When on the new course NEW JERSEY opened fire with her main battery at the retiring destroyer. No signals had been made so IOWA followed the motions of the OTC and also opened fire...at 1547. Five main battery salvos were fired. The initial range was 35,700 yards, and the final range 39,000 yards.

The first salvo was spotted as "No Change" and fire and smoke were observed to appear on the target.* She changed course away, to 222 true, and appeared to slow to about 28 knots. By the time the third salvo fell, 1554:30, the target began to disappear in the sun-glare, haze and distance. Two more salvos were fired in full radar control before the OTC signalled Cease Firing at 1558.

PERFORMANCE OF OWN ORDNANCE MATERIAL AND EQUIPMENT

From 1531 to 1536, the main battery fired 8 salvos (46 rounds; mean gun range of 14,250 yards) at an AOBA class cruiser. Mark 8 radar ranges and spots were used. No air spots were received. The maximum spot was on the first salvo, the spot being "Straddle, Down 2." HC projectiles, half of them...with superquick nose fuzes and the other half with steel nose plugs,** and service charges were used. Splashes were extremely large and easily seen...optically and by Mark 8 radar.

At 1532 the port 5" battery opened on this same...cruiser and fired...124 rounds. Full radar control was used, as the 5" control personnel could not see the target because of own main battery smoke. Because of this smoke, and the splashes from own 16" and cruisers' 8" shells, the MPI of...5" projectiles could not be determined accurately, but was considered...well positioned.

From 1550 to 1557 the Main Battery fired five salvos, ...40 projectiles, at ranges between 35,700 and 39,000 yards, in slow salvo fire at a large destroyer or small cruiser retiring to the westward at 28-31 knots. The splashes were easily discerned...by eye and by

*Wishful thinking; NOWAKI was not hit.

**And base fuzes.

radar even at the maximum range of 39,000 yards. The spot on the first salvo was "No Change" and flame and smoke...were observed.... Spot for second salvo was "Up 2, Left 3" and for third salvo, "Up 1, Left 2" (the target was changing course to the left at this time). Spots on the fourth and fifth salvos were "No Observation" due to...glare, haze and difficulty in seeing the small target at the long range.

For firing high-capacity projectiles with service charges, this ship uses an unnumbered range table titled "Range Table for 16"/50 Caliber Gun, 2690 f.s. Initial Velocity, 1900 lb. HC Projectile." A table of arbitrary spots has been prepared to compensate for the differences in sight angle, drift, and wind effect between this range table and OP 770, the table used when firing 2700-lb. AP projectiles. Arbitrary spots in range and deflection, and a multiplier for the ballistic wind, are tabulated for various ranges between 10,000 and 40,000 yards.

For the first phase of the engagement, fired at 14,500 yards, the arbitrary spot taken from the table was "Down 1200, left 2" with a ballistic-wind multiple of 1.3. All salvos straddled, and the ACTH determined from the results of 7 hot-gun salvos fired at the target was "Down 1300, left 2." The cold-gun correction, for first salvo only, was "Up 100."

For the second phase, in which the opening range was 36,000 yards, the tabulated ACTH was "Down 200, left 12" with a wind multiplier of 1.4. The first salvo was spotted "No change," and included at least one hit on the target. Since the guns were hot at the commencement of this phase, the "Up" corrections for cold guns could not be determined.

Lessons Learned

The need for a doctrine covering assumption of spotting assistance to surface vessels by any observing planes is believed to have been demonstrated.

COMMANDER, BATTLESHIP DIVISION SEVEN, ENDORSEMENT:

High visibility and the sequence of events have permitted details to be observed and recorded with reasonable precision and clarity. The account of IOWA is considered excellent and complete, except that identification of the target ships destroyed appears open to doubt.

NEW JERSEY ACTION REPORT:

16"/50 Battery: Detailed Information on Gunnery

At 1450 the Main Battery started tracking what was believed to be a light cruiser at 32,200 yards bearing 257° (T). It is now considered that the target was an ASASHIO* class destroyer. This target was closed to 30,200 yards before it turned away at full speed. At this time the OTC did not desire to expend sixteen-inch ammunition on light targets. When targets in the vicinity were disposed of, permission was granted ...to fire a few rounds at this target. At 1547 "Commence Firing" was

***The ASASHIO and KAGERO classes were similar in appearance.**

ordered at...32,200 yards. At 1555, because the target was fast disappearing, both optically and by radar, it was decided to cease firing when the loaded guns had been fired and attempt to close the range. At 1556 the last salvo was fired and "Cease Firing" ordered. Range at this time was 35,000 yards. When the splashes from this salvo had subsided, spot one was unable to see any portion of the target and the target disappeared from the radar screen. The target was not again picked up by this vessel, although the Combat Air Patrol reported the target standing away at 25 knots.

Fire Control setup was director fire collective with Director One controlling train, Director Four controlling elevation and firing circuits, continuous aim. Gunnery communication and fire discipline were excellent.

Air spot was provided by the Combat Air Patrol during a portion of the firing. There were no spots on the later salvos, presumably as a result of lack of identification of splashes as IOWA was, at this time, firing on the same target.

The Mark 8 Radar, operated in low speed precision sweep in Director One, gave excellent results. The target disappeared at a range of 35,500 yards, when optical train was lost...the target being obscured by smoke and haze. The radar ranging is considered remarkable in...that the target had only stick masts, with no radars or other structures in the tops to act as reflecting surfaces. There was no difficulty discerning splashes for radar spotting.

Ammunition Expended.

Eighteen rounds of sixteen inch high-capacity projectiles and service powder were expended.

Effectiveness of Gunnery.

Heavy smoke was seen to rise from the target following the fourth salvo. This may have been the result of fragments from a short burst as, following the action, the Air Observer reported several straddles but no hits.

5"/38 Battery

Equipment functioned very well. There were no casualties and no serious difficulties with the ordnance equipment itself.

The major problem encountered was in regard to shifting from one type of ammunition to another. The battery had two air targets followed by two surface targets. The first air target was first seen diving out of low cloud without radar or other warning. As the cloud cover persisted throughout the day, there was considerable anxiety regarding renewal of the attack during the time that the surface targets were being engaged and, as a consequence, the type of ammunition sent up to the guns was shifted five times during the afternoon.

Observation of Gunfire by Carrier Aircraft

On the afternoon of 16 February 1944, while this ship was...searching for enemy vessels near Truk, the Commanding Officer of the BUNKER HILL Air Group* kept this ship informed of the locations of targets.... One enemy destroyer, which was apparently undamaged, began retirement to the westward at high speed, and it became apparent that the main battery should be used.... The position of this ship and the tactical situation were such that it was not practicable to launch our own observation aircraft. Without further request, the Commanding Officer of the BUNKER HILL Air Group spotted...gunfire, which...was of great help....

It is the opinion of this ship that situations under which battleships'... aircraft cannot be used due to location of ship, weather, unexpected engagement, slow speed of observation aircraft,** and difficulty of recovery in heavy weather will be the rule rather than the exception, particularly in the Pacific. It is, therefore, recommended that it be made doctrine for carrier aircraft to be assigned to battleship spotting, that frequencies and procedures be established, and that ships be prepared promptly and fully to utilize such air spot information, It is possible that, had such a doctrine been in effect, the destroyer which eventually escaped IOWA and NEW JERSEY might have been destroyed.

COMMANDER, BATTLESHIP DIVISION SEVEN, ENDORSEMENT:

Attention is specially invited to paragraph...regarding observation of gunfire by carrier aircraft. The prompt initiative of the leader of BUNKER HILL's aircraft...in...spotting for the battleships was commendable and very helpful. The remarks of the Commanding Officer, NEW JERSEY, in recommending the establishment of doctrine, procedures and channels for spotting under similar conditions are concurred in.***

*Commander of the air units assigned to the carrier BUNKER HILL.

**Performance of American catapult floatplanes was, generally, inferior to that of their German and Japanese contemporaries.

***VOF (observation/fighting) units spotted gunfire at Iwo Jima and Okinawa. Floatplane pilots spotted gunfire from borrowed Spitfire VB's at Normandy, where Luftwaffe opposition was anticipated.

Battle of Leyte Gulf

October 1944

During one phase of this complex action, the last great sea battle of World War II, the Fast Carrier Force engaged Japanese carriers and surface ships north of Luzon. The Seventh Fleet, operating off Leyte, was attacked by other Japanese surface forces. Fast battleships and supporting forces were detached and ordered south to assist.

Samuel Eliot Morison, HISTORY OF UNITED STATES NAVAL OPERATIONS IN WORLD WAR II, Volume XII:

While Strike No. 2 was coming in at 0822, Admiral Halsey received Admiral Kinkaid's plain-language message about the surprise off Samar. A succession of urgent pleas for any kind of assistance, air or surface, that Halsey could spare, began to flow in on his flag plot in NEW JERSEY. As early as 0848 Halsey instructed McCain "to proceed at best possible speed" to block Kurita's Center Force, but he did not detach TF 34, Lee's Battle Line, to block Kurita's escape, until it was too late.

At 1000 Halsey received Nimitz's query as to the whereabouts of TF 34. Halsey wished to keep these heavy gunfire ships with TF 38 to sink Ozawa's cripples and catch up with ISE and HYUGA. But the pressure on him to help Seventh Fleet became so great that after another hour's cogitation he yielded. At 1055 he ordered Bogan's TG 38.2, together with the major part of Lee's Battle Line, to reverse course and steam south to help Kinkaid. When his order was executed at 1115, the battleships had reached lat. 18° N, long. 126° E. Even by making best speed they could not expect to reach San Bernardino Strait before 0100 next day.

It almost broke Halsey's heart to pull out Task Force 34 just as the battleships were on the point of reaching good gunfire targets. He afterwards told the writer that it was the only move in the Battle for Leyte Gulf that he regretted; that the query from Nimitz, which he knew meant that Cincpac was alarmed for the safety of the Seventh Fleet, was the final factor that influenced his decision.

Admiral Lee with the six battleships steamed south at only 20 knots, slowing down to about 12 at 1345 in order to fuel destroyers that particularly needed it. At 1622, when fueling was completed, TG 34.5 was formed, under Rear Admiral Badger's command, and at 1701 Halsey ordered it to push on to San Bernardino Strait. This he did at 28 knots. TG 34.5 included Badger's flagship IOWA, Halsey's flagship NEW JERSEY, three light cruisers and eight destroyers. Admiral Bogan's carriers operated to the eastward of them in order to render air support if required.

Badger's orders were to arrive off the Strait by 0100 October 26, sweep the approaches, and continue along the coast of Samar to Leyte Gulf, destroying all enemy ships encountered. This was over three hours too late to catch Kurita before he reentered San Bernardino Strait. The only ship of Kurita's force that he encountered was destroyer NOWAKI, which had been unable to catch up. She was sunk by gunfire at 0100 October 26. Badger's group then made a southerly sweep, but picked up

nothing except six survivors from heavy cruiser SUZUYA. Unfortunately it missed the floating survivors from Clifton Sprague's escort carrier unit.

If TF 34 had been detached a few hours earlier, after Kinkaid's first urgent request for help, and had left the destroyers behind, since their fueling caused a delay of over two hours and a half, a powerful battle line of six modern battleships under the command of Admiral Lee, the most experienced battle squadron commander in the Navy, would have arrived off San Bernardino Strait in time to have clashed with Kurita's Center Force. We may well speculate what might then have happened. Apart from the accidents common in naval warfare, there is every reason to believe that Lee would have crossed Kurita's T and completed the destruction of Center Force. As it was, Badger's TG 34.5, consisting of only two battleships, three light cruisers and eight destroyers, was both too late and too weak for the work in hand. Supported by Bogan's carrier group it would doubtless have put up a good fight, but it would have been seriously outgunned by Kurita's four battleships. Halsey should have sent all TF 34 or nothing, and done it earlier. It is clear that his heart was with the carriers up north, although he himself gallantly sought action down south in NEW JERSEY.

IOWA ACTION REPORT:

At 0258, 25 October, Task Force 34 was formed, and IOWA proceeded north with this force in anticipation of early contact with enemy surface units. Air strikes launched at 0600 contacted the enemy to the north, retiring at 20 knots, and repeated strikes were made during the forenoon. At 1114, course was changed to 180°, Task Group 38.2 was reformed, and destroyers were fueled during the afternoon. About 1130 an enemy snoopier was seen low on the western horizon, and during the next half hour frequent radar and visual contacts were made.... It was not intercepted, nor did it come close enough for any ship to fire at it.

At 1626, 25 October, Task Group 34.5 was formed, and proceeded at 28 knots...towards San Bernardino Strait. At 2315, radar contact was made on Cantanduanes Island bearing 275°, distant 45 miles, and at 2324 cruising disposition 3-R was formed. At 2340 IOWA went to general quarters, and the sweep of the entrance to San Bernardino Strait was started on course 207° at 28 knots. The search having thus far proved negative, formation course and axis were changed at 0025 to 135° by column movement from the van. At 0029, 26 October, STEPHEN POTTER,* acting as picket in the van, reported a single surface target bearing 150° T, distant 50,000 yards from this ship on course 275° at 20 knots. At 0044 this target was picked up by the Mark 8 radar in the forward main battery director bearing 156° T, distant 32,000 yards. At 0032 ComCruDiv 14 was told by the Task Group Commander to take positive action and at 0045 IOWA and NEW JERSEY, with screening destroyers, changed course to the left to 090° T in order to remain clear of the cruisers. During this period the target was tracked on course 273° T at 21 knots. At 0051 the target was abeam to starboard at a range of 28,000 yards and, at 0055, a light cruiser (later determined to be VINCENNES) opened fire on the target with 12-gun salvos from her main battery, followed by fire from her

5-inch battery. At 0057 the target had turned away to a course of 215° T, and appeared to have slowed to about 15 knots. Spot One reported that the target appeared to be returning the cruiser's fire sporadically. At 0100 the target was lost from Director One's radar at a range of 32,000 yards and at 0105 it disappeared from the SG radar screen bearing 204° T, distant 35,500 yards. At 0102 IOWA and NEW JERSEY reversed course to 270° T at 20 knots and, at 0106, Spot One reported that the cruiser's salvos appeared to have hit the target for the first time. At 0107 a large explosion was seen and, at 0111, track on the target was reestablished, giving a target speed of zero and a range of 33,400 yards. At 0116 Spot One reported that the whole after part of the target appeared to be in flames, silhouetting the superstructure, which appeared to be that of a TERUTSUKI Class DD or possibly a YUBARI Class CL. At 0119 course was changed to 090.

In the meantime, OWEN* and MILLER* had been ordered to close and destroy the target and, from 0117 to 0133, they fired 5-inch...at close range. During this period the target continued to burn with intermittent explosions and at 0136 there was a tremendous explosion which threw burning debris high in the air. At 0134 Spot One reported that the show appeared to be over as all fires in the target area had disappeared, the last range being 35,000 yards (rangefinder) bearing 205° T. At 0142 personnel below decks in this ship heard and felt heavy underwater explosions and, shortly thereafter, MILLER reported a heavy explosion in the area where the target had disappeared.** The cruisers had rejoined the formation at 0115 and, at 0130, the task group proceeded on course 135° at 15 knots with OWEN and MILLER rejoining on the starboard quarter.

At 0307 NEW JERSEY reported a possible surface target bearing 200°, distant 32,000 yards. At this time the coast of Samar, on that bearing was 34,000 yards away, with a rain cloud about 5,000 yards off the coast. A hazy pip was visible on the PPI between the rain cloud and the coast, and was picked up by both the Mark 8 radars, and tracked at zero speed. At 0313 NEW JERSEY reported the target's course to be 255° at 18 knots, and at 0314 reported the course as 010° and the speed 20. Inspection of the chart showed a small bay on the coast of Samar at the position indicated, and a point of land which was believed to be NEW JERSEY's contact. At 0325 NEW JERSEY reported the target bearing 256° at 30,000 yards on course 295° at 20 knots, and at 0334 she reported it to be on course 300° at 16 knots. At this time formation course was changed to 315° and at 0340, NEW JERSEY having reported that she had lost the target, the formation course was changed back to 135°.

The sweep down the coast of Samar was continued until dawn, at which time the formation ran through a large oil slick and much debris. About 50 Japanese survivors were seen in the water, and several were picked up by destroyers as well as a CVE pilot who had been shot down the day before.

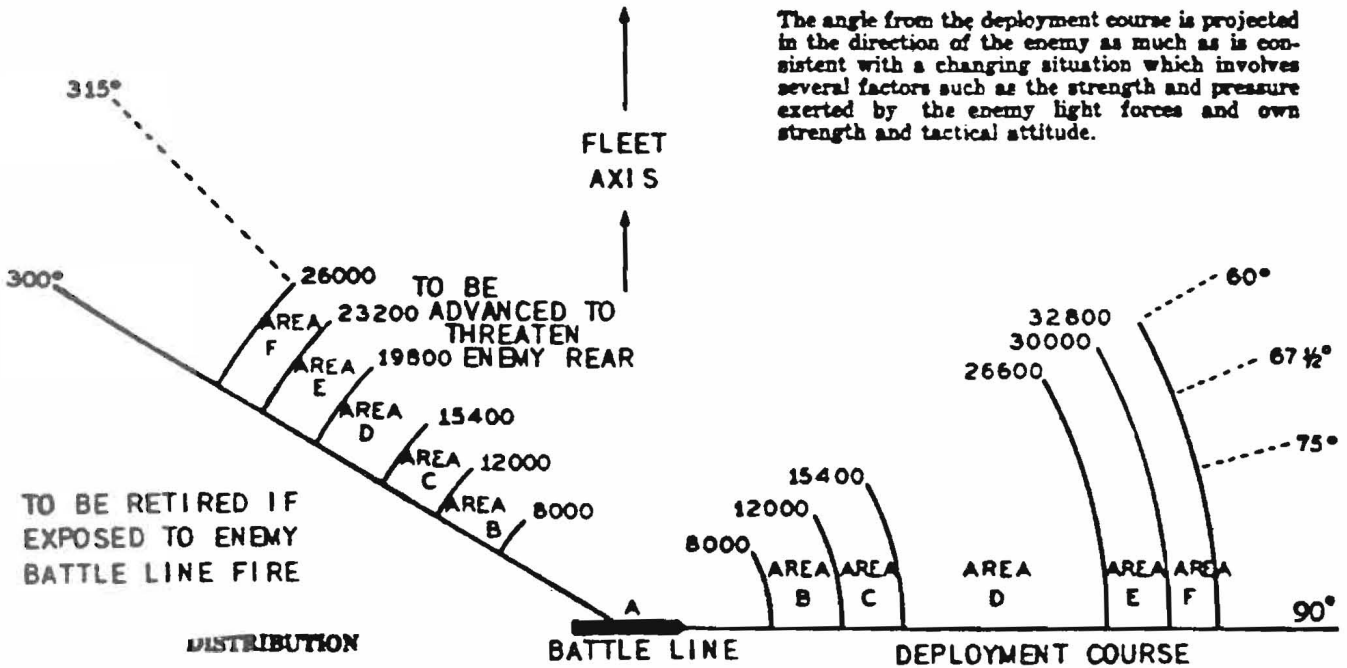
*Destroyer.

**This was NOWAKI, which had eluded IOWA and NEW JERSEY off Truk.

TYPICAL BATTLE DISPOSITION

DIRECTION OF
ENEMY BATTLE LINE

The angle from the deployment course is projected in the direction of the enemy as much as is consistent with a changing situation which involves several factors such as the strength and pressure exerted by the enemy light forces and own strength and tactical attitude.



DISTRIBUTION

AREA	FORCE	REAR	VAN
B	DDs	1 Sq (9DD)	1 Sq (9DD)
C	CLs	1 Dv (4CL)	1 Dv (4CL)
D	DDs	1 Sq (9DD)	3 Sq (27DD)
E	CLs	1 Dv (4CL)	1 Dv (4CL)
F	CA	1 Dv (8CA)	1 Dv (8CA)

The LIGHT FORCE extend from the inner area B outward; the limits of each area depending upon the number of each type assigned by the FLANK FORCE COMMANDER to each area; and as prescribed in subparagraphs 4257, 4258 and 4259.

The classic disposition prescribed for surface battle in the manuals of tactical doctrine at the time of World War II. The battle line is formed in column, with cruisers and destroyers echeloned to the flanks. If the fast battleships had been granted the opportunity for a full-fledged surface action, they might well have engaged along the lines of this theoretical concept.

Battle of Surigao Strait; Battleship Gunnery Action

25 October 1944

This night action was fought between the Japanese battleship YAMASHIRO and destroyer SHIGURE, on the one hand, and the Seventh Fleet's Bombardment and Fire Support Group. The armament of three of the six old battleships which took part in the final gunfire phase of this action had been updated to the approximate standard of the new ships, with modernized fire-control suits and automatic turret control in train and elevation. Considering the general similarity of their main-battery installations, their experience is relevant to that of their descendants.

U.S. NAVAL WAR COLLEGE: THE BATTLE FOR LEYTE GULF; STRATEGICAL AND TACTICAL ANALYSIS, VOL. V:

Commander, Battle Line*...now observed that the enemy range was closing rapidly. He therefore...directed the battle line to open fire when the range had closed to 26,000 yards. Since:

(A) This range was contrary to CTG 77.2's** battle plan, which specified opening-fire ranges for the battle line at 17,000 to 20,000 yards;

(B) These...ranges had been chosen because CTG 77.2 felt that, due to the shortage of ammunition of all types, but especially to the shortage of armor-piercing projectiles, it was essential that the battle line get a high percentage of armor piercing hits at ranges where their effect would be high; and

(C) ComBatLine should have been fully cognizant of this fact... It seems pertinent to discuss the reasons which prompted him to make this sudden change in firing plan.

ComBatLine stated later that his reasons were:

(A) He felt that, if he waited until the range had decreased to 20,000 yards, he would lose some of the range advantage he possessed in firing at a longer range, using armor-piercing projectiles--his first five salvos were to employ these...--and deliberate fire; and

(B) That CTG 77.2 had chosen the range band (17,000-20,000 yards) because of the predominant bombardment loading of the battle line which limited its effective fire to that range in a prolonged engagement.

It is not known whence came the latter idea, for...the important consideration in CTG 77.2's mind was to make armor-piercing hits at the earliest time when, based on all factors, the percentage of hits and their effect would be high, and the possible effect of enemy shells on own units would be acceptable. This...had been analyzed during the planning stage...and it had been determined...and so stated in the night battle plan issued by CTG 77.2 that "long ranges are generally unfavorable to own battle line owing to the relatively poor patterns and low ammunition allowance of armor-piercing projectiles...." Because...the

*Rear Admiral George L. Weyler.

**Rear Admiral Jesse B. Oldendorf, CTG 77.2.

Third Fleet was expected to intercept any threatening enemy surface force, and all preparatory fire had to be provided by TG 77.2 and TG 77.3,* the ammunition allowance of armor-piercing projectiles had been set at but 20 percent of the possible loading. High-capacity projectiles for bombardment comprised the remainder.

Based on the above considerations, it seems clear that ComBatLine's decision to open fire at 26,000 yards, rather than at 20,000 or less, was unsound.

At 0338 ComBatLine noted that the range to the enemy was closing steadily. Since he planned to open fire in a few minutes he decided that, in order to avoid...possible interference...it would be wise to station his van and rear destroyer screens (DESDIV XRAY) in a column ahead and astern of the battleships. He...immediately ordered COMDESDIV XRAY...to concentrate his screens, van and rear, 4,000 yards from the nearest battleship.

The time drew near when ComBatLine would reach his designated open-fire range of 26,000 yards, and he was making preparations to do so. His target at this time, although he did not know it, was YAMASHIRO. **[For various reasons, the battleships which were tracking YAMASHIRO and the other Japanese ships present in Surigao Strait passed the 26,000-yard line without opening fire.]** Whatever...the actual reasons for the failure of the battle line to open fire, it was to the advantage of the Allied command that it did not do so for, as has been pointed out..., the correct firing range was in the range band 20,000-17,000 yards.

CTG 77.2 (OTC) carefully watched the approach of the enemy. At 0351, when the range was 16,500 yards, ...he ordered all cruisers of TG 77.2 to "open fire." At 0353, as the left flank cruisers continued firing...he heard the Commanding Officer, WEST VIRGINIA, inform Commander Battle Line that WEST VIRGINIA was about to open fire, and shortly afterward he observed her open fire.He now observed that more battleships...had opened fire, for CALIFORNIA and TENNESSEE commenced firing at 0355.

[At 0406 ComBatLine radioed that CALIFORNIA had missed a signal to turn, and that other ships should look out for her.] This message was of considerable concern...but was not entirely unexpected for...battleships had had little opportunity to practice station keeping in column or in line of bearing. **[CTG 77.2]** could only hope that this error...was not so serious as to endanger the operations of the battle line, but this hope did not long survive, for he now noted that the fire of the battle line had ceased. WEST VIRGINIA, MARYLAND, CALIFORNIA and TENNESSEE had checked fire, and PENNSYLVANIA and MISSISSIPPI had not...yet opened fire.

It will be noted that...CTG 77.2...did not issue any instructions concerning fire distribution. **[Though doctrine stated that fire distri-**

***The two designated task groups of battleships assigned to gunfire support.**

bution was normally ordered by the task group commander, Oldendorf was thoroughly familiar with the principles of concentration of fire. Under the particular circumstances of Surigao Strait, he chose to leave this to unit commanders and individual ships in accordance with the principle that, in the absence of specific orders from the OTC, subordinate commanders should use their initiative in selecting targets "when, due to low visibility, confusion of battle or other conditions, the control of fire distribution by the senior is impracticable."]

...WEST VIRGINIA...commenced firing with an opening range of 22,800 yards, using salvo fire, at the leading enemy large ship. [ComBat Line was still operating at 15 knots, instead of five knots as ordered, to give his ships sufficient steerageway to avoid torpedoes. His guns would, soon, no longer bear. At 0354 he ordered simultaneous ship turns 30 degrees to starboard to course 120 degrees. At 0355 CALIFORNIA opened fire on YAMASHIRO at 20,400 yards; a minute later TENNESSEE also fired on YAMASHIRO at 20,500 yards. MARYLAND joined in at 0359, opening at 19,800 yards. At 0401 Oldendorf suggested that the battle line change course to 270 degrees, and ComBatLine ordered a simultaneous turn of 150 degrees to starboard. At about this time CALIFORNIA and WEST VIRGINIA, to conserve their AP shells, checked fire.]

[ComBatLine's course change had been passed by voice radio. As she turned, TENNESSEE noticed that CALIFORNIA, next ahead, was not turning. CALIFORNIA had understood the voice signal as a 15-degree, rather than a 150-degree, course change and had come right to 135 degrees and resumed firing. TENNESSEE's range was fouled by CALIFORNIA, and TENNESSEE had to back her engines and maneuver to avoid a collision. CALIFORNIA checked fire again at 0405.]

[ComBatLine broadcast a voice warning to avoid CALIFORNIA; this signal awoke the ship to her mistake, and she now turned right to 270 degrees. Her delayed turn put her south of the battle line, and in the line of fire. No battleships were firing at this time, since MARYLAND had also checked fire during her turn. Just before 0408 TENNESSEE, seeing that her line of sight was now clear, fired her last salvo. CALIFORNIA fired one more salvo, and was ordered to fall in astern of TENNESSEE. At 0409 CTG directed all ships to cease firing. WEST VIRGINIA fired two more guns before ceasing. CALIFORNIA and MARYLAND reported having loaded hot guns, and asked permission to unload them in the direction of the enemy. CALIFORNIA then fired one round, while MARYLAND got off eight. At 0412 ComBatLine's flagship, MISSISSIPPI, "which at long last had finally obtained a solution to the fire control problem," fired one full 12-gun salvo at YAMASHIRO at 19,790 yards.]

The opening-fire ranges and bearings of WEST VIRGINIA, TENNESSEE, AND CALIFORNIA...with their Mark VIII fire-control radars were approximately correct; those of MARYLAND were incorrect, possibly due to the fact that she may have opened fire on a phantom and she was having difficulty with her Mark III fire-control radar and, since she finally picked up her target from WEST VIRGINIA's fall of shot, she may have ranged on a WEST VIRGINIA splash. The bearing of MISSISSIPPI's target was correct, but her time of opening fire was long delayed because she had difficulty in identifying her target and obtaining an acceptable

solution. Finally, PENNSYLVANIA's failure to open fire at all was, likewise, due to her failure to identify her target or to obtain an acceptable solution. The MISSISSIPPI and PENNSYLVANIA difficulties were attributed, by Commander Battle Line, to material (Mark III fire-control radar) and to personnel.

[Through the rest of the night the battle line steamed east and west along a line north of Surigao Strait.]

WEST VIRGINIA ACTION REPORT:

Extensive refitting and modernization of this vessel's ordnance, fire control, and radar equipment was completed on 15 July 1944. The general efficiency of the equipment and the state of training of the personnel were amply demonstrated by the fact that the first salvo was a straddle with numerous hits, on which a "No Change" spot was...applied. Of the thirteen full salvos fired, all were straddles. The general excellent performance of the material was marred by the temporary failure of the forward Mk 8 Mod 2 radar,* and shell hoist casualties in turrets 1 and 3. The right gun of turret 1 missed 3 salvos, while the right gun of turret 3 missed 7 salvos.

Fire was opened with full radar control, with after radar, director 2, rangekeeper 2, and Stable Vertical 2 controlling. All spotting was by radar. Turrets were in full automatic.** Rapid salvo fire was used after the second salvo. Computed ballistic plus arbitrary of UP 100 and UP 100 cold-gun correction was used. After the 1st salvo the cold-gun correction was removed. Opening gun range was 22,400 yards. Average gun range was 20,880 yards.

There were no errors in deflection observed on the MK 8 screen. Because of the known possible error in bearing of the MK 8 Mod 2 radar the 7th, 9th, 11th, and 13th salvos were "rocked" in deflection. Range patterns were noted to average about 300 yards. Average salvo interval for the first 13 salvos was 41 seconds.

Previous instructions from Commander Battle Line were that HC projectiles were to be used against cruisers, carriers, or any unarmored vessel; AP projectiles against battleships and armored vessels.

To be prepared for either type of firing, two HC projectiles were arranged on each side of the shell table in the gun chamber, with the space between the cradle and ramming tray left empty. Also the shell hoists were empty. AP and HC projectiles were arranged on each shell deck...to permit loading of either type. Orders to load the shell hoists and shell tables were not given until it was definitely established that heavy ships were included in the enemy force. This was not known in time for the turrets to rearrange projectiles on the shell deck; therefore, all turrets experienced difficulties in projectile supply after the 12th salvo.

*Mounted on the forward Mark 34 main-battery gun director.

**Automatically controlled by the fire-control system, as in the fast battleships.

The gunfire from this vessel was very effective. There were possible and probable hits in all salvos. Three pronounced flareups were observed on the target* at the splash time of our 1st, 2nd, and 6th salvos. The 4th salvo seemed to be particularly concentrated on the target. The MK 8 radar operators had no difficulty in identifying or spotting our salvos. Splashes from other ships were observed, but did not interfere except on the 5th salvo. It was possible to distinguish between our own and other ships' salvos by the size of the individual splashes.

TENNESSEE ACTION REPORT:

The Mk. 8 radar picked up the designated target from CIC at an initial range of 39,000 yards. A good solution for opening fire** was obtained at a range of 37,500 yards. There were two large and three small targets visible on the...radar screen at the time. TENNESSEE opened fire on the closest heavy ship at...20,500 yards. The performance of both the Mk. 8 radar and the...operator were superlative and cannot be praised too highly. Range spots were based primarily on radar. Deflection spots were made by the top spotter from both visual observation and from the radar screen. Direct spots to the target were used. The range pattern was about 400 yards. The target was either hit directly, or straddled, by 12 salvos. The target was tracked continuously after "cease firing" and was observed to grow smaller on the screen and to finally disappear at about 18,000 yards.***

Damage from the shock of main battery firing...was slight, consisting of a few broken brackets on ventilation and other piping.

COMMENTS BY THE GUNNERY OFFICER

The first salvo hit the target. Thereafter the MPI of each salvo was corrected to center the pattern on the target, which could be seen continuously on the radar screen and, at times, visually. Pattern size was estimated to be 400 yards. The largest spot applied was 300 yards.

Of the 13 salvos fired, it is estimated that 12 salvos were straddles. The majority of the salvos were six-gun salvos fired from the forward turrets. The line of fire was always forward of the beam. Fire distribution afforded no real problem because of the nearly head-on approach of the enemy.

PERSONNEL PERFORMANCE

The handling of the ship during the firing, when a 150-degree countermarch ordered by the Commander Battle Line was not executed by CALIFORNIA, was excellent. By promptly reversing her engines this ship narrowly avoided colliding with CALIFORNIA. Had collision occurred, the entire Battle Line would have been thrown into confusion.

*YAMASHIRO.

**Main battery plot had acquired and assimilated all the necessary information and was ready to provide gun train and elevation orders.

***YAMASHIRO rolled over and sank at 0419.

COMMANDER, BATTLESHIP DIVISION TWO, ENDORSEMENT:

The performance of Mark 8 radar speaks for itself. TENNESSEE, by means of it, had a firing solution in Main Battery Plot and was ready to fire long before enemy formation came within gun range. For night engagements, it is truly a "seeing eye."

CALIFORNIA ACTION REPORT:

GUNNERY OFFICER'S REPORT

Firing was conducted in full radar control with Number I MK. 8 Radar, the Forward Main Battery Director, and Number I Rangekeeper controlling the battery. Both MK. 8 radars were coached on the target by CIC, and a constant comparison of target course and speed was maintained between the rangekeepers and CIC. Radar spot was used, and applied directly. No difficulty was experienced in keeping the director on target, except when the enemy countermarched.

Six-gun salvos were fired as spotting salvos until a straddle was obtained, and then nine-gun salvos were used. Fire was deliberate and, in each case, the salvo was held until the spot had been applied and the rangekeeper solution appeared to be good.

Spotting was done entirely by MK. 8 radar, as neither target nor splashes were visible.

Although the target could not be seen, except indistinctly by Spot I, still we were able to observe what we identified as three CALIFORNIA hits. These were determined by observing a flash at the target which was distinct from enemy gunfire, and which occurred at the time of our salvo's landing. The latter time could be very accurately gauged, as it was simple to follow our tracers all the way.

Pattern size appeared to be no more than three or four hundred yards. Consistent straddles were obtained, and probable hits as indicated.... It appears that fire was effective, and that CALIFORNIA's fire was definitely contributory to the destruction of one enemy battleship.

EXECUTIVE OFFICER'S REPORT

Gunnery.

The performance of the main battery was uniformly excellent. All except the first two salvos were straddles, and undoubtedly numerous hits were registered. With the exception of a torn powder bag in Turret I, and misfires in Turrets II and IV, there were no casualties in nine salvos of 63 rounds. Several instances of loosely-laced and torn powder bags have recently come to light.

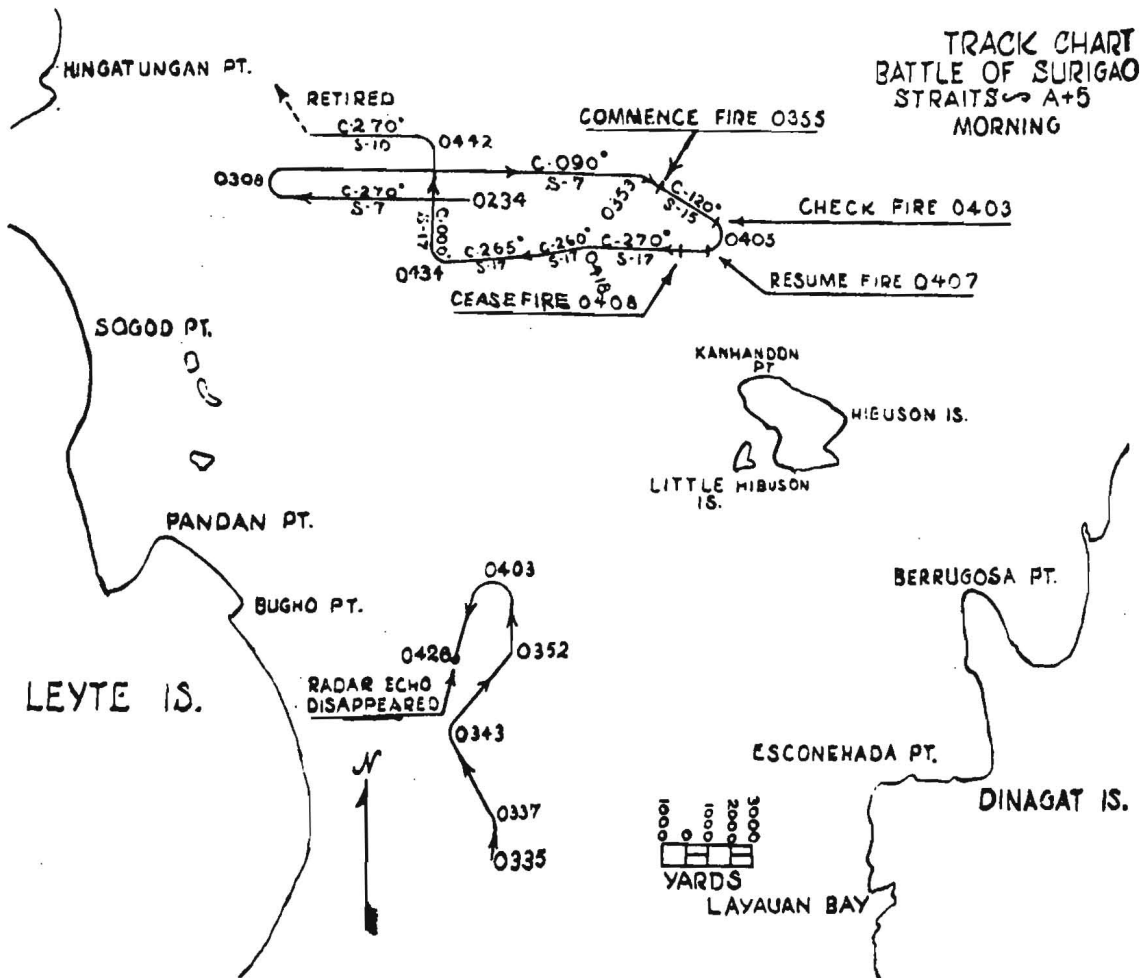
It is interesting to note that the firing of full service charges in nine-gun salvos caused considerably less structural damage to the ship than did... smaller salvos, using reduced charges, during shore

bombardment. Such damage as occurred was extremely minor, while that caused by bombardment was quite extensive and resulted in broken pipe lines, vent ducts, stanchions, boats, and light metal doors throughout the ship.

COMMANDER, BATTLESHIP DIVISION TWO, ENDORSEMENT:

The formation, course, and speed of the enemy force, the fact that enemy force was confined in the comparatively narrow waters of SURIGAO STRAIT, and the position of our own battle line capping the enemy's "T" made the conventional methods of fire distribution inapplicable. While some sort of ...fire distribution plan might have been improvised, the proof that this was not necessary is afforded by the final box score.

Failure of CALIFORNIA to turn 150 degrees at 0401 could have had very disastrous results. Fortune was on our side that night as TENNESSEE just passed under CALIFORNIA's stern. In executing the proper turn after passing TENNESSEE, CALIFORNIA may have blanked the fire of MISSISSIPPI to some extent.



Track chart from TENNESSEE's Action Report

C. FLEET AIR DEFENSE

Defense of task forces against air attack is no longer one of the modern battleships' missions. In World War II, however, it was a major task.

During the war in the Pacific, the fast carrier force became the Pacific Fleet's striking arm. Working in cooperation with the amphibious landing forces, the carrier force spearheaded the island hopping offensive from Guadalcanal to Okinawa and the final attacks on the Japanese home islands. In the Pacific the Japanese airplane was the principal threat. As the new generation of fast battleships "worked out the kinks" and entered fleet service, they were assigned to carrier task groups. Their heavy batteries of 5-inch and lighter antiaircraft guns made them valuable assets. From the early air-sea actions off Guadalcanal through the kamikaze attacks of 1945, the big ships had a large part in providing the umbrella of gunfire that made it possible for the fast carriers to move, at will, through enemy waters.

The attackers were subsonic propeller planes; dive, torpedo, or horizontal bombers. Toward the end of 1944 the deliberate suicide plane, the kamikaze, began to appear; during 1945 it became the fleet's principal concern. Air defense was organized around long-range air-search radars, which had begun to enter service shortly before Pearl Harbor; surface search radar could also detect low-flying torpedo planes. Information was plotted by hand, and communicated by voice radio and sound-powered phones. Five-inch guns, firing mechanical time-fuzed ammunition, were controlled by the Mk 37 directors still used in the IOWA class. Early range-finding radars were installed during 1942, and the first proximity fuzes were introduced. Five-inch fire was supplemented by large numbers of automatic guns using impact-fuzed explosive ammunition.

The extracts from action reports and contemporary narratives which follow illustrate the use of the fast battleship as a vital element of fleet air defense.

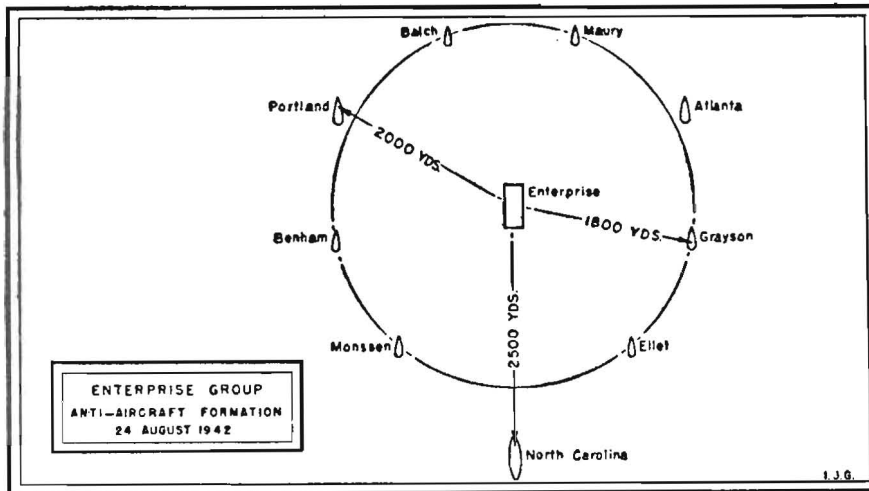
Battle of the Eastern Solomons

August 1942

NORTH CAROLINA (BB 55) was the first fast battleship to see air-defense service in the Pacific, as a unit of Task Force (TF) 61, organized around carriers SARATOGA and ENTERPRISE. During the battle for Guadalcanal a Japanese carrier force headed south from Truk, and TF 61 moved to engage it. The Japanese carriers launched a strike, which was picked up on radar at 88 miles. All available fighters were put into the air. TF 61 went to battle speed, and began to spot incoming attackers.

COMINCH (Commander in Chief, United States Fleet) NARRATIVE:

Task Force 61 was now up to 27 knots, maneuvering radically with maximum rudder. The screen came in to close support distance, 2,000 yards for cruisers, destroyers inside 1,800 yards. North Carolina was on station 2500 yards, bearing 180°. Although 27 knots was full power for her, she maintained station readily at this speed.



The search radar lost the planes as they came inside its minimum range. Although information in all ships mounting search radar appears to have been freely passed to gunnery radar sets, because of multiplicity of own and enemy planes, it was impossible to take over targets and track them in. Hence the first appreciation that the enemy attack had commenced was when planes were sighted in their dives.

On the NORTH CAROLINA this was when they were at about 15,000 feet, beginning to dive on the ENTERPRISE. On the ELLET it was when "sudden flashes of reflected light on a maneuvering plane at high altitude...attracted the attention of the control officer. Binoculars revealed a line of attacking planes being attacked by own VF. Shortly...a plane showed intermittent streaks of smoke then went into a spin." On the carrier itself it was when a 20mm. battery officer sighted them coming down at about 12,000 feet and very properly opened fire without delay, thus giving immediate warning and point of aim to the other batteries. At about the same time the NORTH CAROLINA and other screening ships open fire with 5" guns on the same group of planes.

This first dive ended in a near miss at about 1641. Thereafter for approximately 4 minutes, except for two short breathing spaces of 20-30 seconds each, there was a continuous roar of planes diving at the carrier.

The 5" fire of the ENTERPRISE and accompanying screen, including six of NORTH CAROLINA's 5" guns, forced some of the planes to pull out of their dives at 4,000 to 6,000 feet. Others swerved to avoid the bursts or were so jolted by them that they were thrown off their point of aim. A few jettisoned bombs. Three planes coming through the 5" fire disintegrated as if from direct hits and others came through burning. Of the 25-30 planes that approached to dive on the ENTERPRISE, 15 came down in determined dives approximately 70°, which were pushed home in many instances to 1500 feet or lower before release. Dives were in sections of as many as five planes with very short intervals between planes, many below 7 seconds. Thus AA gunners had the minimum opportunity to clear jams, replenish ammunition, and recover from the shock of hits or misses close aboard.

Meanwhile the NORTH CAROLINA was having a battle of her own. When the attack commenced the ENTERPRISE increased speed to 30 knots. The NORTH CAROLINA gradually fell behind so that at the end of the engagement she was

about 4000 yards from the ENTERPRISE, 1500 yards behind her assigned station. There, separated from the remainder of the Force, the NORTH CAROLINA fought off alone 16 dive bombing and several glide or torpedo plane attacks, and was apparently target for a high altitude attack.

At 1506 the NORTH CAROLINA had picked up many unidentified planes at 141,000 yards; at 1601 three large groups of planes showed on her radar screen distant about 64,000 yards. These apparently maneuvered to avoid fighters, remaining at this approximate range until about 1620 when they began to close rapidly. By 1636 they were within 30,000 yards. Thereafter there were so many contacts on widely varying bearings of own as well as enemy planes, that her radar screen was covered with echoes. It was generally impossible to distinguish friend from foe and therefore impossible to get the gunnery radar sets on for a fire control setup.

At 1641 NORTH CAROLINA picked up about 15 dive bombers over the ENTERPRISE, range 8,000 yards, height 15,000 feet, and within a minute opened up with one group of three mounts. Two minutes later the NORTH CAROLINA herself was attacked by about 10 dive bombers from the starboard bow. These she took under fire, with three other 5" mounts director controlled, still maintaining fire with one group on the dive bombers attacking the ENTERPRISE. Most attacks were from about 20° to the right of the sun, the planes coming down to about 3,000 feet and then into a 70° dive, releasing very low. So heavy was the 5" fire that some of the planes turned away. Several persisted in the attack but only three were able to come through the heavy 5" and automatic weapon fire with sufficient accuracy to place their bombs close the NORTH CAROLINA. Two landed within 15-20 yards. One was about 75 yards away.

During this attack, and well coordinated with the dive bombers, low flying planes appeared on the port quarter and in a few seconds others from numerous directions at altitudes of 50 to 5,000 feet. Some of these low flying planes maneuvered in and out at 6000 to 10,000 yards. Some approached more directly as for torpedo attack "and were shot down." Others came in a glide from about 6,000 feet levelling off at 50-200 feet, 2,000 to 4,000 yards away, which is another method of attack used by Japanese torpedo planes. There were approximately eight of these planes whose movements were coordinated with the dive bombers either making actual attacks or simulated ones to draw the NORTH CAROLINA's fire from the dive bombers. At this time practically all of her battery was firing; viz., twenty 5"/38, four 1.1 [inch] mounts (16 barrels),* forty 20mm. and twenty-six 50 calibers.

At 1645 amidst this widespread firing a second dive bombing attack was made on the NORTH CAROLINA by six planes from the port quarter. Since she had so many targets under fire and firing arcs aft were restricted by her own planes on deck, gassed and armed with bombs, the only guns that got on this group of planes were the after 20mm. which shot down two of them. Four bombs fell within 150 yards of the ship, one close enough to knock gunners down and to flood the deck. Part of this or an earlier attack group was observed by the BENHAM whose report states: "Four dive bombers attempted to bomb the NORTH CAROLINA, and were promptly shot down."

*1.1-inch quad-mount automatic AA gun, developed before WW II. It proved unsatisfactory and was gradually replaced by the 40mm gun.

Coordinated with the dive bombing attack 8 to 12 heavy bombers made a horizontal dive run over the NORTH CAROLINA at 15,000 feet and dropped a pattern of heavy bombs between her and the ENTERPRISE. This attack was unobserved partly because the high level bombers were able to use cloud cover, partly because the NORTH CAROLINA was busy with low altitude and dive bombing planes, two of which flew very low down the length of the ship just above the main deck distracting attention and fire from other planes.

This coordinated high altitude and dive bombing attack on the NORTH CAROLINA ended the runs on the Task Force, though for another 5-7 minutes enemy aircraft at low position angles were flying about and were fired on. One or more of these may have been our own, since one of our planes reports being hit by the NORTH CAROLINA's fire. Most were either dive bombers or possibly torpedo planes escaping. The NORTH CAROLINA's 5" fire appears to have been so heavy and accurate that few planes encountering it were willing to press home an attack through it. The NORTH CAROLINA considers that only three dive bombers attacking her escaped, some of those completing dives being shot down later. It is possible these three were destroyed by fighters.

The anti-aircraft fire of the Task Force was excellent. The ENTERPRISE reports that her own gunfire, particularly from 20 mm. and 1.1's was most gratifying. "Target after target was taken under tremendous fire concentration. This, together with the excellent AA assistance from other ships in the Task Force and our radical turns at high speed, was responsible for the small percent of bomb hits." The NORTH CAROLINA's fire was so heavy that observers in other ships reported that she looked to be ablaze throughout.

Gilbert Islands Operation

November 1943

Fast battleships defend TG 50.2 against night attack by Japanese torpedo planes.

NORTH CAROLINA ACTION REPORT:

1. Task Group 50.2, on the night of 25 November 1943, successfully repelled an air attack between 1854 to 1950 Zone plus 12 time, in a location 45 miles bearing 320 True from Makin Island. From 10 to 12 Japanese attack planes and 1 or more reconnaissance planes engaged this Task Group just after darkness. This ship sustained no damage and shot down 1 enemy plane and probably destroyed 1 additional plane. All enemy planes were either shot down or turned away by anti-aircraft fire.

2. This Task Group had operated all day in an area about 40 miles square, 50 miles northwest of Makin Island while covering the landing operations at Makin. It consisted of the ENTERPRISE, MONTEREY, BELLEAU WOOD, INDIANA, MASSACHUSETTS, NORTH CAROLINA and 6 destroyers. During the day the Task Group was in cruising disposition 5-ROGER, as prescribed in PacFit ltr. 36CL-4?, on various courses and speeds while launching and recovering aircraft. Just prior to sunset, cruising disposition 5-VICTOR was taken with ships disposed as follows: ENTERPRISE guide at 1 000, INDIANA 2.5 060, MASSACHUSETTS 2.5 180, NORTH CAROLINA 2.5 300, MONTEREY 1 240, BELLEAU WOOD 1 120, destroyers on 2.5 circle between battleships, axis 310° True, circle spacing 1000 yards.

3. Enemy planes were known to be operating from bases in the Marshall Islands and indications were that Task Group 50.2 probably had been sighted and tracked during the day. At 1700 a single bogie was contacted by radar. This snooper closed the formation to 17 miles. Fighters from the carriers were vectored out by the fighter director but were not successful in making an interception.

4. The night was clear but dark; sunset at 1817. There was no moon. Surface visibility after darkness was 4,000 yards. The sky was about 0.3 covered with cumulus clouds. The sea was calm, the wind was about 14 knots from 100 True.

5. At sunset all planes had landed on the carriers of this Task Group and the radar screen was clear. At 1840 this ship made visual contact and reported to the OTC one Japanese plane, identified as an "Emily",* bearing 025 True, distance 34,000 yards. This plane was tracked by radar for the next hour. It shadowed the formation at ranges between 30,000 and 40,000 yards until after the attack group arrived on station. At 1904 radar contact was made on a group of 10 or 12 bogies bearing 050 True at 48,000 yards. These planes were designated in this ship as "Raid Baker". All planes maneuvered about the formation and were tracked by search and fire control radars until they withdrew at about 1950. The OTC maneuvered this Task Group by turn signals transmitted by TBS in order to keep Raid Baker astern.

6. At 1911 Raid Baker split into 3 sections; 2 of these sections rejoined at 1920 and never did press home their attacks. At about 1916 two float lights were dropped, bearing 050 True, distance 20,000 yards, parallel to the course of the formation. These float lights burned brightly for at least half an hour. At 1932 five flares were dropped across the head of the formation, bearing 130 True, range 34,000 yards. These flares gave excellent performance and silhouetted the force from a sector astern. They were too far away and covered only a small arc. At 1936 both Raid Able and section 3 of Raid Baker closed rapidly to make their attacks, Raid Able approaching from 210 True and Raid Baker approaching from 020 True. At 1940 orders were given to the port 5" battery to open fire on planes of Raid Able, which were then dead ahead at 4,000 yards. Before a shot could be fired the target passed to starboard. The destroyer RADFORD, in position ahead, opened fire on this group with automatic weapons. Immediately thereafter a plane was sighted visually close aboard on the starboard bow of this ship. A splash was seen under the plane but no wake or explosion was observed. The plane passed down the starboard side at a range of less than 200 yards and at about masthead height. It was taken under fire by 1 40mm gun and 2 20mm guns located on the starboard bow. After passing astern, the plane was seen to break into flames and crash into the water.

