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BUREAU OF SHIPS GROUP

TECHNICAL INSPECTION REPORT.

Classification (Cancelled) (Changed to)
By Authority of JOINT CHIEFS OF STAFF JCS 1793/36 DATED 15 APRIL 1949
By John H. Cayette Date 24 SEP 1953

3667 (6) OPERATION CROSSROADS.

U.S.S. CRITTENDEN (APA 77)

U.S. [redacted] REPORT DIRECTLY THROUGH

TEST ABLE.

[redacted] Support Agency
Washington, D. C. 20301

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BUREAU OF SHIPS GROUP

TECHNICAL INSPECTION REPORT

[redacted] DIRECTLY
U. S. [redacted]
FROM [redacted]

[redacted] Agency
[redacted], D. C. 20301

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APPROVED:

F.X. Forest,
Captain, U.S.N.

SE[redacted]

USS CRITTENDEN (APA77)

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1 JAN 1965

GR 4B3 1 JAN 19[redacted]
Downgraded at [redacted] r intervals;
Not automatically declassified.

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[redacted] USS CRITTENDEN (APA77)

U.S.S. CRITTENDEN (APA 77)

SHIP CHARACTERISTICS

Building Yard: Consolidated Steel Corp.; Wilmington, California.

Commissioned: 17 January 1945.

HULL

Length Overall: 426 feet 0 inches.
Length on Waterline: 400 feet 0 inches.
Beam (extreme): 58 feet 0 inches.
Depth (molded to upper deck): 37 feet 0 inches.
Drafts at time of test: Fwd. 9 feet 6 inches.
Aft. 17 feet 6 inches.
Limiting displacement: 7,080 tons.
Displacement at time of test: 5,866 tons.

MAIN PROPULSION PLANT

Main Engines: Two sets of Westinghouse steam turbines, directly connected to Westinghouse main generators. Two main shaft motors.
Main Condensers: Two are installed in ship.
Boilers: Two Babcock and Wilcox Boilers are installed in ship. 450 psi gauge - 750° F.
Propellers: Two are installed.
Main Shafts: Two are installed in ship.
Ships Service Generators: Five are installed in ship. Two - 250 KW. - 450 V. - A.C., One - 150 KW. - 450 V. - A.C., and Two - 100 KW. - 120/240 V. D. C.