7. At 1941 Sky 3 opened fire with 5-inch mounts 7 and 9 at section 3 of Raid Baker, bearing 330 True, range 11,000 yards, and fired 40 rounds of Mark 32** fuze projectiles. The radar pip on the first plane used as a target was lost after several burst were observed at the point of aim. Fire was immediately shifted to another plane of the group. This second target turned away and rapidly increased range beyond effective gun range. Cease firing was given at a range of 14,000 yards. No planes were actually seen shot down by this firing.

*Emily: Code name for Japanese reconnaissance flying boat.

**Proximity fuze.

8. Another plane of section 3 or Raid Baker, after circling, started its approach bearing 295 True, range 21,000 yards and pressed home an attack. At 1948-1/2 the entire starboard 5" battery opened fire on this plane at a range of 6,000 yards, bearing 260 True. The destroyer BROWN, to starboard, opened fire shortly thereafter. At 1950 the radar signal of this plane was lost from all tracking radars simultaneously. A large ball of smoke and a splash in the water was observed. It is believed probable that this plane was shot down. After this, no other enemy planes approached the formation.

12. Comments on Own Disposition, Maneuvers and Ship Control.

(a) The modified disposition 5-V is considered to be an excellent formation for repelling air attack either night or day, and proved very effective during this attack. The formation is sufficiently tight to allow two battleships and at least two destroyers to fire at any low flying attacking plane without firing over another ship. For a dive attack on any carrier, two battleships and at least four destroyers may fire automatic weapons well within their range. Each battleship is within 2200 yards of two carriers. The formation is sufficiently loose to permit maneuverability, minimum distance between all ships being 1750 yards. Maneuvering was done by TBS* turn signals.

(b) The conn was kept on the bridge. For night air attack this ship has the signal officer stationed in the chart house with duplicate TBS transmitters and receivers. A TBS speaker is also in the pilot house. The signal officer is in direct communication with the Commanding Officer by teletalk. With the excessive noise encountered during an air attack the bridge speaker is unreliable and the teletalk at full volume has proved invaluable. The signal officer uses a headset with helmet, and transmits all maneuvering signals over the teletalk. All glass ports were left down on the bridge, and half the battle ports were left closed, which excluded some of the glare from firing but allowed good vision from ahead to each quarter. This vision and the RPPI** in the pilot house, on the SG*** position, gave the Captain a complete and clear picture of the formation at all times. A running plot of attacking planes was also kept in the pilot house by an officer in direct communication with Combat Information Center.

(c) The maneuvering of the formation was excellent. In general, the attacking planes were kept astern or on the quarter, the formation being maneuvered, using TBS, so radically and quickly that it was difficult for the attacking planes to make an attack, and also kept them under fire a maximum length of time. This ship had no difficulty in keeping station.

FLAG OFFICER COMMENTS:

(a) During the Gilberts operation I served in ENTERPRISE with ComTaskGroup 50.2 (ComCarDiv 11), as an observer. After dusk and in early evening of November 25 and 26, 1943, Task Group 50.2 was attacked by Japanese shore based twin-engined torpedo planes.

*TBS: High-frequency voice radio.

**RPPI: Remote Plan Position Indicator.

***SG: High-frequency surface search radar.

(b) Prior to and during both attacks Rear Admiral RADFORD handled his Task Group in such masterly manner that the enemy attacks were broken up with considerable damage to attacking enemy aircraft and with no damage to Task Group 50.2. During each attack Task Group 50.2 consisted of:

One CV and two CVL - ENTERPRISE, BELLEAU WOOD, and MONTEREY

Three BB - INDIANA, MASSACHUSETTS and NORTH CAROLINA

Six DD

4. Own Anti-Aircraft Defense.

(a) BBs and DDs were directed to open fire when enemy aircraft were known to be approaching our disposition for attack.

(b) CVs were directed to hold fire until directed to open fire until directed to open fire until actually under attack by approaching enemy aircraft.

(c) On both nights BBs and DDs opened fire in volume and with effectiveness when the enemy aircraft dared to approach or drive home an attack. Truly that 5-V disposition formed a ring of steel around the Carriers and gave the torpedo planes a wholesome respect for our withering gunfire.

(d) On neither night did the Carriers open fire with their AA batteries. As a result the carriers were never illuminated by their own gunfire. The gunfire of the screening vessels did not illuminate the Carriers.

NORTH CAROLINA ACTION REPORT:

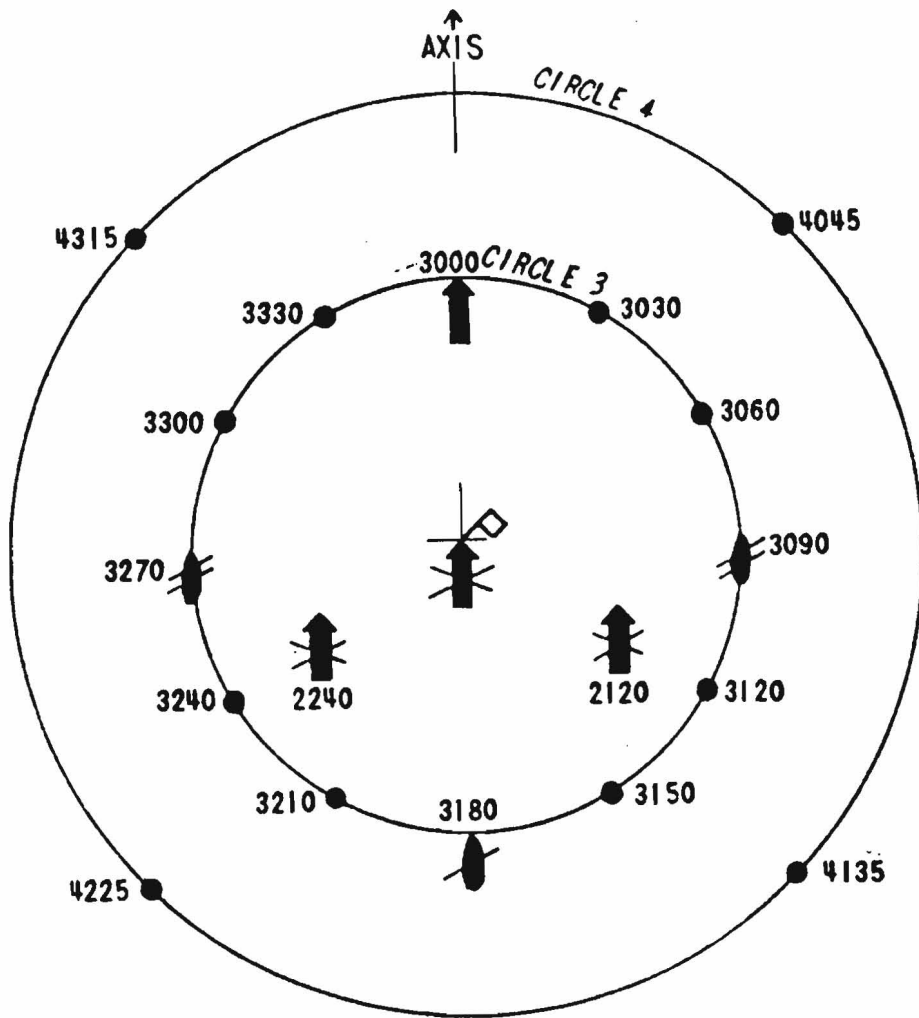
Search Radar Performance

1. Radar contact was not established on bogey planes until the range was approximately 17 miles. This has been a normal occurrence and is explained by the low altitude (50 to 800 feet) of the enemy planes. The procedure for the SK* radar has been to search 360 degrees, stopping only long enough on each contact to determine if friendly or bogey. Once a raid has broken through to attack, the SK operators continue reporting bogies until such time as a minimum range is reached. Inside of 6,000 yards the air search radar loses its effectiveness.

2. The search radars were employed as follows during the action:

(a) SK, continuous sweep for aircraft, reporting contact on a separate circuit (JS) directly to the air plot table.

*SK: Long-range air search radar.



Cruising Disposition 5-V ("Five-Victor"). Versions of this air defense formation were used throughout the Pacific war.

- 3 Carriers - CV and/or CVL's:**
- 3 or more heavy ships - BB, CA, CL:**
- 12 Destroyers.**

(b) SG No. 1 (on foremast), on 15,000 yard scale, used for station keeping and to give a continuous picture of RPPI units for keeping locations of ships of own formation.

(c) The radar signal in the C and I* unit is clearest and strongest and the notch disappears when exactly on in both elevation and train. When off target in either bearing or elevation, the notch remains in place and the target signal is fuzzy.

(d) From the type attack expected, an estimate can be made as to target altitude.

(e) Occasionally a target is momentarily sighted optically, being silhouetted against flares or tracer streams from other ships. One position angle and range is sufficient to determine the altitude.

The computer operator then coaches the director pointer to the proper value of sight elevation to give this altitude. This procedure has the advantages that the director optics are always directed at the target and if the target is sighted optically, no shift in control is required to use optical elevation control. It is slightly more complicated than controlling elevation by level from the stable element, as recommended at destroyer gunnery schools.

4. When low flying planes are in the vicinity of a surface ship, the radar signal on the planes tend to merge with the radar signal of the surface ship. Under these conditions, if the pointer and trainer attempt to keep on target by radar, the director invariably leaves the air target and begins tracking the surface target. The radar range operator must warn the pointer and trainer when another signal approaches his slot on the C and I scope, so that they might let the generated solution carry the director through the interfering signal.

C.I.C.** Performance

1. As noted in the remarks for the search radar, Combat Information Center maintained both an air and a surface plot. Continuous information was furnished the Captain by the Evaluator over the JA circuit. In addition, an auxiliary plot, using a mooring board and pins with colored heads, was maintained on the bridge. By looking at this board, the Captain could better coordinate and understand the information being furnished him and could form a clear conception of enemy movements. This system worked exceedingly well. There was no confusion and information was immediately available as to the location and maneuvers of the various groups of planes.

(c) SG No. 2 (on mainmast), on 75,000 yard scale, constantly searching in manual for any surface targets out side of own formation, and for low flying aircraft.

*C and I: Combat Information Center, first developed during the early months of World War II.

**C.I.C.: Combat Information Center, first developed during the early months of World War II.

The SG radars were on the same sound powered telephone circuit and gave information directly to the surface plotter. The arrangement above proved highly satisfactory and fulfilled all necessary demands. The results of search radar were highly satisfactory. The SG radars have picked up low flying aircraft when not showing on the SK screen.

FD* Radar Performance

1. Three of the four FD radars gave excellent results, tracking designated targets without difficulty at ranges exceeding 35,000 yards. One target was tracked by fire control radars to 80,000 yards. The radar antenna in Sky 4 was not properly aligned in elevation so did not give satisfactory performance. When aligned after navy yard overhaul the radar antenna was set in elevation on a lobe of the target and was therefore 13 degrees out. This occurred also in other directors, but the errors were discovered and corrected. Sky 4 radar antenna was aligned after the action and gave excellent performance.

2. Range, trainers' and pointers' pips were obtained on all designated targets. It was known that the pointers' pips were not reliable at position angles lower than ten degrees. From experiments conducted during daylight it had been found that the error in elevation on low flying aircraft was often greater than the position angle.** The procedure, as developed for control of elevation and actually used during this and subsequent actions, is based on making an estimate of the target's altitude and walking the projectiles back and forth in elevation across this altitude. The control of sight elevation remains in the director synchronized elevation knob in the computer in its "IN" position (normal setting). The computer operator manually turns the dive rate knob back and forth across zero to give an artificial shift in elevation.

3. The best estimate of target altitude is based on several factors:

(a) It has been observed that when the radar is exactly on the target in elevation, even though the pointer's pips are not matched, the trainer's pips are strongest and clearest. By careful teamwork the trainer can give a good estimate of position angle by this means. (Under present circumstances, the director crews get good and learn these things for themselves.)

2. C.I.C. also furnished target designations to the Sky directors, and evaluated all information for Sky Control and Control. This information was transmitted by an officer in C.I.C. over the 5JP circuit.

3. The surface plotting group in C.I.C. kept the conning officer informed as to ranges and bearings to the guide for station keeping and as to any changes in the positions of other ships in the formation.

*FD: 5-inch fire control radar, later redesignated Mark 4.

**Wartime 5-inch fire control radars, Mks 4 and 12, lost accuracy at low angles. The Mk 22 was developed as a supplementary radar to remedy this deficiency. All three radars were later replaced by the Mk 25.

Surface Task Group Sweep Around Truk

February 1944

IOWA and NEW JERSEY repel single-plane air attack; NEW JERSEY serves as fighter-direction ship.

IOWA ACTION REPORT:

At 1318 Iowa was under a heavy black cloud with a ceiling of about 2,000 feet. An intense sun glare shone through a small in this cloud at bearing 240 (relative), elevation about 70°. Suddenly a plane (Zeke or Hap)* dove through this hole and dropped a light bomb when even with the bottom of the cloud. The bomb hit the water about 100 to 200 feet from the starboard side of the ship, abreast Turret 1. Spray was thrown up over Turrets 1 and 2 and the 20mm guns on the main deck at the starboard side of Turret 2. No casualties or damage resulted.

After dropping the bomb, the plane banked sharply up and to the left, making a complete and tight circle just above the ship's port beam at a position angle of about 70°. It was close to the cloud and disappeared intermittently in it.

The plane then started another steep dive on the ship. One observer reported that it was strafing and that its bullets were hitting the water on the starboard side of the ship. Heavy Number 4 fired two rounds and 20mm guns fired 74 rounds at the plane during this dive. The plane pulled out of the dive at about 1,000 feet altitude, crossed the ship, banked left, and stood away on the starboard bow.

NEW JERSEY opened fire but the plane continued ahead to the vicinity of the screen where it turned left and stood off in a southerly direction. Two of the screening destroyers were observed to fire 5" guns at it. Later information indicated that this plane was downed by CAP shortly thereafter.

NEW JERSEY ACTION REPORT:

When T.G. 50.9 was formed for the sweep around TRUK the NEW JERSEY was designated as Fighter Director Ship. T.G. 50.9 headed west about 1130 and C.T.F. 58 was requested to furnish CAP. The CAP arrived overhead about 1325 and consisted of 8 F6F-3 from the COWPENS. They were placed orbiting overhead at 12,000 feet. At 1355 bogey was picked up by SK at 164° T, 16 miles. When bogey was at 180° T, 11 miles, a division of the COWPENS CAP (four planes) was directed to "push over to port, to investigate bogey, south of me eleven, believed to be low altitude." Shortly thereafter NEW JERSEY advised the interceptor group commander we had merged plot. The interceptor group commander reported that there was nothing in sight. Immediately after having advised, "look up, look down," the interceptor group commander reported, "Tallyho popeye."** He later amplified his tallyho as having shot down 1 Zeke as it came out of the clouds at 1600 feet. During the time NEW JERSEY's main and secondary batteries were engaging the enemy, the BUNKER HILL air group commander spotted the NEW JERSEY fall of shot on VHF channel 1.

*Zeke, Hap: Allied identification code names for versions of the Japanese Zero single-engine fighter.

**Voice-radio phrase meaning "enemy aircraft sighted in clouds."

Antiaircraft Action During Carrier Strike Against Palau

March 1944

AA gunfire defends carrier task group against two evening attacks by Japanese land-based torpedo bombers.

ALABAMA ACTION REPORT:

1. NARRATIVE.

(a) While acting as a unit of Task Group 58.3 (Rear Admiral S.P. Ginder, U.S.N., Commander Carrier Division ELEVEN), and Task Force 58 (Vice Admiral M.A. Mitscher, U.S.N.), during the recently completed attack on Palau, this vessel took part in engagements with low-flying Japanese planes which attacked or harassed the Task Group on the nights of 29 and 30 March, 1944.

(b) The first engagement occurred during evening twilight of 29 March, 1944. About six enemy planes approached Task Group 58.3 and of these, four attempted to attack in the vicinity of ALABAMA. One of these was shot down by ALABAMA A.A. and one, which crashed just astern of LANGLEY, by other ships of the Group. Both burst into flames. The other two planes escaped. The enemy was not observed to have dropped bombs or torpedoes.

(c) The second night, March 30, at 2045, an estimated group of six enemy planes, and again at 2146 a single plane, approached Task Group 58.3, and upon being taken under fire by this and other ships, retired without pressing home an attack. No apparent damage was suffered by the enemy or by the ships of this Task Group.

1. PERFORMANCE OF OWN ORDNANCE MATERIAL AND EQUIPMENT.

(a) No new material deficiencies were encountered and no evidence was given of training deficiencies. Personnel performance was effective throughout. However, the many changes continuing to occur in officer and enlisted personnel emphasizes the desirability of having more opportunities and services provided to conduct training fire. The material deficiencies most in evidence during these A.A. actions were; as usual:

- (1) The radar sight elevation difficulties experienced with the MK. 4 radar.
- (2) The lack of satisfactory control equipment for use with the 40mm during darkness.

In the matter of passing targets from search radar for putting MK. 4 radars on a target initially, ALABAMA has used search radar range and bearing designations by 5JP battle telephone as the means of so doing, ever since commissioning. This practice is thoroughly routine and is both easy and reliable. Upon installation of SK radar, it was found that any early difficulties in this connection experienced with SC radar were no longer encountered. One potentially dangerous weakness of the SK in use for designation lies in its inability to hold targets at close range. If close and dangerous targets were multiple this deficiency would assume serious proportions.

SOUTH DAKOTA ACTION REPORT:

"Radar casualties were more serious during this operation than on any previous one. Two anti-aircraft director Mark 4 equipments were out of commission during periods when they were most urgently needed. As it happened, no direct attack was made on the formation after the failure of these equipments. All casualties occurring were distinctly material failures due to factors such as the breakdown of circuit components caused by age or shock of gunfire.

"The enemy resorted to radar jamming for the first time in this ship's experience during this operation. A small amount of the "window"* type was used in the vicinity of Task Group 58.3 and caused no confusion although one anti-aircraft director shifted from the plane to the "window," having concluded that the raid was splitting and that the other director on that side would continue to track the other plane. Considerably more of this type of radar jamming material is believed to have been dropped in the vicinity of Task Group 58.2. The comments of the SK and FD radar operators who experienced the jamming follow.

"Comments by SK radar operator on 'window' dropped during night air action 30 March 1944:

"The first appearance of the enemy having dropped "windows" was observed early during the night attack. One plane tracked in from the south was lost in the water-return for several minutes; it reappeared at six miles on a north-easterly course. The target stood out clearly on the PPI scope as there was about two miles distance between it and the edge of the water-return. Suddenly what looked like a rain squall showed up right behind the plane. On the 'A' scope** it appeared as several sharp, fluctuating, pips while the PPI scope showed an erratic, hazy arc. As this was the only raid in the screen at the time, the operator was able to study it carefully and quickly came to the conclusion that "windows" were dropped. They were evidently dropped at a low altitude as they remained on the screen for a short while and had only an E2 pip strength. (Having observed "windows" during a recent exercise it was concluded that "windows" dropped from any great height at such close range should have saturated pips.)

"Later on another plane coming in from the southeast dropped "windows" at ranges of 29 and 23 miles. Due to the fact that there were several raids on the screen at the time, the operator was unable to give any one raid too much attention and the first report made was that the raid had split into three groups. For several minutes two groups (which later turned out to be "windows") were reported as orbiting - this being greatly due to the fact that the bearings were being determined on the run and the few degrees error obtained from the PPI scope bearing indicator led the operator to believe that the target was in an orbit. After awhile a careful check of the bearings and ranges showed that the targets were practically stationary. This along with the fact that it gave a hazy appearance in comparison to an actual target on the PPI scope made the operator positive that they were "windows". These "windows" were dropped in the vicinity of Task Group 58.2 and for awhile it was

*Window: Wartime code name for chaff.

**"A" scope: Oscilloscope presentation giving target range only.

thought that they might be side lobes but this was quickly disproved by decreasing the receiver gain control. Those "windows" were evidently dropped from a higher altitude as they gave a strong echo on the 'A' scope and remained on the scope for quite some time.

"Comment by FD radar operator on 'windows' dropped during night air action 30 March 1944.

"On the basis of one exhibition of the 'window' type radar jamming and one positive contact with it during action with the enemy, the following points appear to be worthy of mention:

"Properly used this type of jamming could seriously impair the efficiency of the FD type radar equipment. Operators appear to have little difficulty staying on an incoming target that drops the 'window' material but will shift to it when dropped by a target opening range. 'Windows' dropped beyond ten miles should present no great difficulty other than keeping track of a large number of contacts in CIC.

"However, if the enemy coordinated his attack to the extent that one plane was used to drop the 'window' material in the large quantities at ranges of 10,000 yards and less, closely followed by other planes making the attack, it is believed that the FD radar operators would have a great deal of difficulty in staying on the true targets as they came through the 'window' material. The enemy has not yet fully exploited the possibilities of this radar-jamming device.

Marianas Operation; Battle of the Philippine Sea

June 1944

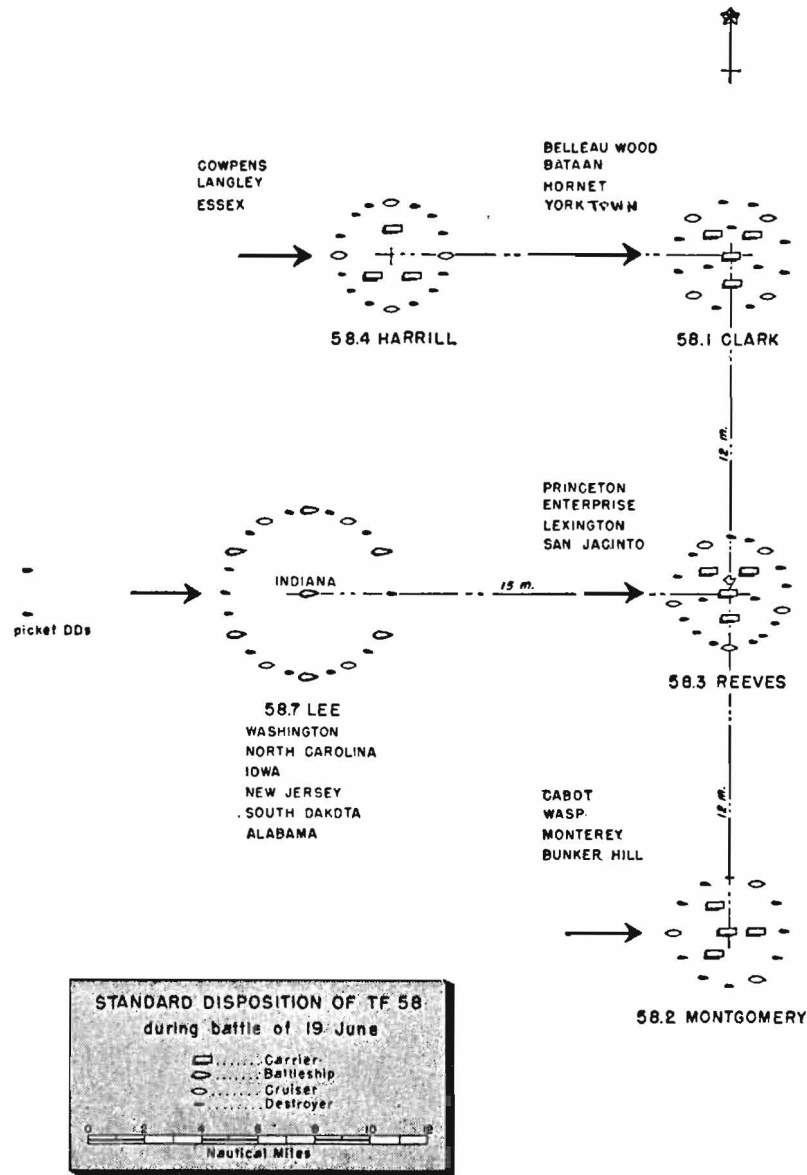
TASK FORCE 58 ACTION REPORT (Vice Admiral M.A. Mitscher):

"On the evening of 15 June at about the time the carriers were recovering their planes and while heading on a southeasterly course several bogeys appeared from the westward. This developed into an aggressive torpedo attack by about a dozen planes thought to be Milky Ways or Frans.* Although their attack was pressed home and there were many close misses, no ship was torpedoed, and at least seven of the attackers were shot down. By this time the landing operation by our huge amphibious forces was under way and the Japanese could no longer be in doubt that we were endeavoring to capture SAIPAN. Their torpedo attack, by planes probably brought into the area, indicated that they were beginning to assemble all the power they could to repel the attack, and start their attrition tactics on our fleet.

"On 19 June, activity started about 0600 with one VAL diving on and being shot down by the screen to Task Group 58.7, composed of the fast battleships with cruisers and destroyers. Shortly after 0830, bogies were picked up on the radar in the vicinity of Guam, and fighters were sent to investigate. Our planes reported many enemy planes over and on the airfields and asked for additional fighters which were immediately sent.

*Fran: The Nakajima P1Y1 Ginga (Milky Way) twin-engined landbased bomber, code-named Frances.

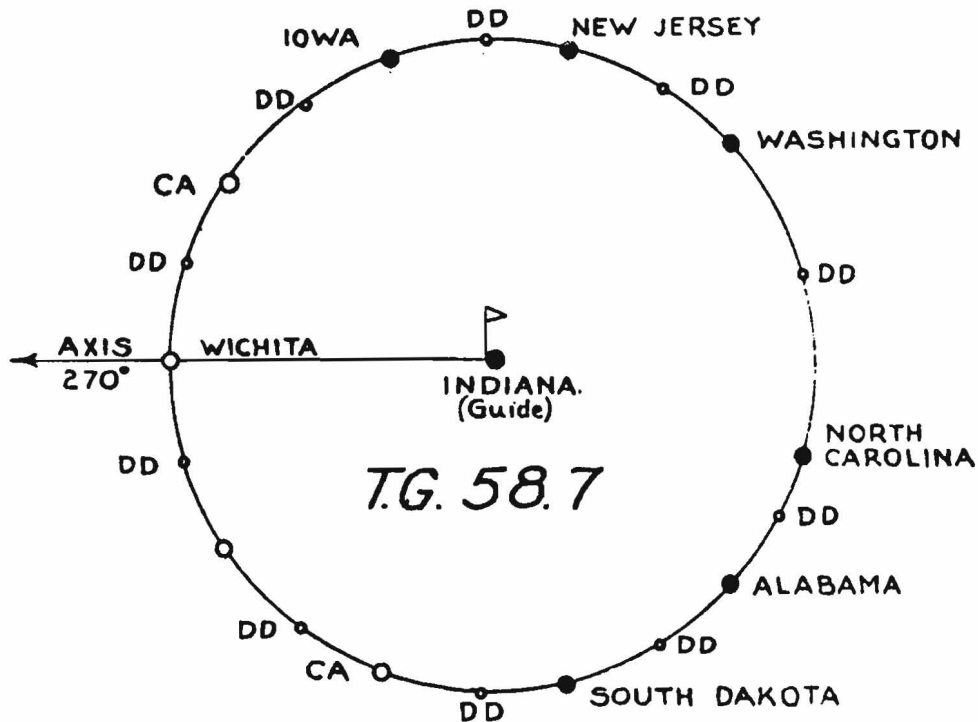
"At about 1000 many planes were picked up on the radar to the west, distance approximately 130 miles, and additional fighters were launched. Our fighters were vectored out and intercepted many enemy carrier fighters, dive bombers and torpedo planes about 35 or 40 miles west of Task Group 58.7, which was nearer to the enemy than any of the four Carrier Task Groups. The fighters shot down most of the enemy planes, but a few got through to attack the battleship group which was subjected to intermittent attacks by groups of three or four to a dozen planes until about 1500. During these attacks nine planes identified as Judys, Jills and Kates* were shot down by ships' gunfire.



*Judy, Jill, Kate: Allied code names for types of single-engined Japanese attack planes.

CRUISING DISPOSITION 7-Y

Air defense formation of TG 58.7 (Battle Line), Philippine Sea



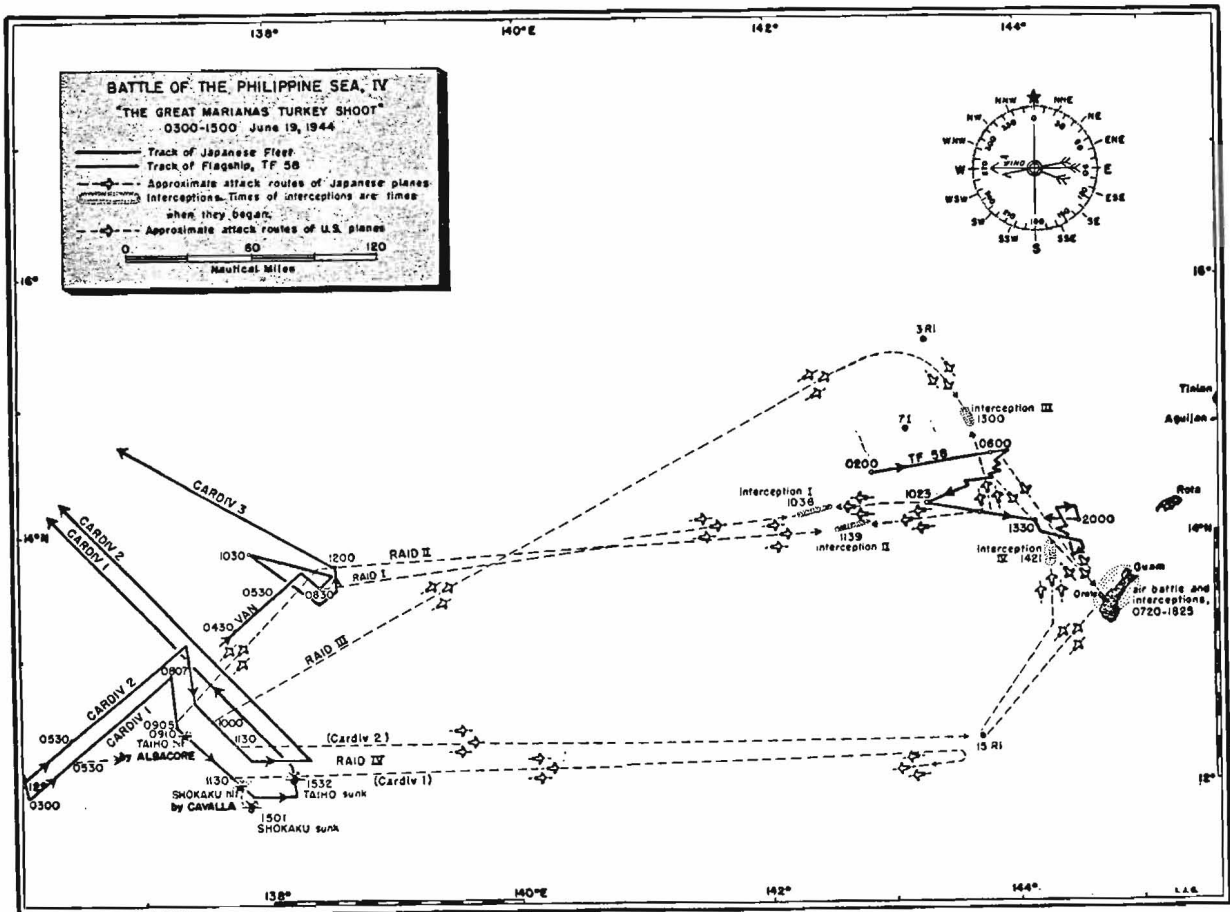
Note: DesDiv 106 as Pickets on Circle 15

"The enemy attack was made in four main raids, all of which were intercepted and broken up by our fighters with only a few planes getting through to attack the force. Two of these raids had Mark III IFF indications. Task Group 58.2 was subjected to two attacks, the first by four JUDYS of which three were shot down by gunfire, and the second by about 10 planes of which three were shot down by fighters very close to the disposition and two more which were shot down by ships' gunfire. Task Group 58.3 suffered one attack by five or six planes which came in singly. Two JUDYS and two JILLS were shot down by gunfire.

"During the attacks on Task Group 58.7 SOUTH DAKOTA and MINNEAPOLIS sustained a direct hit and a near miss respectively and a plane crashed into the side of INDIANA. The battle efficiency of these ships was, however, not impaired. In Task Group 58.2 WASP and BUNKER HILL suffered near misses during both of the attacks on that task group. In BUNKER HILL, one officer and one enlisted man were killed and three officers and 70 enlisted men injured. The hangar deck

gassing system was put out of commission for several days, an F6F was blown off the flight deck, and other damage not affecting her battle efficiency was suffered. WASP had one enlisted man killed and one officer and 11 men injured. Damage to the ship was very slight.

"During the day, fighters were repeatedly sent to Guam and strikes were made by fighters, dive bombers and torpedo planes on both Guam and Rota to deny the enemy the use of these bases for launching shore based attacks or for refueling and rearming planes flown in from carriers far at sea to the west. The Orote and Agana airfields at Guam were well cratered and hits were made on the Rota strip."



RECAPITULATION

- 27 Total airborne enemy aircraft destroyed by ships' gunfire.
- 848 Total airborne enemy aircraft destroyed by our aircraft.
- 875 Total airborne enemy aircraft destroyed by our aircraft and ships' gunfire.

Antiaircraft Defense of TG 38.2 During Fast Carrier Force Operations
in Support of Leyte Landings

October 1944

IOWA ACTION REPORT:

2. The first definite attack on Task Group 38.2 developed about 1900, 12 October. Iowa was in the southeast quadrant of the screen, and the raid approached from the northwest. Ships to the westward began firing at 1905, and at 1906, a Betty* was sighted 1,000 yards on the port quarter inside the disposition at an altitude of about 50 feet, and heading southeast under the stern of the Iowa. The port machine gun batteries did not fire since one carrier, one cruiser, and four destroyers were in the line of fire. The Betty crossed about 500 yards astern between the Iowa and Tingey (the next adjacent ship clockwise in the screen) and turned to the northeast, passing up the starboard side at a range between 1,000 and 2,000 yards. It was fired on by four 5"/38 guns, eight 40MM quads, and nineteen 20MM guns, but no hits were observed. As the Betty proceeded up the east side of the disposition, each ship in the screen fired upon it and it is believed to have been shot down to the north about one minute after passing this ship.

3. At 1912 the second attack group was located to the north consisting of ten to fifteen planes. These planes came in from the north-northwest and at 1915 were fired on by ships in that sector of the screen. Within a space of about 15 seconds, three enemy planes were shot down in flames, and a fourth was shot down to the westward at 1916.

4. At 1922 a three-plane bogey was picked up 12 miles to the northeast and tracked by the AA directors on a southerly course across the head of the formation, which was now on course 135. At 1923 1/2 the target turned towards the formation and fire was opened by the destroyers northeast of the Iowa. The target turned south, crossed the Iowa's bow at 12,000 yards, and fire was opened with ten 5"/38 guns at 1925. Fire was checked after 20 seconds, the range having opened to 14,000 yards.

5. For the next hour, there were numerous bogies in the vicinity of the formation, but none approached closer than 10 miles, and at 2022 the radar screen was clear.

6. At 2106 bogies were again picked up and from then until 0204, 13 October, enemy planes were always in the vicinity of the formation, but no further attacks were made. At 2331 a single enemy plane approached the formation from the west at an altitude of 7,000 feet and at 2332 dropped a series of six flares directly over the center of the formation. The plane was clearly visible in the light of the first flares and is believed to have been a single-engine plane. It turned north after dropping the flares and was fired on by several ships in the western and northwest part of the formation. The whole formation was brilliantly illuminated by these flares which burned for about 1 1/2 minutes, but no attack developed. At 2340 a plane was shot down in flames to the north, presumably by the destroyer picket stationed there.

*Betty: Allied code name for a type of Japanese twin-engined land-based torpedo bomber.

7. At 0145, 13 October, a bogey which had been orbiting 30 miles to the eastward for several hours, began to close the formation. The Iowa at this time was on course 295, and at 0152 a track had been established on the bogey by two AA directors giving a course of 240, speed 150 knots, altitude 5,000 feet. The destroyers on Iowa's starboard quarter opened fire and the target turned left, passing under the stern at a range of 12,000 yards. Iowa opened fire at 0154 1/2 with ten 5"/38 guns, and checked fire 13 seconds later at a range of 14,000 yards, having expended 28 rounds. The AA directors continued to track the target, and at 0157 reported that two distinct pips were visible, one of which appeared to be astern of the other and losing altitude. C.I.C. reported at 0158 that the bogey had separated into two targets, and at 0200 a plane hit the water and burst into flames bearing 210° at a range of 35,000 yards. Only one bogey remained on the screen, and several minutes later it was lost on a southwesterly course at about 40 miles. It is believed that the plane which burned at 0200 was damaged by the fire of Iowa and other ships in the screen, causing it to lose altitude and crash.

8. In the late afternoon of 13 October, enemy planes were reported in the vicinity, and at 1834 radar contact was made on a low-flying plane 20,000 yards to the northeast. Radar contact was lost at 15,000 yards, but at 1835 1/2 a Betty was sighted on the starboard bow, low on the water and on a southwesterly course at a range of 8,000 yards. All ten guns of the starboard battery opened fire at 1836 and checked fire one minute later, when the range reached 14,000 yards. 117 rounds were expended, the only visible effect being to cause the Betty to turn left to a southerly course and make radical changes of altitude. The initial bursts were astern of the target, but were brought on in deflection by increasing target speed from 220 to 240 knots. Except for one destroyer which fired a short burst of 40MM, no other ship in the disposition fired on this plane which was visible from this ship for only 1 1/2 minutes. For the next two hours, many radar contacts were made on enemy planes in the vicinity of the formation but no attacks developed and no planes approached within gun range.

9. At 1513, 14 October, a report was received from the CAP of an enemy raid of about 15 planes approaching from the east. The weather was squally with low clouds, and the task group was in disposition 5-V-5 on a course of 135° T, Iowa being in the van of the screen. At 1515 1/2, three enemy planes came out of a rain squall on the port bow of the formation, each being chased by two Hellcats. One turned east and was shot down by the fighters. Another crossed ahead of the formation and was shot down in flames by fighters south of the formation. The third plane (a Judy) headed directly for the Iowa's port beam and went into a shallow dive towards the ship. As the friendly fighters pulled up sharply and turned west, five 40MM quads and two 20MM guns opened fire at 1516 at a range of about 1,000 yards. All tracers appeared to hit squarely in the engine and right wing of the plane which burst into flames, fell off on the right wing and crashed 300 yards on the port beam, sinking immediately. The plane was identified as a Judy, and was painted light brown with bright red Jap markings on the wings.

10. At about 1710, a raid developed on Task Group 38.3 which was 10 miles away to the southeast. At 1714 one enemy plane, a Jill, was observed retiring north from T.G. 38.3, still carrying its torpedo. At 1715 fire was opened on this plane with ten guns of the starboard battery at a range of 12,000 yards. The plane crossed the bow at 11,000 yards and fire was continued with eight guns of the starboard battery until 1718 when the plane had reached a range of 15,000 yards. 212 rounds were expended, the plane making the customary violent evasive maneuvers, and changing altitude between about 15 feet and several hundred. The

Jill was lost to view in a rain cloud, but was still carrying its torpedo when last seen.

11. There was no further action with the enemy during this period.

Performance of own ordnance materiel and equipment.

(c) Fire discipline on all occasions was excellent. This was particularly apparent in the early evening of 12 October, when machine gunners on the port side refrained from firing on a Betty passing under the stern because of numerous friendly ships in the line of fire. Close control of all antiaircraft weapons to avoid firing into friendly ships requires the constant and unremitting attention of all officers and petty officers in the Gunnery Department. This is particularly true at night, but unfortunate incidents can be prevented with adequate information on clear firing bearings, and timely warnings of impending maneuvers. It is not necessary to shoot up our own side in order to shoot down Japs.

(d) During the period of this report, the Iowa expended 472 rounds of 5"/38, 711 rounds of 40MM, and 859 rounds of 20MM.

(e) Iowa's fire shot down an enemy plane attempting to dive into the ship at 1516, 14 October, with the expenditure of 108 rounds of 40MM, and 23 rounds of 20MM. Five-inch fire of the Iowa, together with that of other ships in the screen, is believed to have damaged an enemy snoopier at 0155, 13 October, causing it to crash into the water and burn five minutes later. Other targets fired on are not believed to have been hit, but in every case in which the five-inch battery was used, the enemy planes turned away and took evasive action because the bursts came close.

Battle of Leyte Gulf

October 1944

Unit Commanders comment on air defense lessons learned and discuss actions to be taken in response to early suicide attacks.

COMBATDIV 9 ACTION REPORT:

1. Actions covering this period illustrate most perfectly the potency of air power. On the other hand, they also illustrate the inadequacy of air power against armored and well armed units unless the attacks be unremitting. The sinking of a NACHI class cruiser in MANILA Harbor on 5 November 1944 by planes from the USS LEXINGTON is a case in point. The first attack disabled the ship. After the second attack she was burning heavily aft. But she broke in two and sank only after three torpedo hits while dead in the water. The afternoon attacks of 24 October should have prevented the enemy from coming out through SAN BERNARDINO Straits but they did not prevent this. It took the sustained attacks of our intrepid CVE groups plus those of Carrier Group One to make the enemy see that he could not reach LEYTE Gulf.

3. Enemy cruisers and battleships do not become disabled by two or three torpedo hits or a few bomb hits unless they hit vital spots such as machinery spaces or propellers. Our own battleships and cruisers similarly are not disabled unless vital zones are hit and we know that enemy torpedoes carry a heavier load of explosive than ours do. This does not detract from the potency of air, but it is a

fact and one that must be appreciated. On the other hand, our own surface vessels made short work of the enemy fleet attempting to enter Southern LEYTE Gulf and we sustained very little damage in this action. It would therefore seem that, whenever possible, use should be made of our armored ships to sink enemy armored ships.

COMMANDER, TG 38.3 RECOMMENDATION:

Doctrine for Defense Against Suicide Attacks.

1. The suicide attacks of the Japanese aviators are not entirely new. The difference in the present attacks seems to be that formerly the suicide dives were made by pilots whose planes had already been damaged, whereas the present attacks are made by pilots who start out with the original intention of making this form of sacrifice. Therefore, the enemy planes bent on suicide missions adopt tactics which will insure success of a one-way trip. They operate in small groups, approach at high speed, and make no prior attempt at a normal attack. Some groups approach at low altitudes and others high, the later gaining additional speed by means of a diving final approach. In addition, they employ cloud cover, evasive changes of course, and may trail our returning strike groups. These tactics make detection by radar more difficult.

2. In order to most effectively counter these suicide attacks, the doctrine for this task group stresses the following defensive measures in the order of their effectiveness.

(a) Interception. Alert and smart interception by the combat air patrol - This involves "heads-up" performance by the pilots of the CAP. The FDO* can only do so much. After the CAP has been placed in close proximity to the bogey, the fighter pilots must be alert to pick them up visually, must deploy to "box in" the bogey so he cannot get away, and must dive instantly when he dives, in order to improve or maintain their relative position on him. The tactical performance of the CAP in contact is of vital importance in shooting the suicide plane down. In addition, the FDO should start a CAP out immediately a bogey appears on the screen, should be more lavish in use of CAP divisions against small bogeys than we have hitherto considered necessary, and must vector them so that one division in reserve is always maintained between the bogey and the disposition.

(b) Maneuvers. The second defense measure is radical maneuvering of the task group and of individual ships at high speed. The following rules for maneuvering are recommended:

(1) Group maneuvering must start when bogies are at least 10 miles distant; at 300 knots the suicide plane will be on you in two minutes.

(2) Never remain on a steady course for any appreciable interval.

(3) For a high suicide plane (which is probably a dive or glider bomber), maneuver to keep him between 30 degrees forward and 30 degrees abaft the beam.

*FDO: Fighter Direction Officer.

(4) For a low-flying plane (which is probably a torpedo plane), maneuver to keep him between 30 degrees on either quarter until he has dropped his torpedo; then look out for his crashing the deck.

(5) Secondary to (3) and (4) (if you have any choice and you probably won't) keep him down wind; it will hold him under your fire longer.

(6) When the plane is inside of 3000-5000 yards, ships for which it is heading maneuver individually.

(c) AA Fire. The third and last defense measure is AA fire from ships. All lookouts and fire control personnel must be alert to spot and identify enemy planes. Maximum volume of fire must be obtained. It is not enough to hit and damage, or set on fire the suicide plane; it must be disintegrated in the air. Fire should not be shifted from the plane until it is destroyed completely or hits the water. The importance of visual lookouts against suicide planes should be reemphasized. The valuable 5" gun with Mk 32 fuses* [sic] should be employed to the utmost at the short ranges (inside 5000 yards) and continue down to the minimum arming range of the fuse.

Third Fleet Operations in Support of Luzon Landings

January 1945

Battleship unit commanders discuss task group air defense formations.

CTG 38.2 ACTION REPORT:

3. In order to give maximum anti-aircraft protection to the carriers it is believed that battle ships and cruisers in a group should be one more than the number of carriers. This will permit one ship with heavy AA batteries to be in the center of the formation with clear arc of fire for high angled targets in any direction and, incidentally, to act as a highly visible guide. The remaining heavy ships should be equally spaced between the carriers, either on the same circle or 500 yards outside the carrier circle. In this position their arcs of fire have the maximum width.

COMCRUDIV 10 ACTION REPORT:

1. Commander Task Group 38.1 extensively employed cruising disposition 5VA, which placed the carriers equally spaced on circle 2.5, cruisers and battleships equally spaced on circle 3.5, on mid-bearings between carriers, destroyers on circle 7; 5VB - as above, except that carriers moved in to circle 2, and cruisers and battleships to circle 2.5.

2. These dispositions were designed to give maximum anti-aircraft protection for carriers against surprise suicide dive-bomber tactics. Although no opportunity was presented to test the effectiveness of these dispositions, it is believed that this type of close-in fire support will provide a partial answer to the difficult problem of defense against suicide attacks.

***Mk 32 fuze: Current type of proximity fuze, considered a major weapon against suicide attackers.**

COMBATDIV 8 ACTION REPORT:

1. Formation 5 Victor Baker was generally used by TG 38.1 with carriers on 2000 yard circle and heavy escorts on the 2500 yard circle. This provides a formation that gives each carrier two powerful anti-aircraft batteries to augment her own against suicide planes and dive bombers; at the same time it gives heavy ships the opportunity to maneuver independently against attacking torpedo planes or submarines.

Okinawa Operation

March - June 1945

During the long Okinawa campaign, the Fast Carrier Force (TF 58) provided air support and attacked bases from which Japanese counterattacks could be launched. Like the naval forces directly supporting the battle on land, TF 58 was subjected to repeated suicide attacks. The task force commander summarizes the accomplishments of AA gunfire and cites some of the problems involved in defense against the kamikaze.

CTF 58 ACTION REPORT:

Of the 555 enemy aircraft destroyed in the vicinity of the task force, 403 were shot down by day and night CAP. Of the remaining 152 enemy aircraft, 141 were shot down by AA gunfire and 11 made suicide hits.

The score by task groups

Task group	Day	Night	Suicide hits	Total
58.1.....	36	7	0	43
58.2.....	8	4	0	12
58.3.....	32	5	5	42
58.4.....	17	5	4	26
58.8.....	25	2	2	29
Total.....	118	28	11	152

Limitations of AA defense. -- The high percentage of attacking aircraft destroyed does not accurately represent the degree of effectiveness of AA gunnery. In addition to the suicide hits, bomb hits and near suicide misses caused various degrees of damage and the criterion of effectiveness is best indicated by the fact that over 90 percent of the planes making daylight attacks on the carrier task groups were shot down inside the formation screens.

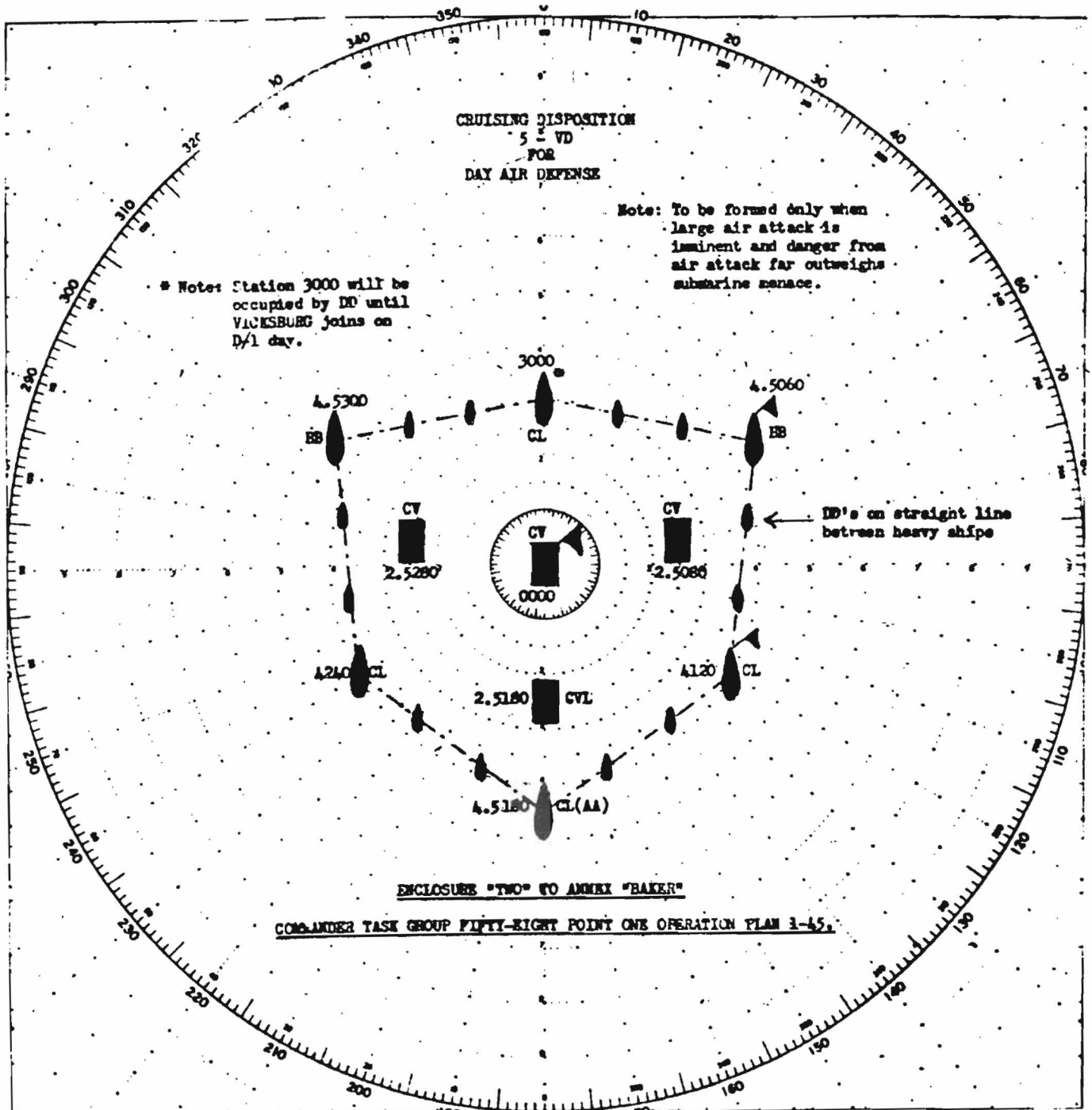
20-mm AA guns. -- The minute percentage of hits obtained with this weapon at effective ranges raises considerable doubt as to its effectiveness in stopping the suicide attack.

Recommendation

That type and task group commanders review the requirements of AA conditions of readiness with a view to utilizing the periods of darkness for resting gun

and fire-control crews who usually spend the entire daylight period at Condition 1 or 1 Easy.

Continuing study by responsible commanders for a system of AA coordination that will consistently develop a large volume of fire in the shortest possible time against long and short range air targets.



Typical air-defense disposition of a carrier task group, 1945. Note the distances used, and placement of DD between bigger ships to provide overlapping fire while maximizing arcs of fire of the heavier AA batteries of BB and cruisers.

The failure of present radar arrangements to give warning and location of incoming single plane attacks as evidenced by the alarming number of surprise attacks where first contacts were visually made at ranges of 5000 yards and less.

Fast Battleship Bombardments of Japan

July - August 1945

Air defense remained a critical problem through the final days of war in the Pacific. One of the battleships taking part in strikes against the Japanese mainland discusses cooperation with covering carrier fighters.

SOUTH DAKOTA ACTION REPORT:

4. South Dakota acted as coordinator for all ships employing visual control of CAP. Immediate responsibility for control of planes was usually divided between two ships, subject to express instructions to the effect that any "snapper"* from any ship having visual contact with a bogie should immediately assume control of a section or division and vector them out for interception, informing the other ships when practicable of the location of his target.

5. In the early stages of the approach, only one division of CAP was available. This was split into sections, one section stationed on the starboard bow (landward side on the approach) and one section on the starboard quarter of the formation, at 3,000 feet. Prior to the start of the bombardment another division of CAP was made available, and, until the bombardment commenced, divisions were stationed in the same manner as previously mentioned for sections. Just before the bombardment started, stations were shifted to the disengaged bow and quarter. On the run-out after the bombardment was completed, the divisions were stationed on the starboard and port quarter of the formation since the retirement was on a generally eastward course. Visual control ceased at 1600 (Item).

6. No bandits were sighted during this period. Several contacts of a suspicious nature were investigated but in each case proved friendly. Division and section leaders, as well as individual pilots, were exceedingly alert, keeping the "snapper" controllers informed of the location and identification of planes sighted by them within visual range of their assigned stations.