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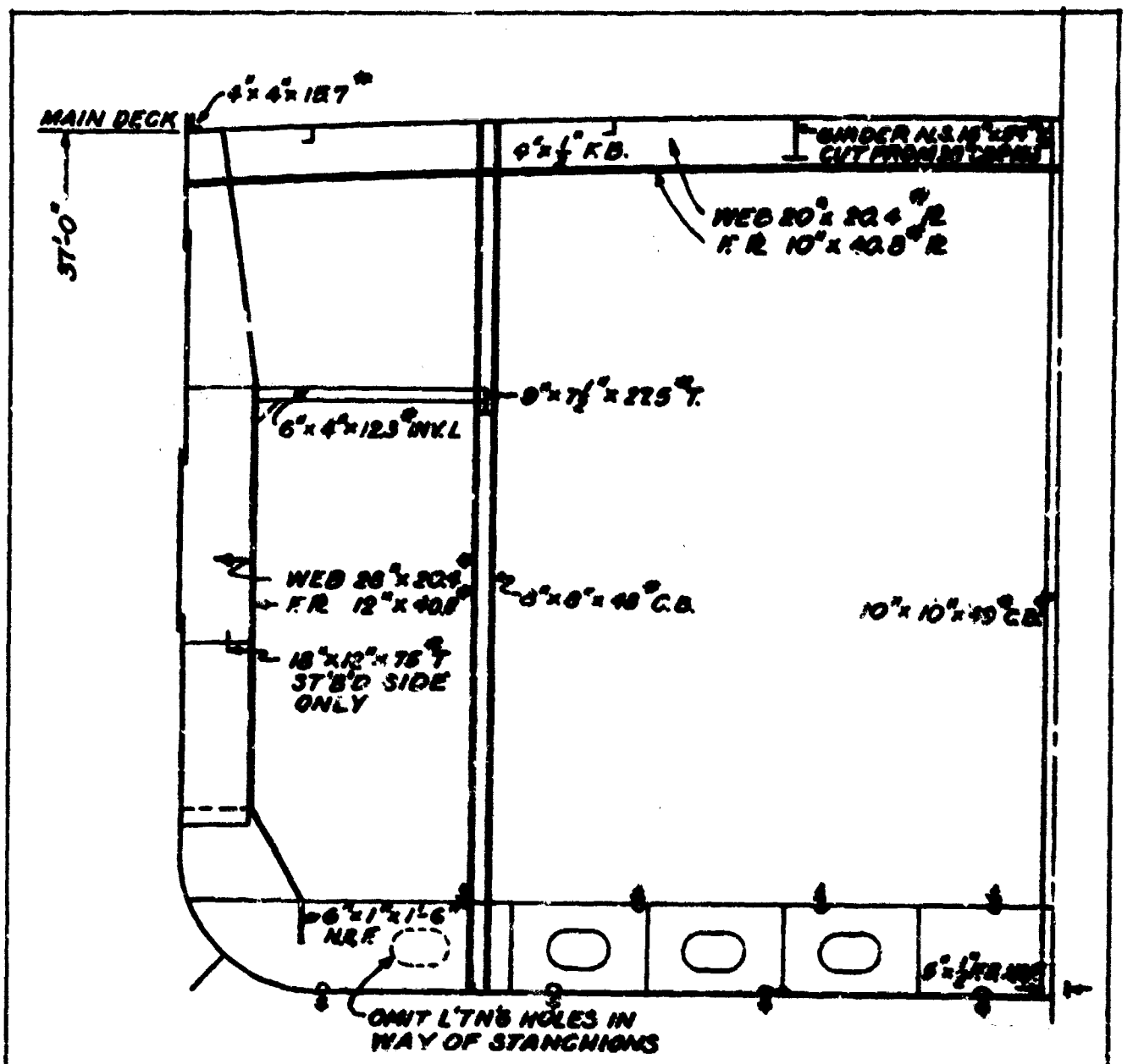

FRAME 76 LOOKING AFT

MIDSHIP SECTION

TEST A

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

(a) Drafts after Test; list; general areas of flooding, sources.

No flooding occurred.

Drafts before and after Test:

Forward, 9' 6" Aft, 17' 6" List, 0°

(b) Structural Damage.

HULL

Major structural damage occurred in the forward and after cargo hatch areas and in the bridge structure. Distortion of structure is much more severe in the forward cargo hatch area than in the after cargo hatch area. In the forward hatch area, the longitudinal girders are deflected, spread, and tilted at the upper, main, and first platform deck levels. The upper deck in way of the forward cargo hatch is dished 20 inches, starboard, and 16 inches, port. The main deck and first platform in this area are deflected similarly but to a lesser degree. Deck dishing in way of the after cargo hatch reaches a maximum of six inches.

The forward face of the superstructure is badly dished, the bridge wings are lifted, and the bulwarks are torn. All weather bulkheads facing forward, port and starboard, are dished. Blast damage diminishes from forward to aft and from the topmasts downward. Blast damage to masts, booms, and boat davits is severe.

Damage to joiner bulkheads and furniture is considerable in the forward part of the superstructure, due principally to the distortion of the forward bulkhead of the bridge structure and its associated longitudinal bulkheads. The most serious structural

damage in the superstructure occurs within the five frame spaces immediately aft of bulkhead 69.