D. CINCPACFLT BOARD ON SHIP AND AIRCRAFT CHARACTERISTICS, 1945.

Two weeks after V-J Day Fleet Admiral Chester Nimitz, Commander-in-Chief of the Pacific Fleet, convened several boards of officers to summarize the Fleet's wartime experience with ships, planes, weapons and electronics and to make recommendations for postwar procurement and development. One of these boards, chaired by Commodore Merrill Comstock, dealt with ships and aircraft; Admiral Raymond Spruance, who had relieved Fleet Admiral Nimitz as CINCPACFLT, forwarded this report to the Chief of Naval Operations on 13 December 1945. As the distilled judgment of a group of experienced officers, who had drawn on the Pacific Fleet's accumulated experience with fast battleships, it is relevant to this study, particularly so since its remarks are specifically focused on the IOWA class.

Pertinent extracts from this report follow. In forwarding it, Admiral Spruance interpolated his own comments. These are set off in (parentheses) where they appear.

PART I

SUMMARY OF MAJOR CONCLUSIONS AND RECOMMENDATIONS

Applicable to All Types

1. Continue an extensive research and development program.
2. Locate the Combat Information Center of... Battleships below decks and within the armored box.
3. Antiaircraft guns and directors should be rearranged and regrouped to form an integrated composite battery providing fire of equal strength on all bearings.

Battleship Types

1. The battleship is an essential type for the postwar fleet.
2. The IOWA design should be used as the basic design for postwar development.
3. Splinter-proof command, conning and fire control stations should replace the heavily armored conning tower.
4. The foremast arrangement and entire bridge structure should be completely redesigned.

PART III

BATTLESHIP TYPES

A. General

1. The Board considers the battleship an essential type for the postwar fleet.
2. The following paragraphs discuss the characteristics of the best type now existing and recommend improvements shown desirable by wartime operation of those ships.

B. Suitability of existing types

1. Of the existing battleships only the so-called "fast" battleship is capable of performing all the functions required of this type as they are employed today. Therefore, all pre-NORTH CAROLINAS must be considered obsolete and only the NORTH CAROLINAS, SOUTH DAKOTAS and IOWAS can be considered as suitable postwar ships.*
2. Any later postwar ship must have a speed at least equal to that of the postwar carriers. The NORTH CAROLINAS and SOUTH DAKOTAS do not have such a speed. The IOWAS do. This quality, plus their other improvements, and a lack of any major inherent deficiency or weakness, makes the IOWA class the logical prototype for future development.
3. The IOWAS proved themselves capable ships. They were able to operate with ease and provided welcome support to the fast carriers. They demonstrated that they could employ effectively the world's longest-ranged ship-mounted gun. Their anti-aircraft installation is today's best. They were able to remain at sea during the longest and most severe operations and not only maintain themselves, but also provide logistic support to other types. That they were not able to prove themselves against enemy heavy ships was a matter of tactical placement and not design. In all, the IOWAS can be considered better ships than any American or foreign predecessor or contemporary.
4. The Board considers that the IOWA design, modified as brought out in the paragraphs following, should be used as the basic design for postwar development.

C. Future Development

1. It must be recognized that the IOWAs are a "pre-Pearl Harbor" design. The first ship of the class was laid down in June 1940...and commissioned in February 1943. Thus by the time the experiences of the war had begun to influence thought, their design had been finished and construction was so near completion no changes could be made in their basic features or characteristics. That this basic design has proven sound and that, even today, after the war, the ships need only relatively minor changes to modernize them, is to the credit of those responsible for that design, as most of the changes stem from the war-fostered development of electronics, operational facilities, increased antiaircraft armament, etc.
2. Hull
 - a. Dimensions

In the open sea and off soundings these ships are highly

*At the end of World War II the United States had 13 older battleships, originally completed between 1912 and 1923 and modernized, in varying degrees, between the 1920s and 1944.

maneuverable, are not unwieldy or unhandy, and easily keep pace with carriers and smaller ships. The only time they seem uncomfortably large is when they are being handled in certain restricted harbors and inland waterways normally used by the U.S. Navy. There are several such ports which are too restricted and many which are too shallow to permit entry of these ships. ...serious thought should be given to designing a ship with a greater beam and less draft. This could be done with no loss and a possible increase in speed. It would permit even better stability and better underwater protection. The additional lateral space topside could be well used for fire control, gun and electronic installations.

b. Seaworthiness

- (1) The seaworthiness of the IOWA class is excellent. The ships are steady gun platforms and they have good stability in all conditions of loading and weather. They have a good freeboard but are wetter, from Turret II* aft, than seems proper for ships of their size. This wetness seems due to the sudden and extreme widening of the hull lines just forward of Turret I. It is understood that the narrow forecastle, distinctive to this class, was adopted to save overall weight and as a means of avoiding the necessity for providing support for the weight of a heavier bow structure forward of the armored box.**
- (2) In future design an attempt should be made to broaden the bow lines above the waterline to provide a drier and more roomy ship, and one with more reserve buoyancy forward. The wetness of the present ships has been of no concern in the normally smooth South or Central Pacific, but would be a decidedly undesirable feature if they were to be employed in other waters, such as the North Atlantic.

c. Damage Control

- (1) Subdivision, underwater protection and general damage control features, as they exist in the ships today, are considered to be at the modern optimum. No IOWA was materially damaged during the war. However, it should be noted that certain of their predecessors, with the same basic underwater protection, took torpedo (or mine) damage below the waterline and still made near full speed with no apparent difficulty.***
 - (2) Gas protection, in the view of war experience, is still of secondary importance and, in this respect, the IOWAs appear to be satisfactorily designed and equipped.
- (3) Mine (degaussing) and fire-protection features are satisfactory.

*Turrets are identified as I, II, and III (or 1, 2, 3) from forward aft.
**IOWA's high length/beam ratio, with fine bow and stern lines and a slight increase in draft, were combined with a large increase in power (212,000 SHP in IOWA, 130,000 in SOUTH DAKOTA) for a designed speed of 33 knots. The fine bow, flaring into a full midsection, made them wet.
***The only American fast battleship to suffer such underwater damage was NORTH CAROLINA, torpedoed by a Japanese submarine off the Solomons in 1942; see Part IV.

3. Armament (Main Battery)

a. Turrets

- (1) There is widespread contention that battleship main batteries, in their present strength, are no longer needed, and advocacy of the removal of one, two, or all turrets, utilizing the weight gained for...additional aircraft detection devices and antiaircraft guns. It may be that the time has come to make further concessions in loss of offensive power as a compromise to gain more antiaircraft...power, but the Board considers any such compromise, at this time, would be unsound or, at the best, definitely premature.
- (2) The Board does recommend...that studies be made to determine whether an IOWA...with two three-gun turrets, or two four-gun turrets, and postwar fire control equipment, could successfully engage foreign battleships and, if so, that thought be given to developing a two-turret ship utilizing the space and weight gained for a better antiaircraft installation.

b. Main Battery Guns

- (1) The IOWA class main battery guns have the longest range of any ship-mounted gun in the world and have been effectively controlled to the extreme limit of their range. They are the most destructive, accurate weapon that is fully developed today. Until such time as the rifled gun may be proven archaic by development of plane-carried, jet-propelled or controlled missiles, these guns can be considered as a satisfactory prototype for any guns to be installed in future heavy ships, with the reservation that effort should be made to develop a much faster method of loading.*

c. Fire Control

- (1) The fire control system of the main battery is, as a whole, satisfactory. There is need for a better means of control when firing at offset targets during shore bombardment and a means by which changes of course and bearing rate of a maneuvering target can be detected and determined more quickly.
- (2) Modern fire control radars now have such accuracy in range that they have made the optical rangefinder a secondary means of range determination. Until such time as radars are produced which can equal the performance of the optical rangefinder in other highly essential respects, i.e., recognition, ruggedness, freedom from interference (jamming), prompt detection of target maneuvers, deflection spotting, etc., the optical rangefinder cannot be replaced completely by radar. However, it is considered that radars should now be substituted for the optical rangefinders in all turrets. The optical rangefinders in the two main-battery directors, which are large enough and high enough to give good ranging and spotting performance at long ranges, provide sufficient instruments of this type.**

*Six- and eight-inch rapid-firing case guns were introduced, after WW II, in WORCESTER- and DES MOINES-class cruisers.

**46' stereoscopic rangefinders have been retained in Turrets II & III.

- (3) Continued consideration should be given to making each turret a complete system in itself. This conclusion has been approached by the inclusion of auxiliary computers in turrets. A better system would include a turret radar, for accurate night as well as day firing, a stable element and a source of local power.

d. Ammunition Handling Facilities

- (1) The method of handling shell on the turret shell decks (sliding them on their bases by parbuckling) is, probably, the best that can be devised if one accepts the principle that shells must be stowed and handled on their bases. The Board is inclined, however, to doubt the soundness of this premise. The present system, excellently developed though it is, would be too slow if a method were developed to enable more rapid loading of the gun itself. There is need for a more efficient and faster method of handling shell and one which insures safe and positive control of the heavy weights regardless of the attitude of the ship.
- (2) The arrangements for striking below replacement ammunition, in particular, projectiles, is highly inefficient and entirely unsatisfactory. The war reemphasized the necessity for a ship to be able to reammunition expeditiously and, in addition, saw the advent of...reammunitioning while at sea. The present method of whipping shells down through the several hatches of a long trunk, transferring them to trolleys to be manhandled around and under the lower edge of the bar-bette, and then hoisting them, with a series of chain falls, to the shell decks is inefficient, slow and dangerous.
- (3) A better method of handling replacement ammunition is needed. Consideration should be given to the possibility of taking this ammunition into the turret through the rear plate and then sending it below with the regular hoists. [This] method works with complete satisfaction in the 5" batteries. Its adaptation to the main battery appears logical, desirable and feasible.

4. Armament (Antiaircraft Batteries)

a. General

- (1) The postwar battleship should have the largest number of antiaircraft guns compatible with weight, space and control considerations and these guns must be located and grouped to form an integrated composite antiaircraft battery providing fire of equal strength on all bearings.
- (2) The antiaircraft batteries of the IOWAs, frozen in basic design before, and added to in piecemeal fashion during, the war, are not such an installation.
- (3) By World War II standards, the ships did not lack for volume of antiaircraft fire, but they did lack proper distribution of...fire as, for example, their inability to develop heavy fire in the arcs dead ahead and dead astern, particularly at close ranges.
- (4) The fire control systems of all the antiaircraft batteries are obsolete or obsolescent, and should be redesigned....

b. Heavy Antiaircraft Battery*

(1) The postwar battleship must be able to employ this battery ahead and astern in greater volume than is possible with the present installation. This can be done by installing centerline mounts** or by altering the present form of superstructure to permit the mounts, as now installed, to fire through a considerably larger arc across the axis of the ship. Both methods have their advantages and disadvantages. The Board favors the centerline mounts, but decision as to which method to adopt should be developed by a study of the entire topside arrangement.

(CINCPACFLT Comment: The ideal arrangement of antiaircraft mounts is something which approaches a circle, rather than the unfortunate arrangement now existing on all of our [fast] BB's and modernized OBB's [older battleships] where the 5" mounts are in two parallel lines on either side of the ship.)

c. Machine Gun Batteries

(1) The present location of the majority of medium and light antiaircraft guns (40MM and 20MM) is unsatisfactory. The original design made provision for but four 1.1" mounts*** and a few caliber .50 machine guns. The ships now have twenty 40mm quads [quadruple mounts] and about fifty 20mm guns, all superimposed on the basic design and many, as an expediency, installed in disadvantageous positions. Some interfere seriously with the arcs of fire of the main-battery guns; many are untenable in any but the best sea conditions; some are untenable due to interference from the blast of other guns, many have extremely limited arcs of fire, and several are in such a position that they seriously restrict the arc of vision from command, ship control, and fire control stations. The present guns, or their successors, should be removed from the main deck and placed as high in the ship as is practicable.

d. Aircraft

(1) The subject of whether planes should...be retained in battleships is one which has given rise to extensive controversy. The pros and cons are multitudinous; ...no point will be served by restating them.

(2) The Board is of the opinion that planes should be retained in battleships for the time being, and that each ship have two or, at the most, three planes. They should not be given...belowdecks hangar space...as...in some cruisers. Serious consideration should be given to installing a flush deck-type catapult.

*The 5-inch 38-caliber secondary battery.

**Centerline 5"/38 mounts were installed forward and aft of the superstructure in the war-built BALTIMORE, CLEVELAND, and ALASKA-class cruisers. also in the postwar DES MOINES class.

***Prewar 1.1" automatic gun, soon found unsatisfactory and replaced by the Bofors-designed 40mm gun.

5. Protection

a. Armor

(1) There has been little experience gained during the war to indicate whether...the...armor characteristics and...installation in the new battleships properly serve their purpose. It must be assumed that they do.

b. Armored Conning Towers

(1) There has been considerable discussion as to the need for heavily armored conning towers in cruisers and battleships. Early in the war there was a universal thought that conning towers should be removed.* As the war progressed, opinion gradually shifted toward a feeling that conning towers should be retained in battleships. This change of opinion may have been caused primarily by the experience of...SOUTH DAKOTA during her night action against enemy heavy ships. As this shift in opinion may be based, principally, upon this one incident, and in view of the almost-universal opinion that armored conning towers have no place in cruisers, it is believed that this...should be restudied with a view to removing, or at least decreasing, this extremely heavy weight from present and future battleships.

b. Signal Shelter

(1) The armored signal shelter is definitely an unnecessary weight. Throughout the war there has been a continual decrease in the use of visual signals for tactical purposes, and this trend will undoubtedly continue, thus making visual signals...an auxiliary means of communication. There is no justification for retaining a separate and tremendously heavy shelter for signal personnel.

c. Splinter and Blast Protection

(1) No postwar ship should have persons exposed on the topside, as do our present ships. Provision must be made for all personnel at battle stations to be protected from splinters, blast and flash. It is realized that this will necessitate added weight and complicated topside mechanisms, but the need is imperative. Modern bombs, including the atomic, even though they may do no material damage to the ship itself, will create blast, heat and flame which will incapacitate unprotected personnel.

6. Propulsion and Power

a. The basic design and...installation of the IOWA class main power plant is considered the present day optimum, and a satisfactory prototype for postwar ships.

b. Speed

(1) The IOWAs, now considerably heavier than originally designed, have a maximum speed, at full load displacement, of about 31 knots. In the postwar fleet, all ships which will operate within the screen of a carrier task force should be able to equal the speed of the carriers. As the postwar carriers will have a maximum speed of 33 knots, the postwar battleship should be capable of...at least 33 knots.

*The old battleships TENNESSEE, CALIFORNIA, and WEST VIRGINIA, totally modernized during WW II, had their conning towers replaced by lightly-protected command stations.

c. Endurance

- (1) The radius of the IOWAs, about 4,900 miles at a maximum sustained speed of 30 knots and about 18,000 miles at the economical speed of 12 to 15 knots, is considered satisfactory.

7. Electronics

a. General

- (1) Spaces for electronic equipment, like those for other equipment developed during the war, have been built into the IOWA design as afterthoughts. ...many are located in unadvantageous positions and are not of the proper...dimensions. In any postwar development the basic design must make provisions for sufficient, and properly located, spaces for electronic equipment.

b. Combat Information Center

- (1) CIC, as now installed within the armored box, is considered to be located in the best position and is adequate as to space and equipment. The CIC and its use are yet very definitely in an experimental and transient stage. There are indications that some battleship CICs are being given too many functions. There is a possibility that further development will prove a need to decentralize some ...gunnery and ship-control functions. ...design will be affected to the extent that it is impracticable to say, now, that the present CIC installation will be satisfactory in future ships.

c. Bridge Radios

- (1) The volume of noise caused by the several voice radio outlets at the ship control stations has increased beyond the point of acceptability. Some means, such as a Bridge Voice Radio Center, should be provided for the purpose of making the voice transmissions immediately available to the ship control personnel without the present high noise level.

8. Miscellaneous

a. Shops

- (1) The shops in the IOWA class...are adequate in number, space and equipment except...the 40mm and 20mm shops are inadequate. Their usefulness is further decreased by being used as crew's berthing spaces.

b. Boats

- (1) During the war battleships were unable, when at anchor in an advanced base, to conduct essential business because of a lack of boats. The ships should be provided with boats in sufficient number and of the proper type to make them independent of outside help for the transportation of persons on business and the handling of stores.

- (2) No decrease should be made in the wartime allowance of guns to provide peacetime boat stowages.

(CINCPACFLT COMMENT: It is basically unsound to sacrifice important wartime armament for considerations of peacetime comfort and convenience. It is doubted whether it is structurally practicable to install anything approaching an adequate number of boats on ships which were not designed to take them. This category includes all our modern ships. ... the answer must be found in boat pools, LSD's to convey landing craft, or attendant patrol-type craft.)

c. Fueling

- (1) Destroyers report that the IOWA class are difficult to fuel from because of bow wave peculiar to the class. Consideration should be given to relocating the fueling station to a better position.

d. Quarters

- (1) Berthing facilities for the crew are, as a whole, of a satisfactory type but inadequate in number. The original design made provision for...about 2200 men. The complements of the ships, as Flags, at the end of the war were about 2500 men and they invariably had additional men aboard. Resort to hammocks in the messing spaces, bunks in offices and in workshops, etc., was necessary. Future ships must have additional enlisted berthing....
- (2) Consideration should be given to...better dispersal of chief petty officer spaces to preclude the possibility of a large number of these key personnel being incapacitated by a single hit. The chief petty officer quarters are located at the stern, and are most uncomfortable at higher speeds due to vibration and propeller noises. They were so hot in the tropics that resort to air conditioning* was necessary to make them livable. ...these leading men should be provided with quarters in a more comfortable part of the ship.
- (3) Officer quarters are not entirely satisfactory.... The contemplated complement of officers was about 100. The authorized complement during the war varied between 130 and 150, but there were few times that the ships, with Flags embarked, had less than 180 officers aboard. The additional officers were accommodated by installing extra bunks in practically all rooms. These rooms, as doubled up, are not satisfactory.
- (4) ...no more space should be diverted to officer accommodations, but...all heavy ships should have part of the present allotted areas equipped as bunkrooms designed to berth large numbers of officers. These would provide space for accommodating the additional officers ordered to the ship during war and the...officers...frequently aboard for short periods during peacetime.

e. Command and Ship Control Stations

- (1) The design of the command and ship control stations is one of the most unsatisfactory features of design in the IOWA class ships.
- (2) The basic design intended that all conning, for cruising as well as action, should be done from the armored conning tower and a supplemental open "catwalk" around the outside of the conning tower. It was found impossible to keep a proper watch from the conning tower. Cruising in northern waters proved that the catwalk was not an acceptable watch station.**

*Still relatively rare in 1945.

**American warships of the early 1900s had open bridges. After duty in the Atlantic and North Sea during WW I, these were quickly enclosed.

- (3) The ships are now equipped with a closed pilot house built around the conning tower, and a closed flag bridge. These bridges are far from satisfactory, because...:
- (a) They provide no vision aft, or of the quarters of the ship. This condition is so bad that some captains make it a practice to shift to, and conn from, the upper conning station* when handling the ship in restricted waters, recovering planes, going alongside, etc.
 - (b) They provide no convenient and satisfactory open conning station.
 - (c) The pilot house is too congested.
 - (d) The structure is subject to damage from own gun blast.
 - (e) The view from the conning tower slits is restricted.
 - (f) If distorted by damage, the structure may completely obstruct vision from the flag and ship control stations in the conning tower.**
- (4) At the time the first ship of the class was nearing completion, great emphasis was...given to providing the captain with an open bridge, near the then-Radar Plot, from which he could conn during air attacks. At that time, because of limitations on the length of waveguides, it was necessary to locate Radar Plot near the search antenna or, in the case of these ships, near the top of the foremast structure. Consequently, to obtain an open bridge near Radar Plot, the "Primary Conning Station" was installed as a small platform on the forward side of the foremast, four levels above the navigating bridge level and, thus, four levels removed from the chart house, armored conning tower, sea cabins, etc., and five levels removed from the flag bridge.
- (5) Whether to locate CIC on the bridge level or below decks was then still a moot point. As an expedient, to enable completing the ship on time, CIC was installed on the navigating bridge level and the executive officer stationed there at general quarters.
- (6) All of the ships of the class now have their CICs below decks in the armored box. As CIC is below armored hatches, the executive officer's battle station has been changed to the upper conning station on the foremast (Battle Two). The result is that both the captain and his second in command are in the same part of the ship during action, and both may be incapacitated by the same hit.
- (7) The foremast arrangement and the entire bridge structure, forward of the foremast and from the first superstructure deck up, should be entirely redesigned, taking into consideration the present undesirable features of the bridges, the location and thickness of armor in that area, and possible added antiaircraft guns on the centerline forward.
- (8) The postwar ship should have a topside secondary conning station located at some distance from the captain's battle station.

*Elevated position in the tower foremast.

**This was one reason for drastic reduction in battleship and cruiser tophamper before World War I.

D. Summary of Conclusions and Recommendations concerning Battleships

1. The battleship is an essential type for the postwar fleet.
2. The IOWA design should be used as the basic design for postwar development.
3. Future ships should be no larger. (CINCPACFLT COMMENT: This is questionable.)
4. The main battery should not be decreased. (CINCPACFLT COMMENT: This is subject to possible development of better weapons than the big guns.)
5. A means of faster loading of the main battery guns is needed.
6. The main battery fire control system needs but minor modifications.
7. Radars should be substituted for optical rangefinders in turrets.
8. There is need for a better method of handling projectiles within the turrets.
9. The present method of striking below main battery ammunition is unsatisfactory.
10. The antiaircraft fire control systems are obsolete or obsolescent and should be redesigned.
11. Antiaircraft guns and directors should be rearranged and regrouped to form an integrated composite battery providing fire of equal strength on all bearings.
12. Aircraft should be retained in battleships for the time being.
13. Flush deck-type catapults should be installed.
14. Splinter-proof command, conning and fire control stations should replace the heavily armored conning tower.
15. Armored signal shelters should not be provided.
16. All personnel at battle stations must be provided with protection from splinters, blast and flash.
17. Postwar battleships should be capable of making at least 33 knots.
18. Basic design must provide sufficient and properly located spaces for electronic equipment.
19. The Combat Information Center should be located within the armored box.
20. Bridge Voice Radio Centers are necessary.
21. No decrease should be made in the wartime allowance of guns to provide peacetime boat stowages.
22. A secondary conning station, removed from the captain's battle station, should be provided.
23. The foremast arrangement and entire bridge structure should be completely redesigned.
24. A study of battleship bridges should be made concurrently with the present study of cruiser bridges.

II. FAST BATTLESHIP OPERATIONS IN KOREA, 1950-53

Nine of the U.S. Navy's 10 fast battleships were inactivated in the general force reduction which followed World War II. MISSOURI was the only American battleship still active when the Korean conflict broke out in June 1950. MISSOURI arrived in Korean waters in September 1950 for duty as a gunfire support ship; her three sister ships were recommissioned during 1950-51. All four ships of the IOWA class deployed to the Far East and operated in the Korean combat zone at least once before the war ended in 1953:

MISSOURI	Sep 50-Mar 51	IOWA	Apr 52-Oct 52
NEW JERSEY	May 51-Nov 51	MISSOURI	Oct 52-Apr 53
WISCONSIN	Nov 51-Apr 52	NEW JERSEY	Apr 53-Jul 53

NAVAL GUNFIRE

EXTRACTS FROM CINCPACFLT INTERIM EVALUATION REPORTS, KOREAN WAR

In reviewing the Korean War several exceptional conditions must be recognized: lack of naval or significant air opposition, unrestricted communications, unmolested logistic support, a nearby secure base, and oriental disregard for human life. But these conditions may not be peculiar to Korea; some or all may well be repeated in similar types of fringe warfare in the Far East or elsewhere. Important phases of major wars may contain some of these conditions. Thus the lessons of Korea cannot be disregarded with the thought that Korea is not typical; no war is typical.

a. Shore bombardment

Ships engaged in shore bombardment operations had as their tasks primarily the following:

- (1) Gunfire support of the ground forces on the flanks of the battle line. Much of this support was in the form of illumination and night unobserved harassing missions.
- (2) Interdiction of the enemy's coastal rail and road net in coordination with the air interdiction effort. In addition to making primary cuts and destruction of rolling stock as practicable, considerable effort was directed towards the maintenance of bridge breaks originally made by naval air. Naval gunfire proved very effective in discouraging the repair of those bridges that were within range.
- (3) Destruction of enemy anti-invasion defenses.

- (4) Siege and/or harassment of such places as Wonsan, Hungnam, Songjin, Chongjin, and the Yalu, Chinnanpo, Haeju and Han River areas.
- (5) Gunfire support of minesweepers.
- (6) Participation in amphibious demonstrations.
- (7) Gunfire support of Commando and Guerrilla raids.
- (8) Flak suppression in support of air strikes.

As the Korean War progressed and the ground situation stabilized the inadequate means for gunfire evaluation and the paucity of target intelligence led to skepticism on the part of many naval commanders regarding the effectiveness of naval gunfire. On the other hand, UN ground forces repeatedly expressed appreciation of NGFS, and, in the Spring of 1953, made strong representations for an increase in heavy caliber naval gunfire support. Battleship sixteen-inch fire was particularly desired because of its extreme accuracy and highly destructive capabilities against the deeply entrenched targets.

In early February 1953, Naval Gunfire Support matters were discussed in an informal conference between the Naval Liaison Officer, EUSAK, Artillery Officers Eighth Army and X Corps, and Senior Advisor 1 ROK Corps, in respect to certain questions raised by the Pacific Fleet Evaluation Group. The gist of comments made by Army representatives follow:

- b. NGFS is very essential as it can give the troops two things which are beyond artillery capabilities: (1) Ships by moving north of the bomblines can shoot back along a direction paralleling the front lines and can reach targets on the reverse slopes of ridges that the artillery, although it has sufficient range to do so, is unable to reach, (2) Ships can fire on targets beyond artillery reach.
- c. Ground troops are well satisfied with NGFS accomplishments as regard accuracy and effectiveness but they would like more of it. For example, the X US Corps during the month of January 1953, received only 4 missions, and none during the first 20 days of February. The effectiveness of 16" guns is much greater than the smaller caliber 5" and 8" guns.



**U.S. NAVAL FORCES, FAR EAST: AMMUNITION EXPENDED, KOREAN WAR
(June 1950-July 1953)**

Caliber	Rounds
16"/50 HC	20,424
8"/55	80,961
6"/47	34,375
5"/38	871,406
3"/50	97,585

EXTRACTS FROM BATTLESHIPS' ACTION REPORTS

MISSOURI Action Report for Period 150001I to 171950I Sep 1950:

Warehouses and docks severely damaged. Many buildings destroyed. Fires started. Considerably more damage suspected but report of estimate not received. 288 rounds of high capacity (16") were fired at troop concentrations and stores in support of an advance of the 23rd Infantry. While a comprehensive summary of damage was not received, shore fire control observers were enthusiastic over the results of close support firing and stated that the bombardment effectively dispersed enemy resistance and allowed our forces to cross the river 'standing up'.

WISCONSIN Action Report 23-30 Jan 52:

When TF 77 air spot planes assigned primarily for NGF spot arrive on station they are generally strike-loaded. As a matter of course it is desirable to unload their air ordnance at the earliest time thereafter in order to lighten their load thus increasing the duration of their stay, and to commence spotting at the earliest practicable time. In all instances gun fire must cease during the period in which air ordnance is being unloaded or actual strikes made in order to eliminate the possibility of planes being hit by friendly fire. Some times the planes arrive without prior briefing or target assignments, thus requiring considerable additional time after arrival before they are ready to unload their ordnance or to spot. Delays in unloading air ordnance under such circumstances have, on occasion, been as great as 45 minutes. With two groups of spot planes during a four-hour gun strike as much as 1 to 1 1/2 hours may thus be required before spot planes are available for spotting. Consequently as little as 2 1/2 to 3 hours may be available for actual shooting. However, when spot planes have previously been briefed and assigned primary targets before departure from carrier they are generally able to unload air ordnance immediately upon completion of neutralization fire for flak suppression and to be ready for spotting within about 15 minutes, thus permitting the early resumption of NGF and its longer duration.

Whenever practicable for gun strikes, as well as for coordinated air-gun strikes, pre-strike and post-strike photo reconnaissance should be conducted for proper damage assessment. Air spot planes should not be directed nor permitted to go down over targets in or near flak areas in order to inspect the targets for damage as gun fire is thus interrupted and the planes themselves are unnecessarily exposed to the risk of being shot down. Furthermore experience to date indicates that a VF spot plane pilot is sufficiently occupied while flying, including avoiding flak areas, and spotting, that damage assessment becomes an additional inordinate task. However the primary difficulty in pilot damage assessment of NGF is the inability from the air at the required safe altitude to see and delineate target details sufficiently for this purpose. General target damage assessment by pilots may be practicable under such circumstances but accurate specific damage assessment is not considered possible.

A TBM or similar type plane which could carry an additional officer as spotter equipped with suitable spotting binoculars would undoubtedly be desirable as a means of improving this limitation. The use of binoculars by present VF spot pilots might be helpful if practicable during air spotting.

IOWA Action Report 7-16 Apr 1952:

Communications through regularly established channels were satisfactory, and presented no new problems. However, shore fire control communications, particularly with naval gunfire spotters places the naval vessel at a tactical disadvantage in many cases when the shore spotters are equipped to operate on radio frequencies which preclude use of currently installed standard equipment. Ships performing bombardment missions are able, through use of portable equipment, to communicate satisfactorily, but unnecessary delay and inconvenience of operations result from the fact that such portable equipments do not operate directly from key points in the internal gunnery organization, such as Main Battery Plot.

IOWA Action Report 19-30 Apr 1952:

The performance of Ordnance Material was satisfactory except that during the TOEJO-SINPO gunstrike the center powder car of Turret II dumped three bags of powder while hoisting and then jammed at the top of the hoist. This casualty was caused by the failure of the lower powder hoist operator to properly secure the powder tray dumping handle. The center gun of Turret II was out of action for the remainder of the gunstrike and until the hoist could be cleared. This casualty has been reported by IOWA's Confidential letter serial 065 of 12 May 1952, direct to the Chief of the Bureau of Ordnance.

Commencing 28 April, it was necessary to use the main battery only for emergency or exceptionally worthwhile targets, as ammunition on hand was below 50% of allowance. For this same reason it was necessary to cancel a strike planned for KOJO on 29 April.

Many of the main battery fire missions were conducted at ranges of 16 or 17 miles. An initial spot of 200 yards or less was frequently received. This is considered excellent shooting.

TE 77.15 Action Report 27 May 1952 (Songjin - Chaho):

IOWA arrived at SONGJIN the afternoon of 26 May for a special SAR mission and conducted a DERAILED strike 27 May. The 16" shells again proved extremely destructive. 98 rounds of 16" were fired at eight MSR targets which included five bridges and four tunnel entrances. All of the bridges were demolished and all tunnel entrances were left sealed by slides. In addition, track was torn up, undermined and covered with slides in the vicinity of the tunnels and bridges. Strike results -OUTSTANDING.

The most effective damage caused by surface ship gunfire if judged by time necessary to clear rails - are large slides covering the tracks. 16" gunfire has caused such slides, and to a lesser extent cruiser main battery fire also. Such slides could not be caused while the ground was frozen during the Winter.

Bridges, when damaged, are the most difficult to repair, sometimes requiring as long as 3 days.

Some rail traffic is getting through the CHAHO area. In that area, PACKAGE FOUR is the most vulnerable target and the most difficult to repair. No bypass seems possible to construct. It has frequently been cut and interdicted.

Interdiction fire has been very effective in stopping rail repair work. Repair crews will not work when ships are interdicting the area. (From POW report).

Large coordinated air-gun strikes, such as those on CHONGJIN, are extremely effective.

Enemy air activity may hereafter be experienced in the CHONGJIN area. It is possible that the planes picked up by IOWA's radar were snooper planes from bases across the Korean border.

The 16" guns of the battleship are the most effective single weapon at the disposal of CTG 77.1.

Seasonal haze and fog (which can be expected at this time of the year) adversely effect the overall Naval Gunfire Support Program, and conversely, favor enemy efforts to move supplies over his coastal MSR routes to his front lines.

IOWA Action Report 26 Jun-11 Jul 1952:

The second mission was only satisfactory; although the area was well covered, considerable difficulty was experienced in having the applied spots take the proper effect. It is thought that this was due to the terrain in the vicinity of the target. The spotting for these missions was done by air spotters from HMS OCEAN. This was the first time the IOWA had worked with British aircraft. It is considered the spotting was excellent and the coordination and teamwork between the spotters and the ship were outstanding.

IOWA Action Report 3-12 Oct 1952:

Bomblines, 4-7 October. Targets for main battery were numerous and particularly lucrative. Results of fire were most rewarding. While secondary battery fire, by nature of targets in the bomblines area, was not so rewarding, the firing may be considered worthwhile. IOWA fired her second illuminating mission this tour on bomblines. Evaluation: EXCELLENT.

IOWA Action Report (Kojo Demonstration):

Pre-invasion and neutralization bombardment, 15 October 1952 (D-Day): A low overcast, low haze overland, and more than moderate winds, delaying H-Hour by four hours, hampered pre-invasion bombardment during the morning. However, clearer weather and improved visibility gave satisfactory conditions for the area saturation immediately preceding and following H-Hour. During this period a high rate of fire was maintained by both main and secondary batteries. Scheduled fire in areas 50 and 51 was canceled when cease fire was ordered from H-5 (0459Z) to H plus 5 (0509Z). In view of the fact that many targets were available along the shoreline so that overland trajectories would not be required, and the fact that over-water trajectories would be sufficiently low as not to interfere with attacking aircraft, it is recommended that the fire support group commander be given discretion as to use of restricted fire plans, or Plan WILLIAM or VICTOR be used instead of cease fire. The target list for the operation was considered too unwieldy. It is recommended that separate lists be compiled for air and naval gunfire targets, and that targets be further separated by sectors.

NEW JERSEY Action Report 24 Apr 1953:

<u>TARGET</u>	<u>Gunstrike - 24 Apr 53</u>	<u>DAMAGE</u>
Derail A, Southern RR Entrance, EV106859	6 rds., 16", HC Reduced velocity	Medium slide. Tunnel 35% blocked.
Derail F, RR Bridge, EA168002	18 rds., 16", HC Reduced velocity	Bridge destroyed.
Ammo Storage Area, EV153994	20 rds., 16", HC Reduced velocity	2 buildings damaged. 35% coverage. No secondary explosion.
Derail E., RR Bridge, EV161994	26 rds., 16", HC Reduced velocity	Destroyed 30 yards track. No hits on bridge.
Derail D, RR Bridge, EV154973	7 rds., 16", HC Reduced velocity	4 hits. Bridge damaged in 2 places and non-operational.
RR Embankment Bridge EV136923	10 rds., 16", HC Reduced velocity	Undermined tracks in 2 places. Bridge non-operational.
Derail B, RR Tracks and Tunnel, EV134904	19 rds., 16", HC Reduced velocity	Tunnel facing blown off. Tunnel 80% closed. Large slide over tracks. 2 hits on tracks.
RR Tunnel, EV088828	5 rds., 16", HC Reduced velocity	Tunnel 75% closed. Large slide over tracks.
RR Tunnel and slide area, EV087825	6 rds., 16", HC Reduced velocity	Medium slide over tracks.
RR Bridge, EV004803	23 rds., 16", HC Reduced velocity	No damage.
RR Tunnel, DV860682	8 rds., 16", HC Reduced velocity	Large slide over tracks.

RR Bridge, EV157980	12 rds., 5", AAC Service charges	2 hits. Bridge non- operational.
Derail C, RR Bridge, EV141935	9 rds., 5", AAC Service charges	3 hits. Bridge non- operational.
27 Supply buildings, EV131909	33 rds., 5", AAC, 1 rd. 5", WP Service charges	4 buildings destroyed 2 Secondary explo- sions.

NEW JERSEY msg 151300Z Jun:

Summary 15 June 1953. The Battleship NEW JERSEY today joined in one of the heaviest bombardments the enemy front lines have taken in recent months raining destruction on enemy strong points, gun and mortar positions. 44 bunkers were destroyed, 20 heavily damaged, 2 caves were closed and 610 yards of trench lines were torn up by the mighty guns of the 'BIG JAY'. 13 guns positions were destroyed with 13 more receiving heavy punishment. 4 mortar positions were destroyed and 3 were heavily damaged. 6 main supply roads were cut and 7 large and 7 other secondary explosions were noted.

[The reports and studies which follow discuss the use of the fast battleship as a bombardment and gunfire support ship.]

Headquarters, 1st Marines
1st Marine Division, Fleet Marine Force

12 Oct 1951

From: Naval Gunfire Liaison Officer, 1st Marines
To: Commanding Officer, 1st Marines

Subj: Naval Gunfire...in direct support of 1st Marines

1. On 23 September 1951, communication was established with USS NEW JERSEY, BB 62, at 1400. After the ship had maneuvered into position a direct support mission was commenced at 1445. Since this was a new or experimental duty for both ship and spotter, the results of the 1st day were not too satisfactory. Firing from a range of approximately eighteen (18) miles - all four (4) salvos were unobserved. Mission was secured due to bad visibility and lateness of the hour at 1533.

2. 24 September 1951 - contact was established with Fire Support Ship and the mission was fired commencing at approximately 1200. Twenty-seven (27) rounds of 16" - HC were fired with good effect on Hills 1190 and 951, resulting with many bunkers destroyed, others revealed and many casualties inflicted on the enemy.

3. 25 September 1951 - ship came up on net in communication with spotter and commenced mission at about 1200. The TA was Hill 951 - which was covered with bunkers and enemy personnel. Fired twenty-five (25) rounds with good neutralizing effect.

4. Ship notified spotter at 1500 it would no longer be available due to the fact it was to proceed to new firing area to fire for air spotter. Said mission never materialized.

5. Fire Support Ship retired for general resupply and was available again on 2 October 1951. Contact was made at approximately 0800 on above date and fire mission commenced. On this date four (4) missions were fired - expending one hundred thirty-six (136) rounds on Hills 802 and 951. Air observers and enemy POWs reported twenty-five (25) counted enemy bunkers destroyed, forty-five (45) estimated destroyed, two hundred (200) KIA - four hundred (400) WIA.

6. 3 October 1951 - ship again available, fired with good effect - eighty-one (81) rounds being expended on Hills 796 and 802. Damage assessment; twenty-two (22) bunkers destroyed by count, forty (40) estimated destroyed, one hundred fifty (150) enemy KIA, two hundred (200) enemy WIA.

8. In the opinion of the writer, Naval Gunfire can be of inestimable value to all our operations where the tactical position permits, and it is highly recommended that it be given the consideration due it.

Headquarters
1st Marine Division (Reinf[orced]) FMF

A9
Ser: 00160-52
1 Mar 52

From: Commanding General
To: Commandant of the Marine Corps
Via: Commanding General, Fleet Marine Force, Pacific
Subj: Submission of Type "C" Special Report of Naval Gunfire support of 1st Marine Division in Korea for the period 23 September - 31 December 1951

As soon as naval gunfire support became available on a fairly regular basis, the Division G-2 directed the prisoner of war interrogation team to question incoming POWs on the effectiveness of our naval gunfire bombardment. A record of the results of this interrogation has been reviewed, and indicates that naval gunfire has been effective. As examples of POW reports, the following excerpts and notes from the Interrogation reports are given below.

"PW heard from Co[mpany] clerk that o/a [on or about] 22 Jan 52 the 45th Div CP was hit by Naval Gunfire which caused considerable damage. It is estimated that approx[imately] half personnel of the 45th Div CP were casualties." (Note: On 25 Jan, 52 USS Wisconsin fired 100 rds 16" HC at area in question. Air Spot and API reported 20 caves closed, 10 KIA counted, est[imated] 35 other cas[ualties] from one round that hit a group of personnel).

All PW reports were not this indicative of the effectiveness of the naval support, but they generally indicated that the enemy had a healthy respect for the major caliber firing. On one occasion a PW stated that he had been told by his battalion political officer that the UN was firing "atomic artillery shells" because of the size of the craters that the 16 inch shells made. All of these POW reports have been checked with the record of firing, and it has been determined that it was naval gunfire that had been fired. As an indication of the adverse morale effect caused by major caliber bombardment, was the statement of another POW, who said that he was induced to surrender after his unit had suffered "heavy casualties" in one bombardment and, when one shell landed near his position and failed to go off, the size of the dud, a 16-inch HC shell, convinced him that it was time to surrender.

Headquarters
1st Marine Division (Reinf) FMF

Sér: 0026952
7 Apr 1952

From: Commanding General
To: Commander 7th Fleet

Subj: Evaluation of Effectiveness of Naval Gun Fire Support
at East Coast Bomblines

Ref: (a) Your dis 210634Z of Mar 1952

1. In response to request contained in the reference, the following information is submitted.

2. During the period 1 January 1952 to 18 March 1952, this division faced an enemy deeply entrenched in heavily constructed fortifications on steep reverse slopes. The superiority of our artillery had forced the enemy to construct these fortifications in positions so located that they could not be attacked effectively by artillery. Although these positions were vulnerable to accurate low level air attack, the use of Close Air Support aircraft was so restricted by higher headquarters, that the results of such aircraft was of very limited consequence. Naval Gunfire Support ships, with their mobility and range were able to attack and destroy these fortifications from an unexpected direction, and with results proportionately more significant than would have been expected in less rugged terrain or against a less well dug-in enemy.

3. During the period covered by this report, this Division received naval gunfire support from battleships and cruisers. A record was kept of all missions to help determine the effectiveness of main battery fire at or near extreme range. A statistical summary of the results obtained during the period is shown below:

<u>Cal.</u>	<u>Number of Missions</u>	<u>Number of Rounds Fired</u>	<u>Av. Number Rounds per Mission</u>	<u>Av. Range</u>
16"	43	977	23	32500
8"	103	1661	16	22000
6"	32	470	15	

b. Spotters reported these results:

Personnel casualties	16"	700 KIA --	359 WIA
	8"	239 KIA --	47 WIA
	6"	163 KIA --	47 WIA
Artillery Pieces	16"	3 destroyed	7 damaged
	8"	2 destroyed	3 damaged
	6"	1 destroyed	8 damaged
Bunkers and personnel	16"	81 destroyed	105 damaged
Shelters (underground	8"	116 destroyed	127 damaged
heavily constructed,	6"	28 destroyed	20 damaged
generally 5-50 man capacity)			

4. The extremely mountainous terrain, variable wind conditions in the target areas, and the extreme ranges from the ships to the impact areas has in most part been the cause of the high average of rounds expended per mission by the 16" caliber weapons. It is to be further noted that the 16" projectiles were used in many cases against large expenditure of 50 to 60 rounds in fire for effect is not uncommon. The destructive and neutralization capabilities of the 16" projectiles have produced valuable results upon enemy installations and morale. It is felt that the expenditure of this ammunition is more than justified by the excellent results obtained on these targets, in view of the fact that in most cases the targets were located in positions that could only be attacked successfully by flanking and enfilade fire.

5. The 8" and 6" gun mission summary shows that the average number of rounds expended per mission was between 15 and 16. The results obtained using this ammunition were in most cases excellent.

CINCPACFLT INTERIM EVALUATION REPORT:

In an analysis of the utilization of the USS MISSOURI in gunfire support during February and March 1951 the following conclusions were reached based upon the total number of rounds fired, type of targets, ammunition cost, effectiveness and other factors.

- (1) Performance was excellent with observed fire.
- (2) Ammunition expenditure rate in support of troops was modest.
- (3) Ammunition expenditure rate in the transportation interdiction program was high (as compared to World War II figures).
- (4) 16" ammunition expenditures in the destruction of bridges is roughly comparable to the sorties per bridge required by carrier aircraft.
- (5) Use of 16" shells against personnel inside 30,000 yards is not efficient. Smaller shells are better employed for this purpose.
- (6) From a gunfire support view point the need for a 16" ship was questionable.

It must be realized that the above analysis does not take into account the following:

- (1) Anti-aircraft capabilities of the BB in defense of TF 77 if required.
- (2) Utilization as a fleet flagship.
- (3) Training Value.
- (4) Psychological effect on the enemy.

The complete research memorandum from which the above was extracted [**follows**]:

PACIFIC FLEET EVALUATION GROUP

RESEARCH MEMORANDUM

UTILIZATION OF THE USS MISSOURI IN GUNFIRE
SUPPORT DURING FEBRUARY AND MARCH, 1951

Reference: (a) PACFLTEVALGRU Research Memorandum, "Analysis of Gunfire Support in the Korean Police Action", Secret of 20 March 1951

SUMMARY

1. An analysis of the USS MISSOURI's activities during February and March 1951 indicated that in general the missions assigned to her were carried out effectively. Although ammunition expenditure rates were high according to WW II standard the ammunition is considered to have been used to good advantage. However, bombardment of small targets seems to be more economical in ammunition expenditure when helicopter spot was provided than when carried air spot was used.

2. While the MISSOURI's performance was of high standard, examination of these missions themselves led to the conclusion that by far the major share of them could have been carried out as well and probably more economically by other means. Recommendations are made relative to selection of targets for battleships in the Korean theater.

CONCLUSIONS AND RECOMMENDATIONS

1. The MISSOURI carried out effectively the gunfire support missions in which she was engaged during February and March, 1951. The amount of unobserved fire was negligible for 16" ammunition and while somewhat larger for 5" it appeared to have been used in an effective manner.

2. Spotting by helicopter proved to be significantly more economical in ammunition than spotting by carrier airplane.

3. Expenditure of ammunition during this period was considerably greater than was characteristic of World War II.

4. While the MISSOURI carried out her assignments well, the nature of these particular assignments was such that they could probably have been done as well and more cheaply by other means. Hence, if battleships are to be used in KOREA, the selection of targets requiring more use of the inherent capabilities of the capital ship appears desirable.

5. The amount of ammunition needed for registration of the 16" guns on small targets was a significant proportion of the ammunition expended. It is believed that spotting techniques

and methods of training should be investigated to see if improvements can be effected.

INTRODUCTION

1. The purpose of this memorandum is to analyse the gunfire support missions performed by the USS MISSOURI (BB-63) during February and March 1951. It is a continuation of reference (a) and as was the case with the prior study, it is based primarily upon the Gunfire Support Cards which were submitted by the ship to the Pacific Fleet Evaluation Group. The present analysis involved 113 of these completed forms corresponding to missions 223 to 335 of the MISSOURI.

2. The gunfire support actions of the MISSOURI in Korean waters during the months of February and March 1951 may be broken down into the four periods shown in table I below:

<u>PERIOD</u>	<u>DATES</u>	<u>LOCATION</u>	<u>MAJOR PURPOSE</u>
I	5, 6 Feb.	Kangnung (East Coast)	Support of ground troops
II	9, 10 Feb.	Inchon-Seoul Area	Support of ground troops
III	20,22,23, Feb. 14, 15,16,18 March	Korean East Coast	East Coast Transportation system
IV	19 March	Wonsan	Siege of Wonsan

3. In evaluating the MISSOURI's performance during the above periods, two questions present themselves:

a. How well did the MISSOURI carry out the gunfire support missions in which she was engaged?

b. Was the battleship the best choice for these missions or could they have been done as well (or better) by other means?

4. An answer to question "a" may be obtained by an examination of the MISSOURI's gunfire support cards and action reports. The second question involves considering what the missions were and to what extent the inherent capabilities of the battleship were actually required for their effective prosecution. Accordingly, the first part of this study will examine how effectively the missions were carried out and the second will consider the missions themselves to see if the

battleship was indeed the best military instrument for the purpose.

5. It is to be noted that this evaluation is concerned only with the gunfire support aspects of the MISSOURI during the period studied. The various other functions such as psychological affects upon the enemy, housing for fleet staff and training value will not be considered in this study. In addition the great potential AA capabilities of the ship have not been taken into account.

TARGET DISTRIBUTION AND OVERALL RESULTS

1. The 113 missions fired by the MISSOURI during the period under consideration are classified in Table II according to the target engaged. This classification essentially follows that used in reference (a). In addition the table lists for each target category the total number of 5" and 16" rounds fired at targets belonging to that category.

TABLE II

<u>TARGET CATEGORY</u>	<u>NUMBER OF MISSIONS</u>	<u>5" ROUNDS EXPENDED</u>	<u>16" ROUNDS EXPENDED</u>
Shore batteries	22	1985	20
Troops	19	61	218
Transportation	41	8	1167
Shore Install.	9	3	167
Military Install.	1	0	38
Naval targets	2	58	0
Illumination	5	31	-
Unspecified	14	250	0
Total	113	2396	1610

2. By far the most important use of the MISSOURI's 16" guns was against transportation targets, essentially against the transportation system of Northeast Korea. These missions were part of the interdiction campaign of that transportation system ordered by COMNAVFE in his dispatch (201440Z) of February, 1951 and implemented by CTG 95.9 Bombardment Plan 2-51. In addition to the surface elements engaged in this interdiction, Task Force 77 was also involved during the same periods.

3. Firing at shore batteries accounted for by far the most of the 5" firing by the MISSOURI. The major share of this counter-battery activity took place at Wonsan on known and suspected targets on Kalmaguk peninsula and at AA batteries firing on the ship's helicopter. Only two sea-going targets were engaged one of which consisted of a number of junks and the other turned out to be a false radar contact.

4. The MISSOURI's assessment of her mission success is presented in table III for the same Target classification as Table II.

TABLE III

<u>TARGET CATEGORY</u>	<u>NO. OF MISSIONS</u>	<u>% MISSIONS UNASSESSED</u>	<u>NO RESULTS</u>	<u>% ASSESSED LIMITED RESULTS</u>
Shore batteries	22	28	0	0
Troops	19	43	11	0
Transportation				
Bridges	20	0	5	25
Tunnels	4	0	50	25
RR yards, stock	6	0	0	0
Vehicles	2	100	-	-
Interdiction	5	100	-	-
Shore targets	9	0	11	0
Other	22	87	67	0

<u>TARGET CATEGORY</u>	<u>MISSIONS SATISFACTORY RESULTS</u>
Shore batteries	100
Troops	89
Transportation	
Bridges	70
Tunnels	25
RR yards, stock	100
Vehicles	-
Interdiction	-
Shore targets	89
Other	33

5. Table III indicates that in general the MISSOURI carried out satisfactorily the missions assigned to her. It is considered that her damage assessment figures are reasonably sound since the majority of them were based on observation by the spotting aircraft or by the helicopter or the shore fire control party.

6. The only significant limitations which table III reveals in the MISSOURI's performance are in the bridge and tunnel categories where the assessed results were 70% satisfactory for the former and 25% satisfactory for the latter. These two categories will be examined in detail in the next two sections.

ATTACKS ON BRIDGES

1. During the period under consideration, the MISSOURI fired at a total of 20 bridges considered critical parts of the northeast Korea transportation system. These bridges were mostly of reinforced concrete construction. Fourteen of the bridges were seriously damaged as a result of the MISSOURI's action. Of the six non-successful attacks, one was apparently caused by communication difficulties with the spotting aircraft, one because the spotter could not locate the target and three were apparently broken off for administrative reasons. The cause of the one remaining failure was not given.

2. The MISSOURI expended a total of 928-16" shells on these targets, an average of 66 rounds per successful attack. If the three cases when the bombardment was concluded because of administrative reasons and the one case where the spotter could not find the target are excluded, the rounds per bridge damaged becomes 61.

3. One of the bridges included in the preceding calculations was the bridge at Chaho which was not a true bridge but a concrete ledge which carried the railroad along the base of a cliff right at the beach. On this target, the MISSOURI found that HC shells made little impression. Satisfactory destruction was obtained only when the ship closed to a range of 10,000 yards and fired AP projectiles with full charges. The special nature of this bridge warrants leaving it out of the "true bridge" category. If this is done, the average rounds per successful bridge attack becomes 55.

4. In addition to being difficult targets to destroy the Korean bridges were difficult targets to hit in the first place. In all 180-16" rounds were fired prior to the first hitting salvoes which means that 20% of the ammunition expended against bridges was for spotting purposes alone. Figure 1 shows the percentage of bridge bombardments in which the first hit occurred by a given salvo as a function of the salvo number. It may be seen that in no less than 50% of the cases, the first hit did not occur until the 10th salvo or later.

5. For all the bridge attacks either the ship's helicopter or aircraft from Task Force 77 were used for spotting purposes. The helicopter proved to be the most efficient spotting instrument both from the view of the number of spotting salvoes required and the total number of rounds expended. With the helicopter, the first hit occurred on an average of the 8th salvo, while for the aircraft spot the average was the 14th salvo. Further, on successful missions, 26 rounds per bridge

were required with the helicopters, while 44 were required with aircraft spot.

6. It is difficult to state the significance of the apparently more efficient spotting performance of the helicopter without further data to investigate. However, it is possible that a good share of the difference may be accounted for by a need for training carrier pilots in gunfire support spotting.