Structural damage in interior spaces is negligible except in the cargo hatch areas. Bulkheads surrounding the hatch areas are moderately dished. Joiner bulkheads in these areas are damaged by pressure which came down through the cargo hatches. All hatch battens, strongbacks, and pontoon type hatch covers were blown into the holds with the the exception of one pontoon cover at the main deck level in the after cargo hatch.

Essentially the only damage to the shell plating is a wrinkle at frames 46-48, starboard, which extends from the upper deck to below the waterline. This shell damage, together with the damage to decks and longitudinal girders in the forward cargo hatch area, constitutes a serious reduction in strength in way of the forward cargo hatch.

MACHINERY

The outer casings of both stacks were badly crushed. The inner casing of the after stack was consderably dished and was torn open on the forward side. Supports, both internal and external, of the after stack failed, leaving the stack in place but in a precarious position. Nos. 2 and 4 (port) Welin davits received severe structural damage.

ELECTRICAL

The ship received considerable structural damage as a result of this test. The only damage to the ship's electrical equipment due to this structural damage was a few cables cut when the bulkheads on which they were mounted gave way. Special electrical test equipment was damaged by falling hatch covers.

(c) Other damage.

HULL

Propulsion and auxiliary machinery are unaffected by the Test. Ship control is affected slightly by damage to instruments at the

secondary conning station. Pilot house instruments remain essentially intact and steering machinery is unaffected. Fire control is reduced in effectiveness by a damaged 40 mm director foundation on the after deckhouse top. Gunnery and electrical equipment is essentially undamaged. Electronics equipment is unaffected except for carrying away of radio and radar antennae. Interior communications are undamaged.

MACHINERY

No. 1 boiler casing seams were opened at the top where the boiler casing is welded onto the uptake. Both smoke periscope sight reflecting units were ruptured. The after stack was severly damaged. There was moderate damage to the uptakes. The forward starboard cargo winch was torn loose from its foundation. The port Welin davits (nos. 2 and 4) were severely damaged structurally. The electric controller of no. 3 Welin davit was torn loose from the bulkhead. The starboard side of the firemain loop was opened at three places just below the upper deck. There was a large amount of scattered minor damage to piping, electric drinking fountains, etc.

ELECTRICAL

Principal electrical damage consisted of the following:

1. Both 24 inch searchlights and one 12 inch searchlight were demolished.

2. Approximately six lighting and fire alarm circuit cables for both cargo holds were ruptured.

3. Two gyro compass repeaters were missing and another repeater was knocked from its stand.

4. The port 6MC bull horn was missing.

5. The anemometer cups were blown off.

6. One boat davit controller was knocked off the bulkhead.

7. A few lamps were broken.

8. A few sound powered telephones were rendered inoperable.

9. Special Bureau of Ships, code 660, test material in the forward cargo hold was damaged by falling hatch covers.

II. Forces evidenced and effects noted.

(a) Heat.

HULL

The heat wave struck the ship at an angle of approximately 350 degrees relative, and at an elevation of about 30 degrees.

Paint damage is confined principally to areas facing forward and to port and diminishes in severity from forward to aft and from the topmasts downward. A few athwartship surfaces facing aft have scorching about one foot inboard from the port side. Fire hoses are darkened and frayed. Manila rope appears dryed out and wire rope boat falls appear to have all the grease burned.

MACHINERY

Paint on the port side of exposed machinery was badly scorched and blistered.

ELECTRICAL

Radiant heat from the port bow scorched paint on exposed electrical equipment and cables. This heat was not of sufficient duration to render any electrical equipment inoperable.

(b) Fires and Explosions.

HULL

No fires or explosions occurred on this ship.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of fires or explosions.

(c) Shock.

HULL

Effect of shock is slight. Pipe berths in troop berthing compartments aft are thrown from their hooks. Electric light globes and bulbs suffered little damage anywhere in the ship. Some equipment was thrown off bulkheads but this is attributable to either the direct effect of air blast or deflection of the structure. Breakage of a nipple on a boat fueling line and separation of pipe flanges in flushing and fire mains are the result of shock. No shock damage to machinery resulted from the test.

MACHINERY

No evidence.

ELECTRICAL

There was evidence that the vessel received considerable shock since some lamps, steamtight globes and fire alarm thermostats were broken.

(d) Pressure.

HULL

Air blast pressure came from approximately 350 degrees relative, at an elevation of about 30 degrees. The areas most severely affected are the forward face of the bridge structure, the forward and after cargo hatch areas, and weather bulkheads facing forward and to port and starboard. In general, dishing of

longitudinal weather bulkheads facing to starboard is as severe as dishing of bulkheads facing to port. Damage in the starboard main deck passageway is more severe than in the port passageway. Reflection of pressure from the forward face of the bridge structure into the forward cargo hatch area is apparent. The superstructure afforded considerable shielding of the after cargo hatch area.

Dishing of both 7 1/2 lb and 10 lb plating is general.

Top masts and booms proved particularly vulnerable to air blast. All cargo booms secured to the foremast and mainmast are badly bent or buckled.

The ship's speed would have been materially reduced pending repairs to the boiler casing in the forward machinery space. If the ship had been in heavy seas, she would be jeopardized because of serious reduction of strength in way of the forward hold.

MACHINERY

Blast pressure, and the whipping motion of the ship following the blast, are believed to have caused all of the damage to machinery. The blast came from the port side.

ELECTRICAL

This vessel was subjected to high pressures (air blast). This is evidenced by the searchlights, davit controller, and bull horn being blown from their mountings and by light metal bulkheads being carried away. Most of the electrical damage was a result of the air blast.

(e) Effects peculiar to the Atomic Bomb.

HULL

Exclusive of radiological features, the atomic bomb, at this range, presents a problem of large scale simultaneous exposure to heat, blast, pressure, and shock.

MACHINERY

A blast pressure of this magnitude is apparently peculiar to the Atom Bomb.

ELECTRICAL

The loss of residual magnetism of #1 Ship Service generator may have been due to an atomic bomb effect.

III. Results of Test on Target.

(a) Effect on machinery, electrical, and ship control.

HULL

The effect of Test A on machinery and electrical equipment is negligible. Ship control is affected only to the extent of damage to instruments at the secondary conning station.

MACHINERY

Both boilers could have continued in operation with an estimated reduction in efficiency of 50% forward, 25% aft. #1 boiler was repaired by the ship's force in about 2 hours and is now fully operable. The after stack was seriously weakened and would probably have fallen over if heavy weather had been encountered, in which case maximum load on the after boiler would be reduced to 50% or less of normal. Damage to the firemain considerably lessened the effectivenessof this system. Three of the four Welin davits were made inoperable and two are believed to be beyond repair. This reduces the ability of the vessel to lower boats by 75%.

ELECTRICAL

Electrically, the damage which occurred as a result of the test had slight effect on the operation of the ship's electrical plant. All propulsion and boiler auxiliaries were operable. Had the #1 AC ship's service generator been operating at the time of the bomb explosion, it would not have lost its residual

magnetism. Since the generator could be easily repaired by the ship's force and since there is a standby generator, the temporary loss of this generator would not affect the operation of the vessel. The most serious effect on the electric plant was the loss of both 24 inch searchlights which were damaged beyond repair. The loss of a few sound powered telephones, the port 6MC bull horn, the 12 inch signal searchlight, and the lighting cables would slightly impair the operation of the ship. The ship could be operated almost indefinitely without these items at only slightly reduced efficiency. Temporary lights could have been rigged by the ship's force to replace those lost.

Secondary ship's control was practically demolished. This control station is seldom used except when the primary control station is inoperable. The ship could therefore, continue to operate, controlled by the normal ship's control station.

(b) Effect on gunnery and fire control.

HULL

Gunnery appears essentially unaffected. Fire control is affected by dislocation of the 40mm director foundation on the after deck house top and by possible severance of electric cables interconnecting the fire control stations.