ATTACKS ON TUNNELS

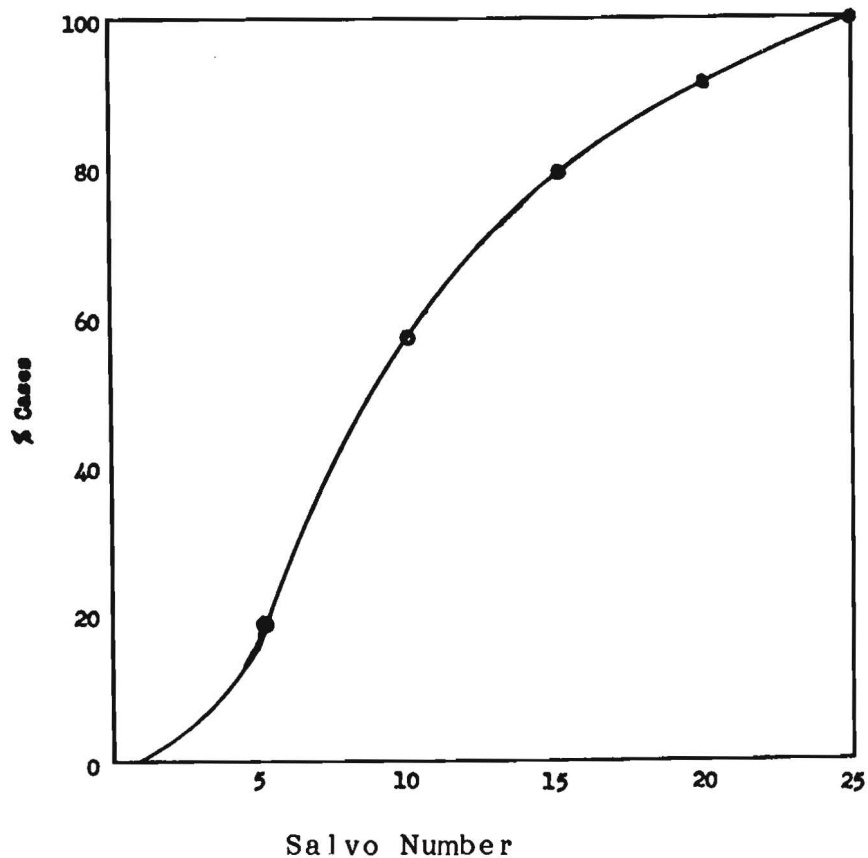
1. The MISSOURI fired at a total of 4 tunnels during the February and March period, expending on these missions 82 rounds of main battery ammunition. Two of these attacks were definitely unsuccessful, one doubtful, and one apparently successful. In the three unsuccessful attacks HC projectiles were fired and it was found that these projectiles did not produce a deep enough hole even when provided with delay fuzes. However, in the successful attack, AP projectiles apparently breached the wall of the tunnel. It is possible then that had this latter type of ammunition been fired in the three earlier missions that the overall success rate in this category might have been considerably higher.

OBSERVATION OF FIRE

1. Effective bombardment of shore targets by naval ships in general requires the fire to be observed. Such observations may be by air spot, shore fire control party or by ship spot. Not only is observation important for determining if the rounds are coming close enough to the target but it is equally important that the effect of the bombardment be known. Accordingly, one measure of the efficiency of ammunition utilization is the fraction of the rounds whose fall of shot was not observed. Such a measure supplements table II, which deals only with missions which were observed and accordingly is significant only if the fraction of unobserved missions is low.

2. For 16" ammunition, only 67 or 3% of the total 16" expenditure of 1610 rounds were unobserved. 30 of these 67 were fired during the day and 37 at night. Excluding 31 illuminating rounds, 459 or 21% of the total 5" expenditure of 2218 rounds were unobserved. 209 of these rounds were fired during daylight conditions and 250 at night or when poor visibility obtained.

3. The unobserved expenditure of 16" ammunition is small enough to be neglected. However, the unobserved 5" is a significant fraction of the total 5" expenditure and will be examined further.



Percentage of bridge bombardments by U.S.S. MISSOURI in which first hit occurred by a given salvo as a function of the salvo number. Period covered is 1 Feb. to 19 Mar. 51.

4. The unobserved 5" firing may be broken down as follows:

Daylight: 199 rounds at AA batteries firing at helicopters.
 2 rounds at suspected shore battery, Wonsan.
 8 rounds at vehicles.

Night: 150 rounds of harassing fire requested by KMAG

Poor visibility conditions:

100 rounds of harassing fire at Inchon, afternoon of 9 February.

5. Examination of the 5" expenditure in unobserved fire leads to the conclusion that it was used in a reasonably profitable manner. Harrassing troops with naval gunfire has been found quite effective even when the fire is unspotted. Certainly the tactical situation which required firing of the AA battery was one which justified the resultant ammunition expenditure.

AMMUNITION EXPENDITURE RATES

1. The ammunition expenditure rates attained by the MISSOURI were considerable when compared to those characteristic of battleships during World War II. Table IV below lists the average rates, in rounds per day of 5" and 16" expenditure for three periods of February and March. The last column of the table gives the rate of expenditure of 16" ammunition in terms of customary unit used in planning requirements, namely, rounds per 16" barrel per month.

TABLE IV

<u>PERIOD</u>	<u>NUMBER OF FIRING DAYS</u>	<u>AVERAGE DAILY EXPENDITURE</u>		<u>16" ROUNDS PER BBL PER MO.</u>
		<u>5"</u>	<u>16"</u>	
5-10 February	4	70	30	100
20-23 February	3	0	166	572
14-19 March	5	420	204	690

1. During the first of these three periods the MISSOURI was supporting troops and the ammunition expenditure was comparatively modest. However, in the last two periods when the ship was involved in the transportation interdiction campaign, the expenditure rate of 16" ammunition increased by a factor of six to over 600 rounds per 16" barrel per month. That this rate is noteworthy may be seen by comparing it with the corresponding rates at Okinawa and Iwo Jima which were 68 and 71 for the battleships engaged in those two campaigns.

2. The figures in table IV are for active firing periods and do not include days when the ship was unable to fire because of weather or was in transit from one point to another. Taking into account these inactive periods by computing the average rate for the entire calendar period from 5 February to 19 March, the rate is 125 rounds per barrel per month, a rate still twice that of World War II.

WEAPON SYSTEMS ASPECT OF BATTLESHIP UTILIZATION

1. The previous sections of this memorandum have indicated that MISSOURI, in general, achieved satisfactory results in

the missions which she undertook during the last two months of her stay in Korean waters. While her ammunition expenditure was high compared to World War II rates, there is no evidence to indicate that this ammunition was not used to the best of her capabilities. In general, when the fire was observed, the MISSOURI dealt well with bridges, shore batteries, troops and shore targets. The only target which she met that was not in this class was the tunnel. However, her last mission against these indicated that the use of AP projectiles would possibly allow the battleship to be as successful against tunnels as against the rest.

2. This section will attempt to estimate on the basis of the nature of the missions themselves the actual need for the battleship for the kind of gunfire support missions fired during the period studied. The specific question which will be considered in this section is the following: Was the MISSOURI really needed for the gunfire support missions which she fired? This question is an important one because the activation, assignment and use of a battleship represents such a considerable investment of naval effort, that every effort should be made to use her capabilities to the utmost.

3. The question of the MISSOURI's utility revolves around the 16" gun for as indicated in reference (a), the performance of the 5" gun on other type vessels does not appear to be significantly inferior to that of this weapon on the battleship.

4. In examining the peculiar capabilities of the battleship it is first necessary to eliminate those missions which reasonably could be expected to be carried out by alternate and readily available means. The bridge targets are certainly within this class of missions to be excluded for in spite of the fact that among surface ships only the battleship has demonstrated equal effectiveness. It is difficult to compare these two alternate methods quantitatively with regard to the effort involved. However, they certainly appear to be within an order of magnitude of one another in this respect for the average of 55 16" rounds per bridge destroyed required by the battleship is roughly comparable to the 12-16 sorties per bridge (assuming two spans destroyed) required by carrier aircraft in Korea (6-8 sorties per span). The same thing is true if the comparison is made on the basis of bridges per ship day. The MISSOURI averaged two bridges per day and a carrier flying 60-70 offensive sorties per day would average about the same number of bridges (assuming two spans destroyed).

5. A further set of targets which must also be eliminated are fixed shore installations such as factories, marshalling yards, etc., which the carrier aircraft has already proved itself quite capable of destroying.

6. If then the missions which could have been handled satisfactorily by aircraft are eliminated, there are left 26 missions on which a total of 298 - 16" rounds were fired. These 298 rounds amount to 17% of the 16" effort. They were all fired against mobile targets (mainly troops) which presumably required action to be initiated quickly. A surface ship which is able to be on station for long periods of time may be considered to be the best weapon for such targets. The need for 16" shells for these targets will now be examined in terms of the mission ranges and the type of ammunition killing power required.

7. The range distribution of the 26 missions is shown in Figure 2, the ordinate corresponding to each range giving the percentage of the rounds which were fired at ranges in excess of that range. Thus, for example, about 50% of the 16" rounds against troops were fired at ranges in excess of 18,000 yards.

8. The use of 16" shells against personnel targets, is not a very efficient use of ammunition. In general, unless psychological considerations are paramount or unless the troops are protected by heavy permanent fortifications, the smallest shell which will reach the target is the best one to use. Since neither of these latter qualifications appear to have existed, it follows that all the missions below 30,000 yards in range would have been better fired by smaller ships and also would be within their capabilities.

9. Hence, the whole justifications for the battleship lies in the 28 rounds fired at the longer ranges which represents only 1.7% of the entire 16" expenditure. In view of this small number, and also in view of the fact that these particular missions were not observed it seems clear that battleship was an extremely complicated weapon system to be used for the particular targets it was called upon to engage.

10. While this memorandum has concluded that the gunfire support missions fired by the MISSOURI in February and March 1951 did not employ fully the potentialities of the battleship, it has not been intended in any way to suggest or imply that the performance of the ship itself was anything but excellent.

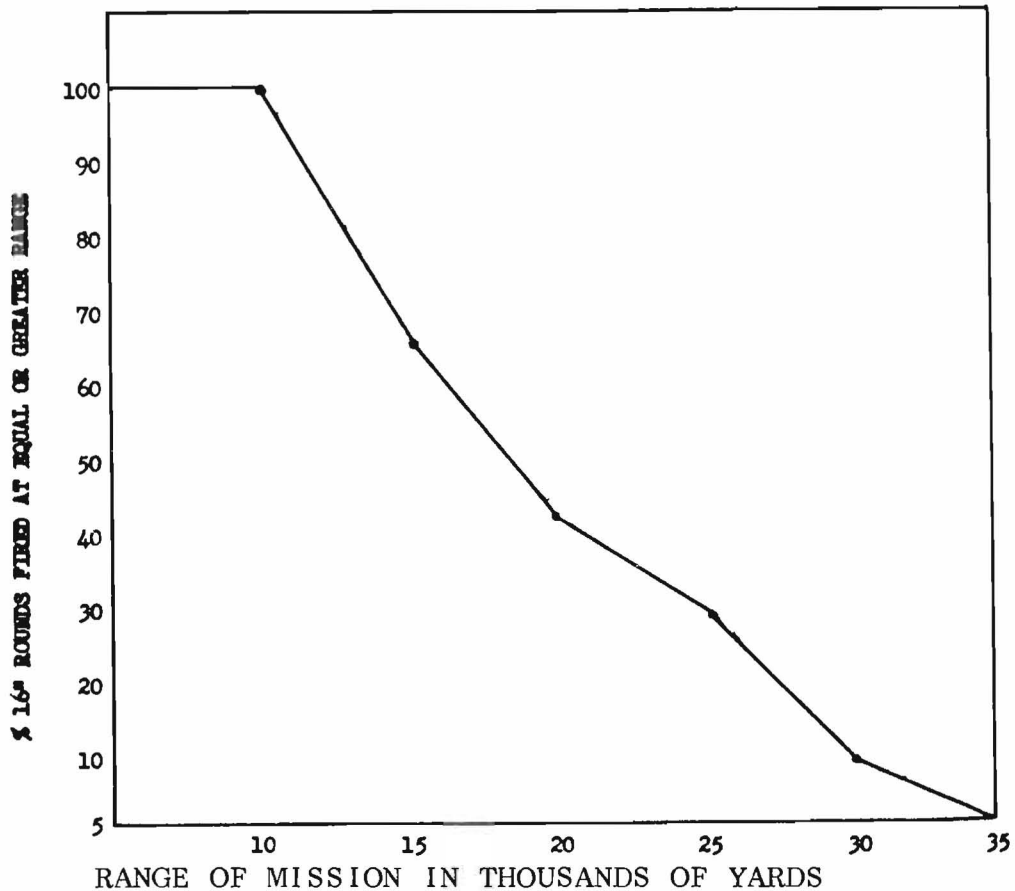
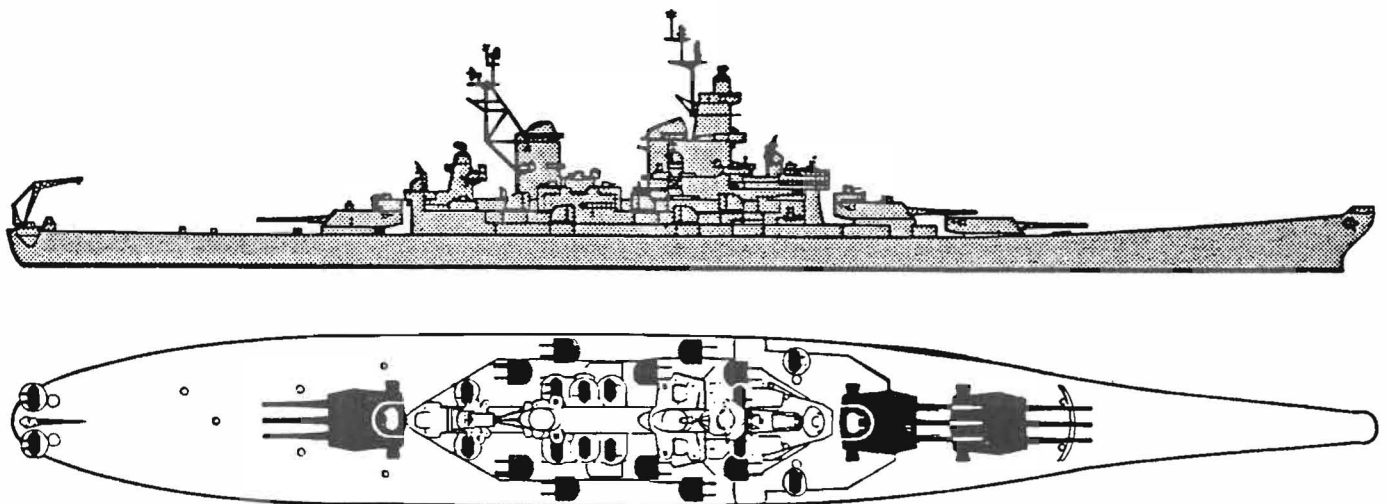


Figure 2: Cumulative range distribution of rounds against personnel fired by the U. S. S. MISSOURI during February and March 1951



The IOWAs lost their catapults in 1949, when floatplanes were superseded by helicopters. Upgraded search and heightfinding radars made heavier masts necessary. When war began in Korea, IOWA had lost her 20mm battery; by the end of that conflict, these guns were gone from the rest of the class. Postwar plans, never carried out, called for ten 3-inch 50-caliber rapid-fire twin mounts to replace 40mm guns.

There is appended a study prepared by the OEG section of the PacFlt Evaluation Group on the utilization of NEW JERSEY (BB 62) in gunfire support during the period, May - November 1951. As in previous studies of this nature, the PacFlt Evaluation Group's Gunfire Support Records, as submitted by the firing ship, are the basis for the report. It must be realized that "effect of mission" data included in these records is based on spotters' estimates which, for the most part, are uncorroborated. The study attempts to compare the effectiveness of New Jersey firing with that of MISSOURI for the period, February - March, 1951. It is not intended as a measure of the contribution to the war effort by the two ships. It should be noted that the greatest portion of the NEW JERSEY firing was against enemy personnel, i.e. in direct support of UN troops, whereas that of MISSOURI was against MSR targets. The growing emphasis on ammunition conservation in late 1951, is reflected in the NEW JERSEY firing. Her firing of single ranging salvos for registering on target, and less rounds for "fire for effect" make direct comparison of effectiveness impracticable. The devastating effect of 16" fire against the enemy's dug-in troops and enemy MSR was repeatedly demonstrated and attested.

Pacific Fleet Evaluation Group

Research Memorandum

No. 19

Utilization of USS NEW JERSEY (BB 62)
in Gunfire Support, May-November 1951

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Summary

This memorandum summarizes the gunfire support missions undertaken by USS NEW JERSEY (BB 62) in Korea during May-November, 1951. It shows that the greatest effort of 16" guns during this period was against enemy personnel, in contrast with the primary use of the 16" guns of USS MISSOURI (BB 63) during February-March, 1951, when transportation targets received the greatest attention. During both of these periods the major effort of the battleships' 5" batteries was against weapons installations. The majority of the 16" missions utilized the unique capabilities of the battleship.

The level of effectiveness of NEW JERSEY and the variation of effectiveness with the target type, missions purpose, and spotting method are shown. Where information is available for MISSOURI, her effectiveness is compared with that of NEW JERSEY. The two ships appear to have had comparable success against bridges, although NEW JERSEY required lower average expenditures. This was due probably to the less resistant bridges encountered. On the other hand, NEW JERSEY had less success against weapons installations than did MISSOURI, probably because of much lower expenditures. Although results are not conclusive because of the small sample of missions, it appears that ground spot is the most effective spotting method, followed closely by air spot (helicopter and other types) and ship spot.

CONCLUSIONS

1. NEW JERSEY's 16" battery was used against personnel in nearly one-half of the main battery missions and achieved a high degree of success against these targets. This represents a shift from transportation as the primary main battery target, characteristic of the MISSOURI's utilization during an earlier period.
2. The conclusion of reference (a) based on MISSOURI's Korean duty that personnel targets could have been better and more efficiently attacked by smaller ships does not apply to the utilization of the NEW JERSEY. Nearly one-half of the latter's missions were fired at ranges exceeding the effective ranges of a heavy cruiser's guns and most of the remainder were fired on days when the battleship was present to fire at targets that only the 16" guns could reach.
3. Over one-third of the 5" missions were against gun emplacements. While the fraction of missions assessed by NEW JERSEY as satisfactory was low (less than one-fourth of those observed) about three-fourths of the observed missions showed at least limited results.

4. The 16" guns had less effect against bridges than against other targets, although the average expenditure per mission was no less than the average against other targets.

5. Although NEW JERSEY's expenditure per mission was only about 40% of MISSOURI's, there was no significant decrease in effectiveness of the 16" battery. In the case of bridges, the decrease in average expenditures was apparently due to the less resistant type of bridges encountered.

6. NEW JERSEY's low effectiveness of the 5" battery against weapons installations appears due to insufficient expenditures. MISSOURI's average 5" expenditures against weapons installations was about 3]-4 times NEW JERSEY's, and the percentage of satisfactory missions was over 5 times that of NEW JERSEY.

7. On the basis of rounds expended, NEW JERSEY's unobserved destruction missions could be expected to achieve no higher than limited success, while unobserved neutralization missions may have been somewhat successful.

8. Differences in effectiveness for the various spotting methods are small, and because of the small number of missions are not statistically significant.

9. On the basis of the small sample of data, the conclusion of reference (b) that shore fire control party spotting is the most effective is also suggested for NEW JERSEY's 16" firings.

10. The conclusion of reference (b) that spotting by helicopter was significantly more economical in ammunition than was spotting by carrier aircraft is not confirmed. Against bridges there appears to have been an improvement in the expenditures for both spotting methods.

11. For the 5" battery, ship spot appears to be less effective than other spotting methods. Although based on a small sample of data, this confirms a conclusion of reference (b).

Utilization of USS NEW JERSEY (BB 62)
in Gunfire Support, May-November 1951

I. Introduction

During May-November, 1951, USS NEW JERSEY (BB 62) was assigned to Naval Forces, Far East, having relieved USS MISSOURI (BB 63) at the beginning of the period. Her assignments to various units of the Seventh Fleet and of Task Force 95 resulted in her carrying out 423 gunfire support missions. The purpose of this memorandum is to summarize these gunfire support missions in order to compare NEW

JERSEY's assignments and effectiveness in carrying out these assignments with those of MISSOURI in an earlier period (reference (a)), and to re-examine on the basis of additional data several tentative conclusions of references (a) and (b). These conclusions are concerned with the relative effectiveness of various spotting methods and with the large expenditures of 16" rounds for registration against small targets.

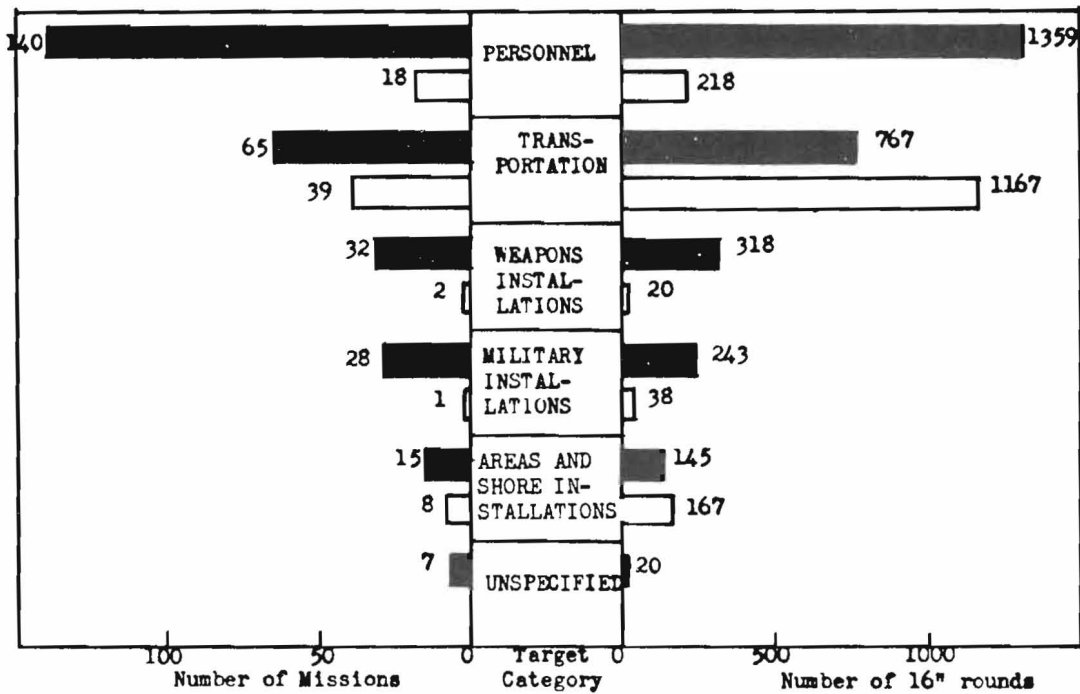
The data for this memorandum were obtained from Gunfire Support records submitted by NEW JERSEY to the Pacific Fleet Evaluation Group. A sample record is shown in appendix 1. Records are available for 411 of the 423 missions fired by NEW JERSEY during her tour of duty in Korean waters. Of these 411 missions, 12 were excluded from the tabulations since in those cases more than one target was listed for each mission. Included then were 399 missions - 287 for the 16" battery and 112 for the 5". The firings of the two batteries are treated separately.

II. CHARACTER AND SCOPE OF THE OPERATION



During her tour of duty in the Korean Area NEW JERSEY supported two east coast offensives by United Nations ground troops, in the Yangyang area in May and in the Kansong-Kosong area in September. During these periods in the primary targets were enemy personnel and military installations. At other times NEW JERSEY was engaged in firing at transportation targets in the areas near Kansong (until occupied by UN troops), Kosong, and Wonsan. Special strikes against transportation targets and shore installations north of Wonsan were made in October (Hamhung and Tanchon) and in November (Hungnam, Iwon, Tanchon, Songjin, and Chongjin). NEW JERSEY's missions were concluded on November 13 with one mission against troops in a village on the Ongjin Peninsula on the west coast of Korea in connection with the continuing naval demonstration near the Han River for the purpose of influencing the peace talks.

Figure 1 shows the distributions of missions and of expenditures of 16" shells for various major target categories for NEW JERSEY. Shown for comparison are similar data on MISSOURI during the months of February and March 1951, the period studied in reference (a). The specific target types comprising these major target categories are listed in appendix 2.

FIGURE 1



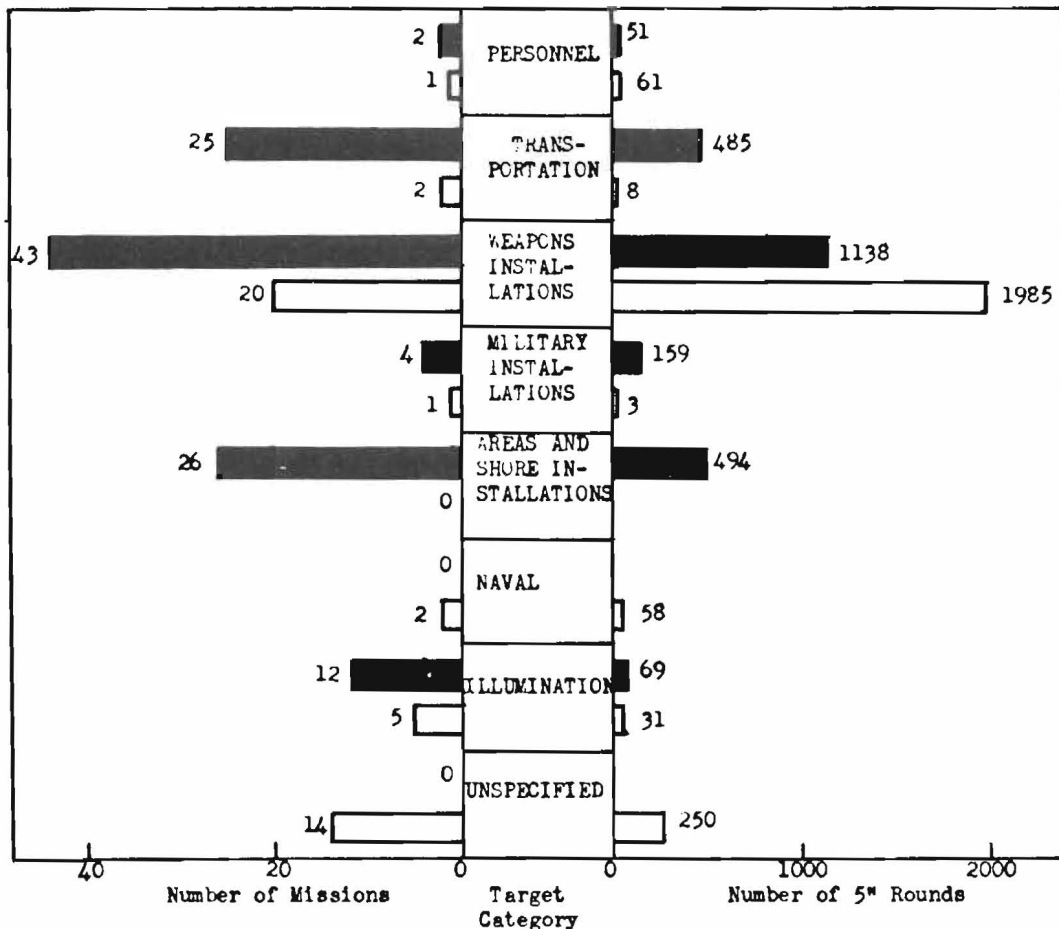
DISTRIBUTION OF MAIN BATTERY EFFORT WITH RESPECT TO TARGET CATEGORY

			Total Missions	Total Rounds
	NEW JERSEY	May - Nov 1951	287	2852
	MISSOURI	Feb - Mar 1951	68	1610

The greatest effort of NEW JERSEY's 16" guns was against personnel targets. It is noted that nearly one-half the main battery missions and nearly one-half the 16" rounds expended were directed against enemy personnel. This is in contrast to the primary use of MISSOURI's 16" guns in February and March, 1951, when transportation targets received the greatest attention. NEW JERSEY's expenditure against personnel was almost twice the expenditure against transportation targets, while MISSOURI fired only one round at troops for every five fired at railroad and highway targets.

Figure 2 shows the distributions of 5" missions and of expenditures for each ship against various targets.

FIGURE 2



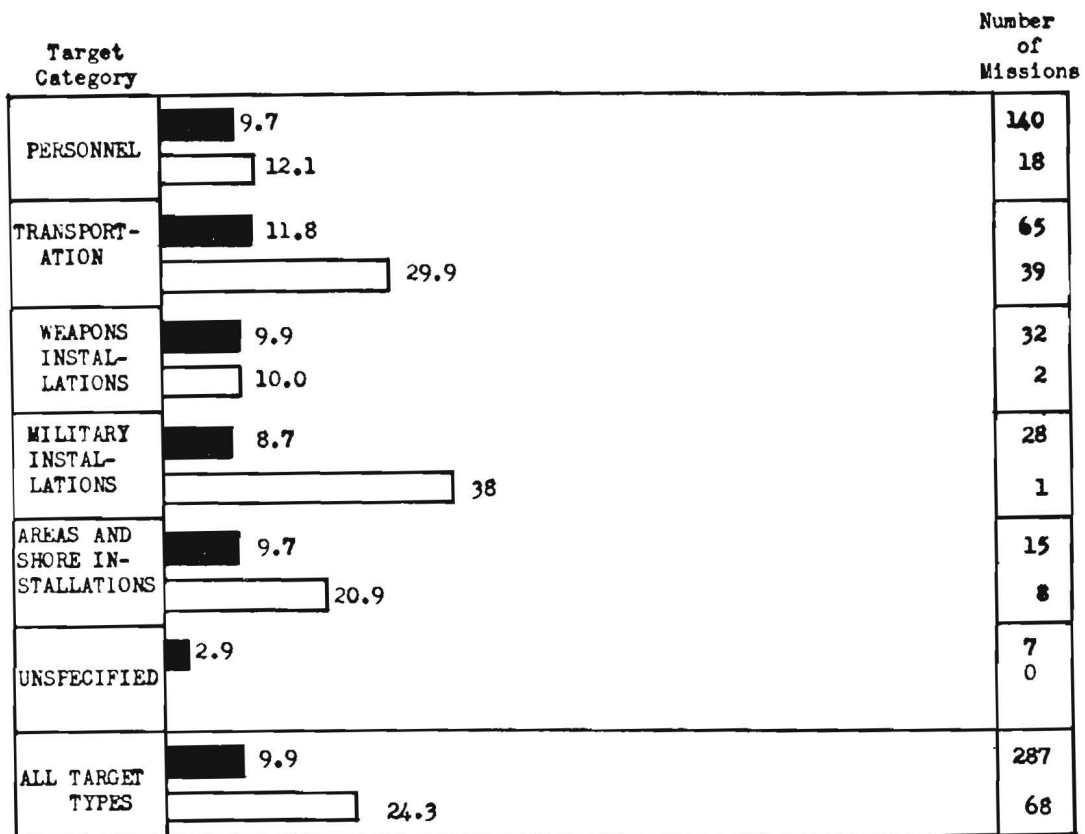
DISTRIBUTION OF SECONDARY BATTERY EFFORT WITH RESPECT TO TARGET CATEGORY

		Total Missions	Total Rounds
NEW JERSEY	May - Nov 1951	112	2396
MISSOURI	Feb - Mar 1951	45	2396

For the 5" battery, over one-third of NEW JERSEY's missions and nearly one-half of the rounds expended were directed against gun emplacements. These targets were also the object of MISSOURI's primary 5" effort (over two-thirds of the missions and over four-fifths of the rounds). Secondary target categories for NEW JERSEY were towns and villages and transportation targets, together accounting for slightly over one-third of the rounds expended.

Figures 3 and 4, which show average expenditures per mission against various target types, indicate that NEW JERSEY was more conservative than MISSOURI in using both 16" and 5" ammunition. The outstanding examples of this are against transportation targets for the 16" battery and against weapons installations for the 5" guns. The question may now be asked, "was NEW JERSEY any less effective against these targets because of this decreased expenditure?" This question is discussed in Section IV.

FIGURE 3



AVERAGE 16" EXPENDITURES AGAINST VARIOUS TARGET CATEGORIES

NEW JERSEY May - Nov 1951

MISSOURI Feb - Mar 1951

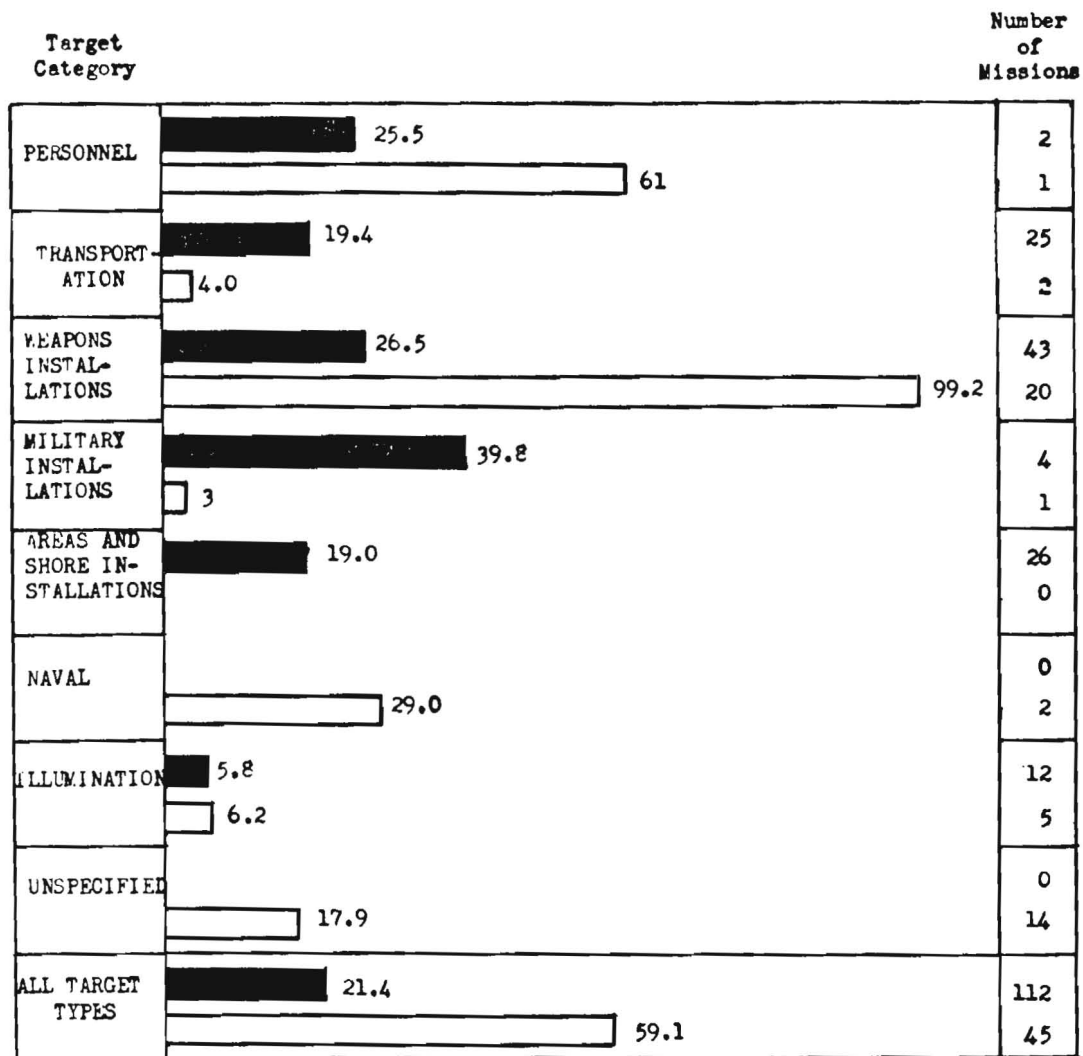


FIGURE 4: AVERAGE 5" EXPENDITURES AGAINST VARIOUS TARGET CATEGORIES

NEW JERSEY May - Nov 1951

MISSOURI Feb - Mar 1951

The second factor in the characterization of NEW JERSEY's gunfire support operations is purpose of the missions. Destruction, neutralization, and harassing and interdiction missions according to purpose are given in figures 5 and 6. In addition, these figures show for each mission purpose the fraction of missions directed against various target categories. The major effort of the main battery, in terms of

number of missions fired, consisted of harassing and interdiction missions against personnel (16%) and destruction missions against transportation targets (10%). Of the 5" missions, 28% were destruction missions against weapons installations and 15% were neutralization missions against areas and shore installations.

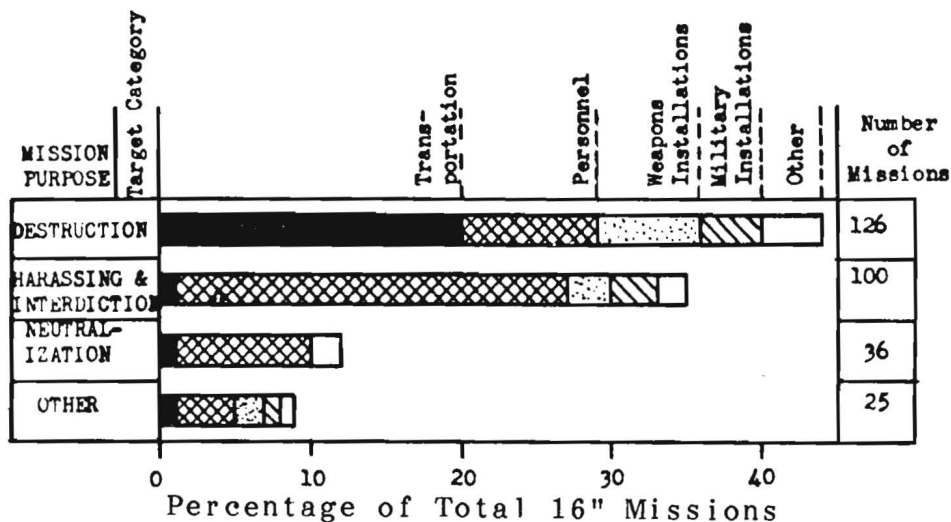


FIGURE 5: DISTRIBUTION OF NEW JERSEY'S 16" MISSIONS WITH RESPECT TO MISSION PURPOSE

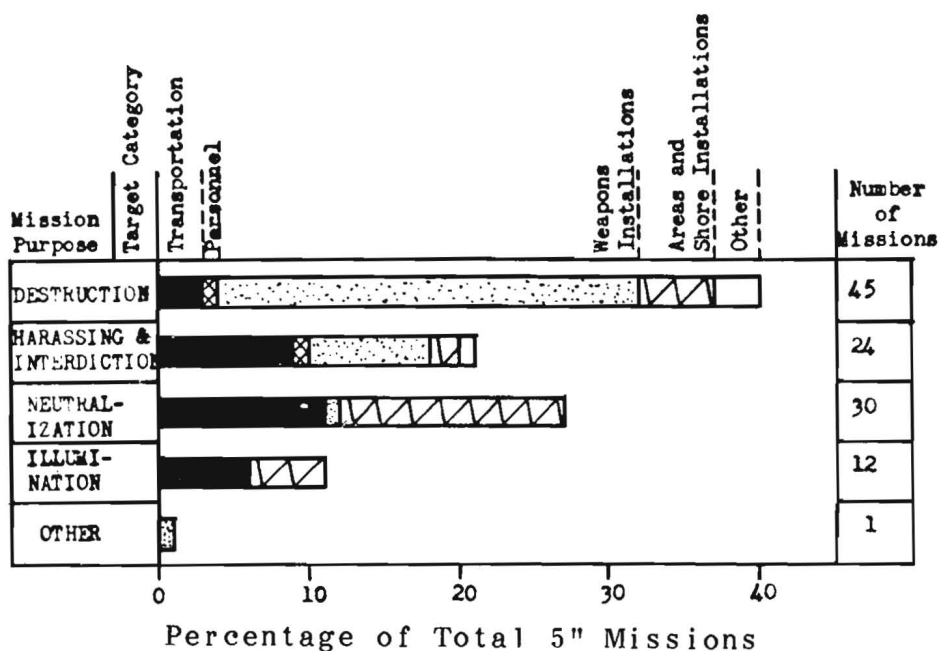
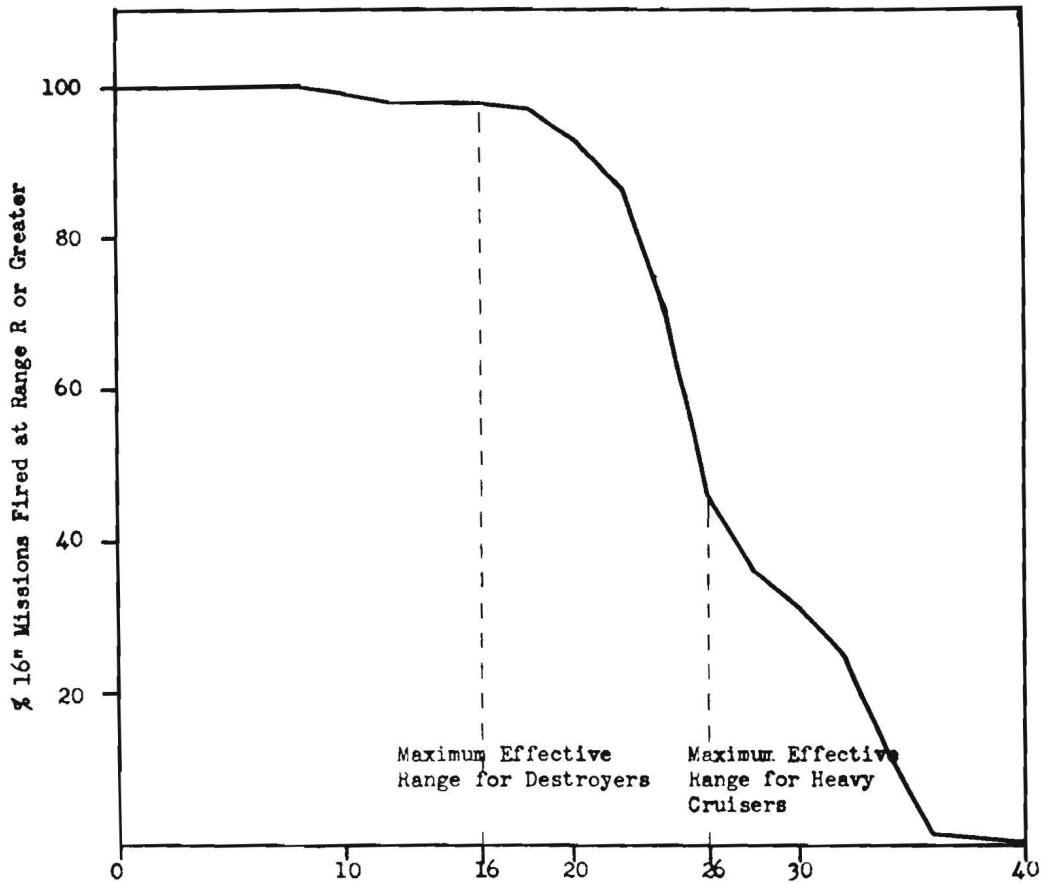


FIGURE 6: DISTRIBUTION OF NEW JERSEY'S 5" MISSIONS WITH RESPECT TO MISSION PURPOSE

III. UTILIZATION OF NEW JERSEY AGAINST PERSONNEL

In reference (a) the use of MISSOURI's main battery against personnel was commented on as follows: "The use of 16" shells against personnel targets is not a very efficient use of ammunition. In general, unless psychological considerations are paramount or unless the troops are protected by heavy permanent fortifications, the smallest shell which will reach the target is the best one to use." Since the utilization of NEW JERSEY indicated that personnel were considered her most important main battery target, it is of interest to see whether the conclusion of reference (a) that such targets could be better and more efficiently attacked by smaller ships applies to NEW JERSEY as it did for MISSOURI.

Figure 7 shows that less than 3% of NEW JERSEY's missions against personnel were within the range of the guns of a destroyer (approximately 16,000 yards for effective fire), but over half were within the range of a cruiser's guns (approximately 26,000 yards). The remainder of the missions were fired at targets which were well inland, about three-quarters of the targets being over 24,000 yards from the shore. In general then, these longer range missions actually did require a battleship. An inspection of the 78 missions fired at 26,000 yards and under shows that 44 of these missions were harassing and interdiction missions in the Kosong area on four separate occasions between 17 August and 8 October. While 16" shells may have been larger than necessary for these shorter range missions, they were fired in conjunction with front line support of friendly troops during which NEW JERSEY fired about an equal number of personnel missions at ranges over 26,000 yards.



R = Range (Thousands of Yards)

FIGURE 7: CUMULATIVE RANGE DISTRIBUTION
OF MISSIONS FIRED AGAINST PERSONNEL
BY NEW JERSEY, MAY - NOV 1951

These 44 harassing and interdiction missions plus the 61 missions fired at ranges exceeding 26,000 yards account for 75% of all the personnel missions. The remaining 34 missions fired at cruiser range were destruction, neutralization, and

deep support missions. It is not certain that all of the targets required the larger shells in order for the purpose of the mission to be carried out, since NEW JERSEY's gunfire support records do not in general describe the character of the protection available to the enemy troops. It is quite likely from the general nature of the front lines, however, that these troops were well dug in. In any case, many of these missions were fired on days that the battleship was present to fire on targets at longer ranges. Since over three-quarters of NEW JERSEY's personnel missions were undertaken during periods when the presence of a battleship was required to fire on targets at long range, it appears that the conclusion of reference (a) that personnel targets could be better and more efficiently attacked by smaller ships does not apply in general to the utilization of NEW JERSEY.

IV. VARIATION OF EFFECTIVENESS WITH TARGET TYPE

The Gunfire Support Records provide for the recording of four degrees of success of a mission when the results of a mission are observed. Ships have been instructed to make the assessment on the basis of the extent to which the purpose of the mission was achieved. A mission which achieved its purpose not at all is classed as 1 - no results. When some small degree of success is observed (class 3) or one which was carried out with complete success (class 4) is considered to have fulfilled its purpose to a satisfactory degree. In this memorandum missions in classes 3 and 4 are combined into one class and are called "satisfactory."

NEW JERSEY's assessment of mission success against targets in various categories is given in figures 8 and 9. Most of these assessments were based on observations by spotting aircraft or by shore fire control party. Statistical tests applied to the various percentages show that the differences in effectiveness indicated in figures 8 and 9 are not always significant due to the small number of missions observed for some cases. For the 16" battery it is only when results obtained against personnel and against other target types that differences in effectiveness does not differ significantly from one type to another. Against personnel NEW JERSEY's main battery achieved a high degree of success while in the transportation category there is a high percentage of missions assessed as showing no results. Lack of success against bridges was the main cause for the relatively low effectiveness in the transportation category. This is shown in figure 10. MISSOURI also had less success against bridges than against other targets (reference (a)). The difficulty with bridge targets experienced by NEW JERSEY seems to be due to the nature of the target, since the average expenditure

against bridges was no less than the average against other targets. Average 16" expenditures for NEW JERSEY are shown in table 1.

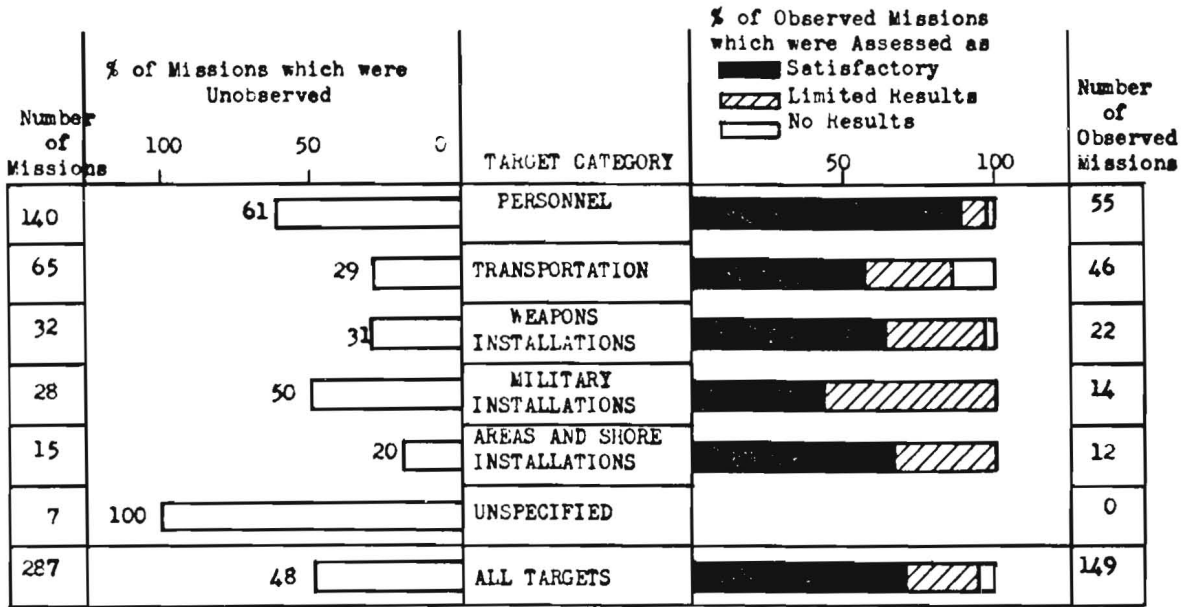


FIGURE 8: EFFECTIVENESS OF NEW JERSEY'S 16" BATTERY BY TARGET CATEGORY

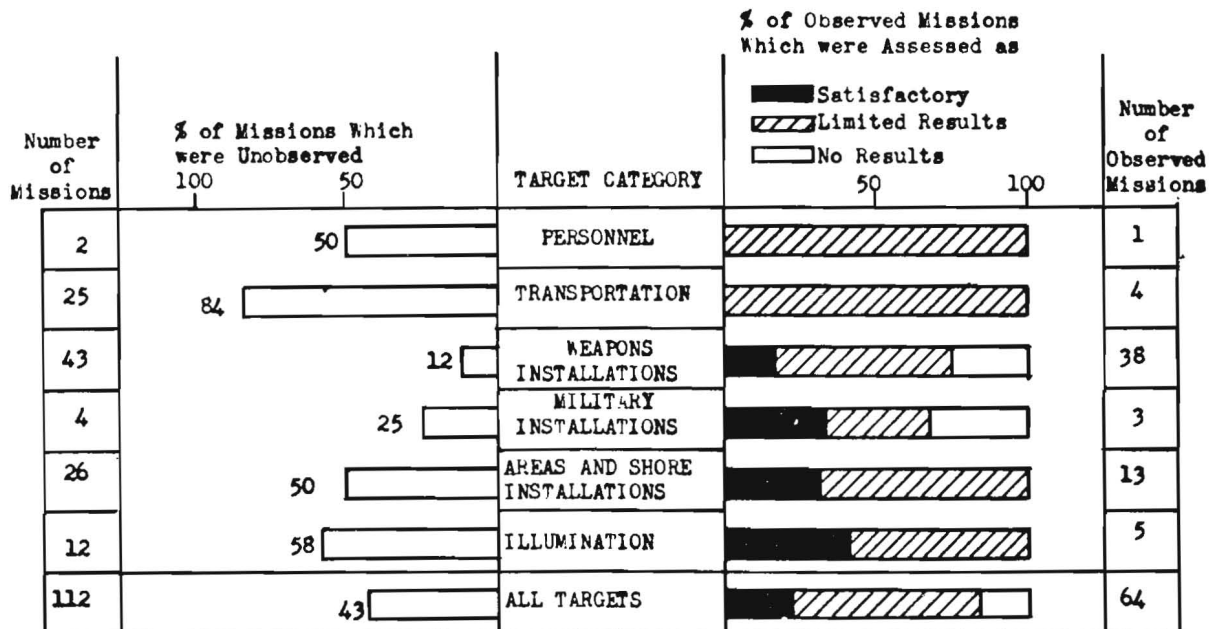
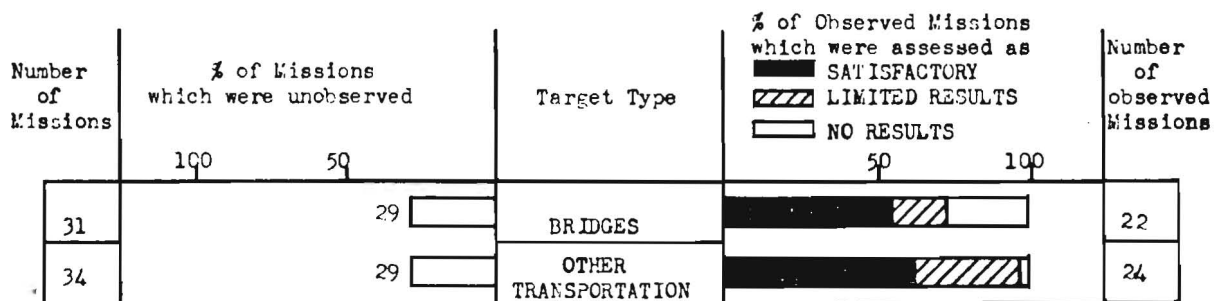


FIGURE 9: EFFECTIVENESS OF NEW JERSEY'S 5" BATTERY BY TARGET CATEGORY

FIGURE 10



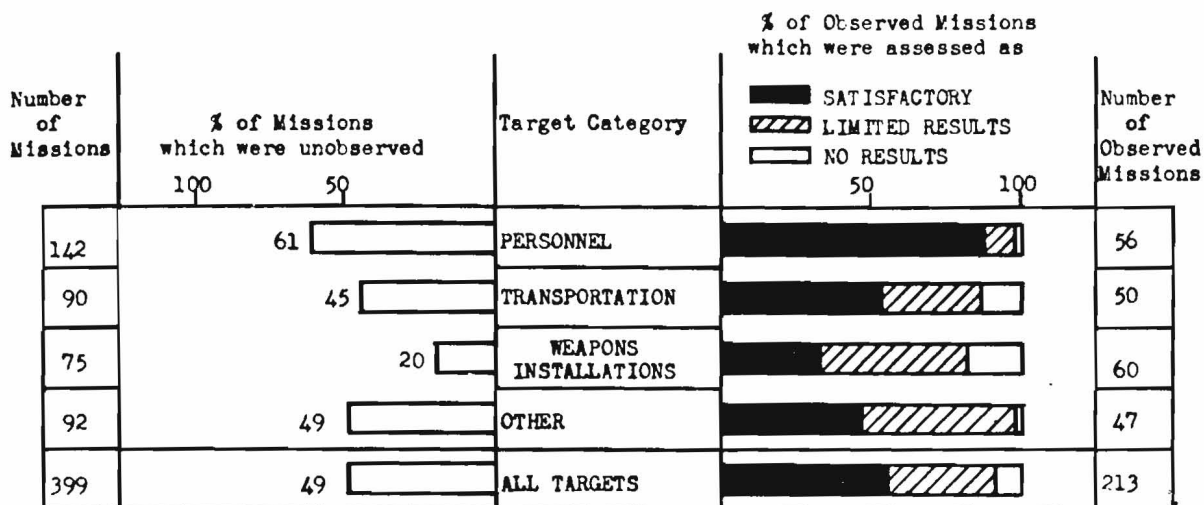
EFFECTIVENESS OF NEW JERSEY'S 16" BATTERY AGAINST TRANSPORTATION TARGETS

Table 1. Average 16" Expenditures per Mission

	Satisfactory		Limited and no results		Unobserved	
	Missions	Rounds/Mission	Missions	Rounds/Mission	Missions	Rounds/Mission
Bridges	12	22.8	10	10.0	9	6.6
Other transportation	15	13.2	9	6.0	10	7.3
Other targets	77	17.7	26	7.8	110	4.3

In comparing the effectiveness of NEW JERSEY during May-November, 1951, with the effectiveness of MISSOURI during February-March, it is necessary to consider 5" and 16" missions together, since reference (a) does not give an effectiveness breakdown by gun caliber. Figures 11 and 12 show for several target categories the percentages of observed missions which had various degrees of success. While MISSOURI appears to have been more effective, the small number of missions makes it impossible to state in most cases that the differences between the ships are significant. Only against weapons installations was MISSOURI significantly more effective.