MACHINERY

No comment.

ELECTRICAL

The only damage to gunnery and fire control equipment was to that equipment secured to the masts. This consits of radar equipment which is covered by the electronics report.

(c) Effect on watertight integrity and stability.

HULL

Watertight integrity and stability are unaffected. No damage to main transverse bulkheads exists below the main deck.

MACHINERY

No comment.

ELECTRICAL

Watertight integrity was not affected by damage to electrical equipment. No electrical equipment shifted sufficiently to affect stability.

(d) Effect on personnel and habitability.

HULL

The commanding officer estimates that 50 percent of the topside personnel would be serious casualties from the effects of heat, blast, flying debris, and radioactivity and that 20 percent of personnel in the interior of the ship would suffer injuries. Some machinery space casualties could be expected from boiler flarebacks.

Habitability is affected, by damage to ventilation ducts in the forward and after cargo hatch spaces, by temporary disarrangement of berths and lockers, and by obstruction of passages by damaged joiner bulkheads.

MACHINERY

It is estimated that there would have been few if any, casualties among personnel below decks. Habitability was slightly reduced temporarily by damage to piping and the general disarrangement of the ship.

ELECTRICAL

The personnel on this vessel might have been affected by radioactivity, however, the extent of these effects is unknown. Disregarding radioactivity, it is considered that all exposed topside personnel would have been casualties due to the flash and air blast. There would also have been casualties around the cargo holds due to structure distortion and due to falling hatch covers. From an electrical standpoint, casualties might have resulted from electrical equipment such as the searchlights and the bull horn becoming missiles.

Electrically, the only effect on habitability was the slight inconvenience due to the lighting failures.

(e) Effect on fighting efficiency.

HULL

Fighting efficiency is reduced by damaged to the port after 40mm director foundation and by damage to radio and radar antennae. The ship could not carry out her mission in amphibious operations because of damage to all cargo booms and the inoperability of three of the four sets of boat davits.

MACHINERY

Damage to the Welin davits, reducing the vessel's ability to lower boats, would seriously reduce her efficiency as a transport in certain tactical situations. It is to be noted that if the ship had her normal complement of boats aboard, many of these would have been wrecked. It is estimated that maximum speed was reduced to about 6 knots for 2 hours, and that after temporary repairs to the forward boiler speed could be built up to about 13 knotes (16 knots is designed speed). It is estimated that approximately 25 days' work at a shipyard would be required to restore all machinery to normal operating condition.

ELECTRICAL

Due to personnel casualties and due to the damage to the vessel, its fighting efficiency was greatly reduced. Electrically, the effects were slight. Disembarkation would have been hampered by the loss of the davit controller, however, this damage could have been repaired by the ship's force in a few hours. Night cargo handling operations would have been hampered by the loss of the cargo lights. It is considered that the ship could operate electrically at approximately 90% efficiency.

IV. General Summary.

HULL

This ship proved to be extremely vulnerable to the affects of air blast on topside structure, masts, booms, rigging, and cargo hatch areas. The discontinuity of structure in way of the cargo hatches is likely to contribute materially to reduction in local strength as a result of proximity to an air burst Atom Bomb.

MACHINERY

The CRITTENDEN was apparently near the edge of the lethal range of this type of attack for vessels of her type. A slightly greater amount of damage to the boilers and stacks would have immobilized the vessel.

ELECTRICAL

This vessel received the most damage of any of the transports that survived the first atomic bomb test. Although the ship's hull received considerable damage there was very little electrical damage. Part of the electrical damage that occurred was due to the failure of associated hull equipment.

V. Preliminary Recommendations.

HULL

(a) Increase in strength in way of cargo hatch areas is necessary and greater resistance to blast pressure is required for cargo hatch closures.

(b) Long spans between stowage cradles for cargo booms should be eliminated.

(c) Boat handling arrangements should be redesigned to eliminate broad surfaces exposed to blast pressure. Boats should be housed below the weather deck or in protective inclosures.

(d) Top masts should be eliminated and radar and radio antennae should be replaceable by spares.

(e) Plating less than 10 lbs. in weight should not be used in structure exposed to air blast. Stacks should be of less projected area. Fire control and ship control stations should be spherical or cylindrical inclosures, preferable streamlined with the surrounding structure. Bridge wings should be eliminated.

(f) Life rafts, and loose topside gear in general, should be more securely attached to the ship's structure.

(g) Studies should be conducted to determine the most suitable paints for resisting heat.

MACHINERY

Stacks should be made more resistant to blast pressure.

Piping, especially main lines, should be so located that it is not likely to be damaged by deflection of decks and bulkheads.

ELECTRICAL

(a) It is recommended that consideration be given to the redesign of the 24 inch searchlights to give them more resistance to air blast. This is considered necessary to give them comparable strength to other electrical equipment.

(b) It is recommended that the gimbal and binnacle pins on gyro compass repeaters be lengthened to prevent the repeaters from being freed from their mounting stands.

(c) It is recommended that consideration be given to mounting equipment such as controllers on some sort of mounting pads or straps so that some bulkhead distortion can occur without damage to the equipment.

(d) It is recommended that where possible, cable be run along beams instead of along light metal joiner bulkheads. It is considered that most of the damage to cables that occurred on this vessel could have been avoided if more consideration had been given to the routing of the cable.

(e) It is recommended that some means of pinning the 12 inch signal searchlights in their sockets be devised to prevent them from being jarred or blown from their sockets.

TECHNICAL INSPECTION REPORT

SECTION I - HULL

GENERAL SUMMARY OF HULL DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

No flooding occurred.

Drafts before and after test:

Forward, 9' 6" Aft., 17' 6" List, 0°

(b) Structural damage.

Major structural damage occurred in the forward and after cargo hatch areas and in the bridge structure. Distortion of structure is much more severe in the forward cargo hatch area than in the after cargo hatch area. In the forward hatch area, the longitudinal girders are deflected, spread, and tilted at the upper, main, and first platform deck levels. The upper deck in way of the forward cargo hatch is dished 20 inches, starboard, and 16 inches, port. The main deck and first platform in this area are deflected similarly but to a lesser degree. Deck dishing in way of the after cargo hatch reaches a maximum of six inches.

The forward face of the superstructure is badly dished, the bridge wings are lifted, and the bulwarks are torn. All weather bulkheads facing forward, port and starboard, are dished. Blast damage diminishes from forward to aft and from the topmasts downward. Blast damage to masts, booms, and boat davits is severe.

Damage to joiner bulkheads and furniture is considerable in the forward part of the superstructure, due principally to the distortion of the forward bulkhead of the bridge structure and its associated

longitudinal bulkheads. The most serious structural damage in the superstructure occurs within the five frame spaces immediately aft of bulkhead 59.

Structural damage in interior spaces is negligible except in the cargo hatch areas. Bulkheads surrounding the hatch areas are moderately dished. Joiner bulkheads in these areas are damaged by pressure which came down through the cargo hatches. All hatch battens, strongbacks, and pontoon type hatch covers were blown into the holds with the exception of one pontoon cover at the main deck level in the after cargo hatch.

Essentially the only damage to the shell plating is a wrinkle at frames 45-48, starboard, which extends from the upper deck to below the waterline. This shell damage, together with the damage to decks and longitudinal girders in the forward cargo hatch area, constitutes a serious reduction in strength in way of the forward cargo hatch.

(c) Other damage.

Propulsion and auxiliary machinery are unaffected by the test. Ship control is affected slightly by damage to instruments at the secondary conning station. Pilot house instruments remain essentially intact and steering machinery is unaffected. Fire control is reduced in effectiveness by a damaged 40 mm director foundation on the after deckhouse top. Gunnery and electrical equipment is essentially undamaged. Electronics equipment is unaffected except for carrying away of radio and radar antennae. Interior communications are undamaged.