FIGURE 11



EFFECTIVENESS OF NEW JERSEY'S
16" AND 5" BATTERIES

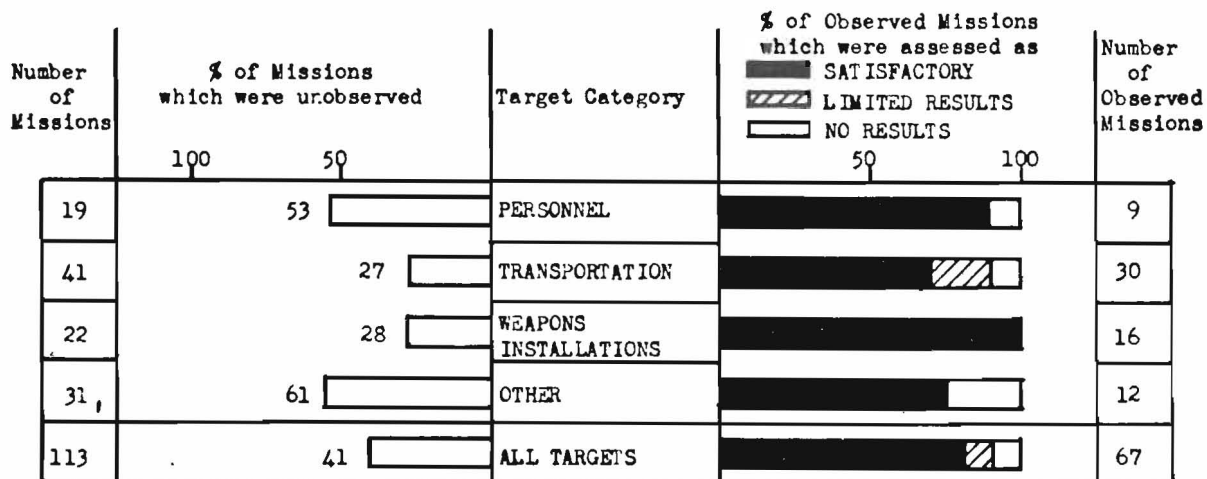


FIGURE 12: EFFECTIVENESS OF MISSOURI'S 16" AND 5" BATTERIES

It is of interest to look further into the relative effectiveness of the two battleships against bridges and weapons installations, since it is against these two target types where large differences are found in the average expenditures per mission. Figure 13 shows the percentages of bridge missions and of weapons installations in the various effectiveness classifications.

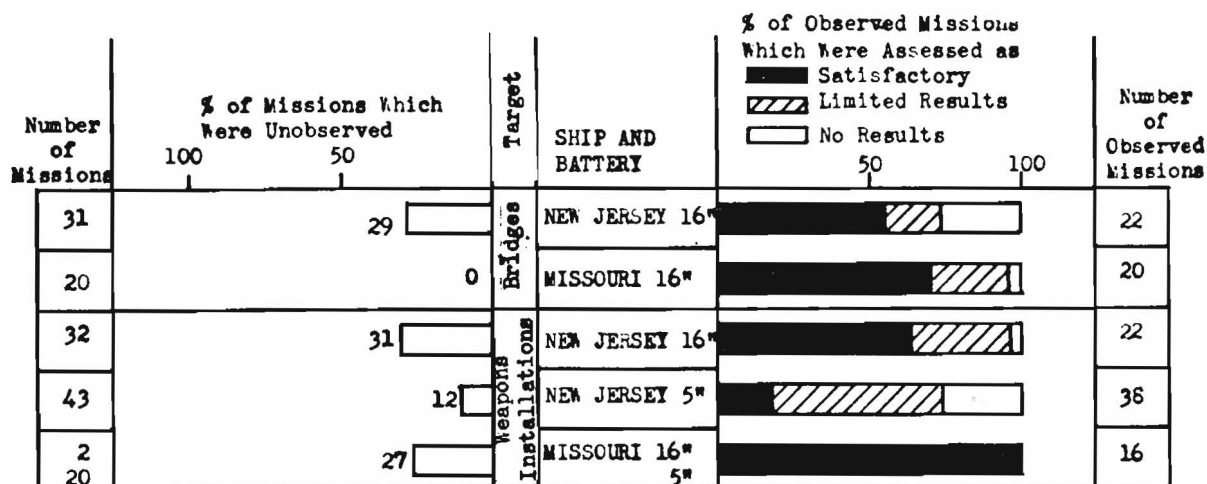
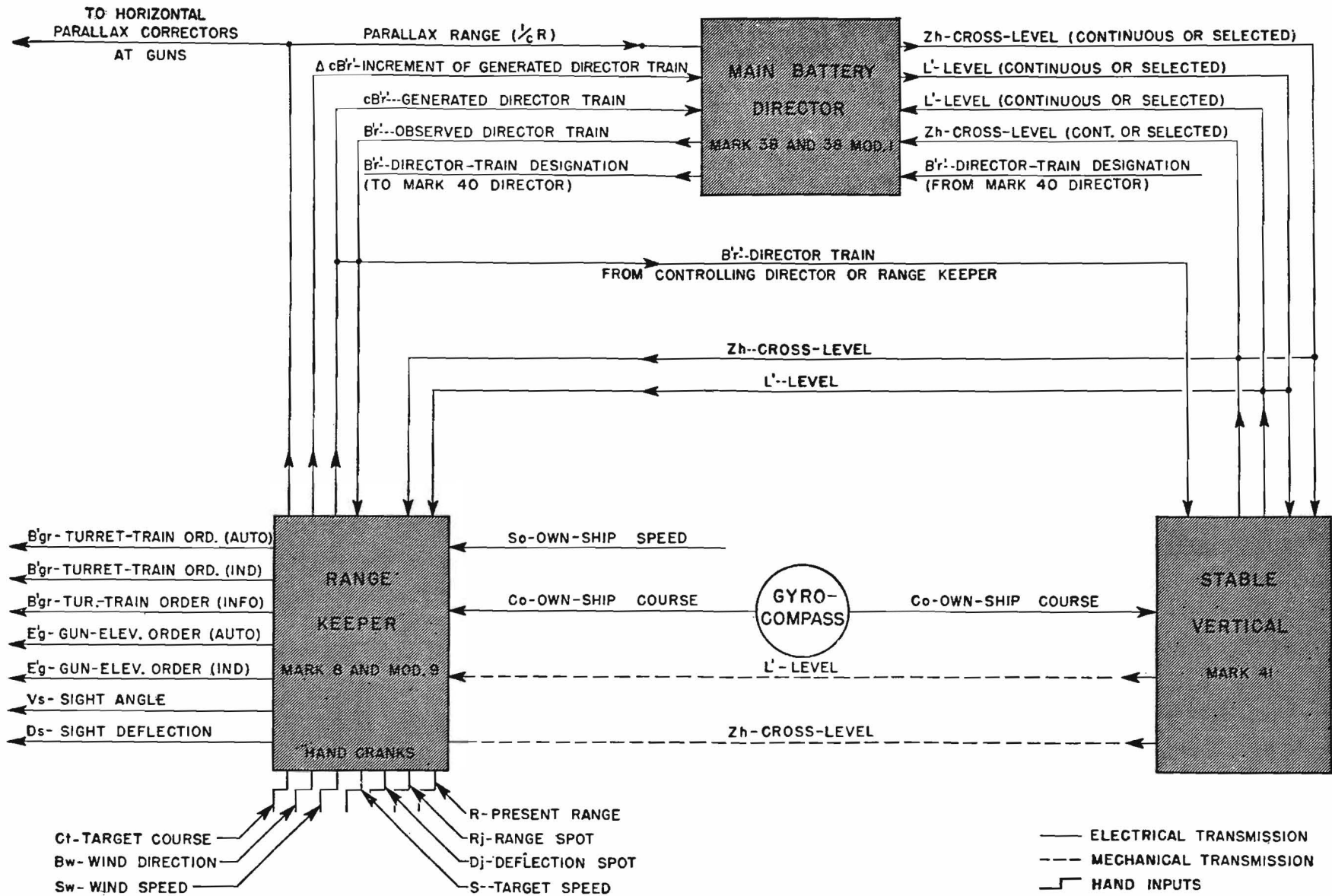


FIGURE 13: EFFECTIVENESS OF BATTLESHIPS AGAINST BRIDGES AND WEAPON INSTALLATIONS



Flow of inputs and outputs in battleship main-battery fire control system.

Bridges. Although MISSOURI showed a higher fraction of bridges attacked satisfactorily, the difference is not statistically significant because of the small number of missions. To see whether the comparatively low expenditures for NEW JERSEY are unduly influenced by the inclusion of missions whose purpose was relatively easy to achieve, let us consider expenditures for only the most difficult bridge missions, those for destruction. Further, let us consider only those which were not interrupted. NEW JERSEY's 16" battery fired a total of 31 bridge missions, all but two for the purpose of destruction. One of these two was a neutralization mission during an amphibious demonstration at Kosong (7 rounds) and the other was intended to harass repair crews working on a previously damaged bridge near Kosong (2 rounds). Ten of the destruction missions were broken off early for various reasons, such as, "spotter over wrong area," "target did not seem profitable or economical for 16" fire," "limit of endurance of spotting plane," "communication failure."* The remaining 19 missions accounted for 364 or 86% of the 423 16" rounds fired at bridges.

Two (11%) of these 19 missions were unassessed. Of those assessed, 10 (59%) were carried out with satisfactory results, 3 (18%) showed limited results, and 4 (23%) had no results. These percentages of observed missions differ only slightly from those shown in figure 13 for all of NEW JERSEY's bridge missions. It appears then that NEW JERSEY achieved satisfactory results on 55%-60% of the observed missions. This does not differ significantly from MISSOURI's 70%, when the size of the samples considered is taken into account.

The average expenditure on the preceding 10 satisfactory destructive missions was 25.7 rounds. This differs by only a small amount from the average given in table 1, 22.8 rounds per mission when all satisfactory bridge missions are included. Reference (a) states that MISSOURI's corresponding figure for 14 missions was 55. Thus MISSOURI expended at least 2-2] times the number of rounds per satisfactory mission than NEW JERSEY expended.

Since NEW JERSEY was not significantly less effective against bridges, the decrease in average expenditure must have been due to fewer number of spotting rounds fired, less resistant bridges encountered, or overkilling by MISSOURI.

The large difference in expenditures cannot be accounted for by a decrease in the number of rounds fired for spotting, since MISSOURI's average spotting rounds per bridge mission -

- - - - -
*Missions on which there were communication difficulties are listed in Table 3-2.

was 9 and NEW JERSEY's was about 5. Thus, MISSOURI's average rounds "for effect" amounts to 2-2] times NEW JERSEY's.

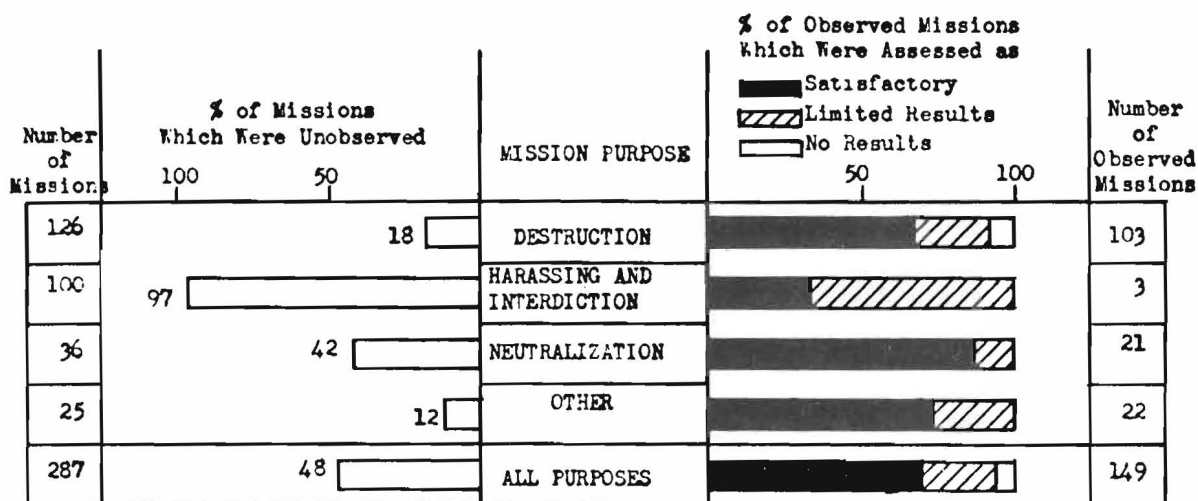
The type of bridges seems to have been a dominant factor. MISSOURI's bridge targets were described by reference (a) as "mostly of reinforced concrete construction." For NEW JERSEY's 19 uninterrupted destruction missions 10 targets were pontoon bridges or bypass bridges of dirt fill and wood piling construction. Of the other 9, one was a steel bridge and 8 had no special type of construction listed. The pontoon bridges and bypass bridges required about 20 rounds per satisfactory mission (7 missions) and the others required about 40 rounds per satisfactory mission (3 missions). It must be recognized that these averages are unstable because of the few missions involved. However, they do indicate that NEW JERSEY's decreased average expenditures were due to less resistant bridge targets.

Whether MISSOURI fired more rounds than necessary to achieve success in missions against bridges cannot be determined. The single known instance of a mission fired by NEW JERSEY against a strongly constructed bridge makes a comparison of the efforts required by the two ships against similar targets impossible.

WEAPONS INSTALLATIONS. Figure 13 shows that MISSOURI's 5" battery was much more effective against weapons installations than was NEW JERSEY's. It is difficult to get a clear understanding of why this should be so, since detailed information concerning MISSOURI's firings is not available. A clue to the reason for this difference in effectiveness, however, may be found in the significant difference in average expenditures. MISSOURI's average expenditure was 99.2 rounds, 3 1/2-4 times NEW JERSEY's. Since all 20 of MISSOURI's missions were satisfactory, the average expenditure per satisfactory mission also is 99.2 rounds. NEW JERSEY achieved satisfactory results on only three destruction and counterbattery missions, expending 61, 106, and 236 rounds. On none of the other 29 destruction and counterbattery missions was 48 rounds exceeded, and the average expenditure was only 18.4. This seems to indicate that NEW JERSEY was less successful than MISSOURI against weapons installations because of its very much smaller expenditures.

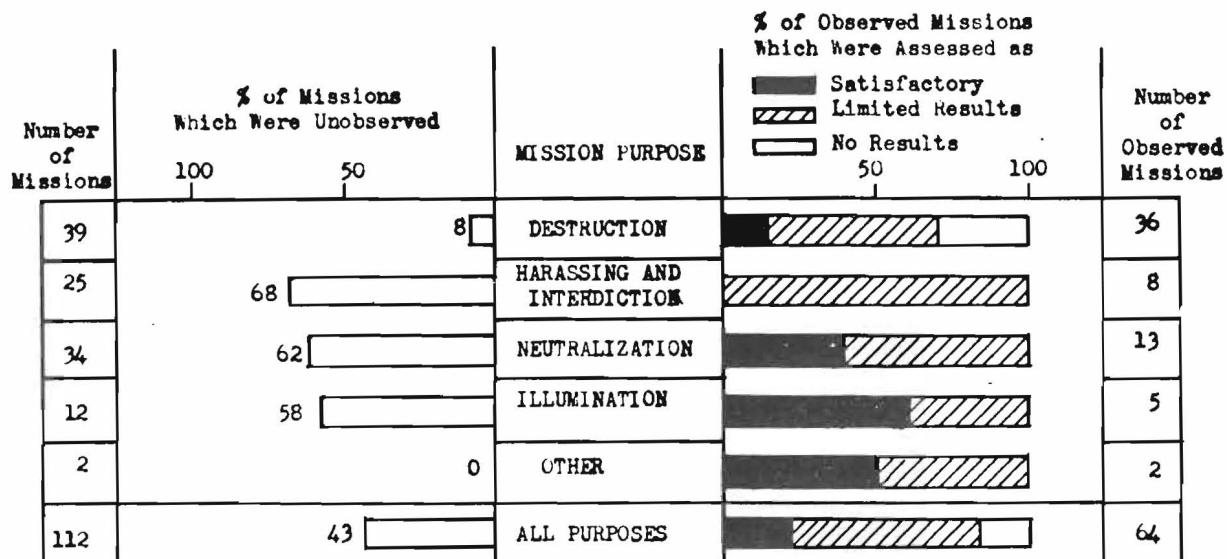
Tunnels. NEW JERSEY was assigned two missions against tunnels and achieved satisfactory results on both, having used 16" AP projectiles. This tends to confirm the suggestion of reference (a) that AP projectiles are more effective than HC projectiles against tunnels.

FIGURE 14



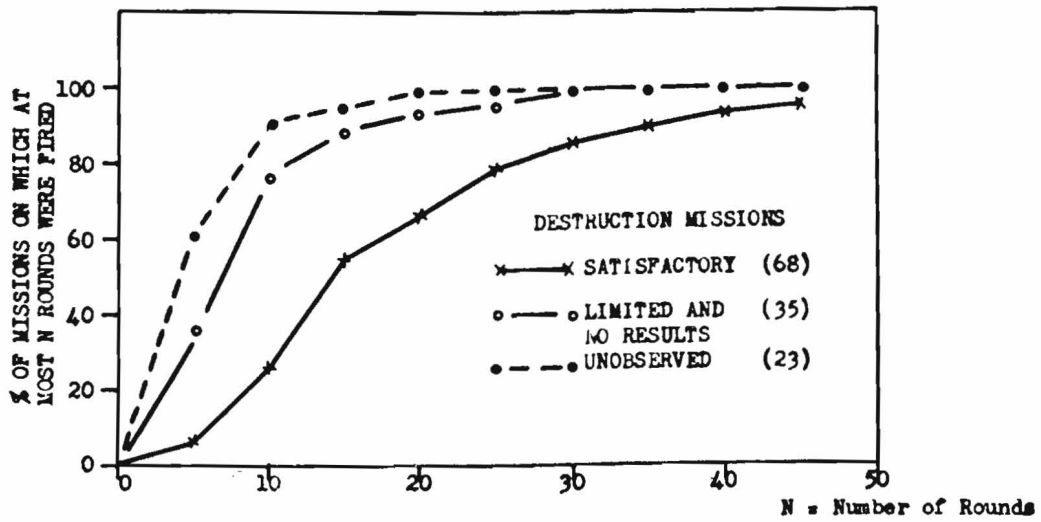
EFFECTIVENESS OF NEW JERSEY'S 16" BATTERY
BY MISSION PURPOSE

FIGURE 15



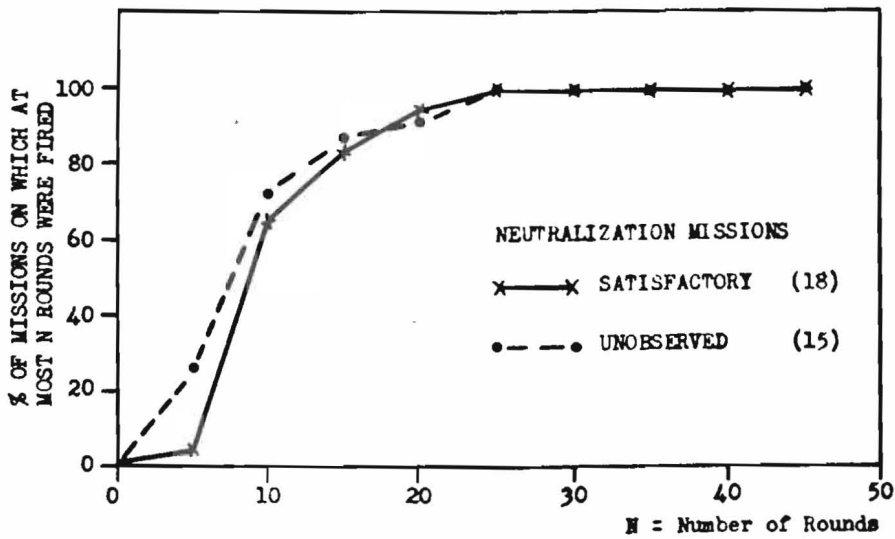
EFFECTIVENESS OF NEW JERSEY'S 5" BATTERY
BY MISSION PURPOSE

FIGURE 16



CUMULATIVE DISTRIBUTION OF 16" DESTRUCTION MISSIONS WITH RESPECT TO NUMBER OF ROUNDS FIRED

FIGURE 17



CUMULATIVE DISTRIBUTION OF 16" NEUTRALIZATION MISSIONS WITH RESPECT TO NUMBER OF ROUNDS FIRED

In the case of neutralization so few "limited" or "no success" missions occurred that it is not certain that there is a correspondence between the number of rounds fired and the success category. Figure 17 shows that the cumulative distribution curve of rounds for unobserved missions is almost indistinguishable from that for satisfactory missions. The small number of missions makes a definite conclusion impossible, but it appears that the expenditures on the unobserved missions may have been sufficiently large to produce a fair degree of success.

In the case of the 5" battery, NEW JERSEY achieved limited or satisfactory results on all observed missions, except when destruction was desired. For destruction missions, 11 (or about one-third) were observed to achieve no effect, and all but one of these were against weapons installations. Figure 15 shows there were too few observed 5" missions in purpose categories other than destruction to permit statistically valid comparisons of effectiveness. For the same reason, no conclusions can be made concerning the unobserved missions. However, Figure 15 indicates that the destruction of weapons installations was the most difficult task undertaken by the 5" batteries.

VI. VARIATION OF EFFECTIVENESS WITH SPOTTING METHOD

Figure 18 presents NEW JERSEY's assessment of mission effectiveness for various spotting methods for 16" batteries.

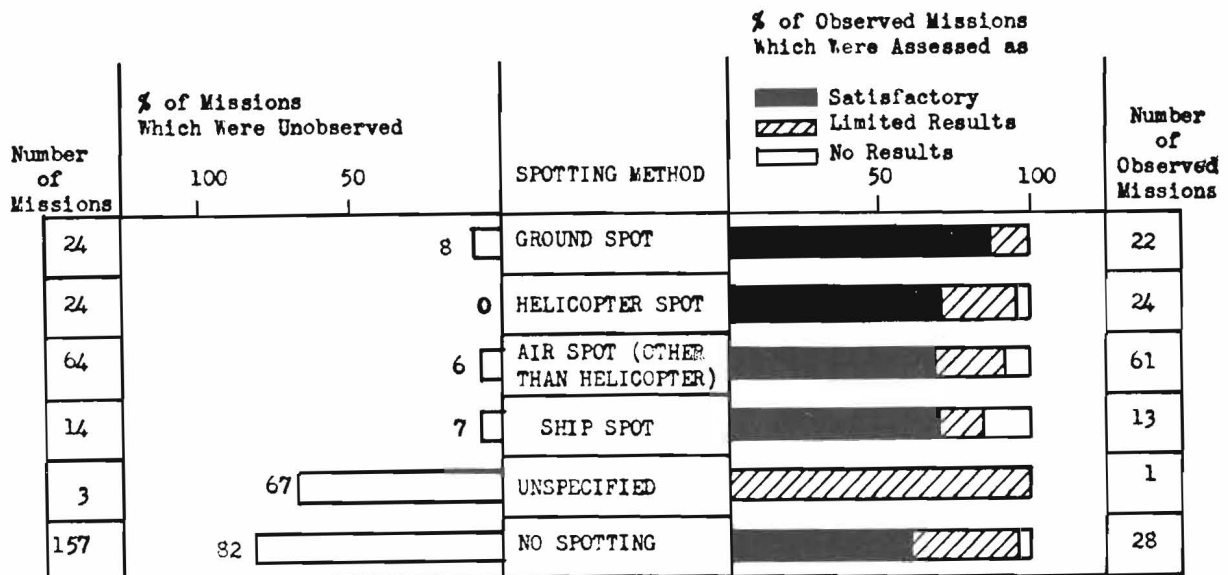


FIGURE 18: EFFECTIVENESS OF NEW JERSEY'S 16" BATTERY BY SPOTTING METHOD

Differences in effectiveness for the various spotting methods are small, and because of the small number of missions are not statistically significant. Even the expected low success with no spotting is not conclusively demonstrated by Figure 18. This figure does tend to confirm, however, the conclusion of reference (b) that shore fire control spotting produces greater effectiveness than other types of spotting. A comparison of helicopter spotting and spotting by other aircraft with respect to fraction of observed missions which were satisfactory (Figure 18), average salvo number of first hit, and the number of rounds per satisfactory mission (table 2), shows little difference between these two methods of spotting.

Table 2. Average Salvo Number of First Hit and Average rounds per Satisfactory Mission

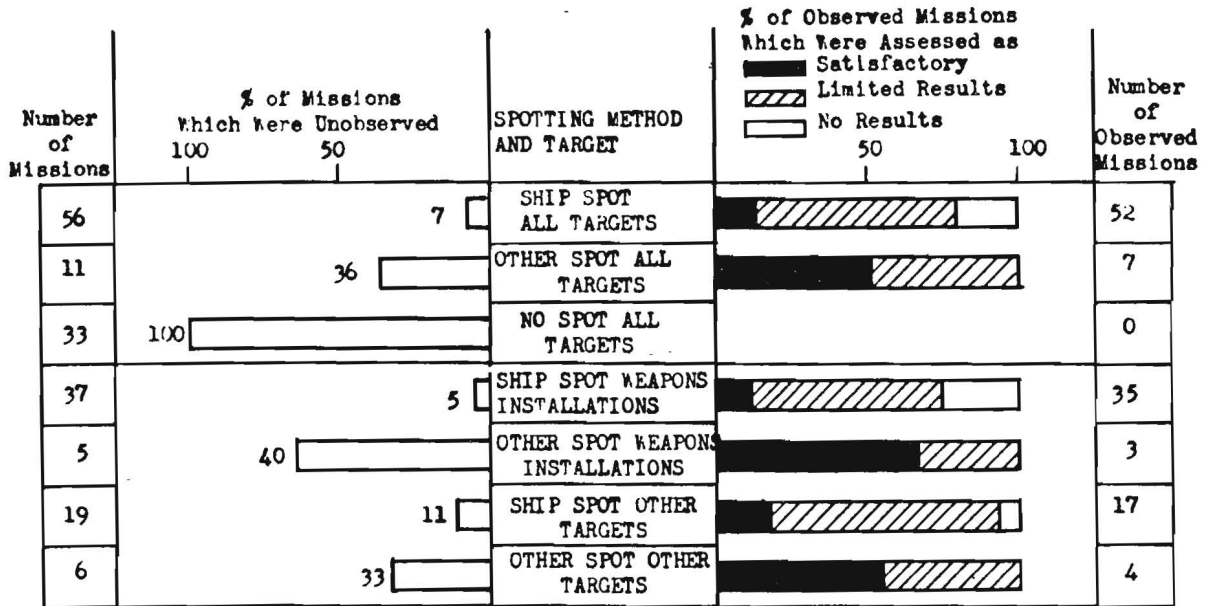
	Ship	NEW JERSEY	NEW JERSEY	MISSOURI
	Target	Bridges	Other targets	Bridges
Helicopter Spotting	Av. salvo no. of 1st hit	4.0	3.3	8
	No. of missions	4	18	**
Spotting by other aircraft	Av. salvo no. of 1st hit	6.1	3.8	14
	No. of missions	12	36	*
Helicopter Spotting	Av. rounds per satisfactory mission	12.0	13.3	26
	No. of missions	2	11	*
Spotting by other aircraft	Av. rounds per satisfactory mission	27.6	17.9	44
	No. of missions	8	28	*

*The numbers of missions for MISSOURI are not given in reference (a). Since MISSOURI fired only 20 bridge missions, the averages are based on small samples.

This does not confirm the conclusion...that spotting by helicopter was significantly more economical in ammunition than was spotting by carrier aircraft. In the case of NEW JERSEY the differences in expenditures were not statistically significant although the helicopter spotting seems to have retained the advantage. It is noted from table 2 that with both methods of spotting NEW JERSEY obtained hits on earlier salvos, on the average, than did MISSOURI. Reference (a) suggested that the difference in spotting performances of helicopters and carrier aircraft might be accounted for by the lack of spotting training for the pilots of the carrier aircraft. It is possible that carrier pilots more experienced in spotting were responsible for the reduction in the gap between spotting performances of helicopters and of other aircraft.

Figure 19 presents NEW JERSEY's assessment of mission effectiveness for various spotting methods for 5" batteries.

FIGURE 19



EFFECTIVENESS OF NEW JERSEY'S
5" BATTERY BY SPOTTING METHOD

Figure 19 indicates that for the 5" battery ship spotting was less effective than other methods, although it is not certain that this difference is statistically significant. This indication of lower effectiveness with ship spotting is observed for both weapons installations and other targets, in spite of the fact that average expenditures with ship spotting were as great as with other spotting methods. These average expenditures are shown in table 3.

Table 3. Average 5" Expenditures

	Number of missions	Rounds per mission
Weapons Installations		
Ship spotting	37	27.5
Other spotting	5	23.0
Other Targets (excluding illumination)		
Ship spotting	19	26.6
Other spotting	6	24.7

While it is not possible to state conclusively the relative sizes of the differences in effectiveness for the various spotting methods, it should be pointed out that figures 18 and 19 tend to confirm the order of effectiveness recorded in reference (b). This order is: ground spot, air spot (helicopter and other types), ship spot, no spotting. It is hoped that a much larger sample of Gunfire Support Records now being studied will bring out the sizes of the differences, if such differences do indeed exist.

RESTRICTED SECURITY INFORMATION

GUNFIRE SUPPORT RECORD

1400-GUN-04
NAVY--PEARL HARBOR, T.H.

PACFLT EVALUATION GROUP

Mail one (1) copy to:
PACFLT EVALUATION GROUP
CIBCPACFLT HEADQTRS.
FLEET P.O., SAN FRANCISCO, CALIF.

CONFIDENTIAL WHEN FILLED IN

SHIP	NUMBER	DATE	SUNRISE	SUNSET
LOCATION (LAT) (LONG)		PLACE NAME	HRS.	HRS.
TARGET (Type, Coordinates, Terrain) (One Mission Only Per Sheet if Possible)				

REQUESTED BY	METHOD OF SPOTTING	CLASSIFICATION
<input checked="" type="checkbox"/> CHECK APPROPRIATE BOXES)	<input checked="" type="checkbox"/> CHECK APPROPRIATE BOXES)	<input checked="" type="checkbox"/> CHECK APPROPRIATE BOXES)
1. PREINVASION BOMBARDMENT	0. NO INFORMATION	0. CLOSE SUPPORT
2. SATURATION BOMBARDMENT	1. NO SPOTTING	1. DEEP SUPPORT
3. SHORE FIRE CONTROL PARTY	2. DIRECT VISUAL SHIP SPOT	2. HARASSING
4. AIR SPOT	3. SFCP ON OTHER GROUND SPOT	3. INTERDICTION
5. TARGET OF OPPORTUNITY	4. AIRSPOT (OTHER THAN HELICOPTER)	4. COUNTERBATTERY
6. DEFENSIVE (PROTECT OWN SHIP)	5. HELICOPTER	5. ILLUMINATION
7. OTHER (SPECIFY)	6. OTHER (SPECIFY)	6. NEUTRALIZATION
		7. DESTRUCTION
		8. OTHER (SPECIFY) *

TIME REQUESTED →	HOURS	MINUTES	TYPE OF FIRE →	<input type="checkbox"/> DIRECT	<input type="checkbox"/> INDIRECT
TIME TAKEN UNDER FIRE	TIME OF CEASE FIRE		SALVO NUMBER OF FIRST OBSERVED HIT (After Open Fire)		
APPROXIMATE BEAR RANGE			TIME (After Open Fire) TO FIRST OBSERVED HIT		

EFFECT OF MISSION*	VERIFICATION*	
<input checked="" type="checkbox"/> CHECK APPROPRIATE BOXES)	<input checked="" type="checkbox"/> CHECK APPROPRIATE BOXES)	<input checked="" type="checkbox"/> CHECK APPROPRIATE BOXES)
0. UNOBSERVED, UNREPORTED OR NO REPORT AVAILABLE	0. NO INFORMATION	5. SPOTTER UNSUCCESSFUL IN ATTEMPT
1. NO APPARENT RESULTS	1. UNOBSERVED (NO ATTEMPT MADE TO OBSERVE)	6. AERIAL RECON. BY HELICOPTER
2. SOME EFFECT OBSERVED	2. OBSERVED BY SPOTTER	7. OBSERVED FROM SHIP
3. LARGE EFFECT OBSERVED	3. OBSERVED AT A LATER TIME	8. PHOTOGRAPHIC RECONNAISSANCE
4. MISSION COMPLETELY SUCCESSFUL	4. ESTIMATED FROM EFFECT UPON OPERATIONS	9. OTHER (SPECIFY)

NUMBER OF TARGETS IF MULTIPLE (Report Single Mission on Each Sheet if Possible)	WIND VELOCITY (Knots)
WEATHER & VISIBILITY (If Considered They May Have Affected Operations)	

NUMBER OF ROUNDS				
NUMBER	CALIBER & TYPE	CHECK ONE		FUZE
		FULL	REDUCED	

<input checked="" type="checkbox"/> CHECK APPROPRIATE BOXES)	COMMUNICATIONS
1. SATISFACTORY	
2. NOT COMPLETELY SATISFACTORY BUT DID NOT IMPAIR SUCCESS OF OPERATION	
3. UNSATISFACTORY TO THE POINT OF MAKING MISSION DIFFICULT	
4. UNSATISFACTORY TO THE POINT OF MAKING MISSION UNSUCCESSFUL	

CONFIDENTIAL WHEN FILLED IN

*Indicate On Reverse Side As Necessary (Over)

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PACFLT EVALUATION GROUP

TARGET CLASSIFICATION

Target classification code, using numerals in left-hand column to identify specific types of targets within overall categories (top line). A highway bridge, for instance, would be 42; self-propelled guns would be 52; an airfield would be 67.

TARGET CLASSIFICATION

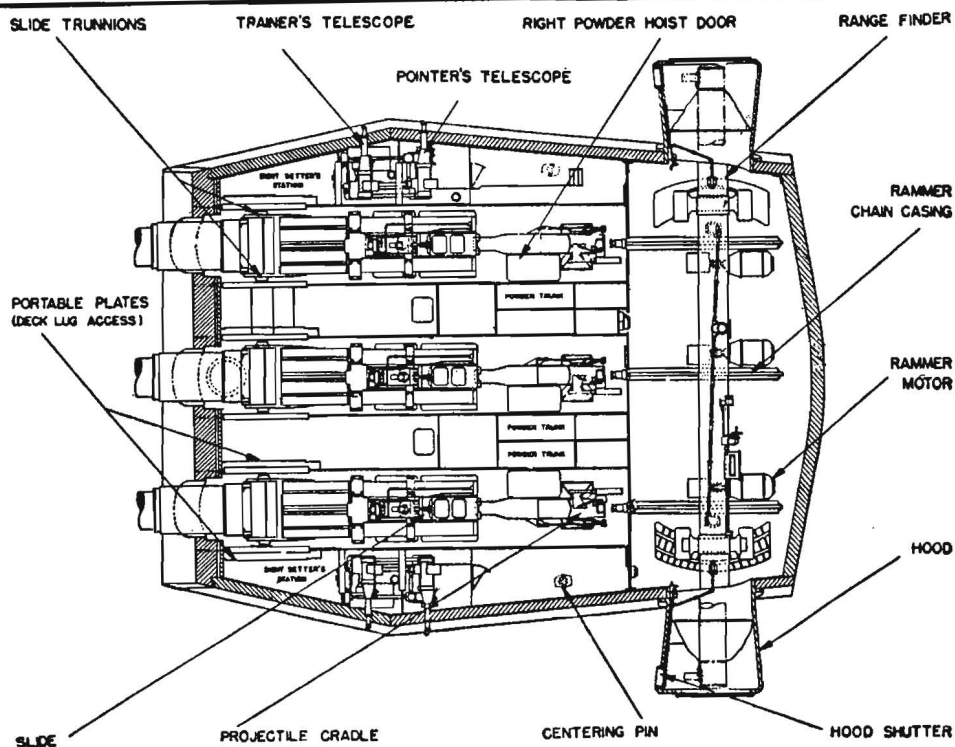
Fixed Weapon Installations	Personnel	RR	Highway	Armored vehicles	Military install.	Areas	Shore installations	Naval
1	2	3	4	5	6	7	8	9
1 Gun emplacement	Troops in open	RR tracks	Highway	Tanks	Supply dump	Assembly area	Shore installations	Moored
2 Mach. gun empl.	Troops dug in	RR bridge	Highway bridge	Self-prop. guns	Fuel dump	Industrial area	Factories	Beached
3 Shore battery	Troops on roads	RR tunnel	Highway tunnel		Ammo dump	Waterfront area	Docks	Underway
4 Pill box, large	Troop concentration	RR yard	Highway traffic (moving)		Headquarters	Dock area	Warehouses	Landing craft, small boats
5 Pill-box, small	Troops & guns	RR junction	Highway junction		Command post	Cities & Towns	Ramping stations	tugs & barges
6 Bunker	Troops & tanks	RR rolling stock	Vehicle concentrations		Observation post	Warehouse area	Buildings	
7	Troops & vehicles	Locomotive	Horses		Airfield	Warehouse & dock area	Shore inst. & moored vessels	
8 Covered gun empl.	Troops tanks & artill.	Grade crossing	Bypass		Radio station	Illumination area	Oil tanks	
9 Mortar position	Troops supply dumps		Truck		Troop trenches or strong point	Town with troops	Elec. power installation	

COMMUNICATIONS

Gunfire Support Records submitted by ships to the Pacific Fleet Evaluation Group include data concerning the degree of satisfaction of communications between the ship and the air or ground spotters or observers. These degrees of satisfaction are as follows:

1. Satisfactory
2. Not completely satisfactory but did not impair the success of the operation
3. Unsatisfactory to the point of making the mission difficult
4. Unsatisfactory to the point of making the mission unsuccessful

This memorandum summarizes 287 16" battery missions and 112 5" battery missions fired by NEW JERSEY in Korea in 1951. On 157 of the 16" missions no communications were required, the missions being carried out with spotting from the ship or with no spotting. On four records no report concerning the degree of satisfaction was made. A tabulation of the reports of the 126 remaining missions is given in table 3-1. It is noted that communications were completely satisfactory on 75% of the missions. Communications were unsatisfactory (degrees 3 and 4) on only 7% of the missions.



Plan view of 16"/45 turret.

TABLE 3-1

Distribution of 16" Battery Missions with respect to
Degree of Satisfaction of Communications and Party
Communicated with

Communications with	Degree of satisfaction of communications				Total
	1	2	3	4	
SFCP	19	2	2	0	23
Aircraft (other than helicopter)	57	4	0	3	64
Helicopter	15	6	1	2	24
Other ship	1	0	0	0	1
Front Line Troops	3	11	0	0	14
Total	95	23	3	5	126

Table 3-2 lists those missions on which communications were less than completely satisfactory, giving date, location, target, and any comments made by the ship.

Table 3-2

16" Battery Missions on Which Communications Were
Less than Completely Successful

<u>Date</u>	<u>Target and Location</u>	<u>Communications With</u>	<u>Degree of Satisfaction of Communications</u>	<u>Comments</u>
4 Jun 51	Gun emplacements on Kaimagak	AIRCRAFT	2	"Communications were delayed and the overall picture confused by the fact that the ship could not hear the air spotter direct, but all air spotter remarks were relayed by ships helicopter which was airborne but not used for spotting because of heavy AA reported."
6 Jun 51	Trucks near Kosong	AIRCRAFT	4	None
6 Jun 51	Artillery Regiment near Kosong	AIRCRAFT	4	None
6 Jul 51	Troops near Kansong	SFCP	2	"Communications were through two relaying stations but no difficulty was experienced."

<u>Date</u>	<u>Target and Location</u>	<u>Communications With</u>	<u>Degree of Satisfaction of Communications</u>	<u>Comments</u>
6 Jul 51	Road Junction near Kansong	AIRCRAFT	2	None
18 Aug 51	11 missions against troops near Kosong	FRONT LINE TROOPS	2	Reports were relayed to ship via SFCP.
18 Aug 51	Troops dug in near Kosong	SFCP	3	"After first salvo was fired there was considerable interference on the spotting circuit caused by a materiel or personnel failure on another ship."
30 Aug 51	Two missions during the amphibious demonstration at Kosong.	HELICOPTER	4	One of these missions, against a bridge, "was interrupted by communication failures which caused large delays between salvos."
30-31 Aug 51	Six missions against targets of various types during an amphibious demonstration at Kosong.	HELICOPTER	2	None
22 Sep 51	Guns and troops near Kosong	AIRCRAFT	4	"Communications were poor because of intervening hills."
23 Sep 51	Troops dug in near Kosong	SFCP	3	"Communications were by relay through a spotting aircraft. Aircraft had to leave after four salvos thus discontinuing the mission and preventing receipt of the results."
2 Nov 51	Railroad and highway bridge near Wonsan	AIRCRAFT	2	None
3 Nov 51	Railroad yard at Hungnam	HELICOPTER	3	None
11 Nov 51	Assembly area near Kosong	SFCP	2	None
13 Nov 51	Troops in village Ongjin Peninsula (West coast of Korea)	AIRCRAFT	2	HMS SYDNEY PLANE

On 95 of the 5" missions no communications were required. No report concerning communications was made on two other missions. Communications were not completely satisfactory on only one of the remaining 15 missions. This was in connection with an SFCP-spotted mission against a shore battery at Wonsan on 2 November. No indication was made, in the report, as to the nature of the difficulty.

9 October 1953

COMMENTS TO PACIFIC FLEET EVALUATION GROUP - Naval Liaison
Officer, 8th U.S. Army, formerly Commander Destroyer Division
32.

The answers given below should be considered in proper perspective. Naval gunfire was particularly valuable and effective on the East coast of Korea during hostilities because the following considerations governed. In the event that one or more were not present in a future imbroglio, the Navy would probably not have it so good.

a. The Communists did not possess sufficient land-based artillery or aircraft to effectively oppose our ships at the bomblines.

b. They possessed no naval capabilities at all as far as aerial, surface, or sub-surface attacks were concerned. Their mining ability, while greater, actually proved only a minor hindrance and annoyance except in Wonsan Harbor.

c. The I ROK Corps possessed inadequate artillery. Even the 10th U.S. Corps possessed no 240 MM guns until two weeks before the Armistice.

1. PLEASE DISCUSS NGFS AT THE BOMBLINE.

Naval gunfire on the bomblines, East coast, Korea, fulfilled the function of supplementing the fires of the supporting arms, artillery and close air support. This sector of the Eighth Army front was the responsibility of the I ROK Corps.

The fire support available varied from the 5-inch fires of one destroyer to the combined fires of a BB, a CA or CL, and two to three DD's. Throughout, at least one DD was available at all times. Starting with approximately March, 1953, a CA was on the line continuously except during special gun strikes such as those at Wonsan.

As much as possible air spot was used with the heavier ships to provide better observation and to take advantage of those ships' ability to strike the deeper and more vulnerable areas of the enemy. Because the battle line was static for so long, it was usually felt to be more economical to use only the 5-inch fires of the DD's in close support, except in case of attack or counterattack, when all fires available would be used in direct support of the division engaged.

On a normal day the ground OP's would call in as many as six to twelve fire missions, expending anywhere from 100 to 200 rounds, usually of five-inch. The combined activity of the air spotters, during operational weather, would average

approximately the same. They used mainly 8-inch and 16-inch, when available. This Corps I ROK also handled the assignment and coordination of fires for the X U.S. Corps. All of these were 8 or 16-inch missions air-spotted on deep targets, such as supply centers. During the period 1 April 1952 to 27 July 1953 approximately 4,000 rounds of 8 and 16-inch ammunition was expended in support of X U.S. Corps. By contrast 158,947 rounds of various calibers were fired in support of I ROK Corps during the same period.

(a) EFFECTIVENESS OF DIFFERENT CALIBRES.

1. It was generally noted that the larger the calibre the more accurate the initial salvo. This perhaps indicates that larger-calibre fire support ships and fire control systems were better adapted to the firing of shore bombardment.

2. There were no enemy fortifications known which could withstand the fire of 16-inch guns. It is also felt that 8-inch fires were capable of destroying any enemy fortifications in the I ROK Corps sector. However, at extreme effective ranges, as when firing inland in X U.S. Corps, there may have been some enemy positions capable of withstanding 8-inch fire, but not without taking heavy damage.

3. In many cases 5-inch fires were not effective against strong fortifications, and it generally took a large number of 5-inch rounds to destroy or do permanent damage. However, much destruction was accomplished against lightly fortified targets, such as might be found on reverse or seaward slopes. Also 5-inch fire was effective against troops in the open and in trenches, and for area neutralization fire. It was most effective at short ranges and when circumstances enabled the ship to take targets under direct fire. Many ships had difficulty with their fire control solution in indirect fire, and used an excessive number of rounds in adjustment. Such difficulties also caused the fire for effect to drift off the target, since by that time solution errors were sizeable.

5. It should be added on the effectiveness of various calibres of naval gunfire, that there was a noticeable difference in accuracy among ships firing on the bomblines with the same size guns. It was quite evident that some ships' state of training in shore bombardment was inadequate upon their arrival. Generally most ships improved, proportionate to the length of time they stayed on the bomblines. However, had the tactical situation been fluid, it is believed that a small number of ships, especially destroyers, would have found it difficult to render adequate support. West Coast destroyers were, on the average, more effective than East Coast destroyers.

(c) MOST EFFECTIVE RANGES

1. Range did not have a noticeable effect on accuracy as long as ships did not fire outside the maximum effective ranges of their guns. At ranges greater than maximum effective range,* the dispersion usually was so great that spots did not take effect. This indicates area neutralization only at such ranges.

(d) TYPE OF TARGETS

1. In the front-line area there was a predominance of point targets, such as bunkers and trench lines, with gun positions and fighting positions attached. A series of off-set missions were found the most effective way to destroy such a chain of point targets. The bunkers varied from those of flimsy construction to well dug-in, heavily reenforced positions, requiring large calibres for destruction. Built largely of logs, sandbags, and earth, some of these positions had overheads 5 to 10 feet thick and were imbedded 6 to 10 yards into the side of hills. Naval gunfire with its characteristic flat trajectory and high velocity was quite effective against these structures. This type of bunker housed automatic weapons, 76-mm. guns, OP's, CP's, and living shelters.

2. Deep targets consisted of supply shelters, ammunition storage, bivouac areas, motor parks, etc. These targets were all good Naval gunfire targets, but necessitated the use of air spot because of their location and the use of large calibres because they were usually too far inland for 5-inch.

3. The terrain presented a great problem because of its ruggedness versus the flat trajectory of naval rifles. Caution was required in the selection of a line of fire and in the positioning of the ship in order to place the range dispersion along the long axis of the target** and to provide a high enough ordinate to clear intervening hills.

4. O.P. 1714 was pretty reliable in general.***

5. Considering the bomblines, Kojo, Wonsan, Hungnam, i.e. the whole East Coast, the following should be good and profitable targets. Accept the statement that excessive range does not justify the use of larger calibre, with reservation for emergencies and an individual situation exception to the general rule.

* The greatest distance at which accuracy may be expected.

** See note, P. 29.

***OP 1714, Selection of Projectiles & Fuzes for Attack of Ship & Shore Targets (Bureau of Ordnance, 1951), described ammunition in Fleet use and recommended combinations of shells and fuzes for use against various targets.

- 16" In heavily fortified emplacements at effective ranges, or area (close up) targets at longer ranges. Emplacement with gun, fortified bunker to be taken, guns holding up advance. Oil tanks, hangars with planes, factories, vehicle parks, landing field runways, reen forced concrete command posts, direct support of MLR under attack.
- 8" In moderately or heavily fortified emplacements at effective ranges, or productive area targets at longer ranges.
(Same as for 16" gun)
- 5" In exposed, or lightly protected emplacements or areas: Mortars, machine guns, moving vehicles, personnel, light artillery pieces, interdiction, illumination, harassing, direct support of MLR under attack.

(e) ACCURACY vs. RANGE

1. Accuracy of large calibres was good at all ranges inside maximum effective range. Range patterns appeared to vary with the gun-wear curves* for the various ships. Often a large difference in range patterns could be discerned when adjustment was made with one gun and multiple-gun salvos were used in fire for effect. Most spotters eventually adopted the procedure of using the same gun throughout the mission for destruction of point targets in order to overcome the excessive dispersion in salvos of two or more guns. Some more work can be done on correcting ship batteries for parallax, erosion, etc.

(f) SPOTTING - RELATIVE EFFICIENCY OF DIFFERENT TYPES: HOW TO IMPROVE

1. At least 90 percent of the ground spotting was adjusted along the observer-target line. Often if the ship was visible to the spotter, it was more advantageous to make adjustments along the GT line. This method decreased the delay between rounds and in rugged terrain helped the spotter visualize the needed corrections as they would actually be applied to the guns. It was found that altitude spots were much more effective than range spots in many cases and resulted in quicker adjustment. This may seem to be obvious considering the terrain fired on, but it was surprising the number of spotters who had been taught to adjust with range corrections only.

* Dispersion -- the size of the pattern of fall of shot in a salvo -- increases as the guns' rifling erodes.

3. The speed with which the various ships made correction to their fire control problem varied with the individual ship's state of training but almost without exception the faster the correction the greater was its accuracy. For adjustment along the GT line the accuracy was much greater when the ships were lying to rather than underway. If the ship must be underway during an air-spotted mission, it might be possible for the corrections to be made by the spotter along some fixed imaginary line along the ground, from which the ship could correct to the GT line, as in ground spotting. It is understood that ATP 4* will make provision for such a method.

4. The use of a slope factor by ground spotters was found to increase the accuracy of firing on point targets situated in rugged terrain. It is believed that much more experimentation should be conducted with this method before it is recommended for general use. U.S.S. ST. PAUL tried it shortly before the end of hostilities, but inadequate time existed to evaluate the method.

6. Accuracy of firing was increased by use of a combination direct fire-shore spot method. The ship was given a reference point, which they could see, within offset distance of the target. They put their director on this point; the spotter gave an offset and adjusted along the GT or OT line as desired. In this way both speed and accuracy of adjustment were increased. This was tried only with targets at short range, not greater than 8-10,000 yards, that were not visible to the ship, but had a point within 1,000 yards that was visible. The method was used only with destroyers.

7. For security reasons a system was developed whereby azimuths were done away with as an element of the fire mission transmitted to the ship by the spotter. The observation posts were given letter designations such as CA, CB, etc. The coordinates of these positions were given to the ships by guard mail. The spotter then used the call signs "Charley Able," "Charley Baker," etc., depending upon which OP he was firing from. The call signs of the OP's changed daily according to a monthly designator code worked out by the liaison officer.

* ATP 4, a tactical publication then in preparation for joint US-Allied use. Designation of positions by referring to a "thrust line" drawn on the map was used in WWII; Rommel made good use of it in North Africa.

(h) WHY NGF NECESSARY IF ARTILLERY ADEQUATE

1. Aside from complementing the artillery and aircraft fires, naval gunfire had a great psychological importance, not only to the ROK's but also the enemy. Both sides learned to have great respect for the destructive capabilities of naval gunfire. When heavy fighting was in progress, it was impossible to fill all the requests made for naval gunfire.

2. The ability to strike the enemy from so many different angles made naval gunfire especially effective. The fact that naval gunfire could hit deep inland and in the enemy rear areas made it a constant threat and played much on enemy nerves. PW reports verified this.

3. Our flat trajectory and high muzzle velocity were excellent for destroying bunker type targets, which could be made relatively immune to the high angle artillery fire.* The large calibres of naval gunfire were capable of destroying any target they could reach.