II. Forces Evidenced and Effects Noted.

(a) Heat.

The heat wave struck the ship at an angle of approximately 350 degrees relative, and at an elevation of about 30 degrees.

Paint damage is confined principally to areas facing forward and to port and diminishes in severity from forward to aft and from the topmasts downward. A few athwartship surfaces facing aft have scorching about one foot inboard from the port side. Fire hoses are darkened

and frayed. Manila rope appears dryed out and wire rope boat falls appear to have all the grease burned.

(b) Fires and explosions.

No fires or explosions occurred on this ship.

(c) Shock.

Effect of shock is slight. Pipe berths in troop berthing compartments aft are thrown from their hooks. Electric light globes and bulbs suffered little damage anywhere in the ship. Some equipment was thrown off bulkheads but this is attributable to either the direct effect of air blast or deflection of the structure. Breakage of a nipple on a boat fueling line and separation of pipe flanges in flushing and fire mains are the result of shock. No shock damage to machinery resulted from the test.

(d) Pressure.

Air blast pressure came from approximately 305 degrees relative, at an elevation of about 30 degrees. The areas most severely affected are the forward face of the bridge structure, the forward and after cargo hatch areas, and weather bulkheads facing forward and to port and starboard. In general, dishing of longitudinal weather bulkheads facing to starboard is as severe as dishing of bulkheads facing to port. Damage in the starboard main deck passageway is more severe than in the port passageway. Reflection of pressure from the forward face of the bridge structure into the forward cargo hatch area is apparent. The superstructure afforded considerable shielding of the after cargo hatch area.

Dishing of both 7-1/2 lb and 10 lb plating is general.

Top masts and booms proved particularly vulnerable to air blast. All cargo booms secured to the foremast and mainmast are badly bent or buckled.

The ship's speed would have been materially reduced pending repairs to the boiler casing in the forward machinery space.

If the ship had been in heavy seas, she would be jeopardized because of serious reduction of strength in way of the forward hold.

(e) Effects apparently peculiar to the atom bomb.

Exclusive of radiological features, the atomic bomb, at this range, presents a problem of large scale simultaneous exposure to heat, blast, pressure, and shock.

III. Effects of Damage.

(a) Effect on machinery, electrical and ship control.

The effect of Test A on machinery and electrical equipment is negligible. Ship control is affected only to the extent of damage to instruments at the secondary conning station.

(b) Effect on gunnery and fire control.

Gunnery appears essentially unaffected. Fire control is affected by dislocation of the 40 mm director foundation on the after deck house top and by possible severance of electric cables interconnecting the fire control stations.

(c) Effect on water-tight integrity and stability.

Water-tight integrity and stability are unaffected. No damage to main transverse bulkheads exists below the main deck.

(d) Effect on personnel and habitability.

The commanding officer estimates that 50 percent of the topside personnel would be serious casualties from the effects of heat, blast, flying debris, and radioactivity and that 20 percent of personnel in the interior of the ship would suffer injuries. Some machinery space casualties could be expected from boiler flarebacks.

Habitability is affected, by damage to ventilation ducts in the forward and after cargo hatch spaces, by temporary disarrangement of berths and lockers, and by obstruction of passages by damaged joiner bulkheads.

(e) Effect on fighting efficiency.

Fighting efficiency is reduced by damage to the port after 40 mm director foundation and by damage to radio and radar antennae. The ship could not carry out her mission in amphibious operations because of damage to all cargo booms and the inoperability of three of the four sets of boat davits.

IV. General Summary of Observers' Impressions and Conclusions.

This ship proved to be extremely vulnerable to the effects of air blast on topside structure, masts, booms, rigging, and cargo hatch areas. The discontinuity of structure in way of the cargo hatches is likely to contribute materially to reduction in local strength as a result of proximity to an air burst atomic bomb.