4. Naval gunfire illumination was superior in all respects to artillery and mortar illumination.

5. In many cases it was possible to fire on the reverse slopes of the enemy MLR by using a line of fire directly towards our own front lines. This was possible, since the ships could steam north up the coast and fire south.

6. In addition, it is felt that the training acquired in shore bombardment under combat conditions by most line ships in the Fleet would alone have justified the use of naval gunfire in Korea.

(i) WHY NGF NECESSARY IF CLOSE AIR SUPPORT ADEQUATE

1. Naval gunfire was in most cases able to replace close air support, thus releasing the available air to more critical sectors of the front. Since in many cases our line of fire could parallel friendly front lines, the tight deflection pattern of naval gunfire was excellent in a close support role. Eight and 16-inch calibres were fired as close as 300 yards to friendly units, which is as close or closer than air could have supported.

2. Economically speaking a few rounds of 8- or 16-inch naval gunfire could achieve the same or greater destruction as a combat-loaded AD from a carrier, and the aircraft was not endangered.

* Fire of howitzers and mortars.

Comments compiled from PACFLT Evaluation Group Questionnaire and Action Reports follow:

Q. Please comment on spotting services for various types of fire missions. Were special measures taken for elevated targets in rough terrain? Were communications generally satisfactory?

A. Air Spots: Air spotters were provided by the following sources:

a. Task Force 77 - Fighter aircraft, furnished in all areas north of the bomblines. Within the limits of CTF 77's ability to provide air spotters along with other commitments, and in consideration of the stalemate conditions adequate numbers of aircraft for naval gunfire spotting were available. Where time permitted the pre-briefing of pilots, the spotting services were good. The ability of individual spotters varied from excellent to poor; in general, the level of training of pilots as gunfire spotters appeared to be fairly low. It is felt that gunfire spotters should be given intensive training in spotting methods and procedures, emphasizing three-dimensional spotting. Contingent upon the availability of escort carriers, in future operations it is recommended that one CVE be assigned for the purpose of providing trained gunfire spotters.

b. Mosquito Spotters flown by ROK pilots were available on a very limited basis in the vicinity of the bomblines. Due to the fact that NGLO had no assigned aircraft but was dependent upon I ROK Corps FSCC for air spotters, insufficient mosquito planes were available. Frequently one aircraft provided spotting services for two ships simultaneously. The marine spotters who flew in these Mosquito aircraft were expert and very well trained.

c. The availability of helicopter spot depended upon weather, the amount of AA fire that would be anticipated, and the proximity of targets to the beach. Helicopter operations were limited to off-shore observation. The Marine gunfire spotters assigned to the ship were well trained and performed very well.

SFCP Spotters: Available at Wonsan, and at the bomblines. Spotters were also available off Kojo, but were not used. These in general were well trained and spotted freely in 3 dimensions.

In rough terrain, three-dimension spotting was necessary, but many air spotters were reluctant to use elevation spots. Those spotters who used elevation spots were usually successful in obtaining adjustment after relatively few salvos. In training spotters the use of elevation spots in rough terrain should be emphasized.

The most effective spotting was by helicopter in the areas where it could be used. The helicopter spotter was supplied by the ship, so it was possible to brief him on all targets prior to firing, thereby reducing the possibility of spotting to wrong targets. The spotting service supplied by Navy planes ranged from fair to excellent - the times that it was other than excellent seemed due to lack of knowledge of spotting techniques. In all cases enthusiasm and cooperation on their part left nothing to be desired. The ship developed a spotting technique of using own deflection spot on visible targets and air spot in range. This proved to be highly effective against small pin-point targets. The high altitude at which the Air Force spotters flew seemed to make them completely ineffective.

SFCP spotting was used almost exclusively in Wonsan with excellent results. They were usually up to date on the most active gun positions and were very helpful in directing counterbattery fire.

Q. What do you consider was your class ship's most significant accomplishment during the Korean War? Please evaluate.

A. Training - overall readiness of the Fleet and Navy greatly raised by experience gained by thousands of men serving in WESTPAC operations.

The most significant accomplishment of the fast battleship during the Korean War has been the effective employment of the main battery for destructive fire at all ranges against enemy targets otherwise immune to major damage from bombing or small caliber gunfire.

Destroying MSR bridges and tunnels.

Q. Do you feel that the employment of the heavy support ships in the Korean War was the most effective and practical?

A. Employment of the battleship on Korean coastal targets was considered very effective. The 16" gun often was the only weapon that had the capability to reach and destroy reinforced gun emplacements in Wonsan, and MSR bridges and tunnels on the Korean East Coast. Usually after a visit to a target area by a Battleship, enemy transportation along the eastern MSR ceased almost altogether for several days.

Q. Based upon your contacts with troops and SFCP at the bomblines, do you consider that NGFS made a substantial contribution to the accomplishment of the ground tasks?

A. Definitely yes. Personal conversations with SFCP and NGLO personnel indicated that battleship naval gunfire was of tremendous value in the support of ground operations. By virtue of mobility, heavy hitting power, and long range, the sixteen-inch battery was able to reach important targets, many of which were beyond artillery range, and inaccessible to aircraft, with good results.

Q. What restrictions were necessary to place on your maneuvers in order to maintain accurate NGF?

A. Extent of maneuvering depends upon the limits of accuracy of the pitometer log system. In general, this if ship either lay to or steamed at speeds above five (5) knots, a reasonably accurate solution can be maintained while maneuvering. Below five (5) knots, holding an accurate solution while maneuvering is difficult.

The installed computers and rangekeepers are capable, if properly operated, of maintaining a good fire control solution with the ship making extreme or evasive maneuvers. During operations in Korea this vessel had well trained fire control personnel on board, and it is felt these personnel could cope with any battle or tactical situation effectively.

Q. What procedure do you recommend against pin-point targets?

A. Direct Destructive Fire where practical. Where indirect fire is necessary, recommend the following procedure:

a. Careful navigational tracking.

b. Careful selection of target elevation from the grid chart.

c. Frequent checks of navigational range and bearing against the generated values on the computer or rangekeeper.

d. The spotter should spot directly to the target, using three-dimension spotting, not using a bracketing or halving method.

e. Spots should be applied to the generated values on the rangekeeper or computer rather than being applied on the spot knobs. This method employs the known trajectory as a measuring stick and, in effect, corrects the ship's position with reference to the target.

Q. Please comment on your air defense capability--detection, controlling intercepts land effect, altitude, --against props and jets, single and multiple? Type radar?

A. The air defense capability of the ship could be improved with the installation of more up to date equipment.

At present the SR-3 is the primary air search radar; the SP radar is used for height finding. During task force operations jet aircraft could be detected and be tracked at ranges of 50 miles maximum; propeller driven aircraft could be detected and tracked at an average maximum range of 75 miles. At times however, the latter type aircraft were detected and tracked at distances of 110 miles.

Q. Please comment on your AA gunnery capability -- readiness, training, batteries, multiple targets, coordination?

(AA gunnery capabilities vary considerably depending upon type equipment and amount of training received. Many ships experienced numerous changes in personnel, also long lapses in AA training due to weather and/or operational schedules. AA training in WESTPAC is expected to increase considerably with cessation of hostilities. Most ships report weakness in target acquisition and coordination, and preparation to cope with multiple targets.)

A. The equipment of the AA battery of this vessel is relatively antiquated, and of World War II vintage. Only two of the four MK 37 directors are equipped with MK 25-3 radar. The heavy machine gun battery still consists of 20 quadruple 40mm mounts, employing MK 51 or MK 57 control systems. The target designation system is entirely inadequate.

The AA battery is organized on the basis of four groups for the 5" battery, and four sectors of 40mm. Four 5" mounts can be controlled from MK 57 directors which provides additional flexibility for control against multiple targets.

Due to the nature of the ship's employment as a Flagship Unit, the state of training of the AA battery is relatively low. Until very recently there were few opportunities for conducting AA practice firings.

Every opportunity was taken for training AA Battery crews by tracking when air targets were available. When operating with TF 77 all vessels were afforded an opportunity for firing against sleeves and small drone targets. This vessel operated singly a great part of the period covered by this report and AA sleeve and small drone practices were conducted at every opportunity. However, extensive AA training could not be had.

Q. Action reports have repeatedly contained adverse comments concerning communications. Remarks on the excessive circuit requirements of various communication plans, excessive volume of traffic, misuse of precedence, unnecessary messages, etc., were usually general and seldom accompanied by specific examples and/or recommendations. Can you cite specific examples?

A. Flag circuit requirements, when added to the ship's normal tactical and control circuits requirements, produced some situations in which all of the ship's transmitters and receivers were in use simultaneously. At such times, two harmful effects were noted:

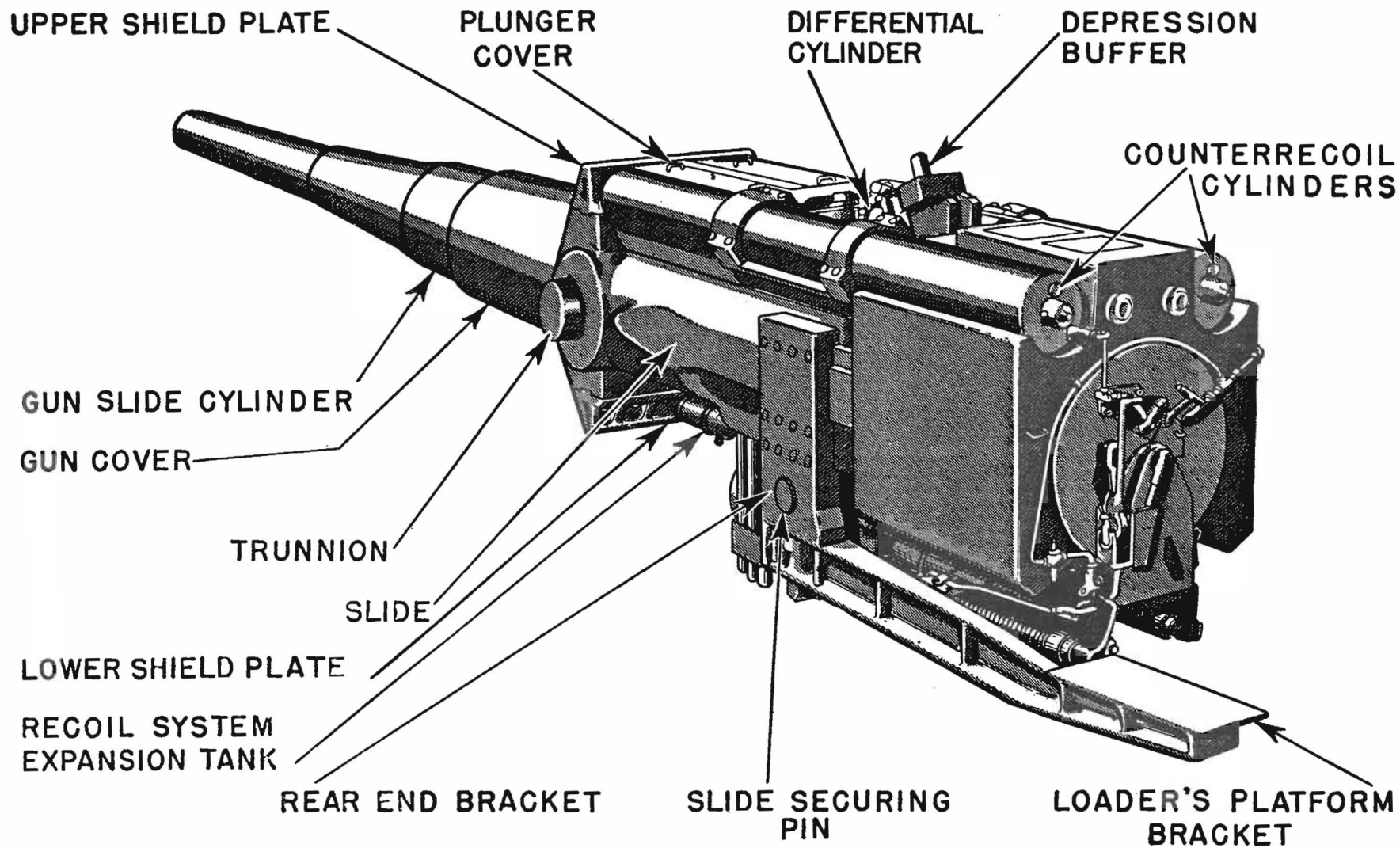
a. The ship's tactical and CI circuits sometimes suffered because the strongest transmitter and receiver equipment had already been utilized for Flag requirements.

b. Interference on tactical and CI nets was occasionally experienced which was traceable to the number of circuits being guarded at the same time. (Interference between transmitter and receiver antennas located close together, where the necessity for using all equipment made it impossible to so select antennas as to minimize such interference).

There is some indication, therefore, that from the standpoint of communications, particularly tactical communications, the use of a battleship as the flagship of a major command (which necessarily must handle a large amount of administrative traffic) is not entirely satisfactory.

Generally far too many circuits are employed, causing over-crowding of communications spaces and CIC and imposing excessive maintenance work on Electronics Technicians. As a general rule, circuits should be consolidated to the point at which traffic is not excessive from the standpoint of both quantity and timeliness. Actual determination of which circuits should be consolidated would take careful and extended study. Logging* of most circuits is considered a luxury and an undue convenience not consonant with the manpower required.

*** Maintenance of a written record of message traffic.**



Quartering view of 16-inch gun assembly.

III. VIETNAM

NEW JERSEY COMMAND HISTORIES, 1968-69:

In August of 1967, the decision was made to commission NEW JERSEY for the third time, this time to serve for the duration of hostilities in Southeast Asia. The program change decision which approved the activation of the battleship was "for employment in the Pacific Fleet to augment the naval gunfire support force in Southeast Asia." The real motivation behind the activation was that "a major calibre* gunfire support ship is necessary if we are to continue, after October 1968, the present deployment level of two such ships (major calibre gunfire support) in Southeast Asia." Much has been said as to why the Secretary of Defense chose the battleship over another eight-inch cruiser. Some contend it was because the 16-inch guns have a greater range and pack a more powerful punch. This was not the rationale of the Secretary of Defense. His primary contention was that the battleship was significantly harder, i.e., less vulnerable than the eight-inch cruiser. Additionally, the Secretary's decision stated "analysis shows that the battleship with 16-inch guns provides greater effectiveness for equal cost than the cruiser with eight-inch guns in this limited mission (naval gunfire support).

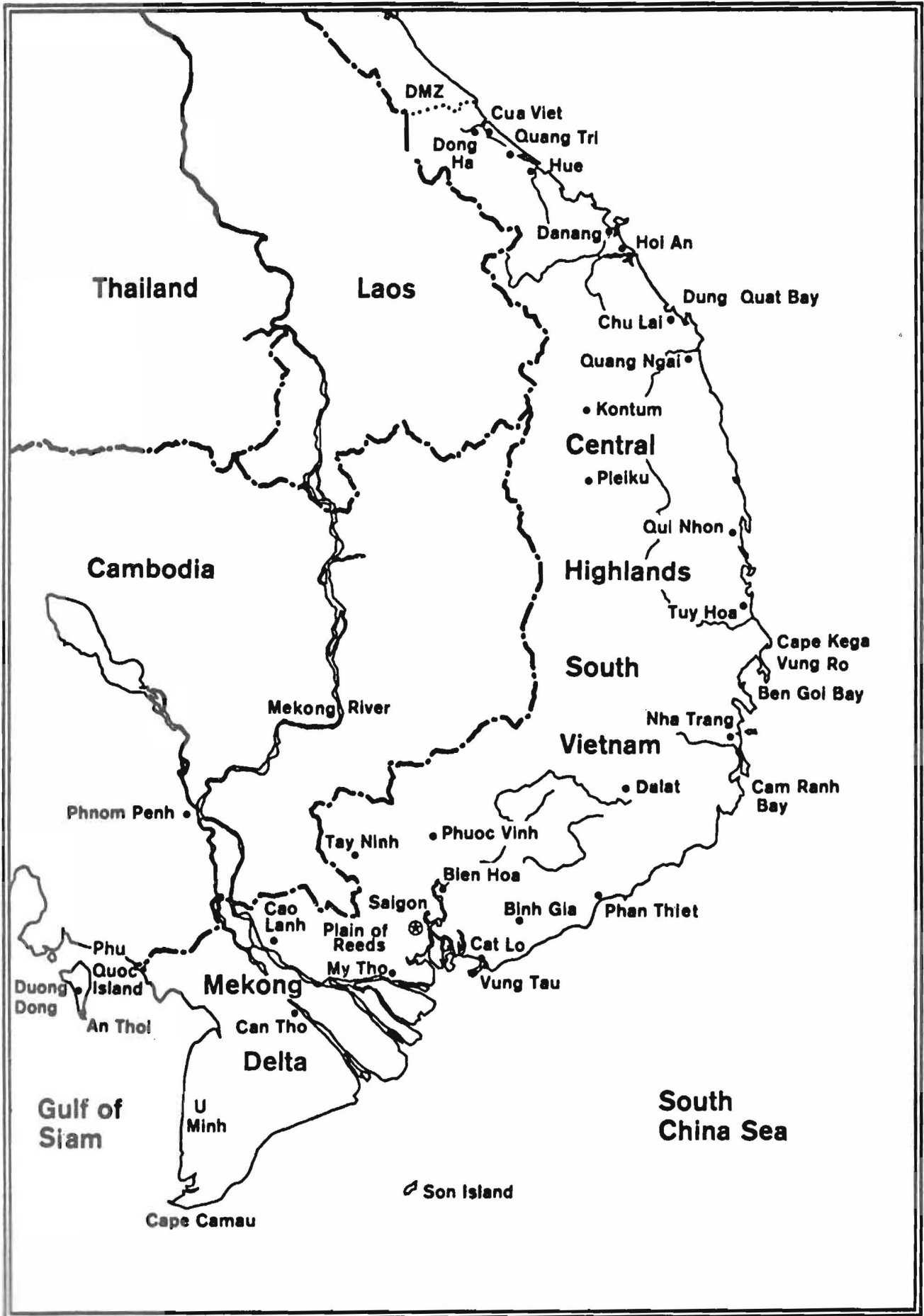
The huge ship performed well that first day [30 September 1968] expending 29 main battery rounds on four targets in and around the DMZ. A fortified storage area was destroyed, with the access road cut in two places and 300 meters of trench line torn up. An automatic weapons position which threatened the Marine spotter aloft in a TA-4 was silenced. An enemy artillery site was totally destroyed. Another storage area, with five fortified bunkers, was destroyed.

On Tuesday, 1 October, the ship took station to the north of Tiger Island and fired at targets seven to twelve miles north of the DMZ. The ship again moved south in the afternoon to fire into the buffer zone. A Marine TA-4 aircraft, assigned to NEW JERSEY for spotting, was hit by ground fire while en route to one of the afternoon's targets. He reported that he was fast losing fuel and that he would have to ditch. Vectored to NEW JERSEY's position by Chief Radarman Macdonald Shand, NEW JERSEY's air controller, both men ejected safely and were rescued within minutes by TOWERS. Chief Shand was recommended for the Navy Achievement Medal for his role in the drama. Six bunkers, a supply truck and an anti-aircraft site were destroyed by the big guns that day.

During the afternoon of the 14th, again with the A7's from the AMERICA doing the spotting, NEW JERSEY fired for 30 minutes at coastal artillery sites on Hon Matt Island. The spotter noted one secondary explosion and one battery obliterated. As the debris settled, the spotter reported, "you've blown away a large slice of the island--it's down in the ocean."

After departing II Corps, NEW JERSEY was the recipient of a Chinese made machine gun, captured at the battle of Kinh Mon. The presentation

* 8-inch or larger. In 1968 the Navy had active 8"-gun cruisers.



was made to Captain Snyder on behalf of the officers and men of the First Battalion, 61st Infantry and First Brigade, 5th Infantry in appreciation for NEW JERSEY's preparation fire just before the battle, which lasted from 23-27 October. The area had long been a Communist stronghold, and the Army had made two previous attempts to sweep it. The first try resulted in 30 U. S. killed and 60 enemy dead. The second attempt, after a B-52 strike, resulted in 61 Americans dead versus zero enemy. Then NEW JERSEY came on the scene, to soften the area for a third try. Results of the third sweep were: seven Americans lost and 301 enemy confirmed killed.

During the day two main and two secondary spotted missions were fired with 12 confirmed enemy killed included in the damage assessment. A Communist troop movement was discovered by the aerial spotter, and NEW JERSEY quickly answered his call for fire with 16-inch high capacity projectiles fitted with mechanical time fuzes. The observer reported the projectiles burst at optimum height, about 75 feet directly over the troops, who had taken cover in open trenches.

Staff Sergeant Robert Gauthier summed up the marine's feelings for NEW JERSEY in an interview over the ship's TV system: "You are doing more to improve the morale of the men on the beach than anything else in the war. Every time we go on patrol, someone says, 'The big one is out there. Nobody better mess with us or she'll get them.' You are saving lives out here...American lives. And we thank you."

He then told how he had been leading a platoon in the area where NEW JERSEY was firing in support of the Third Marine Division. "We were ordered to pull back about 200 yards so that somebody, we didn't know who at the time, could start shooting at some Communist bunkers and emplacements that had been giving us a lot of trouble. When we finally moved back about 500 yards, we heard what at first sounded like a subway train moving through a tunnel--a big rushing noise--then BANG! Later on when we went back into the area, there was nothing...just nothing. It was like something had come along with a big eraser and wiped everything clean. And they were big, heavily fortified bunkers, targets our own artillery couldn't touch."

About that same time a young marine's mother wrote the editor of a Yonkers, New York newspaper a letter that reiterated Sergeant Gauthier's words:

"...I received a letter from my son, a marine fighting in Vietnam. He closed his letter this way: 'The NEW JERSEY arrived here last week, and man, is she playing hell with Charlie! She sits out there about seven miles, big and beautiful, and when she lets go with her 16-inch guns Charlie knows he is in for some big trouble. I hope she stays out there for 135 more days. That is my time to come home, Mom, so just pray for me that I make it....To all of us here in America surrounded by all the comforts and luxuries that our country has to offer, we take a lot for granted. But to our boys so far from home, this battleship stands for freedom, security, and the renewal of faith in the fact that there are still many Americans who haven't forgotten that they are there.'"

On Tuesday, the 29th, NEW JERSEY destroyed 30 structures, three underground bunkers and 350 meters of trench line. During the afternoon the aerial observer located an enemy artillery position on a hilltop about four miles southwest of Cap Lay. The site was active and had recently been harassing allied ground troops in northern I Corps. After NEW JERSEY laid in four 16-inch rounds, the spotter radioed back "excellent coverage...keep them coming." Two rounds later the radio crackled once again. "You've just lowered the mountain by 20 feet. Artillery site destroyed."

On the 25th, the battleship notched the greatest single day's tally of the year. With General George S. Brown, Commanding General, Seventh Air Force at the firing key, and Rear Admiral David H. Bagley, Commander Task Group 70.8, on board to observe, NEW JERSEY fired eight main battery missions. One hundred seventeen structures and 32 bunkers were destroyed, and eight secondary explosions ripped through two storage areas near Quang Ngai. High capacity projectiles killed an estimated 40 Communist troops. NEW JERSEY also inflicted heavy damage to 93 structures, tore up 110 meters of trench line, and destroyed several tunnel complexes. Several of the targets were widely dispersed and the battleship fired what Chief Gunner's Mate Billie G. Baker called "spreading fire." The spotter got the ship on target then walked the shots around until the whole area had been decimated. Lookouts 120 feet above the ship's main deck reported smoke and debris rising 1,000 feet in the air over the targets.

Two other guests on Christmas Day were Army Captains Charles S. Finch, Jr. and Roger S. Bounds. Both had served as airborne spotters for NEW JERSEY during firing missions. They told NEW JERSEYMEN of the effect their shellings were having on the Communists.

"The Communist troops certainly don't like to come out when NEW JERSEY is firing," said Captain Finch. "One of our biggest problems flying into a Red infested area is the antiaircraft fire we take. But after NEW JERSEY got on station over here and started shooting, she held station over here and started shooting, she held ground fire to a minimum. As long as you are in the area and firing, the Communists hole up with their flak machines and antiaircraft weapons. This gives us more freedom in picking out better targets."

Captain Finch went on, "NEW JERSEY is best at rooting out and destroying enemy bunkers. The eight-inch, 155mm and 105mm land-based artillery make a small impression on the land, compared to what the 16-inch does; it really clears out the area."

Captain Bounds added, "The Viet Cong and North Vietnamese Army troops also store large quantities of ammunition, supplies and other materials underneath the jungle canopy. When NEW JERSEY shells an area, she levels all the trees shielding these caches. Even if the supplies aren't destroyed, the Communists still have to move all their materials and this is when we come in with Marine and Air Force jets and really get them. It's a tremendous effort you are making. I know it's a difficult thing for anybody to understand the fact that when you're mowing down trees, it is really an important target--something that is vital to the war effort. But the enemy uses camouflage and cover to an extreme

extent. Jungle warfare is serious warfare. It is planned around cover and concealment, small groups of people, dispersion and things like this. The ability to remove terrain features denies them their most valuable asset in jungle warfare, and it is for this reason that we find large ordnance, good delivery system, rapid firepower like the NEW JERSEY's to be such a great asset in our war."

The words of the two Army Captains were echoed later by Corporal Daryle W. Lewis, a marine ground spotter. He told of his experience with NEW JERSEY. "Each round has a tremendous psychological effect on Communist troops. Air spotters have told me they have seen Communist gun crews get scared and run away from their guns when you are laying in your big ones. I've talked to some of the Chieu Hoi (Viet Cong defectors) who say that even though the round doesn't hit close to them, it makes them think they're going to die right there."

NEW JERSEY moved to the DMZ on Sunday, the 29th, where she would operate into the New Year. In one mission into the southern half of the Zone that afternoon, the battleship destroyed eight 2,500 square foot bunkers and demolished six structures. The spotter called in the fire when it was discovered the Communists had violated the buffer zone and built fortifications. One large secondary explosion was reported by the spotter as he shifted targets. "Don't ever let anyone tell you you can't put two bullets in the same hole," he said. "You can't miss. You must have a pair of magic tubes." At 1612 that day turret one became the first of the three to have fired 1,000 combat rounds since September. The other two turrets reached this mark shortly after the New Year.

The ship demonstrated her all-weather capability in the afternoon of 8 January 1969. Visibility on the beach was slightly improved, allowing spotters to see about 1500 meters. The ship was about four miles off shore, totally enveloped in fog. The observer located a bunker complex and some enemy troops in, and just south of the DMZ. "The soup was so thick we couldn't even see the beach," said Lieutenant Commander Leroy A. Short, Jr., the Battleship's Weapons Officer. "But our fire control radar was locked onto the reference point, and the spotter could see well enough to adjust our fire." The ship fired simultaneous five- and 16-inch salvos and destroyed four bunkers. The spotter also reported four enemy troops killed in the action.

NEW JERSEY remained near Danang until the night of 13 February supporting both the Korean Marines and elements of the U.S. First Marine Division. During this tenure in central I Corps the ship was visited by Lieutenant Commander Norman Corlett, Navy Liaison Officer with the First Marine Division.

He expressed the gratitude of the Marines for having NEW JERSEY in the area. He explained that the targets being fired were part of a staging area for a suspected Viet Cong regiment. The targets were bunker and tunnel complexes. "In the tunnels beneath a bunker," said LCDR Corlett, "there can be as many as 30 men hiding...that's why we want to use the 16-inch projectile. It penetrates and obliterates a bunker. It's the most effective weapon for this type of target."

That night three of NEW JERSEY's Fire Control Technicians were instrumental in the safe recovery of a downed pilot. Petty Officers third class William D. Meskimen, Richard R. Guy, and Richard B. George were on watch in the ship's forward MK 37 director when the ship responded to an emergency call from the downed aviator in the vicinity of Tiger Island. The trio initiated a [radar] search and in short order they found their tiny target bobbing in the darkness that was the South China Sea. Their alertness made it possible for the man to be picked up by helicopter.

On Saturday, the 15th, NEW JERSEY continued firing her main and secondary batteries in support of the Third Marines. Just before dusk the ship received word from the beach that communists were setting up a rocket site for night firing. The site was in the southern half of the DMZ, 11 miles northeast of Con Thien. NEW JERSEY immediately opened up with her main battery and fired until well after dark. The ground observer reported 25 secondary explosions and seven fire balls rising 500 feet in the air and completely lighting up the night sky.

Just after 0100, while NEW JERSEY was firing prearranged unobserved fire, she received an urgent call for fire from a Marine outpost about 1,000 meters south of the DMZ which was under attack. The post, named Oceanview, was manned by about 20 Marines and a Naval Gunfire Liaison team. It was attacked by a force later estimated to be about 130 North Vietnamese Regulars. Following is a chronological record of the night's action taken from the ship's operation report:

- 0106 - Emergency call for fire from forward observation post, Third Marine Division. Unknown number of enemy troops attacking. Commenced secondary battery fire, two mounts, increasing to four mounts and adding main battery as attack intensified.
- 0400 - Continued high explosive fire, multiple targets, main and secondary batteries, while providing spotter illumination.
- 0530 - Attack intensity diminishing, continued responding to calls for fire, spotter reports enemy withdrawing carrying casualties.
- 0633 - Ceased all fire; attack repulsed.

One thousand-seven hundred ten 5-inch rounds were fired that night in nearly six hours of continuous fire. At various times throughout the night NEW JERSEY was teamed with the Coast Guard cutter OWASCO and two artillery batteries. One spotter, Lance Corporal Roger Clouse of Lincoln, Nebraska, controlled all fire that night, and at one point he was firing six batteries simultaneously. He was recommended for the Bronze Star for his night's work.

NEW JERSEY remained on station until 0600 1 April, finishing the deployment where she had begun it more than six months earlier. The last observed mission was fired on the evening of 30 March against an enemy bunker complex three-and-one-half miles northeast of Con Thien. The aerial observer reported seven bunkers destroyed. An additional 50 rounds of main battery and 815 rounds of secondary battery were fired unobserved that night.

This brought the total ordnance expended to nearly 12,000,000 pounds in 120 days on the gunline; total rounds expended were 5,866 16-inch inch and 14,891 five-inch. Main battery rounds expended during NEW JERSEY's deployment to Vietnam were only 1,500 short of the total she fired in World War II, two cruises to Korea, and several midshipmen cruises.

GUN DAMAGE ASSESSMENT, 1968-1969

MAIN BATTERY

Structures destroyed-----	439
Structures damaged -----	259
Bunkers destroyed-----	596
Bunkers damaged -----	250
Artillery sites neutralized-----	19
Automatic weapons, AA, and mortar sites silenced -----	35
Secondary explosions -----	130
Roads interdicted -----	26
Meters of trenchline rendered unusable -----	1925
Cave and tunnel complexes destroyed -----	75
Enemy Killed in action (confirmed)-----	136
Enemy Killed in action (probable) -----	17
Troop movements stopped -----	12

SECONDARY BATTERY

Structures destroyed-----	56
Structures damaged -----	92
Bunkers destroyed-----	59
Bunkers damaged -----	73
Artillery sites neutralized-----	2
Mortar sites silenced -----	6
Waterborne Logistic Craft (WBLC) destroyed (Sea Dragon)-	9
Secondary explosions -----	46
Enemy killed in action (confirmed) -----	10
Enemy killed in action (probable) -----	7
Troop movements stopped -----	7

CINCPACFLT ANALYSIS STAFF STUDY 3-69

MAIN BATTERY MISSIONS OF THE USS NEW JERSEY (BB-62)
AND TWO 8" CRUISERS
BETWEEN SEPTEMBER 1968 AND FEBRUARY 1969

ABSTRACT

Main battery missions of the battleship and of two heavy gun cruisers are compared. This comparison is made in terms of success rates, mission types, projectile usage, range, target type, and spotting provided. The number of rounds expended by target type and mission type for both successful missions and overall is presented. Data available from a 5"/54 ship (USS DAVIS (DD-937)) is included for comparison purposes.*

I. INTRODUCTION.

1. During the Vietnam War, ships of the United States Navy have been opposed neither by an enemy surface fleet nor by an effective enemy air force. Naval gunfire has instead found employment almost exclusively against shore based targets. Even this employment has differed considerably in its intent and nature from the traditional saturation type bombardment provided during amphibious operations of World War II and Korea (Hungnam evacuation and the Inchon invasion). Instead of an intense, concentrated but fairly brief bombardment coordinated with friendly troop movements and with neutralization of the enemy as its primary objective, Naval gunfire in Vietnam has supplemented the role of artillery and air bombardment. During the period of this study, and for the ships involved, preparatory or neutralization fire was almost nonexistent; fire for destruction or harassment was the objective of essentially all fire missions. The targets in general have been small and relatively soft, and enemy troop concentrations have been small in size with the possible exception of those in Hue during the Tet offensive of 1968.

2. Unlike the Korean War, which was a fairly static land battle with a well defined forward edge of the battle area, Vietnam has been a counterinsurgency type operation with enemy troops and facilities thoroughly interspersed with friendly installations. Whereas personnel targets were the largest target class in Korea for heavy gunships, bunkers were by far the largest target class for these same ships in Vietnam.

3. The major caliber gunships fired the preponderance of their missions in Vietnam at either point or small area targets. The intent of these missions was destruction, and spotting was always available.

*Other ships involved in this study:

CANBERRA (CA-70), commissioned 1943. Six 8"/55 bag guns.

NEWPORT NEWS (CA-148), commissioned 1949. Nine 8"/55 rapid-fire case guns.

DAVIS (DD-937), commissioned 1955. Three 5"/54 rapid-fire guns.

5. The purpose of this study is:

a. To make a comparative effectiveness analysis of ... NEW JERSEY vice other heavy gunfire ships in terms of:

- (1) Target class
- (2) Range
- (3) Number of rounds
- (4) Spotting type and success rate
- (5) Mission distribution....

II. FINDINGS.

6. The primary finding of this study is that major caliber gunfire is a remarkably efficient method of destroying assigned and spotted targets. The spotters reported that about 50% of the missions resulted in success. Even if a significant degradation factor is applied for possible spotter optimism this would still indicate that a respectable success rate was obtained by Naval bombardment. The questions of military value of targets, appropriateness of assigned target, and assignment procedures are beyond the scope of this study.

7. ...NEW JERSEY showed operational flexibility in that her success rate and projectile usage were essentially independent of target, and of range to target. These numerics averaged out to approximately a 50% success rate and 16 rounds per mission. The smaller ships were more sensitive to target and range parameters, e.g., the projectile usage for the 5"/54 ship against area targets averaged over 94 rounds per target, but was only 44 rounds per target against bunkers. The 5"/54 ship was decidedly unsuccessful against artillery.

8. ...NEW JERSEY's main battery was used almost exclusively for spotted destruction missions. Less than 10% of her 16" projectile usage was for harassment purposes. This can be compared with 26.4% harassment for the 8"/55 batteries and 61.3% for the 5"/54 battery.

9. For all the ships studied, the average number of rounds expended per harassment mission was a small percentage of the expenditure required for success on the average spotted mission. Accordingly, the likelihood that substantive target damage resulted from harassment fire appears to be very low, particularly considering that this fire was unspotted. The value of harassment in itself cannot, with currently available data, be quantified.

10. The long range capability of NEW JERSEY's main battery was used to a greater extent than similar batteries in Korea. In Korea only 20% of the 16" missions were outside the range of an 8" cruiser. During the period of this study NEW JERSEY fired more than half her missions outside the range of any other naval gun. This is to be compared with the 8"/55 ships which fired only 12.1% of their missions outside the range of a 5"/54, and with the one 5"/54

ship which fired 41.8% of her missions outside the range of a 5"/38.

IV. TEST FIRINGS BY NEW JERSEY AT SAN CLEMENTE RANGE

15. Prior to her combat deployment, the newly rehabilitated NEW JERSEY tested and exercised her main and secondary batteries against the San Clemente [California] firing range. It was possible...to obtain an estimate of the accuracy of firing against the range targets.

16. Accuracy. The measure of gunfire accuracy discussed below has been taken to be the Initial Salvo Error (ISE), the radial distance between the target and the point of impact of the first salvo. It is recognized that the ISE does not describe overall gunfire accuracy, which will, of course, improve with subsequent salvos as the spotter's adjustments are entered. However, the ISE is of interest in that this quantity provides a measure both of the magnitude of the necessary spotting corrections and of the potential effectiveness of the ship in the absence of spotting.

17. Of the approximately 50 main battery missions fired on San Clemente during the week of 27 July 1968, 16 had an estimate of ISE. The overall average ISE for these 16 missions was 144 yards with a standard deviation of 98.2 yards. The median radial impact (MRI) was 112 yards.

18. Although most of the "Call for Fire" sheets did not include range information, discussions with ship's personnel indicated that all but three of the 16 reported missions were fired at ranges between 8,000 to 12,000 yards. Three of the 16 missions were fired on 30 July at approximately 20,000 yards.... Considering the two range bands as independent events yields:

<u>RANGE</u>	<u>FIRINGS</u>	<u>MEAN ISE</u>	<u>STD.DEV.</u>
8-12,000	13	115	71
20,000	3	268	103

Although the sample size is small, the Mann Whitney test indicates that the difference in Mean ISE between the two sets of firings is statistically significant at more than the 95% level. In these firings the Initial Salvo Error appeared to be approximately proportional to range.

19. Of the secondary battery missions, 21 had an estimate of the ISE. All of these missions were fired in the 8,000-12,000 yard range zone. The accuracy data indicates: Mean ISE=169 yards, Standard Deviation=127 yards, MRI=150 yards. Included in the data is one "gross miss" of 600 yards, or more than four times the MRI. If this data point is excluded from the sample the remaining statistics indicate: Mean ISE=148 yards, Standard Deviation=84 yards, MRI=138 yards.

20. The data sheets did not provide enough information to determine the range and deflection error components of the ISE. A few data points, taken for main battery missions fired at 9,500-10,000 yard ranges, indicates that at this distance the ratio between range and deflection dispersions was between 2.2 and 3.

21. Effectiveness. Several 16" HC air burst rounds were fired in such a manner as to permit observation of their fragment impact patterns. The firing range for this mission was 9,600 yards. The observed shrapnel [**fragmentation**] pattern was that of a quite elongated double fan, with the beam spray fragments from the 16" round often ricocheting and tumbling along the ground for great distances from the burst point. In one observed case the arms of this fan of fragments were oriented at an angle of about 25 - 40 degrees from a plane perpendicular to the axis of the shell, and the impacts of the fragments along the ground extended as far as 900 yards from the burst point. Although the area covered by this fragment pattern was impressive, the density of coverage did not seem high. This observation was partially verified by the size of the shrapnel found when the area was examined after the firing, fragments...weighing from 1 to 30 pounds being found. There is a conflict between the massive size of the fragments observed and those listed in [**an earlier study**] as typical of the 16" projectile (1094 grains or about 2] ounces).

22. ...NEW JERSEY fired four rounds, using either quick or base detonating fuzing,* ...to obtain the dimensions of craters produced by 16" HC rounds. The observed craters...were shallow and small, a result which was not consistent with the large craters later observed when the 16" round was employed in Vietnam. The difference in soil consistency between the hard, dry desert soil of San Clemente and the wet soil of Vietnam probably accounts for the difference in cratering effectiveness.

V. DMZ AND SEA DRAGON OPERATIONS 30 SEP - 1 NOV 1968

23. The character of the war was changed with the cessation of operations north of the DMZ on 1 November 1968, and although only a small sample of data was available for gunfire operations prior to this date, it is felt that these firings should be considered separately. The information available for the firings before 1 Nov[ember] 1968 will be summarized in this section of the study. The subsequent sections of the study will deal with the total data base for all firings, including those before 1 November.

24. Data collection began on 30 September 1968 for...NEW JERSEY. ...CANBERRA was the deployed 8"/55 ship in the month of October 1968, and information from its firings will be compared below with that of...NEW JERSEY.

*I.e., using point- or base-detonating fuzes.

25. The following table presents general information on main battery missions during this time period:

TABLE I
GENERAL INFORMATION, MAIN BATTERY MISSIONS
DMZ AND SEA DRAGON OPERATIONS

	30 Sep-1 Nov 68 16"/50	15 Oct-1 Nov 68 8"/55
Number of Missions	78	28
Number of Rounds (fired on destruction missions)	910	1119
Average Range of Destruction Mission	29,823	23,160
Average Number of Rounds per Destruction Mission	11.7	40.0
Number of Rounds, Reduced Charge	217	0
Number of Rounds, Base Detonating Fuzed	127	17

In terms of...successful missions as defined...,* we have the following table:

TABLE 2
DESTRUCTION MAIN BATTERY MISSIONS
DMZ AND SEA DRAGON OPERATIONS

	16"/50			8"/55		
	<u>Miss.</u>	<u>% Succ.</u>	<u>Rds./ Succ. Miss.</u>	<u>Miss.</u>	<u>% Succ.</u>	<u>Rds./ Succ. Miss.</u>
Overall	78	46.6%	14.5	28	25.0%	28.1.
DMZ	52	65.4%	14.1	11	36.4%	23.5
S. Sea Dragon	16	12.5%	19.0	0		
N. Sea Dragon	10	50.0%	16.2	17	17.6%	34.3

26. Two effects are apparent in Table 2. First, for both the 16"/50 and the 8"/55 ships the success rate for missions in the DMZ was

***Successful: complete success or large effects observed. Limited: some effects observed. Unknown: no apparent results; unobserved; unreported; or no report available.**

noticeably higher than the rate for Sea Dragon missions. ...the 16"/50 missions appear to have exhibited a higher overall success rate than the 8"/55 missions.

27. The difference in spotting practices appears to be the most likely cause of the significantly higher success rate observed in the DMZ vice the Sea Dragon areas. Spotting...in the DMZ was either by ground based USN/USMC FIRST ANGLICO observers or by comparably trained USMC personnel, either in shore fire control parties or flying as air observers in either an OV-10 or TA-4 aircraft. Spotting in Sea Dragon was either by F-100's, A-4 or A-7's; the altitude of the spotting aircraft was consistently higher in the southern Sea Dragon vice the DMZ or Northern Sea Dragon. ...of the five successful missions fired in Northern Sea Dragon, four were spotted by USMC TA-4's.

28. The NEW JERSEY during this time...made very effective use of the extended range capability of her 16' guns. [A reference publication] lists the maximum range of various calibers as follows:

<u>Caliber</u>	<u>Maximum Range (Yards)</u>
5"/38	18,000
5"/54	25,900
8"/55	29,800
16"/50	41,600

29. The following table presents information on ranges at which NEW JERSEY and CANBERRA opened fire:

TABLE 3
RANGE OVERLAP OF THE 16"/50 AND 8"/55
DURING DMZ AND SEA DRAGON OPERATIONS

	0-18,000 Yards	18,000- 25,900 Yards	25,900- 29,800 Yards	Over 29,800 Yards
BB-62: Misses	2	21	8	46
Percent	2.6	27.3	10.4	59.7
Cumulative %	2.6	29.9	40.3	100.0
CA-70: Misses	4	15	9	-
Percent	14.3	53.6	32.1	-
Cumulative %	14.3	67.9	100.0	-

30. The above table shows that...NEW JERSEY fired almost 60% of her missions outside of the range of any other naval gun, whereas CA-70 fired almost 68% of her main battery missions within the maximum range of a 5"/54.

VI. GUNFIRE OPERATIONS 30 SEP 68 - FEB 69; CHARACTERISTICS OF FIRE

31. Overall Magnitude of Effort. Information available...for the four ships submitting data is summarized in Table 4. The expenditure and mission totals listed are for [the following periods]:

<u>Ship</u>	<u>Battery</u>	<u>Firing Period</u>
NEW JERSEY (BB-62)	16"/50	30 Sep 68-11 Jan 69
CANBERRA (CA-70)*	8"/55	15 Oct 68-21 Dec 68
NEWPORT NEWS (CA-148)**	8"/55	26 Dec 68-21 Feb 69
DAVIS (DD-937)***	5"/54	24 Oct 68-12 Feb 69

TABLE 4
EXPENDITURE BY CALIBER

<u>Gun Caliber</u>	<u>Total Rounds</u>	<u>Total Missions</u>	<u>Average Rounds per Mission</u>
16"/50	3,229	297	10.87
8"/55	5,704	398	14.33
5"/54	7,397	1,779	4.16

These numbers include harassment missions. The vast majority of the 5"/54 ship's missions were for harassment.... This explains the low average number of rounds per mission for this ship.

32. Distribution of effort by mission purpose...the character of this war with respect to Naval Gunfire is unique in the experience of the U.S. Navy. The distribution of missions with respect to purpose is an example of this difference. It is seen, in Table 5, that during the time period of this study there was no neutralization fire and only a very limited amount of preparatory fire, whereas during the Korean War, for example, these two categories of missions accounted for 10% to 15% of all missions fired.

TABLE 5
DISTRIBUTION OF EFFORT BY MISSION PURPOSE

<u>Gun Caliber</u>	<u>Destruction Missions</u>	<u>Harassment Missions</u>	<u>Prep-Fire Missions</u>	<u>Other Missions</u>
16"/50	216 (72.7%)	81 (27.3%)	0	0
8"/55	124 (31.2%)	270 (67.8%)	4 (1.0%)	0
5"/54	71 (4.0%)	1708 (96.0%)	0	1

33. The above table also makes apparent the real difference in utilization of the various classes of ships. ...almost all of...DAVIS' missions were for harassment..., whereas almost three quarters of...NEW JERSEY's missions were fired...for destruction. The 8"/55 data is between these two extremes.

34. ...there is some ambiguity in the definition of a harassment mission. The following table avoids this ambiguity by presenting the data in terms of numbers of rounds.

TABLE 6
EXPENDITURE BY MISSION PURPOSE

Gun Caliber	Destruction Rounds	Harassment Rounds	Prep-Fire Rounds	Other Rounds
16"/50	2914 (90.2%)	315 (9.8%)	0	0
8"/55	3989 (69.9%)	1506 (26.4%)	209 (3.7%)	0
5"/54	2791 (37.7%)	4538 (61.3%)	68 (0.9%)	10 (0.1%)

35. Table 6 indicates that the utilization with respect to rounds is somewhat different from the utilization with respect to missions. DD-937 fired 37.7% of her total rounds...on destruction missions even though these missions were only 4% of her total missions. Also note...NEW JERSEY fired less than 10% [of] her rounds on harassment missions.

36. Table 7 breaks down the round expenditure by...NEW JERSEY according to line period.

TABLE 7
NEW JERSEY MAIN BATTERY EXPENDITURE

Line Period	Total Rounds	Harassment Rds/Miss/Rds per Mission	Destruction Rds/Miss/Rds per Mission
1	1528	66/20/3.3	1462/120/12.1
2	777	21/8/6.6	756/51/14.8
3	924	228/53/4.3	696/45/15.5
Totals	3229	315/81/3.9	2914/216/13.5

It can be seen that there was a noticeable increase in the rounds and missions devoted to harassment fire during the third line period. A partial explanation of this change in the nature of the utilization of the 16" battery would be...NEW JERSEY's role in support of operation BOLD MARINER. This was a large scale Marine amphibious cordon operation, in which the major role of the battleship was to provide a heavy visible diversionary force.

37. Distribution of Effort by Target Type. A large variety of targets were reported.... For the purposes of this Study the following major target classifications were defined:

- a. Bunkers
- b. Artillery (coastal defense sites; field artillery; antiaircraft artillery; mortars)
- c. Areas (storage areas; groups of structures; truck parks)
- d. Troops (NVA or VC in open configuration)
- e. Interdiction (roads; trails; bridges; WBLC)
- f. Caves

39. Table 8 shows the numbers of missions fired for destruction against each of these target types. As can be seen, for each of the three calibers considered, Bunkers constituted the largest target class, with Area targets a distant second.

TABLE 8
DISTRIBUTION OF...DESTRUCTION MISSIONS BY TARGET TYPE

Target Type	16"/50	8"/55	5"/54
	Missions	Missions	Missions
Bunkers	96 (48.0%)	67 (55.3%)	21 (30.0%)
Artillery	21 (10.5%)	7 (5.8%)	20 (28.6%)
Areas	36 (18.0%)	19 (15.7%)	16 (22.9%)
Interdiction	12 (6.0%)	17 (14.1%)	5 (7.1%)
Troops	19 (9.5%)	10 (8.3%)	8 (11.4%)
Caves	16 (8.0%)	1 (0.8%)	0
<u>Totals*</u>	200	121	70

*These totals will not necessarily correspond to [those] in Table 5, since in a few cases those targets were either unspecified or were not one of the above types.

40. ...harassment...expenditure is considerably less (by a factor of 4 to 10 depending on caliber) than expended in successful spotted destruct missions.

41. Range to target at open fire. It has already been noted, in paragraph 30, that, before 1 November 1968, ...NEW JERSEY fired about 60% of her destruction missions at ranges greater than the 29,800-yard maximum range of the 8"/55 gun. This high degree of utilization of the ability of NEW JERSEY to strike targets beyond the range of any other Naval Gunfire platform was continued throughout the ship's first two line periods. During the third line period, however, only one third of the missions were fired at ranges beyond 29,800 yards. This reduction during the third period...resulted from...:

- a. The increased use, by...NEW JERSEY, of reduced charges;
- b. The role of NEW JERSEY as a highly visible diversion force, firing several missions at relatively short ranges, during the landing operation BOLD MARINER.

42. Table 9 shows the fraction of each gun caliber's destruction missions that were fired within 0 - 18,000 yards (...maximum range of 5"/38), 18,000 - 25,900 yards (maximum range of 5"/54), 25,900 - 29,800 yards, and greater than 29,800 range bands. This table shows that, during the first two line periods, roughly one-third of...NEW JERSEY's main-battery missions were fired at targets within the range of a 5"/54, but that during the third line period more than 55% of the 16" missions were fired at these short ranges. Figure 1 shows the same effect of the reduced-charge firings on the range distribution. This figure plots, for destruction missions, the cumulative percent of the missions of each caliber that are fired

within a given range. The abscissa in this figure is the range expressed as a percent of the maximum range for each gun caliber.

43. Figure 1 shows that the median 5"/54 mission was fired at about 55% of maximum range; the median 8"/55 mission...at about 60% of maximum range; and the median 16"/50 mission...at 66% of maximum range. The irregularity in the 16"/50 range distribution curve introduced by the reduced charge firings of the third line period is clearly visible in Figure 1.

44. Use of Reduced Charges. It is desirable from a standpoint of economy, both in...dollars and...gun barrel wear, to fire with reduced charges whenever this can be done without degradation of the mission. In...a 16"/50 firing, for example, the cost of a full charge is \$578 vice \$315 for a reduced charge and the number of pseudo-equivalent service rounds (PESR) for a...HC bullet is 0.43 for a full charge vice 0.07 for a reduced charge. Thus the use of reduced charges results not only in a considerable saving per firing, but also in a reduction in gun wear by a factor of six.

45. As...seen in Table 10, ...NEW JERSEY made a greater use of reduced charges, both in terms of percentage of missions and...percentage of rounds, than did the two 8"/55 ships. ...DAVIS reported that all missions made use of full charge.

TABLE 9
DISTRIBUTION OF OPEN-FIRE RANGES FOR DESTRUCTION MISSIONS
FIRED BY BB-62, CA-70, CA-148, AND DD-937

<u>Missions Fired in Each Range Band:</u>		
<u>Gun Caliber</u>	<u>0-18,000 yds</u>	<u>18,000-25,900 yds</u>
16"/50, 1st L.P.*	5 (4.2%)	40 (33.2%)
2nd L.P.	5 (9.8%)	11 (21.6%)
3rd L.P.	0	26 (57.7%)
<u>OVERALL</u>	<u>10 (4.6%)</u>	<u>77 (35.6%)</u>
8"/55, Overall	26 (22.4%)	76 (65.5%)
5"/54, Overall	39 (58.2%)	28 (41.8%)
	<u>25,900-29,800 yds</u>	<u>Beyond 29,800 yds</u>
16"/50, 1st L.P.	12 (10.0%)	63 (52.5%)
2nd L.P.	2 (3.9%)	33 (64.7%)
3rd L.P.	4 (8.9%)	15 (33.3%)
<u>OVERALL</u>	<u>18 (8.3%)</u>	<u>111 (51.4%)</u>
8"/55, Overall	14 (12.1%)	0

*Line Period

TABLE 10
REDUCED-CHARGE FIRINGS FOR SPOTTED DESTRUCT MISSIONS

16"/50 Firings, Reduced Charges

<u>Line Period</u>	<u>Missions Red. Chg.</u>	<u>% All Missions</u>	<u>Rounds Red.Chg.</u>	<u>% All Rounds</u>
1st	41	34.2%	445	30.4%
2nd	16	31.3%	331	43.8%
3rd	23	51.1%	473	68.0%
OVERALL	80	37.0%	1249	42.9%

8"/55 Firings

All	27	21.8%	660	16.5%
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46. The table shows that...NEW JERSEY's use of reduced charges increased markedly in the third line period. This change in charge utilization is related to a problem with the full charge powder, i.e., the tendency of apparently equivalent charges to produce variability in projectile initial velocity (I.V.). Such changes in I.V. were less severe in the reduced charge loads, possibly because these loads were produced at a more recent date. The increased utilization of reduced-charge loads in the 3rd line period stemmed, in part, from the ship's request for shorter range targets as a temporary adaptation to the operational problems introduced by I.V. variability.

47. Selection of Fuzes. The majority of the rounds fired by...NEW JERSEY and...the two cruisers were Point Detonating Fuzed (PDF). The remainder were almost entirely Base Detonating Fuzed (BDF). Mechanical Time Fuzed (MTF) bullets were seldom used by the heavy caliber gunships'; there were only two 8"/55 and six 16"/50 missions which used MT fuzes. There were two reasons for this:

a. The non-availability, during this...period, of a Navy MTF...which could be set at greater than 45 seconds. This time of flight would reduce the maximum range of the Battleship to 27,300 yards.

b. Relatively small number of soft targets available.

[NEW JERSEY fired 62 missions using at least one BDF round (28.7% of all missions), firing 412 BDF rounds (14.1% of all rounds fired).]

49. The higher utilization of BD fuzing by NEW JERSEY during the first line period...resulted from the change in character of the war during the ship's first line period. During this period gunships were allowed north of the DMZ. This allowed hard targets, such as the Vinh cave storage area and Hon Matt coastal defense sites, to be brought under fire.

50. For the most part, spotters had great difficulty with BD bullets. They either lost the round, or could not give more than coverage aspects for Gun Damage Assessment (GDA). The soft ground

prevalent in Vietnam, combined with the fuze delay of 0.033 seconds, would cause the bullet to penetrate to great depths before detonating. As an example of the difficulty inherent in spotting BD fuized projectiles, all BD bullets fired by...NEW JERSEY were reported lost (except for the firings at the Vinh cave storage area), and on each of these missions point-detonating fuized bullets were used for spotting.

52. Use of Spotters. The vast preponderance of spotting for the heavy gunships was done by aircraft. ...NEW JERSEY relied most heavily on airborne spotters, with almost 90% of its missions being directed from the air. The NEWPORT NEWS and CANBERRA missions relied less heavily on airborne direction (about 75% of missions) than did...NEW JERSEY, and used ground spotters somewhat more. Neither the 16" nor 8" ships used own-ship spotting to a significant extent, and all of the few missions which were self-spotted were counterbattery missions against coastal defense sites. ...DAVIS, on the other hand, relied on its own spotting for about 20% of its destruction missions...because of the shorter range of the 5"/54 [and] one can conclude that considerably less in...air spotting assets were made available....

54. ...spotting practices in Vietnam (at least, during the period examined) have differed sharply from the spotting usage for Naval gunfire in Korea. During Korean operations much more ship spotting was used, even when the 16" guns were being fired. Ship spotting was probably more lucrative against coastal Korean targets, because of the mountainous terrain, than...against the often flat Vietnamese shores.

55. A more pronounced difference between Korean and Vietnamese bombardment spotting practices has been the decrease in the number of unspotted firing missions. ...NEW JERSEY fired no missions for destruction during the period of this study without the presence of some sort of spotter, and only 27% of NEW JERSEY's firings were for unspotted harassment. The battleships of the Korean War, on the other hand, fired nearly half (46%) of their missions without spotting.

VII. EFFECTIVENESS OF BOMBARDMENT

TABLE 15
CLASSIFICATION OF MISSIONS BY RESULTS

<u>Gun Caliber</u>	<u>Missions</u>	<u>Successful</u>	<u>Limited</u>	<u>Unknown</u>
16"/50	216	45.4%	32.4%	22.2%
8"/55	124	40.3%	40.0%	19.4%
5"/54	71	47.3%	21.1%	36.6%

This table shows that the percentage of "successful" destruction missions was roughly the same for NEW JERSEY, the cruisers, and DAVIS. The number of missions...rated as "Unknown" was...significantly greater for the 5"/54 ship than for the heavier ships. This difference...possibly was a result of difficulty in

assessing the damage caused by the smaller round....

58. [This] has indicated that the 5"/54 destroyer had the same fraction of missions completely successful as did the heavier ships, even though it did have a higher proportion of missions which were either failures or unknown. ...to determine whether this apparent independence of success rate to gun caliber was only a reflection of differences in the targets assigned to each ship, the following Table 16 was prepared.

TABLE 16
EFFECTIVENESS OF GUN PLATFORMS BY CLASS OF TARGET STRUCK

<u>Target Class</u>	16"/50 Miss. Successful*	8"/55 Miss. Successful*	5"/54 Miss. Successful*
Bunkers	57.3%	47.7%	66.6%
Artillery	42.9%	14.3%	0%
Areas	38.9%	47.4%	68.8%
Interdiction	50.0%	23.5%	60.0%
Troops	47.4%	10.0%	25.0%
Caves	18.8%	100.0%	0%
All Above	48.0%	39.7%	42.9%

*The...indicated total success rates cited here will not necessarily agree with...Table 15 because of occasional omissions in reporting type of target struck.

59. The results appear to indicate that the fraction of gunfire missions achieving a rating of "successful" was almost independent of gun caliber when firing against bunkers, ...interdiction targets, and...area targets.... This was not the case for...missions against Artillery or Troops. In both of these latter cases the 16" battery of NEW JERSEY appeared to be considerably more effective than either the 8" or 5" caliber guns. Against all classes of targets except the caves around Vinh the success rate of the 16" gun was roughly the same; between 40% and 60% of the firing missions were adjudged "successful." The smaller caliber guns appeared to be more sensitive to the type of target taken under fire.

60. When using...Table 16 for comparison of the apparent success rates of the various caliber guns, several caveats should be considered. First, the sample sizes are small, and a good deal of statistical variability in the observed success rates can be expected. Only two of the listed differences in success rates per mission are, in fact, statistically significant at the 95% level; these are the difference between the 16" gun and the 5" gun when used against Artillery targets, and the difference between the 16" gun and the 8" gun when used against Troops. This is not to say that the other differences are not real, only that not enough firing missions were recorded for statistical significance.

61. A second caveat has to do with the very small numbers of ships considered. Only four ships are represented in the Table 16 sample, so that the effects of individual variations in gunfire proficiency might tend to overshadow variations in inherent gun system capability against the different targets.

63. Effectiveness in terms of round expenditure. As can be expected, the number of rounds per successful destruction mission decreases as the gun caliber increases. ...the number of 5" rounds fired per successful mission was four times the number for 16" rounds. It should be noted that expenditures...included not only the rounds fired for destruction but also those expended during the initial spotting of the fire onto the target. If one employs the rule of thumb that the ratio of lethalties of two projectiles should vary as the one-half to two-thirds power of the ratio of their charge weights, the predicted ratio of effectiveness of the 16" to the 5" bullets should be somewhere between 4.5 and 7.5.

90. Line Period of,,,NEW JERSEY. Table 25 shows how the overall effectiveness of...NEW JERSEY varied by line period.

TABLE 25
NEW JERSEY MISSION RESULTS BY LINE
PERIOD

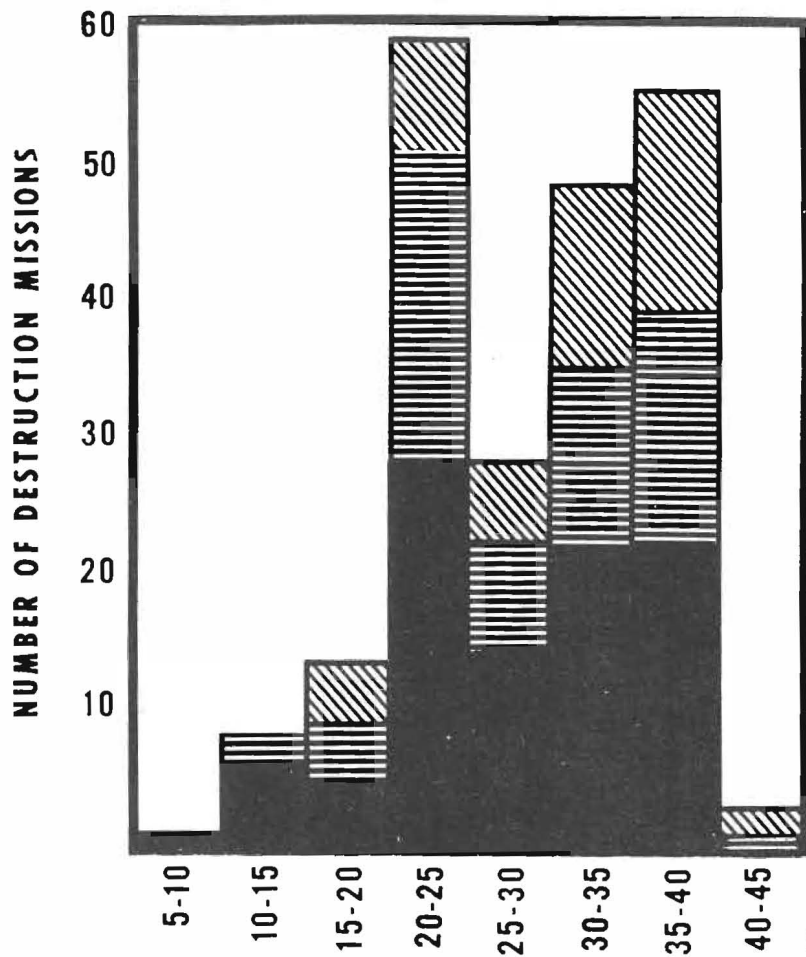
<u>Line Period</u>	Successful	Limited	Unknown
1	41.7%	31.7%	26.6%
2	60.8%	24.5%	13.7%
3	37.8%	40.0%	22.2%

As was indicated...in paragraph 24, the character of the war changed during the first line period, and there was a corresponding change in the...spotting services provided after this time. It is not, then, surprising that the success rate would change between the first and second line period. The success rate, however, also changed substantially between the second and third line periods

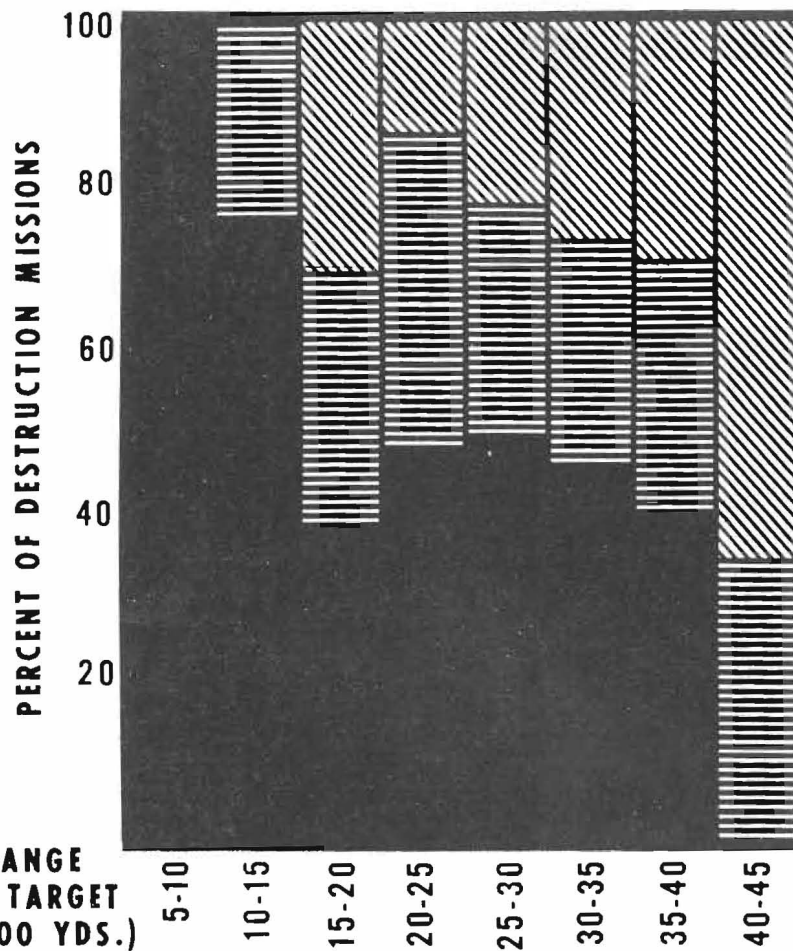
92. This decrease in NEW JERSEY's success rate between the second and third line periods is possibly due to the effects of I.V. variations in the ship's powder. Although, in general, ...NEW JERSEY was consistently capable of accurate long-range shooting, occasional wild shots were experienced. Even though the inaccurate shots were uncommon, the frequency of their occurrence appeared to be increasing with time during the ship's deployment. Because of this rate increase, a thorough check of the gunfire control system was made and it was felt by ship's personnel that powder variations, resulting in unpredictable changes in I.V., was [sic] the most probable cause of the trouble.

DISTRIBUTION BY RANGE BAND OF MAIN BATTERY MISSIONS OF USS NEW JERSEY

NUMBER MISSIONS IN BAND



PERCENT MISSIONS IN BAND



SUCCESSFUL
 LIMITED
 UNKNOWN

212

95. b. ...the typical full charge mission of December 1968 experienced at least one bullet which fell 600 - 1200 yards short or long with respect to the nominal impact point just because of I.V. variations. About half of the bullets of the mission would show I.V.-induced variations in range of about 200 yards.

96. The effects of I.V. upon the accuracy of missions fired with reduced charges is seen to have been considerably less severe. All powder aboard...NEW JERSEY was examined. It was discovered that the powder of all reduced charges aboard in January of 1969 was produced in 1968, whereas the youngest full-charge powder was produced in 1953.

APPENDIX F INITIAL VELOCITY MEASUREMENTS

1. Although...NEW JERSEY has shown itself consistently capable of accurate long range shooting, occasional wild shots have been observed. These shots have, in general, been long, ,and. there has been no gross inaccuracy in deflection. A thorough check of the entire gunfire system was made and it was felt, by ship's personnel, that powder variation resulting in unpredictable changes in projectile I.V. (initial velocity) was the most probable cause of the trouble. Because of this conclusion, and at the request of NAVORDSYSCOM [**Naval Ordnance Systems Command**] an attempt has been made to obtain I.V. measurements on every 16"/50 projectile fired since 1 December 1968.

2. Procedure for I.V. Measurement. The equipment required...is already aboard the ship. It has been in more or less continuous use since the beginning of the deployment, although the measured I.V.'s have been recorded only infrequently....

3. The equipment for I.V. measurement consists of:

- a. MK-25 radar with the RSPE ALT;
- b. MK-56 computer with the chronograph alteration;
- c. Chronograph

(1) This set of equipment is used roughly as follows:

(a) The MK-25 radar is directed along the gun line prior to firing.

(b) The bullet is tracked by the MK-25 radar from close to the muzzle out to somewhat over 5,000 yards.

(c) The time required for the bullet to pass through radar gates established at 2,000 yards and 4,000 yards is measured to the nearest millisecond by the chronograph. If the 2,000-yard gate is missed for any reason, the circuitry automatically switches to measurement of the time for passage of the bullet between the 3,000-yard to 5,000-yard ranges.

(d) The I.V. is determined by entering the measured time into a set of tables prepared by Drysdale Corp.

Although the absolute accuracy of numerics obtained by this measurement technique might not be great, the reproducibility and the differences between I.V. values is [sic] considered to be reasonably accurate. As an example...NEW JERSEY used both forward and aft chronograph systems to make measurements on the same bullet and obtained I.V. values which differed, on the average, by less than 5 ft./sec.

4. Results. Table F-1* summarizes the I.V. measurements recorded for full-charge firings during the month of December 1968. Table F-II records the same measurements for reduced-charge firings. Each row entry on [sic] these tables refers to the results of a single firing mission. The column labeled delta IV reports the difference between the maximum measured I.V. and the minimum measured I.V. for each mission. The S IV column gives the standard deviation of all the I.V. measurements for each mission; this statistic gives a measure of the inherent variability in initial projectile velocity from shot to shot. In columns 13 and 14, respectively, the delta IV and S IV statistics have been translated into the expected changes in the range at which the bullet will impact. These columns show the extent of the range dispersion resulting from the observed variations in I.V.

5. The data of Table F-1 show that the average of column 13 is 1187 yards, with the standard deviation of the column 13 values being 614 yards. This means that, for the average full charge firing mission of December 1968, at least one of the bullets might be expected to fall about 600-1200 yards short or over the target just because of the effects of I.V. variations. Not all of the bullets, of course, would show this large dispersion in range, since the numbers in column 13 represent the maximum observed I.V. difference. However, Table F-1 shows that the average of column 14 (the S IV [**sample standard deviation**]), which is more representative of the variability of the average bullet) value was 395 yards, and that the variation of this value between firing missions was such that the standard deviation of this S IV was 199 yards.

6. Fluctuations in I.V. appeared to cause less degradation in accuracy when reduced-charge missions were fired. Thus, Table F-II shows that, for the December 1968 firings with reduced charge--

Range variation equivalent to delta IV (Col. 13):

Average = 312 yards; Standard Deviation = 196 yards.

Range variation equivalent to S IV (Col. 14):

Average = 102 yards; Standard Deviation = 61 yards.

8. Operational Implications. One obvious effect of the excessive I.V. variations encountered when shooting at full charge ranges will be to cause a larger bullet requirement and to decrease the probability of a successful mission. This will partially negate the unique characteristics, i.e., long range capability and terminal

*Information from Tables F-I (Full Charge Firings) and F-II (Reduced Charge Firings) is summarized on the facing page.

accuracy, of...NEW JERSEY. There are, moreover, other consequences which could ensue. Some of these are:

a. During discussion with the Commanding Officer of...NEW JERSEY I was told that, because of their problems with full-charge I.V., they had, whenever possible, shifted their emphasis to targets within reduced-charge range. ...during the first two weeks in October, less than 10% of the main-battery missions of NEW JERSEY were fired with reduced charge. As seen in Tables F-I and F-II, the percentage of reduced-charge firings has increased to 44% in December 1968.

b. The possibility of firing at targets which are only slightly separated in range (say, 1,000 yards) from friendly forces is reduced somewhat, and this will reduce somewhat the ability of...NEW JERSEY to serve in [a] close-support role at maximum 16" gun range. Unless scatter, due to I.V., is reduced, the use of the MK-19 bullet, with its large area of lethality, would seem prudent only when no friendly troops are in the area.

9. As a result of on-the-scene observation by NWC, Dahlgren [Naval Weapons Center, Dahlgren, Va.],* personnel, two powder lots were suspended. Recent conversation with ship's personnel indicated that this has helped, but not completely solved, the problem.

SUMMARY OF DATA, TABLES:	<u>F-I (Full Charge)</u>	<u>F-II (Reduced Charge)</u>
Firings:	24 (238 salvos)	12 (188 salvos)
	(max/min/average)	(max/min/average)
Gun Elevation (deg.):	38/17.5/28.5	35.5/20/28.75
Approx. Range (yd.)	40K/26.6K/34.95K	26.2K/19.7K/23.74K
Change/10 FSIV (yd.):	267/162/223	202/153/183
Observed IV Variations:	2691/2542/2611.8 FS	2085/2031/2051.4 FS
IV (Max minus Min IV):	111/6/54.1 FS	37/4/16.6 FS
Range Dispersion Corresponding to IV (yd.):	2442/139/1187.3	725/68/312.2

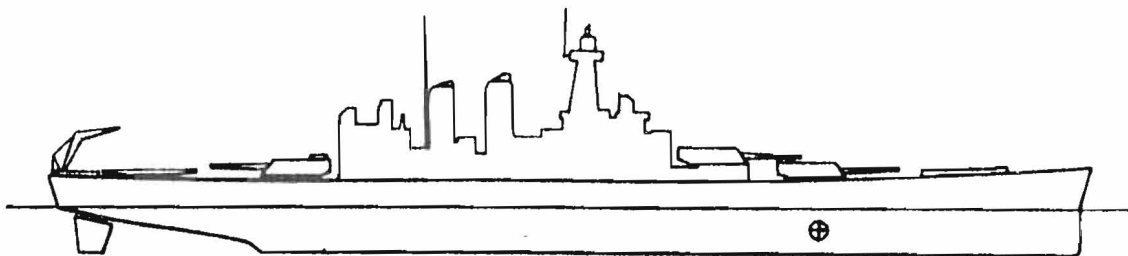
[Since her reactivation in 1984, IOWA's gunners have worked to develop the full potential of the 16-inch gun and have discovered the source of these difficulties. The initial velocity (IV) of a gun must be exactly known for accuracy; an error of only 10 foot/seconds will throw the bullet off 127 yards in range at 20,000 yards. NEW JERSEY's problem was thought to involve possible inaccuracies in published range tables (tables of performance of guns, usually derived from proving-ground tests) and in the ballistic cams used in her Mark 8 rangekeeper, as well as powder composition. Modern doppler velocimeters permit highly precise measurement of IV. Tests recently carried out by IOWA, NEW JERSEY, and MISSOURI, using these velocimeters, have shown that inaccurate IV measurement contributed to bias errors in computed IV which led to the unpredictable range performance shown by NEW JERSEY's guns in 1968-69.]

IV. WAR DAMAGE

SUMMARY OF WAR DAMAGE TO AMERICAN FAST BATTLESHIPS

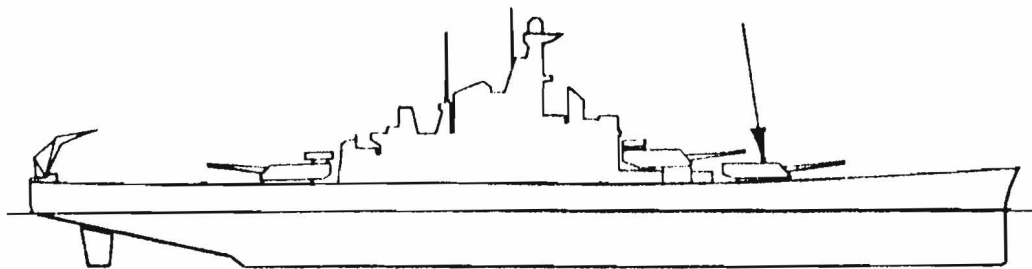
15 September 1942: NORTH CAROLINA (BB 55), off Solomon Islands

Struck by a deep-running torpedo at frame 55, port side. Holding bulk-head failed along a vertical butt, permitting some flooding. After damage, speed was increased from 19 to 25 knots.



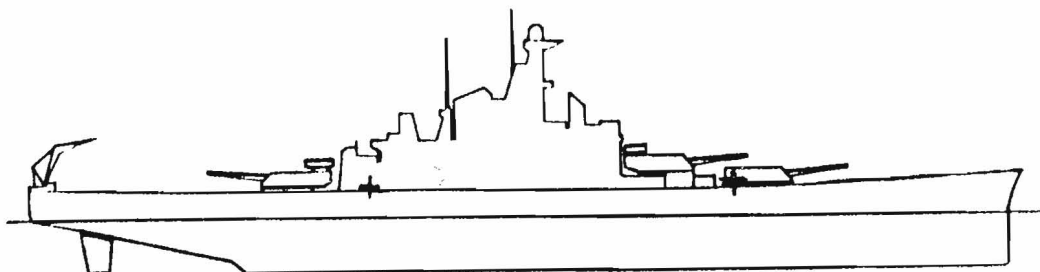
26 October 1942: SOUTH DAKOTA (BB 57), Battle of the Santa Cruz Islands

Struck by bomb on top of turret I. Only damage was scoring of slides of center and right guns of turret II.



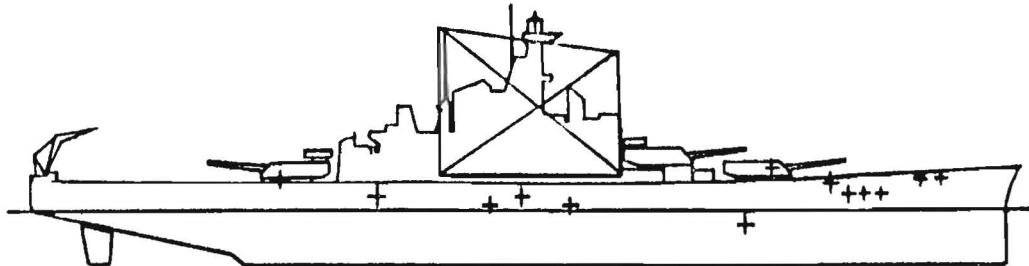
8 November 1942: MASSACHUSETTS (BB 59), off Casablanca, French Morocco

Direct hits by two 240mm SAP projectiles and one ricochet; minor damage.



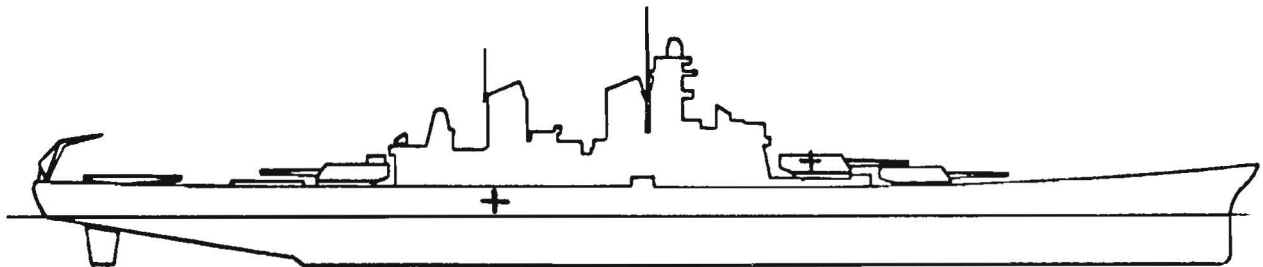
15 NOVEMBER 1942: SOUTH DAKOTA (BB 57), Battleship Night Action off Guadalcanal

General gunfire damage topside with heaviest concentration on forward superstructure. One 14" (apparently bombardment) projectile struck starboard side of Turret III barbette, just above main deck, causing minor damage outside barbette.



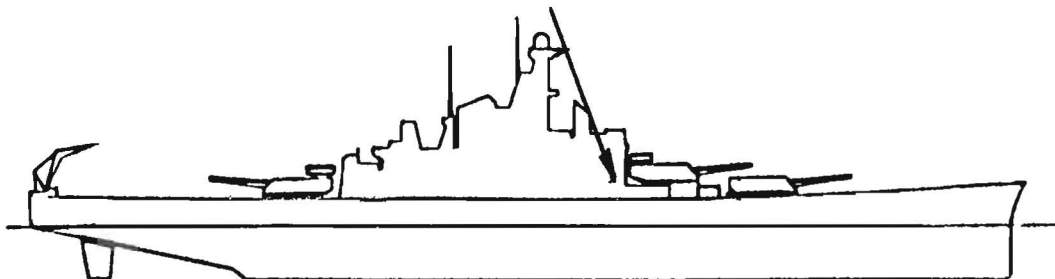
18 MARCH 1944: IOWA (BB 61), Bombardment of Mili Atoll, Marshall Islands

Medium-caliber Japanese shore-battery projectile detonated on port side of Turret II. Fragment damage to turret fire control instruments. Second projectile detonated on contact with port shell plating just below main deck at frame 134. Minor damage.



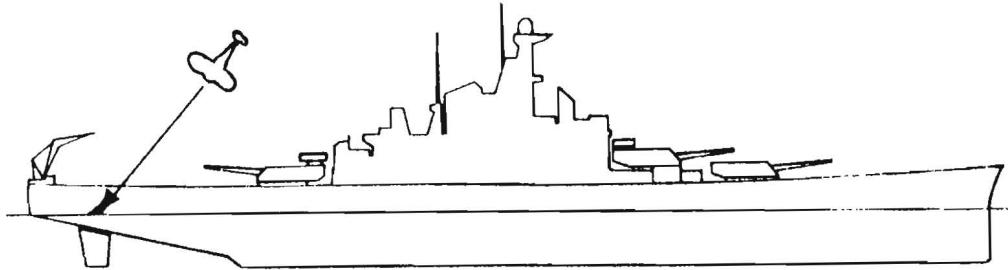
19 JUN 1944: SOUTH DAKOTA (BB 57), off Saipan, Mariana Islands: Battle of the Philippine Sea

250 kg. Japanese SAP bomb, with instantaneous fuze, detonated on port side of superstructure deck at frame 72-1/2. Severe blast and fragment damage in wardroom and nearby vicinity. Small local fires.



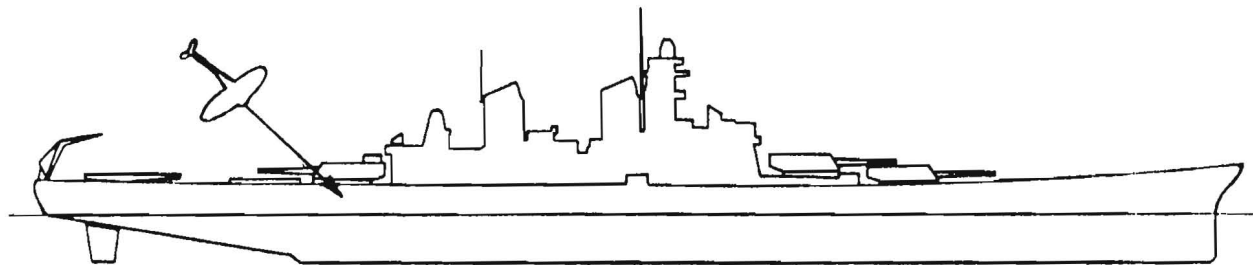
19 JUNE 1944: INDIANA (BB 58), Battle of the Philippine Sea

Burning Japanese suicide plane crashed into starboard quarter at waterline. Shell dented but not ruptured. Minor damage.



11 APRIL 1945: MISSOURI (BB 63), off Okinawa

Japanese suicide plane struck at frame 160-] to starboard, just below main deck edge, and fell into sea. Slight structural damage; small gasoline fire.



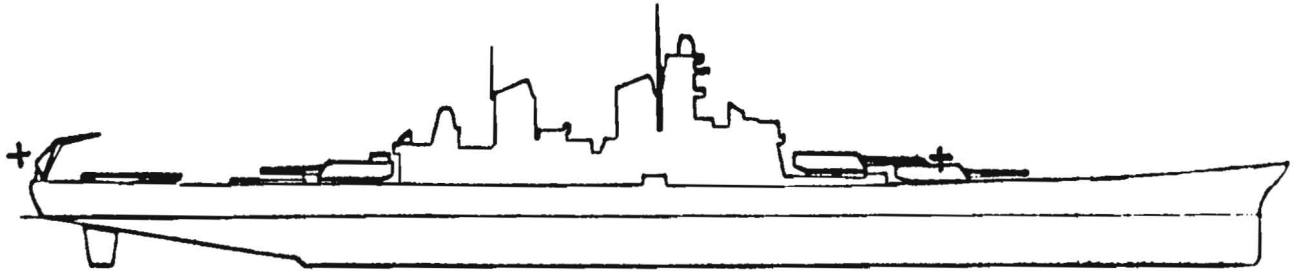
16 APRIL 1945: MISSOURI (BB 63), off Okinawa

Japanese plane crashed just astern of ship. Slight shock and fragment damage.



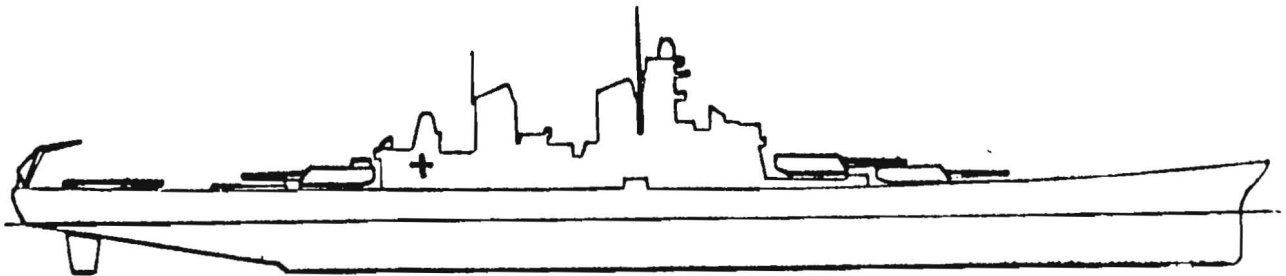
20 MAY 1951: NEW JERSEY (BB 62), off Wonsan, Korea

Projectile, about 4" caliber, from shore battery struck top of Turret I and exploded. Second projectile was air burst off port quarter. Slight damage.



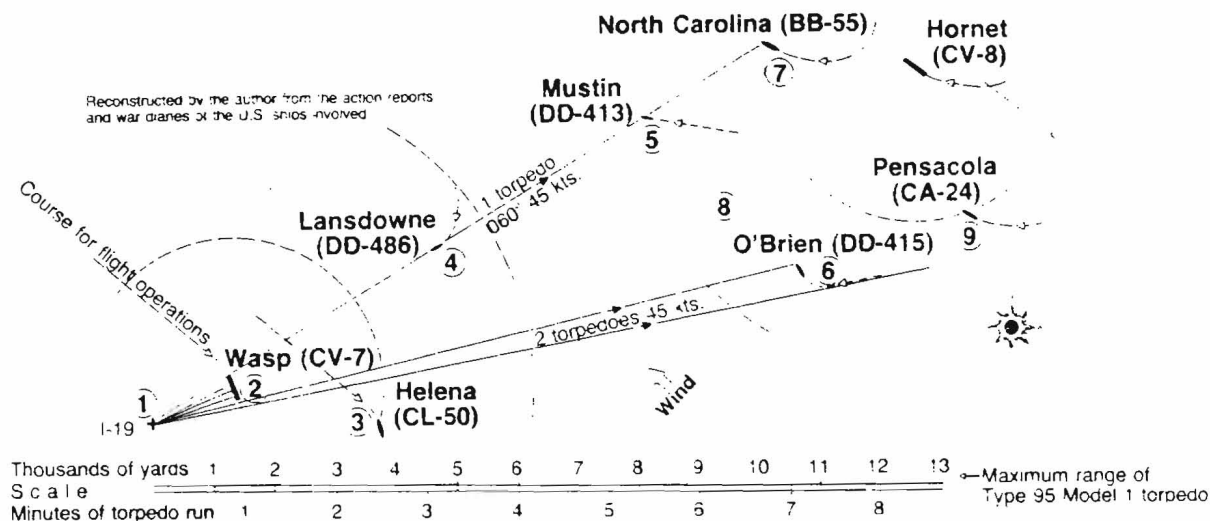
15 MARCH 1952: WISCONSIN (BB 64), off Songjin, Korea

152mm projectile from shore battery struck 02 Deck (deck immediately above superstructure deck) between frames 144-145. Slight structural damage; 24"X30" hole in 02 Deck, starboard side.



**Torpedoing of NORTH CAROLINA by Japanese Submarine I-19,
15 September 1942**

Drawing by CAPT Ben W. Blee, USN (Ret.), in U.S. NAVAL INSTITUTE PROCEEDINGS (July 1982), p. 46:



(I-19 fired a spread of six torpedoes. Three struck WASP; of the other three, one hit O'BRIEN and another damaged NORTH CAROLINA.)

COMINCH NARRATIVE:

Task Force 17 began turning to base course at 1444 and, during the turn, noted smoke and flame on WASP. At 1450, after steadying on 280°, NORTH CAROLINA intercepted this message broadcast by TBS from LANSDOWNE in the WASP Task Force: "Torpedo passed directly over 86 coming directly for force, course 080 ." Half a minute later while the battleship was starting a right turn under 10 rudder, conforming with HORNET, MUSTIN reported by TBS: "Torpedo passed astern, headed for you." MUSTIN was then about 60° on the port bow of the NORTH CAROLINA, 500 yards distant, regaining screen station.

Full right rudder and emergency flank speed were ordered but, at 1452, ship's head 295°, a torpedo struck at about frame 45 port. It was not seen from the ship until just before it hit. Its course may have been between 000° and 030°.

The point of impact was about 20 feet below the water line. A heavy column of oil and water rose nearly as high as the tops. Immediately a 5]° list developed, but it was removed in six minutes. Flooding on the first platform deck carried through four bulkheads from the skin of the ship. Flash from the explosion penetrated to Turret One handling room and spaces in the vicinity. Smoke with a heavy odor filled the forward spaces, pouring up through the forecandle hatch lending credence to the report that the magazines were on fire so that they were ordered flooded.

BUREAU OF SHIPS WAR DAMAGE REPORT NO. 61
U.S.S. NORTH CAROLINA (BB55) TORPEDO DAMAGE
SOLOMON ISLANDS, 15 SEPTEMBER 1942

SECTION I, SUMMARY

I-1. NORTH CAROLINA was damaged by a submarine torpedo which struck the port side abreast No. I Turret. The holding bulkhead failed and permitted limited flooding inboard. The torpedo protection system in way of the hit is thinner than amidships as necessitated by the speed characteristics. Abreast Turret I there is one less torpedo protection bulkhead and, therefore, one less torpedo protection layer on either side of the ship. The Bureau has given consideration to the addition of blisters and to certain recommendations for increased underwater protection. Blisters have not been added principally due to their adverse effect on speed.

I-2. The ship was not at General Quarters when hit. Speed was immediately increased from 19 to 25 kts. The 5] list was removed within six minutes. Turret I remained operable. The flooding, although extending inboard of the holding bulkhead and above the third deck, was not extensive. Progressive flooding was minor. Loss of life was small. No fires occurred as a result of the flash. There was no machinery damage, and shock effects were not severe.

SECTION II, SUMMARY

II-1. At 1452 on 15 September 1942, while operating as a unit of Task Force 17, NORTH CAROLINA was hit by a submarine torpedo. The torpedo detonated abreast Turret I at about frame 46, port, two feet below the lower edge of the armor belt.

II-2. General Quarters was sounded and Condition ZED set. Speed was increased from 19 to 25 kts. A 5] port list was removed in six minutes by counterflooding. The ship maintained station for five hours and then was directed to proceed to port for temporary repairs by tender.

II-3. Structural damage was of average amount. The hole in the shell was 36 feet long. It extended from the foot of torpedo protection bulkhead No. 5 to the bottom edge of the side belt. Torpedo protection bulkhead No. 1 was demolished between frames 46 and 50, and torpedo protection bulkheads 3 and 4 were forced inboard and torn. Vertical and horizontal seams in armored torpedo protection bulkhead No. 5 were opened up and several compartments inboard of this bulkhead were flooded. An area of the 30 lb. S.T.S. third deck was blown upward to the overhead in [one compartment]. The first and second platform decks and third skin shelf were crushed abreast the hit. The turret stool was indented slightly. There was some minor deformation of Turret I lower handling room deck and framing beneath.

II-4. Flooding was not extensive and progressive flooding, limited. List and trim were quickly removed by counterflooding.

II-5. There was no fire. Flash from the torpedo was reported in the lower handling room of Turret I and in other spaces. It produced no damage. Whether the flash could have produced a smokeless powder fire or explosion, had there been exposed powder charges, is problematical.

II-6. Damage to armor, except for torpedo protection bulkhead No. 5, was inconsequential. Several plates of the side belt were partially cracked and pushed inward at the bottom. Seams of armored torpedo protection bulkhead No. 5 opened up as described above. The second deck was buckled slightly upward.

II-7. Damage to Turret I was not severe. Burrs on the training pinion and rack were removed by ship's force. Stool indentation was local and of small amount. About two feet of water entered the lower handling room through a vent duct. Power circuits were not affected, although it was reported that some seepage into [one compartment] caused saturation of the lower ends of cables leading down the turret center column.

II-8. Electric power and lighting circuits and equipment were damaged in flooded spaces. Shock damage to electric equipment was slight and shock damage, in general, was not serious. Miscellaneous piping and ventilation damage occurred in way of the hit.

II-9. After temporary repairs by [repair ship] VESTAL at Tonga-Tabu, NORTH CAROLINA proceeded to Pearl Harbor Navy Yard for permanent repairs.

II-10. All factors considered, it is believed that NORTH CAROLINA's power of survival was not severely strained by the torpedo hit, and that the effect of the damage on her fighting efficiency was limited. Sustained speed was reduced to about 18 kts., although speeds up to 24 kts. could be made. Radius was reduced by loss of 150,000 gallons of oil. Although flooding occurred through the holding bulkhead, overall flooding was not extensive. Turret I apparently was still able to fire.

SECTION V, DISCUSSION

V-B, Location and Size of Torpedo Hit

V-B-3. It has been found from both war experience and model tests that with a liquid-backed shell the damaged plating will usually be turned inboard. With an air-backed shell, the damaged edges of plating will generally be turned outboard. NORTH CAROLINA's shell plating was air-backed. Outward turned shell plating increases resistance to propulsion (resulting in loss of speed) and increases the probability of extension of damage by tearing the plating.

V-C. Flooding, Counterflooding and Damage Control

1. Liquid Loading before Damage

V-C-1. The voids in the damaged area were empty prior to the detonation.. The void layers were the outer and inner layers of the four-layer underwater protection system.* The two fuel oil layers, as well as the

***The underwater hull was protected against torpedoes by a succession of watertight longitudinal bulkheads. These formed compartments, or layers, kept empty or filled with liquid (oil or water), designed to absorb the force of a mine or torpedo before it could reach the ship's vitals.**

bottom fuel oil tanks in the vicinity of the damaged area, were full of oil at the time of the explosion. The total weight of liquid in the damaged area prior to damage was 597 tons.

V-C-2. At the time of the design of NORTH CAROLINA, the liquid loading (AWWA)* was selected to minimize the damage to the holding bulkhead. Since that time, the conviction has become established that, in most cases, there is a greater net gain in reducing list after damage, by carrying the outer two layers full, than loss in the slightly increased damage to the torpedo protection system. Extensive piping changes would be necessary to permit carrying the outboard layer in NORTH CAROLINA full. Since this Class has good transverse stability characteristics, the increased angle of heel after damage, by reason of the outer layer being void, has been accepted.

2. Liquid Loading Immediately after Damage

V-C-3. As a result of the damage, the following compartments and tanks flooded or were opened to the sea immediately: [**Fifteen voids; 14 fuel tanks (13 filled with oil or ballast water before damage); two magazines; five storerooms; six trunks; two living compartments.**] The total weight of liquid added in the damaged area...was 970 tons.

3. Progressive Flooding

V-C-4. The extent of slow flooding was negligible. [**Three**] compartments were partially flooded by seepage from flooded compartments....

4. Counterflooding and Damage Control

V-C-5. **The partially-flooded compartments** were pumped dry by portable submersible pumps after a few inches of water had accumulated in each compartment.

V-C-6. Following the explosion which occurred at 1452, the ship listed to port and trimmed slightly by the head. The Damage Control Station was ordered to remove the list and trim. This was accomplished by 1458. [**Ten**] voids...were partially counterflooded immediately following the explosion.... Counterflooding was stopped as soon as the ship returned to an even keel. Time required to return the ship to zero list, from the time of detonation of the torpedo, was approximately six minutes. It was estimated that 480 tons of counterflood water was taken in voids.

V-C-7. Soon after the damage, it was possible to pump overboard 144 tons of contaminated** oil and to transfer the remaining uncontaminated oil from the damaged area to the starboard side. This permitted the three forward counterflooded voids...to be emptied.....

V-C-8. Later on the same day [**three**] voids...were flooded and the remaining seven counterflooded voids...were emptied.

*Outer and inner layers empty, two middle ones filled with liquid.

**Mixed with seawater.

V-C-9. [Shoring was done in seven compartments soon after the explosion. One void was flooded to shore its forward bulkhead.]

V-C-10. BuShips Manual states that, for ships with torpedo protection systems (underwater protection systems), counterflooding should be undertaken as soon as clinometers and reports give evidence of a list developing from torpedo attack. NORTH CAROLINA's action in immediately removing the list was in agreement with the present policy of the Bureau. The Manual further states that, for ships with torpedo protection systems, the overall ship survival measures in the order of their importance are:

Step 1. Counterflood.

Step 2. Restore reserve buoyancy:

- (a) By pumping damage water overboard.
- (b) By transferring fuel oil across the ship and pumping out the counterflooding water.

Step 3. Correct trim:

- (a) By pumping damage water overboard.
- (b) By transferring fuel fore-and-aft.
- (c) By pumping liquids overboard from intact tanks at the low end.

V-C-11. Thus, for ships with underwater protection systems, it is to be noted from the above paragraph that:

1. List removal is of prime importance, restoration of lost reserve buoyancy is of next importance, and finally, trim correction is of third importance.

2. List correction is of such great importance that it should be undertaken as soon as list develops, and in spite of the fact that the means selected... (i.e., counterflooding) might result in reducing the total number of torpedo hits on both sides that the ship might ultimately survive, and in spite of the reduction of the effectiveness of the underwater protection system in the event that the void layer immediately outboard of the holding bulkhead were counterflooded.

3. List correction is so important that it should be accomplished by counterflooding (Step 1.) even though Step 2. directs restoring reserve buoyancy by pumping out the counterflood water as soon as possible after counterflooding.

V-C-12. Any list removal policy...must support the basic precept of maximizing the protective resistance of the ship and prolonging her life. The policy...must meet the conditions of expected attack. Torpedoes may strike singly or severally, simultaneously or intermittently, on one side or both sides, and variously distributed with regard to the ship's length. ...it is more important to have the ship survive a given number of hits already received than to maximize the number of hits the ship might ultimately receive.

V-C-17. The Bureau's objective in recommending liquid loadings is to place the ship and keep the ship in a condition of maximum resistance to underwater attack. It is desirable to take all practicable steps before damage to insure against large angles of heel after damage and to keep to a minimum the amount of counterflood water required to remove given amounts of list.

V-C-26. Summarizing, in ships with an underwater protection system, list removal, by counterflooding, should be undertaken as soon as list occurs after damage. After the list has been removed, reserve buoyancy should be regained by pumping damage water or liquids on the damaged side overboard, by transferring liquids within the ship, and by removing counterflood water. Removal of list is of prime importance; and trim removal, generally, of secondary importance. Thus, the ship will be returned quickly to the upright in which attitude it will best be able to continue operating, and it should then be returned expeditiously to the best condition to resist further damage.

V-C-27. In counterflooding, therefore, the best judgment should be exercised. The stability and buoyancy characteristics of the ship should be known.* The general effects of various attacks by underwater weapons, particularly torpedoes, on the ship should also be known. The number of torpedo hits, their location..., the amount of list (and trim) and the rate of increase of list should be ascertained. Rapid means of list removal by counterflooding, and for removal and transfer of flood water, fuel oil and ballast water after and during counterflooding should be available. Then, with an appreciation of the urgency and importance of list removal and the desirability of restoration of reserve buoyancy as soon as practicable after list correction, the amount, location and speed of counterflooding required can be determined by the responsible central authority and explicit orders issued to proceed. An emergency counterflooding doctrine should be established to meet the situation in which the central authority is isolated or incapacitated, but such emergency doctrine should not so limit the repair parties as to prevent their meeting the requirements of the emergency.

V-D. Fire

V-D-1. No fires resulted from the explosion. A flash of flame was reported in Turret I handling room, in the access trunk leading from the handling room to the second and third decks, and in [an adjacent compartment] A yellowish-brown smoke filled every open compartment between frames 37 and 71. Apparently the smoke came from the explosion. In most areas it was quickly dissipated when the exhaust blowers were started.... Fire was reported, but not confirmed, in [two] 16 in. powder magazines.... Both magazines were sprinkled immediately. After draining, no evidence of fire was found.

*(BUSHIPS NOTE) Due to the considerable variations in size, hull form, compartmentation, liquid loading, etc. and hence, in stability, buoyancy and resistance to damage for different combatant types..., it is essential that a ship's personnel study and know their own ship, its resistance to damage and power of survival.

V-F. Armor Damage

5. Summary of Armor Damage

V-F-6. It is of interest to note that no armor plates were knocked off in spite of the proximity of the hit to the side armor. Damage to the armored deck was negligible, as was to be expected. The 117-lb. STS lower barrette was not damaged. The opening of the riveted scarphed seams of the armored torpedo protection bulkhead No. 5 (holding bulkhead), as well as its connections to the first and second platform decks and to the third skin shelf, permitted flooding of interior spaces. ...the holding bulkhead was designed as an armored bulkhead...to protect the magazines against long range projectiles striking below the armor belt. It was also expected that this bulkhead would compensate somewhat for the reduction in the transverse depth of the torpedo protection system, which depth was limited by the general design restrictions on displacement, beam, speed and length.* The case of NORTH CAROLINA, therefore, did not constitute a test of the ballistic effectiveness of the armor; however, it did illustrate the inability of the holding bulkhead to maintain a watertight boundary. Thus, it appears that the side belt and second deck armor were of little value in limiting damage and were not subjected to direct ballistic attack. The armored holding bulkhead failed to perform one of its two principal functions--prevention of internal flooding.

V-G. Turret I Damage

V-G-1. The center of the turret is at frame 45]. The torpedo struck just forward of frame 46 at about the level of the lower 16 in. projectile shelf. Shock effect was not serious. The high pressure air line in Turret I was ruptured at the valve in the outer powder circle...and the Bristol regulator valves were torn from the bulkhead in the same compartment. The shock effect to electrical equipment was remarkably slight. No circuit breakers tripped out at the switchboards and no motors were started or stopped by shock. Power circuits in Turret I were not affected.... Likewise, there was little shock damage to piping.

V-G-2. The flash of flame reported in Turret I lower handling room produced no damage.

V-G-3. The scarphed joints of the armored holding bulkhead failed in way of the turret. Two magazines...flooded. Six magazines remained dry following the hit. Two of these magazines...were sprinkled after...a report of fire.... Approximately two feet of oil and water entered the lower handling room through the ventilation duct.

V-G-4. Torpedo protection bulkhead No. 5 was forced by the torpedo explosion to within about 3 in. of the 60 lb.** turret stool at the first platform deck. The first platform deck collapsed and its connections to the S.T.S. bulkhead plating were completely ruptured. The cylindrical stool was bulged inboard on the port side about 3 in. approximately 2 ft. below the first platform deck at frame 46.... The stool stiffener

***NORTH CAROLINA was designed within the 35,000-ton standard displacement limit prescribed by the Washington naval limitation treaty.**

****Made of steel plates approximately 1]" in thickness.**

at frame 45] was fractured near the top.... Leakage through loosened rivets in the damaged area of the stool occurred at the rate of about 50 gal. per hour into the outer powder circle.

V-G-5. The ventilation duct leading from the lower handling room...was damaged in the electrical booth. ...approximately two feet of oil and water entered the lower handling room through this vent....

V-G-6. The turret training pinion was burred. After the burrs were removed, it was reported that the turret was trained without difficulty.

V-G-8. Damage to the stool proper was very minor; only the horizontal stool connections at one place in the periphery received significant damage. The damage to the stool is not considered sufficient to have prevented the firing of the turret.

V-H. Electrical Damage

[Shock and flooding caused some damage to power, lighting, fire control, interior communication, and degaussing systems in the general area of damage.]

V-H-3. ...the shock effect to electrical equipment was remarkably slight. No circuit breakers tripped out at the switchboards and no motors were started or stopped by shock. Power circuits in Turret I... were not affected by shock. All known alterations for securing fuses, switches, etc. against shock had been installed.

V-I. Shock Effects

V-I-1. The shock effect was not serious. No violent general flexural vibration of the ship was noted.

V-I-2. The shock effect to electrical equipment was slight.

V-I-3. The amount of shock damage to piping was remarkably small. The only piping ruptured was in the voids, storerooms, oil tanks and magazines immediately adjacent to the explosion.

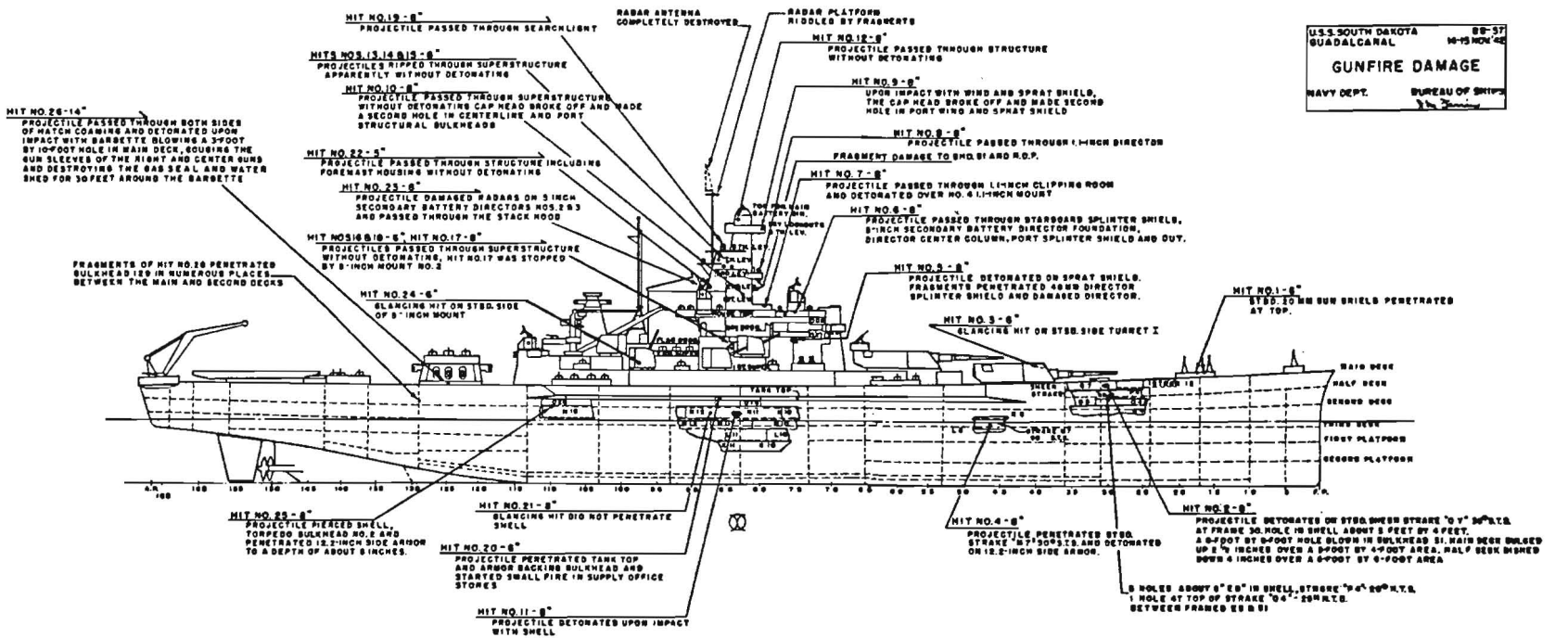
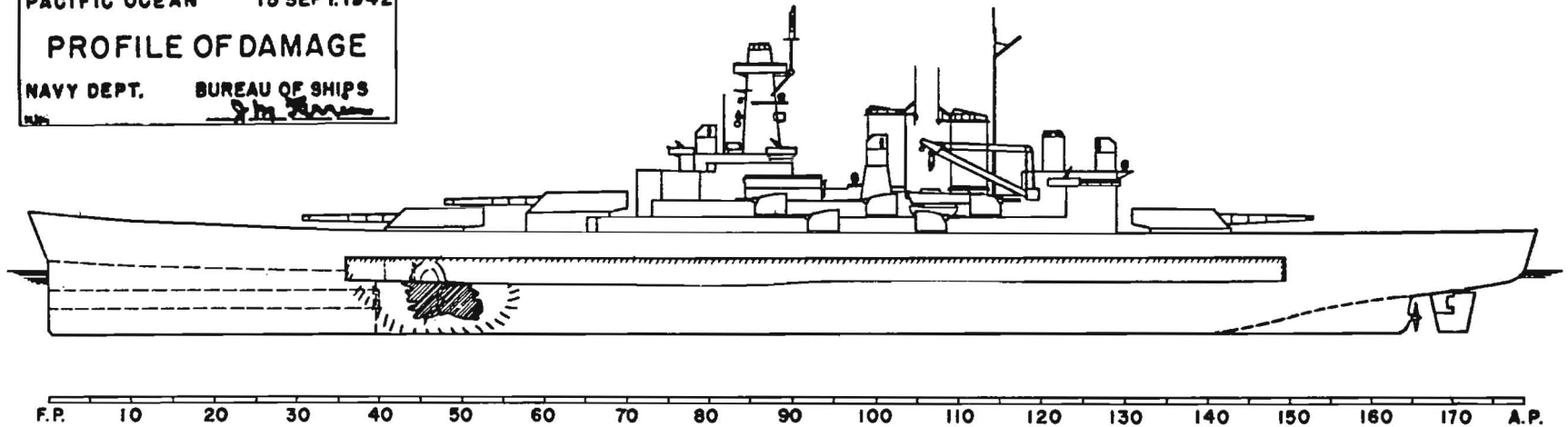
V-J. Piping and Ventilation Damage

[Shock and fragmentation caused some damage to piping and ventilation systems in the area of the explosion.]

SECTION VI - CONCLUSION

VI-1. The case of NORTH CAROLINA indicates the need for increased torpedo protection. It illustrates the continual competition between weapon effectiveness and ship protection. The Bureau is pursuing a program of research and testing to improve underwater protection systems. Increased thickness of the torpedo protection layer, the use of cellular compartmentation, or a combination of both systems could be used to gain additional protection against side contact and underbottom torpedo hits. The damage was sustained by NORTH CAROLINA without marked reduction of her fighting ability and was ably handled by the ship.

U.S.S. NORTH CAROLINA BB-55
 PACIFIC OCEAN 15 SEPT. 1942
PROFILE OF DAMAGE
 NAVY DEPT. BUREAU OF SHIPS



Battle damage to NORTH CAROLINA and SOUTH DAKOTA. F.P. and A.P., in these drawings, indicate the forward and after perpendiculars, the extremities of the waterline. The distance between these is the length used in making design calculations. Numerals are location of frames, spaced 4 feet apart. Frame numbers are used to locate points along the longitudinal axis of a ship.

BUREAU OF SHIPS WAR DAMAGE REPORT NO. 57
U.S.S. SOUTH DAKOTA (BB 57) GUNFIRE DAMAGE
BATTLE OF GUADALCANAL, 14-15 NOVEMBER 1942

SECTION I, SUMMARY

1. During the action off Guadalcanal on the night of 14-15 November 1942, SOUTH DAKOTA was hit by at least 26 projectiles. The most serious material damage was that sustained by electrical wiring circuits. Many interior communication and fire control circuits were severed, particularly in the superstructure where the damage was most extensive. All radio transmitting antennae and all radars, except the one on Main Battery Director II, were rendered inoperative. Short circuits from this damage caused an overload on the I.C. switchboard, which resulted in loss of power on fire control and interior communication circuits throughout the ship for approximately three minutes.

2. Minor flooding resulted from one hit below the waterline and two hits close to the waterline. The list of about 3/4 degree which developed was removed by shifting fuel oil.

3. Before receiving the first hit, SOUTH DAKOTA experienced electrical difficulties initiated by the shock of Turret III firing astern. Although not the direct result of enemy action, an analysis of this casualty has been included herein because the loss of power to Turret III seriously hampered SOUTH DAKOTA during the action.

4. In spite of numerous hits, SOUTH DAKOTA received only superficial damage. Neither... strength, buoyancy nor stability were measurably impaired.

SECTION II, NARRATIVE

5. SOUTH DAKOTA, WASHINGTON [and four destroyers] comprised Task Force 64 on the night of 14-15 November 1942. During the day... numerous units of the enemy fleet, including battleships, ...had been sighted north and west of Guadalcanal. ...Task Force 64 was directed to take...position...to intercept the enemy bombardment group.

6. During the night the sea was calm. Surface visibility... progressively decreased as...overcast developed. Action was expected, and SOUTH DAKOTA was at General Quarters and Material Condition AFIRM had been set. The firemain was divided into four sections with fire and flushing pumps 2, 3, 4 and 5 in machinery spaces...on the line.

7. SOUTH DAKOTA was the second ship in column, astern of WASHINGTON. At 0007 three enemy vessels were sighted...at...about 18,000 yards. ...the battleship KIRISHIMA and cruisers ATAGO and TAKAO were present during the action.... At 0018 SOUTH DAKOTA opened fire with the main battery on the second ship in formation at...about 15,700 yards. Firing on this target continued until 0024, when it disappeared from the radar screen. SOUTH DAKOTA shifted her main battery to another target and fired five salvos.

8. Just as SOUTH DAKOTA checked fire, at 0033, she began to suffer a series of electrical failures initiated by the shock of firing. Power was progressively lost in the after half of the ship. By 0036 the short-circuit was isolated and power restored except on 5-inch mounts Nos. 6 and 8. Temporary repairs were made, and power was regained on gained on those mounts later. At no time was 440-volt power lost on

Turrets I and II or any 5-inch mount except Nos. 6 and 8.

9. At 0040, Turrets I and II commenced firing on targets... which were tentatively identified as...destroyers. Turret III was firing over the stern at a target at 0042. The blast from the guns of Turret III set fire to the planes,* but the next salvo blew two planes overboard and extinguished most of the fires.

10. The SG radar was inoperative from 0041 to 0046, which complicated station keeping and detection of new targets. One report of enemy vessels on the starboard bow at...7000 yards had been overlooked in conn while directing fire on targets bearing 070 degrees relative, range 5800 yards, when SOUTH DAKOTA was illuminated at 0048 by four searchlights on the second ship in the enemy column. SOUTH DAKOTA identified the first ship as a battleship [KIRISHIMA] and the second and third ships in column as cruisers [ATAGO, TAKAO]. WASHINGTON opened fire on the leading ship...almost immediately. About thirty seconds after illumination, the enemy opened fire, concentrating on SOUTH DAKOTA. Simultaneously, SOUTH DAKOTA's secondary battery commenced firing on the illuminating ship. The searchlights were quickly extinguished...and the third ship assumed...illumination. SOUTH DAKOTA's main battery fired two or three salvos at the second ship in column, and then shifted to the third ship. The enemy began hitting almost immediately and continued hitting until 0105. Steering and engine control were never lost, but extensive damage was done to radar, radio, fire control, and I.C. circuits and instruments. At 0108 SOUTH DAKOTA ceased firing when all targets were lost. SOUTH DAKOTA...withdrew to the...rendezvous, as her night-fighting efficiency had been seriously impaired.

SECTION III, DISCUSSION

Type of Projectile

11. During the engagement...SOUTH DAKOTA sustained at least 26 projectile hits. It is estimated that one hit was 5-inch, six were 6-inch, eighteen were 8-inch and one was 14-inch. The caliber of these hits was estimated from the damage produced and fragments recovered of one projectile. In many cases the entry hole of the projectile almost gave a direct measure of its caliber. Although structural damage was extensive it was considerably less than would be generally expected from this number and caliber of hits. That...can be attributed to the fact that most projectiles passed through the ship's structure without detonating. SOUTH DAKOTA reported that fragmentation was chiefly due to impact rather than detonation. Because of [the] long time delay [of Japanese fuzes, designed to explode after penetrating heavy belt armor], most projectiles passed through the superstructure without detonating.

Structural Damage

Note: Hits sustained in the engagement are numbered on PLATE I for convenience from forward aft without regard to size or time of hit. The sizes of the projectiles were estimated from the effects of the hits.

***SOUTH DAKOTA carried three Vought OS2U Kingfisher observation float-planes on her fantail, normal stowage for planes in fast battleships.**

In some cases, the hits were so concentrated that it was difficult to associate damage with a specific hit.

Turret Blast Damage

39. The blast from Turrets I and II, while trained aft as far as possible on the starboard side, did considerable damage on the first superstructure, and main, decks. The 3/8-inch STS shield around the 40mm mount at frame 73 starboard on the first superstructure deck was tilted inboard and...the 40mm mount itself was wrecked. The 3/8-inch STS shield around 20mm guns...on the starboard side of the main deck between frames 54 and 64 was blown inboard and torn loose from the deck. Telephone boxes, 20mm ready service lockers, ladders and ventilation closure covers in the vicinity were damaged by the blast.

Armor Performance

40. ...the armor performed as designed. No projectile penetrated the armored box. Hits Nos. 3, 4, 17, 24, 25 and 26 struck armor before detonation and failed to penetrate. The Commanding Officer...made this comment:

Armor: Fire control and conning tower have definitely proven their worth. Further agitation for the removal of this weight is definitely suspended. Control stations behind armor should be used more frequently. Too much stress in the past has been laid to the space restrictions at these stations. Had these stations not been utilized during the engagement, control and conn personnel would probably have been destroyed.

Electrical Damage and Casualties

41. Extensive damage was done to electrical circuits in the superstructure. The loss of many fire control, interior communication, radio and radar facilities seriously impaired the fighting power of the ship, particularly in night actions. The SOUTH DAKOTA Electrical Work List enumerated thirty-five different kinds of circuits needing repairs, including such items as renewing all flexible wiring to main battery director No. 1 and to secondary battery director No. 1 [**the two forward gun directors**]. ...in most cases electrical damage cannot be associated with specific hits.

42. The loss of all search radar was a serious handicap to SOUTH DAKOTA. In this regard the Commanding Officer stated:

The trust and faith in the search radar equipment is amazing. After this ship lost both SG and SC equipment, the psychological effect on the officers and crew was most depressing. The absence of this gear gave all hands a feeling of being blindfolded.

43. During the action, power on fire control and interior communication circuits throughout the ship was lost for approximately three minutes as a result of short-circuits due to the destruction, by gunfire, of cable and equipment on I.C. and F.C. circuits in the superstructure. The short-circuits produced an overload such that the cir-

cuit breaker, on the normal feeder to the I.C. switchboard, tripped on main generator and distribution switchboard No. 1. The I.C. switchboard was equipped with automatic bus transfer to shift the power supply to the emergency Diesel generator switchboard No. 1 in case of interruption of normal power.... As the capacity of the Diesel generator was considerably smaller..., the F.C. and I.C. bus was energized through a 1000-ampere circuit breaker which was designed to automatically open before the automatic bus transfer operated. Thus, only the load on the I.C. restricted bus, which was well within the capacity of the emergency generator, would remain on the board. The circuit breaker opened properly. But, after the automatic bus transfer operated, the fuses protecting the emergency supply "blew." Apparently several of the circuits connected to the I.C. restricted bus were still short-circuited. Defective circuits were isolated and power restored on all serviceable I.C. and F.C. circuits in approximately three minutes.

44. Ordinarily, matters which are not the result of damage by enemy action are not included in damage reports. In this case, however, the fact that electrical failure initiated by the shock of gunfire was a handicap to SOUTH DAKOTA while in action requires some comment. As a result of this failure, numerous control shifts had to be made and it was reported that all power on the after part of the ship was lost for about a minute. This occurred before receiving the first hit.

46. The shock produced by Turret III firing astern caused the contactor for the alternate power supply in the automatic bus transfer switch to close, thereby paralleling generator and distribution switchboards No. 4 and No. 2. As the two power sources were not in phase, the resulting synchronizing current surge welded the contacts on the automatic bus transfer switch closed and the normal feeder cable to the after 5-inch director ruptured and short-circuited between phases on the No. 4 generator and distribution switchboard side of the rupture.

47. The operator then energized generator and distribution switchboard No. 4 from generator and distribution switchboard No. 3 by closing the bus tie circuit breaker. The circuit breaker for the normal feeder to the bus transfer panel was closed manually, causing the circuit breaker to Generator No. 6 to trip. At this time, the circuit breakers...to the bus transfer panel were opened. Power was restored to generator and distribution switchboards Nos. 3 and 4 by closing the circuit breakers to generators Nos. 5 and 6. The alternate feeder circuit breaker to the bus transfer panel was closed at generator and distribution switchboard No. 3, tripping out circuit breakers for generators Nos. 5 and 6 and the alternate feeder. Circuit breakers for generators Nos. 5, 6 and 7 were immediately closed again, while circuit breakers on normal...and alternate feeder remained open. From the...closure of the automatic bus transfer switch until closure of the circuit breakers for generators Nos. 5, 6 and 7...about one minute elapsed. Repair parties then located the fault, isolated it and restored power to 5-inch mounts Nos. 6 and 8.

48. The source of these electrical failures was the unreliable operation of the automatic bus transfer switch. All of these switches have been replaced by a manual type transfer switch.

49. The power interruption on the after main switchboards was made more extensive by the failure of the feeder and the main generator circuit breakers to operate selectively under short-circuit conditions. ...instead of the feeder breaker operating alone to isolate the short-

circuit, the generator breaker also tripped out at the same time. For proper operation, the generator circuit breakers should not open under fault conditions except when the fault is on the switchboard bus or between the generator and the switchboard. ...the generator circuit breaker should have sufficient time delay at currents equal to the maximum short-circuit current of the generator to permit the feeder breakers only to trip. As the same time, the generator breakers must provide a reasonable amount of switchboard bus fault protection. After considerable study and development and subsequent to this casualty, improved circuit breaker performance was obtained by replacing the time delay dashpot trip devices on the main generator circuit breakers with a type PQ relay. The...PQ relays installed on [sic]...SOUTH DAKOTA were the first that became available. Nearly comparable improvement in selective breaker operation has been obtained on [sic] similar ships by the installation of special time delay dashpots on the generator breakers.

Fires and Firefighting

50. There were no serious fires during or following the action. Fires were small and quickly extinguished before they spread beyond the immediate vicinity of ignition. The fire potentially most dangerous was in two life jackets...found burning in passage B-319-T. These were believed to have been ignited by a flash through the ammunition hoist from 1.1-inch clipping room B-0502-M. This passage is within the armored box and adjacent to a 5-inch magazine. Other fires were started in the following locations:

After end of main deck in the vicinity of catapults; 40mm mount No. 2, frame 72 port on first superstructure deck; 5-inch loading machine; 5-inch director No. 1; 1.1-inch clipping room B-0502-M; Radar plot B-0801-C; Radio direction finder room B-0701-CT; Starboard flag bag; Main-battery radar transmitting room; [Compartments] A-206-L, A-207-L; Outside Turret III

In addition...numerous small fires on the first and second superstructure decks...consisted, mainly, of burning pieces of life jackets.

51. The fires in the superstructure, although not serious, were difficult to extinguish. Fire hoses had to be led up on the outside of the superstructure from the main deck to the 07 level as many of the ladders were damaged. Also the large number of personnel trapped in the superstructure complicated the firefighting problem. The water used in firefighting accumulated on deck and filled adjacent areas to the level of the access coamings. Heeling of the ship caused this water to spill over and successively flood the areas below to the level of their access coamings. Lighting transformers on the main and second superstructure decks were partly immersed.

Conclusion

54. Damage to SOUTH DAKOTA did not imperil the ship. Loss of fire control, interior communication and radar facilities seriously impaired her fighting power, particularly in night actions. During the action SOUTH DAKOTA attracted all of the enemy fire so that WASHINGTON was able to sink the Japanese battleship KIRISHIMA practically unmolested.

V. GLOSSARY

AA; A.A.	Antiaircraft.
ACTH	Arbitrary Correction to Hit. Empirical correction, based on analysis of previous firings, in range or deflection to compensate for indeterminate errors in the gun fire control solution.
"A" scope	Radar display screen showing target range only. Often called a <u>range scope</u> .
AD	Douglas AD <u>Skyraider</u> single-engined carrier attack plane.
A-4	Douglas A-4 <u>Skyhawk</u> jet attack plane.
ANGLICO	Air and Naval Gunfire Liaison Company. Organization, in Marine division, responsible for control and use of naval gunfire and air support. An SFCP (<u>q.v.</u>) is part of an ANGLICO.
AP	Armor-piercing. Bomb or projectile with a relatively heavy case, lighter explosive charge, and delay fuze, designed to punch through armor or fortifications before exploding.
A-7	Ling-Temco-Vought A-7 <u>Corsair II</u> jet attack plane.
Armored box	Boxlike structure formed by the decks, side belt, and transverse protective bulkheads of an armored warship to protect magazines, machinery, propeller shafts, steering gear, and plotting rooms.
Avenger	Grumman TBF/General Motors TBM carrier torpedo plane and horizontal bomber, WW II. Some later used as transport, utility, antisubmarine planes.
Axis	Formation axis; line originating at center of a formation of ships and expressed as a true (<u>q.v.</u>) bearing. Stations of ships in formation are expressed with reference to this line.
Bandit	Confirmed enemy contact. <u>See bogey</u> .
Barbette	Fixed cylinder of heavy armor extending down to a warship's armored, or <u>protective</u> , deck. It shields the revolving turret structure below the <u>gun house</u> , the visible armor box containing the guns, and protects the operating machinery and the hoists which supply the guns.
BatDiv --	Battleship Division --.
BDF	Base detonating fuze. Impact fuze, containing a delay detonation, installed in the base of a projectile. Used as primary fuze in AP (<u>q.v.</u>) secondary fuze in HC (<u>q.v.</u>).
Betty	WW II code name for Japanese Mitsubishi G4M twin-engined landbased torpedo bomber.
Blisters	Watertight compartments built on, or added to, the sides of a hull for additional buoyancy and improved resistance to underwater damage. Also called <u>bulges</u> .
Bogey	Unidentified contact. <u>See bandit</u> .
Bold Mariner	Largest landing operation of the Vietnam War, Navy/Marine amphibious forces and Army troops landed on Batangan Peninsula, S. Vietnam, supported by naval gunfire.
Bracketing	Firing pairs of salvos to either side of the best available range or deflection to put the target between impact areas, either to widen the hitting zone or to permit fire to be adjusted onto the target.

Butt Connection between plates, made by bringing edges together and welding, or fastening with an overlapping strap; sometimes called flush joint.

CA Heavy Cruiser (Main battery of 8-inch guns).

C & I Control and Indicator. Fire-control radar range operator's station, with controls and display screen.

CAP Combat air patrol. Fighter planes on station over a force or area.

CI circuit/net Combat Information circuit/net. Radio channels used by Combat Information Centers of ships operating together to exchange information.

CIC, C.I.C. Combat Information Center. Ship's central facility for plotting, display of tactical information. Developed in WW II after introduction of radar.

CL Light Cruiser (6-inch main battery).

Clinometer Pendulum device, installed on a ship's centerline to indicate the degree of roll or list.

Cold-gun correction Elevation correction applied to first rounds to compensate for loss of initial velocity caused by oil in the bore and for the lower temperature of the bore when first fired.

Collective fire Fire on the same target by two or more ships.

COM___ Commander, ___.

Concentration fire Another term for collective fire.

Condition ONE General quarters; ship closed up and crew at battle stations.

Counter-flooding Letting seawater into outboard hull spaces on the side opposite to a torpedo hit to bring a ship back toward an even keel.

CP Command Post.

Crosslevel Tilt, of a gun mount or director, in the lateral axis.

CTF ___ Commander, Task Force ___.

CTG ___ Commander, Task Group ___.

CV Aircraft Carrier.

CVE Escort Aircraft Carrier (Small, slower carrier built on merchant-type hull for antisubmarine warfare, close air support of ground troops).

CVL Small Aircraft Carrier (Built on cruiser hull; served in carrier striking force, WW II).

DD Destroyer.

Deflection Lateral angular correction applied to target bearing to bring fire onto a target.

Degaussing Process by which a ship's magnetic field is neutralized for protection against magnetic mines.

DERAIL Code name for attacks on North Korean rail lines.

Director Instrument for controlling gunfire from a remote position. It constantly measures the bearing, elevation and range of a target and transmits these to a plotting room to be incorporated into the fire-control solution.

dis Dispatch (older term for a radio message).

Dispersion Pattern of fall of shot in a salvo. As rifling wears, this increases. After a certain number of service rounds, rounds, or their equivalent in reduced charges, accuracy is degraded to a point where a gun must be relined.

DMZ "Demilitarized Zone" along the 17th Parallel, the border between North and South Vietnam.

DRT Dead-Reckoning Tracer. Navigational device which automatically combines gyrocompass courses and propeller revolutions to plot the track of a ship on paper.

Emily WW II code name for Japanese Kawanishi H8K long-range reconnaissance flying boat.

EUSAK Eighth United States Army in Korea.

Executive Officer Second-in-command of a naval ship, responsible for its organization and administration.

F.C. Fire Control. Process by which weapons are directed to their targets.

FD Original designation for a fire-control radar used with 5-inch gun directors; later redesignated Mark 4.

FDO Fighter Direction Officer.

FFE Fire for Effect. Destructive fire delivered after fall of shot has been adjusted onto a target.

FH Earlier designation for a main-battery fire-control radar later redesignated Mark 8.

Flag Flagship, carrying a force or unit commander and staff.

F-100 North American F-100 Super Sabre, Air Force jet fighter.

Fran Misspelling of Frances, WW II code name for Japanese Yokosuka P1Y1 Ginga twin-engined landbased bomber.

f.s., f/s Feet per second; measurement of velocity.

FSCC Fire Support Coordination Center. In an amphibious task force, the organization within the landing force charged with that force's share of the planning and execution of naval gunfire support.

GDA Gun Damage Assessment.

General Quarters Ship's maximum condition of readiness, watertight doors and hatches closed and crew at battle stations. See Conditon ONE.

GT line Gun-to-target line.

G-2 Organization, within a higher Marine staff, responsible for intelligence operations.

Halving Obtaining a bracket (q.v.) in range or deflection, then splitting the difference in setting between salvos until the target is hit.

Handling room Compartment, at bottom of a turret structure, where powder bags brought from the magazines are loaded into hoists to be raised to the guns.

Hap WW II Allied code name for the Mitsubishi A6M3 Model 32 "clipped-wing" version of the Japanese Zero fighter. Originally called Hap, it was renamed Hamp when General "Hap" Arnold, Army Air Forces, objected.

HC High Capacity. Thin-walled bombardment projectiles, developed in WW II for blast and fragmentation effect against unarmored or lightly-protected targets.

Hellcat Grumman F6F carrier fighter.

Helldiver Curtiss SB2C carrier dive bomber.

High order Explosives are classed as **low**, or comparatively slow-burning (e.g., gunpowder), and **high**, or extremely rapid-burning (TNT, other explosives used in shells, bombs, warheads). The reaction of a high explosive is called detonation; normal rapid reaction is high-order detonation.

HMS His/Her Majesty's Ship; British naval ship.

Holding bulkhead Innermost longitudinal bulkhead in a major warship's torpedo protection system, designed to withstand damage without serious leaking when outboard protective bulkheads are penetrated.

IC Interior communications. Ship's internal communication system.

Indices Individual lots of smokeless powder, identified by combinations of letters and numbers (e.g., SPD 5104). 16-inch powder is manufactured in batches, called **sections**; five sections make an **index**. Ballistic properties of sections vary, and equal parts of all sections of an index are **blended** and fired to determine the exact charge needed. When this is ascertained, powder is blended, weighed, and bagged into charges for issue. This process is followed with smaller-caliber powder, but an index consists of one production batch. All charges in a ship's allowance of powder for a given caliber are made up from one index for uniform performance.

Indirect fire Gunfire at a target out of sight of the firing ship. Requires ground or air spotting to be effective.

ISE Initial Salvo Error.

I.V. Initial velocity. Velocity of a projectile on leaving the muzzle of a gun, equivalent to muzzle velocity in small arms.

JICPOA Joint Intelligence Center, Pacific Ocean Areas. WW II Pacific intelligence collection and dissemination center, based at Pearl Harbor.

Jill WW II code name for Japanese Nakajima B6N Tenzan torpedo bomber.

Judy Code name for Japanese Aichi D4Y Suisei dive bomber.

Kate Code name for Japanese Nakajima B5N torpedo bomber.

KIA Killed in action.

Ladder Successive salvos fired with predetermined changes in range, used to establish hitting range or to cover an area target with gunfire.

Level Tilt of a gun mount or director in the fore-and-aft axis. See crosslevel.

Local control Control of fire of a gun mount or turret by its own crew, using sights and other fire-control equipment installed in the turret or mount.

LSD Dock Landing Ship. Seagoing ship with a floodable well deck capable of carrying landing craft or other small craft, launching and recovering through a stern gate.

Main battery A ship's principal offensive armament.

Maneuvering board Circular diagram used to plot and calculate the relative motion of ships operating in company. It is used to solve problems involving distances, courses and speeds required for various maneuvers, hence its name. Also called a mooring board up to WW II.

Mark 3 Main-battery fire-control radar, originally designated Model FC. Replaced by Mark 8.

Mark 4 Dual-purpose (surface and antiaircraft) fire-control radar, used with Director Mark 37 to control 5" guns. Originally designated Model FD. Replaced by Mark 12.

Mark 8 Main-battery fire-control radar, originally designated Model FH. Replaced by Mark 13.
 Mark 13 Main-battery fire-control radar, developed late in WW II. Still used with Mark 38 directors in the IOWA class.
 Mark 25 Dual-purpose fire-control radar which replaced the Mark 4 and Mark 12 for use with the 5" gun Director Mark 37.
 Mark 32 WW II proximity fuze used with 5" ammunition, a major weapon against suicide planes.
 Mark 51 Director developed early in WW II for light AA guns; later versions could also control 3" and 5" guns. A simple pedestal with a gyroscopic lead-computing gun sight, it controlled 40mm guns in fast battleships into the 1950s.
 Mark 57 Late-WW II gyroscopic gun director, with its own electromechanical computer, for 40mm and 5" guns.
 Mil A unit of angle used to measure deflection and elevation. In this context, the angle subtended by 1 yard at a range of 1,000 yards (approximately 3.44 minutes of arc).
 Milky Way English translation of Ginga, Japanese name for an aircraft codenamed Frances (see Fran).
 MLR Main Line of Resistance.
 Mk Mark (designation of ordnance equipment).
 Mooring board Earlier term for maneuvering board (q.v.).
 Mosquito Radio call sign for 5th U.S. Air Force T-6 training planes, used by gunfire spotters in Korea.
 MPI Mean Point of Impact. Geometrical center of a salvo pattern, excluding wild shots.
 MRI Median Radial Impact. Point having an equal number of impacts on either side of it.
 MSR Main supply route.
 MTB Motor torpedo boat.
 MTF Mechanical time fuze. Clockwork fuze used to detonate a projectile a preset number of seconds after firing. Used to produce air bursts over a target.
 NGF Naval gunfire.
 NGFS Naval gunfire support (of ground forces).
 NGLO Naval Gunfire Liaison Organization.
 NVA North Vietnamese Army.
 OEG Operational Evaluation Group.
 Offset As used here, method of designating a target in terms of a charted reference point. The target is designated by corrections in range, deflection, and altitude from the reference point.
 OOD Officer of the Deck. Officer taking his turn in charge of a naval ship. As such he is the Commanding Officer's representative, with authority over all except the CO and Executive Officer.
 OP Observation post.
 Ordinate Any point along the trajectory of a shot fired from a gun. Maximum ordinate is the apogee, or highest point, of the trajectory.
 OTC Officer in Tactical Command. Senior officer in on-the-scene command of a naval force.
 Overs Shots, in a salvo (q.v.), which fall beyond the target. See Shorts.

Parbuckling Method of moving a large shell by passing a cable around it, taking the free end to a capstan, and heaving around to slide the shell on its base. Used to move battleship main-battery shells from their stowage to the hoists.

PDF Point-detonating fuze. Highly sensitive fuze used in the nose of an HC (q.v.) projectile to detonate it before penetration for large burst radius and surface effect.

Phonetic Alphabet As used during WW II and Korea. Name changes made during WW II are in (parentheses).

Afirm (Able)	Jig	Sail (Sugar)
Baker	King	Tare
Cast (Charlie)	Love	Unit (Uncle)
Dog	Mike	Victor
Easy	Negat (Nan)	William
Fox	Option (Oboe)	Xray
George	Prep (Peter)	Yoke
Hypo (How)	Queen	Zed (Zebra)
Int (Item)	Roger	

Platform deck Partial deck beneath the lowest complete (bow-to-stern) deck in a hull, forward or aft of machinery spaces.

Plot Plotting room.

Plotting room Central computing station for main, or secondary, battery fire-control data. Receives inputs from gun directors, radars, rangefinders and other sources, and converts these to angles of train and elevation for the guns. Continuously transmits corrected orders to guns to keep them on target. Located behind armor and below the waterline in armored warships for maximum protection.

Pointer Member of a gun or director crew who controls its motion in elevation. A skilled gun pointer is a key member of its crew.

Position angle Angle, above the horizontal, of an aircraft target measured from the observer's position.

POW Prisoner of war.

PPI Plan position indicator. Radar scope presentation which shows a true geographic picture of the area scanned by a search radar, with the originating ship in the center. Outlines of land areas are shown; ships and aircraft appear as points of light called pips.

PW Prisoner of war.

Rangefinder Optical device for measuring target ranges. Battleship rangefinders are mounted in turrets and in the main- and secondary-battery directors.

Rangekeeper Later called computer. Earlier U.S. Navy term for electromechanical analog computers which receive manual and automatic inputs, and compute gun elevation and deflection settings to hit. The first rangekeepers simply produced calculations. Later ones automatically combine their outputs with the relative bearing of the target from the firing ship, and with other corrections, and transmit train and elevation orders to the guns.

Reduced velocity Powder charge, smaller than the full service charge, used to reduce gun bore wear and provide higher bombardment trajectories.

Rocking ladder Movement of salvos back and forth by small successive changes to increase pattern size to increase area coverage or hit a maneuvering target. See ladder.

ROK Republic of Korea (South Korea).

RPPI Remote PPI. "Repeater" radarscope, located some distance from the control unit. Introduction of radar repeaters, during WW II, improved the tactical use of radar at sea.

RSPE ALT Radar System Processing Equipment Alteration; modification to radar to improve handling of signals received.

Salvo One or more rounds from the same gun battery fired simultaneously, or nearly so, at the same target.

SAP Semi-armor-piercing bomb or projectile, between AP and HC (q.v.) in case thickness and explosive charge.

SC Early-WW II air- and surface-search radar.

Scarphed Two pieces of steel connected by tapering their joined ends, or edges, so they will mortise together in an overlapping joint of the same thickness as the pieces being scarphed together. This technique was originally used to join timbers in sailing ships.

Sea Dragon Naval gunfire attacks on coastal lines of communication and seaborne supply craft along the "panhandle" region of North Vietnam above the 17th Paralle.

Secondary battery A ship's second-heaviest gun battery. This, in a fast battleship, consisted of 5-inch dual-purpose guns in twin mounts.

Service charge Powder charge required to fire a gun at its designed velocity. The life of a gun is measured in service rounds, or their mathematical equivalent in reduced charges (q.v.).

SFCP Shore Fire Control Party. Naval gunfire observation and spotting part operating with troops ashore, and communicating with supporting ships; part of an ANGLICO (q.v.).

SG High-frequency surface-search radar, developed early in WW II for navigation and tactical use. Effective and highly regarded in the fleet.

Shell Outer structural plating of a ship's hull.

Shoring Bracing a damaged bulkhead or watertight door with timbers, cut and fitted in place by a damage-control party.

Shorts Rounds, in a salvo, which fall short of a target. See Overs.

SHP Shaft Horsepower. Measurement of power output of a turbine power plant.

SK Long-range air-search radar, introduced late in WW II.

Side belt Heavy face-hardened armor installed along a warship's waterline; more often simply called the belt.

Snapper Fighter-direction controller operating in a visual, as opposed to radar, mode.

Snooper Enemy scouting plane.

SP Long-range height-finding radar, introduced late in WW II for fleet air defense and fighter direction.

SPGPM Shots per gun per minute; rate of fire attained by a gun.

Spotting Visual observation of gunfire to adjust it onto a target. This can be done from the firing ship, from an aircraft, or from a ground position.

SR Air- and surface-search radar used in larger warships.

Stable vertical Electromechanical gyroscopic mechanism which determines and maintains true vertical and horizontal, continuously measures the inclination of the deck plane, and transmits this to the rangekeeper.

Straddle Multi-round salvo which is "on target" in deflection with some shots falling short and others beyond the target. A ship is most likely to hit when its salvos fall in this manner.

Strake Horizontal course of hull plating.

STS Special-Treatment Steel. Homogeneous (non-face-hardened) armor, 3" or less in thickness. STS is identified by weight. A square foot of 1" plate weighs about 40 lbs.; 25-lb. STS, for instance, would thus be about 5/8" thick. Homogeneous armor over 3" thick is called Class B armor.

T. True (q.v.).

TA-4 Two-seat trainer version of the A-4 Skyhawk, used to spot gunfire for NEW JERSEY in Vietnam.

Tallyho pop-eye Voice radio phrase meaning "enemy aircraft sighted in clouds."

Task organization During this period naval ships were grouped into two kinds of organizations: an administrative arrangement of divisions, squadrons and type commands and a flexible, ad-hoc system used for operational and tactical purposes. In the latter, called task organization, ships and other forces were regrouped as needs changed. A task force (TF) was subdivided into task groups (TG), divided in turn into task units (TU) and task units (TU) and task elements as necessary. These organizations had no fixed composition, but were made up to suit the mission and forces at hand.

TBM General Motors-built version of the Grumman TBF Avenger carrier torpedo bomber.

TBS High-frequency tactical voice radio.

Tender Generic term for any maintenance and repair ship.

Top spotters Gunfire spotters stationed in a ship's elevated main battery directors.

Train Lateral movement of a gun or director. The trainer is the crew member who controls such movement.

True Course or bearing measured with reference to actual, or geographic, North as differentiated from directions measured by gyro or magnetic compass.

Turret stool Cylindrical foundation supporting the roller path, the circle of roller bearings upon which a gun turret turns.

UDT Underwater demolition team. Highly-skilled divers who clear mines and obstacles from the approaches to a landing beach.

UN United Nations.

VC Viet Cong. South Vietnamese Communist armed forces. There was, at least in theory, a distinction between these and the North Vietnamese Army (NVA).

VF Generic Navy designation for fighter plane.
 vice In place of.
 Void Watertight compartment in a ship's underwater hull, normally kept empty as part of the hull protection system or because of awkward size or location.
 VOS Generic Navy designation for observation-scouting planes, catapult floatplanes operated from battleships from the early 1920s to the late 1940s. Their primary mission was gunfire spotting; they were also used for reconnaissance, antisubmarine patrol, and air-sea rescue. Battleship and cruiser aircraft were a major element of naval aviation between the World Wars.
 Watershed Also called **turret water seal**. Device which prevents water from entering the gap between the gun house and the top of the barbette.
 Waveguide Hollow pipe used to transmit radio-frequency energy between a radar transmitter-receiver and its antenna.
 WBLC Waterborne logistic craft (Vietnam). Generic term for small supply craft.
 WESTPAC Western Pacific.
 WIA Wounded in action.
 Window WW II code name for chaff, strips of aluminum foil dispersed in the air to jam an enemy's radar.
 WP White phosphorus. Projectile filler for smoke, incendiary, and antipersonnel use.
 Zeke WW II code name for the Japanese Mitsubishi A6M Reisen (Zero fighter). A "clipped-wing" version of this famous airplane was codenamed Hamp (see Hap).

VI. SUGGESTED READINGS

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IOWA looses a salvo. The modern battleship sailor inherits a legacy of skill and hard work.



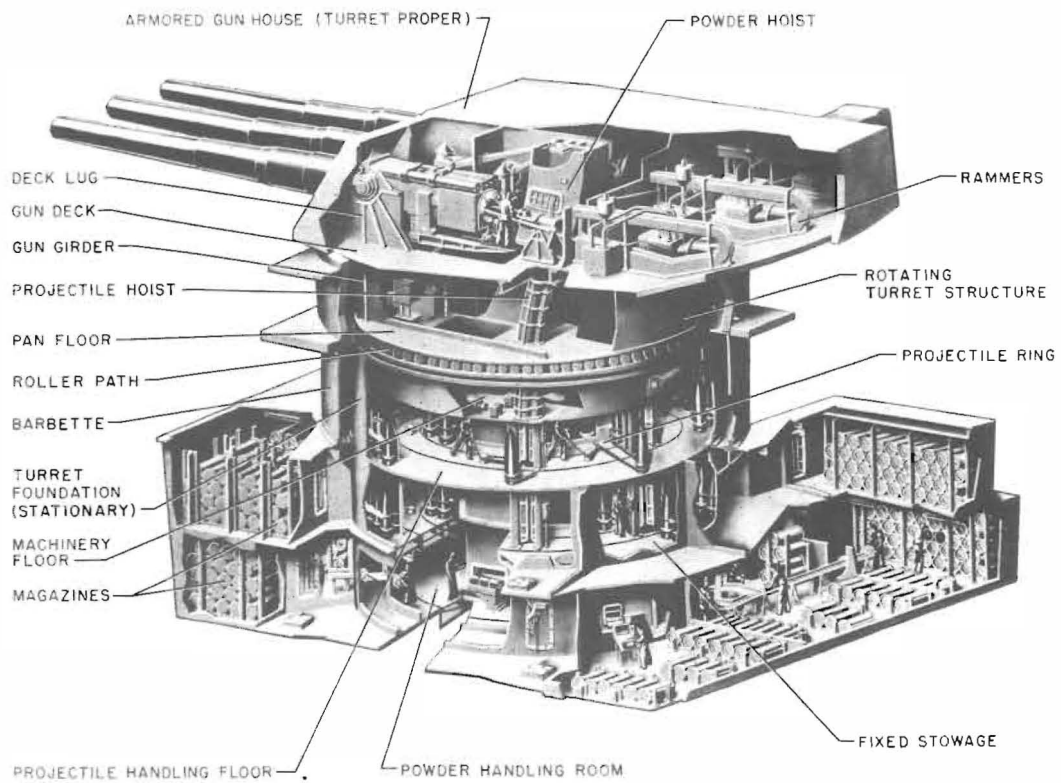
NORTH CAROLINA, the Navy's first new battleship since the Washington Treaty.



ALABAMA shows off the SOUTH DAKOTA class' compact silhouette.

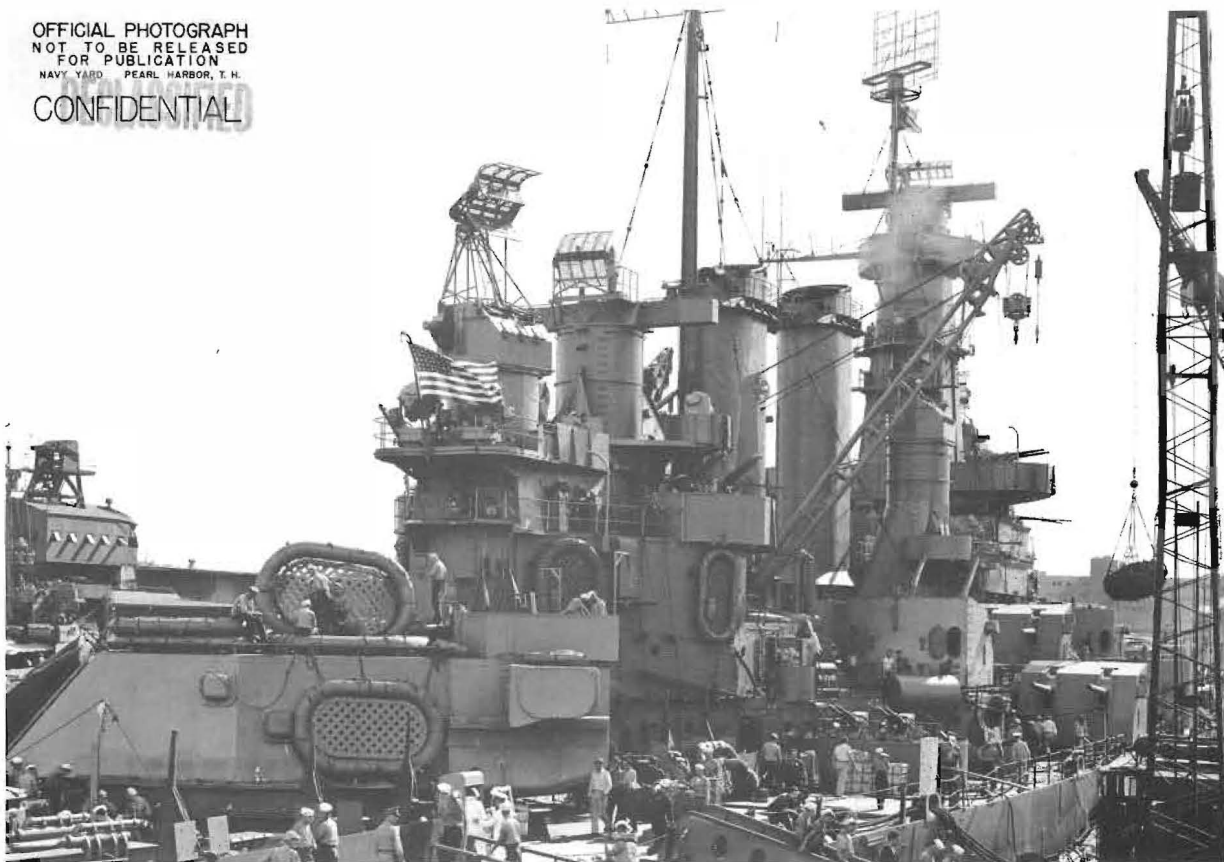


NEW JERSEY in the Delaware River, 1943.

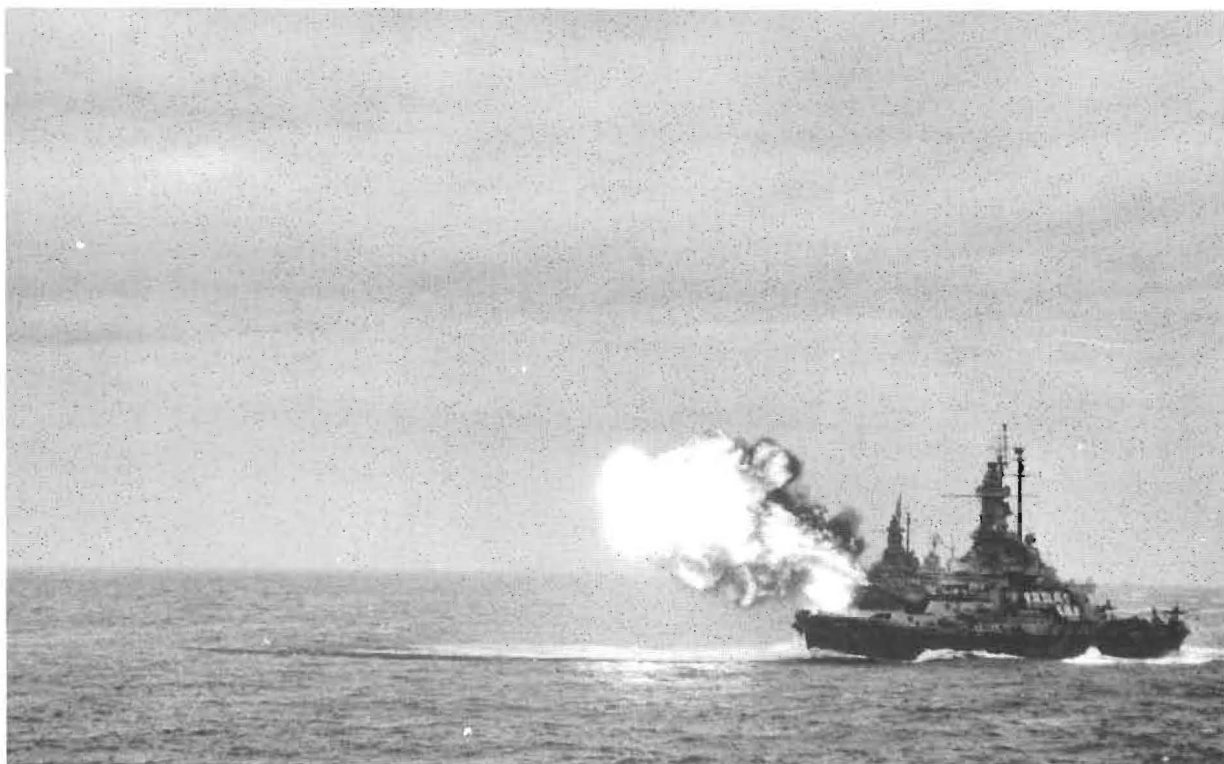


A 16"/45 turret, with the magazines and hoists that feed it.

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NORTH CAROLINA at Pearl Harbor, November 1942. After being torpedoed in the Solomons, she prepares to return to sea.



INDIANA and MASSACHUSETTS bombard Kamaishi, 1945.



One of MISSOURI's two main-battery plotting rooms. Here, many inputs are combined to produce continuous train and elevation orders to the guns. (See p. 164.)



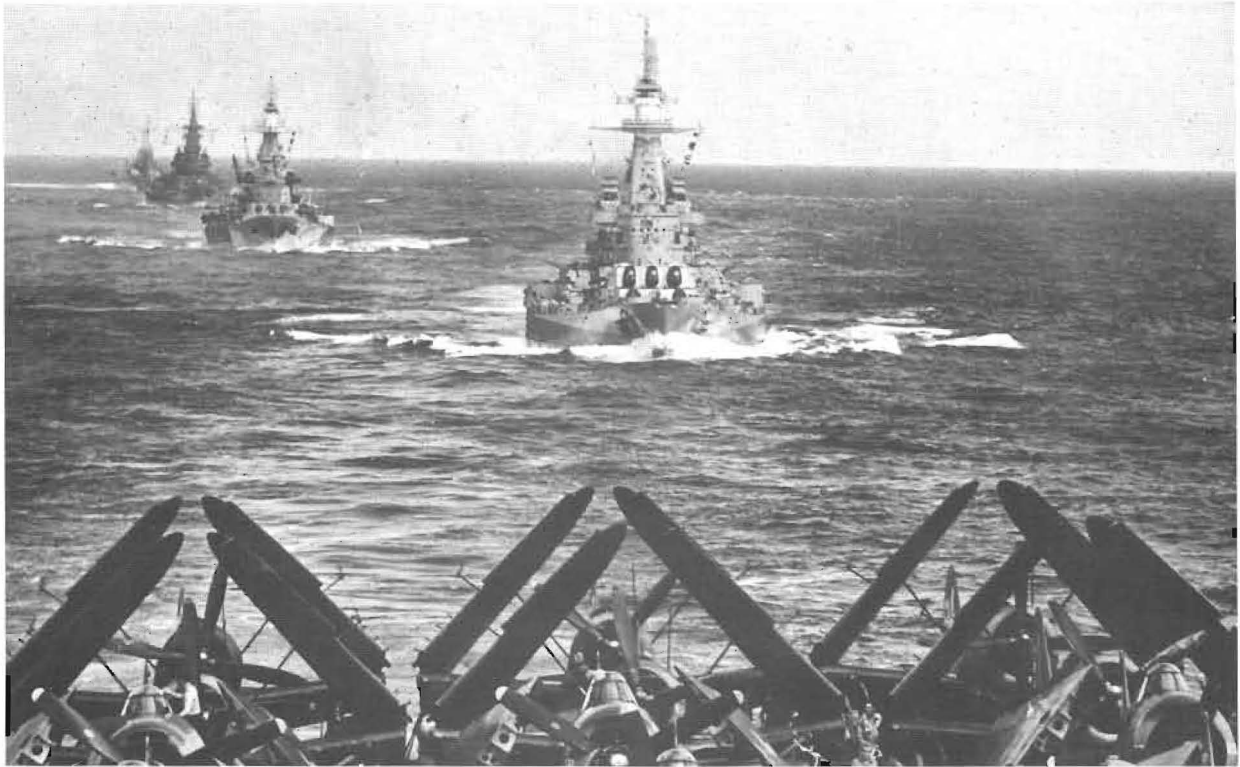
A SOUTH DAKOTA-class battleship fuels from an oiler. She, in turn, will extend the reach of her task group by replenishing screening destroyers.



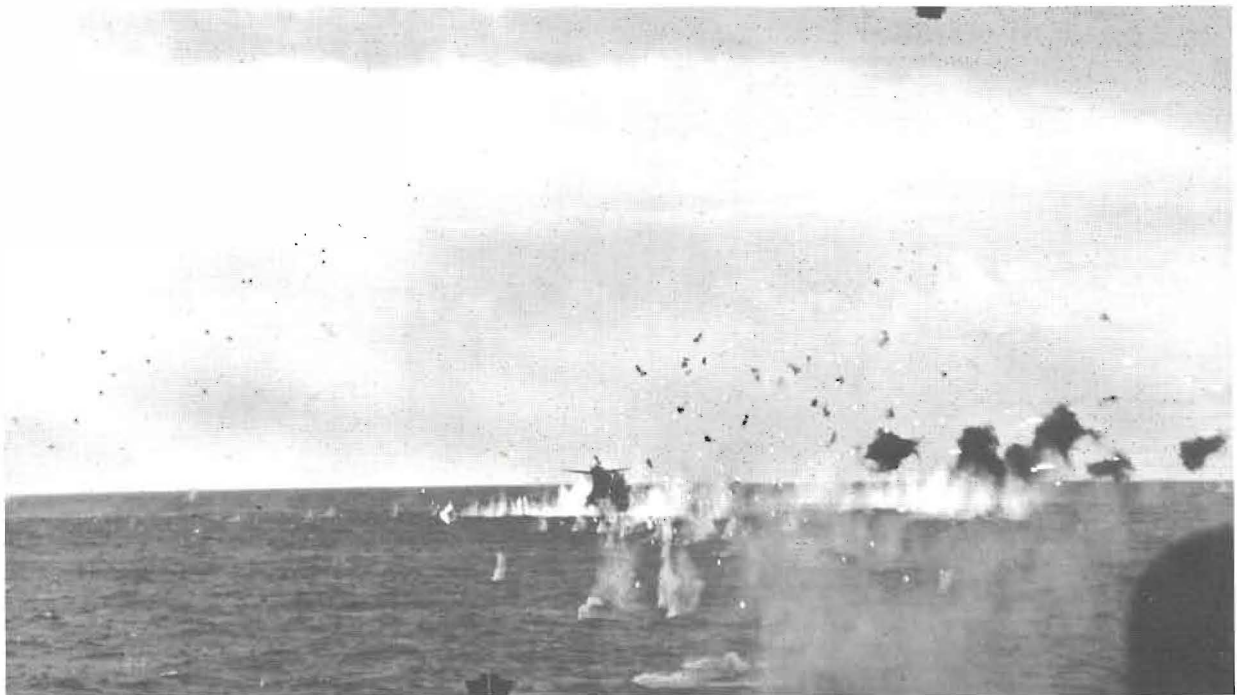
IOWA takes on 16-inch bullets.



NEW JERSEY and HANCOCK plow through heavy weather, November 1944.



WASHINGTON, NORTH CAROLINA, SOUTH DAKOTA, and cruiser SANTA FE sail from Ulithi with carrier TICONDEROGA to support landings on Mindoro, December 1944.



A Japanese torpedo bomber attacks through a storm of gunfire. Close-in air defense, during World War II, depended on large numbers of optically-controlled automatic shell guns.



A kamikaze attacks MISSOURI off Okinawa, 11 April 1945. From the Philippines to V-J Day the surface fleet fought off what amounted to the first large-scale cruise missile offensive.



Worship on MISSOURI's fantail, 1949. In the background are Sikorsky HO3S-1 helicopters, new replacements for catapult floatplanes.



MISSOURI hits Chongjin, North Korea, 1950. She has new search and 5-inch fire control radars, and has lost catapults and 20mm guns, but otherwise has changed little since Tokyo Bay.



After Korea the IOWAs gradually entered the "mothball fleet."
When WISCONSIN was decommissioned in 1958, the Navy was without an active battleship for the first time since 1895.



NORTH CAROLINA rests in honor as a state memorial.



NEW JERSEY prepares for Vietnam, April 1968 after an austere reactivation. 40mm guns are gone, and her new electronic suit includes an ECM installation for antimissile defense.