V. Preliminary General or Specific Recommendations of Inspection Group.

(a) Increase in strength in way of cargo hatch areas is necessary and greater resistance to blast pressure is required for cargo hatch closures.

(b) Long spans between stowage cradles for cargo booms should be eliminated.

(c) Boat handling arrangements should be redesigned to eliminate broad surfaces exposed to blast pressure. Boats should be housed below the weather deck or in protective inclosures.

(d) Top masts should be eliminated and radar and radio antennae should be replaceable by spares.

(e) Plating less than 10 lbs in weight should not be used in structure exposed to air blast. Stacks should be of less projected area. Fire control and ship control stations should be spherical or cylindrical inclosures, preferable streamlined with the surrounding structure. Bridge wings should be eliminated.

(f) Life rafts, and loose topside gear in general, should be more securely attached to the ships structure.

(g) Studies should be conducted to determine the most suitable paints for resisting heat.

VI. Instructions for loading the vessel specified the following:

ITEM	LOADING
Fuel Oil	95%
Diesel Oil	95%
Ammunition	100%
Potable and reserve feed water	95%
Salt water ballast	None

Details of the actual quantities of the various items aboard are included in Report 7, Stability Inspection Report, submitted by the ship's force in accordance with "Instructions to Target Vessels for Tests and Observations by Ship's Force" issued by the Director of Ships Material. This report is available for inspection in the Bureau of Ships Crossroads Files.

DETAILED DESCRIPTION OF HULL DAMAGE

A. General Description of Hull Damage.

(a) Overall condition of vessel.

This ship suffered major structural damage in the forward and after cargo hatch areas and on the forward bulkhead of the bridge structure. Considerable reduction in longitudinal strength is considered to have resulted from damage in way of the forward cargo hold.

The starboard shell plates are buckled between frames 45 and 48 from the upper deck to below the waterline. The upper deck is dished approximately 20-inches, starboard, and 16-inches, port, in way of the forward cargo hatch. The hatch coamings are severely deflected and tilted. Similar damage, to a lesser degree, occurs on the main deck and first platform levels in the forward cargo hatch area. Damage in the after cargo hatch area is much less than in the forward hatch area. The upper deck is dished approximately six inches on the starboard side of the after cargo hatch. Distortion of hatch girders is much less severe in the after cargo hatch area.

All exposed superstructure bulkheads, stacks, and masts are damaged. Failure of cargo booms and boat davits would prevent the ship from carrying out her assigned functions.

The pressure from the blast came from about 360 degrees relative and an elevation of about 30 degrees. The forward bulkhead of the bridge structure apparently reflected the blast into the forward cargo hatch area. Conversely, the amidship superstructure partially shielded the after cargo hatch area.

General photographs of the exterior are shown on page 2 to page 17 inclusive. Principal damage is shown on diagram, page 82.

(b) General areas of hull damage.

Regions of major structural damage are the forward and after cargo hatch areas, the bridge structure, the superstructure

immediately aft of the bridges, the port and starboard main deck weather passageways, and the starboard shell plating forward. Hatch battens, strong backs, and pontoon covers, were blown into both cargo holds.

In the forward cargo hatch area, the upper, main and first platform decks are dished (photos 1907-5, 6, 1891-2, 3, pages 18, 19, 30 and 21). The intensity of deck dishing diminishes downward and is more severe along the starboard side of the hatch openings. In the after cargo hatch area, dishing of the main deck is slight, (photos 1907-11, 12, pages 22 and 23). In both forward and after cargo hatch areas, deflection and tilting of hatch coaming girders occurs. Web columns supporting these girders are severely strained. In the superstructure, damage to longitudinal bulkheads is most severe in way of the five frame spaces immediately aft of bulkhead 59, as the result of deflection of the forward face of the bridge structure. In the main deck weather passageways, longitudinal and transverse bulkheads and doors are dished. Damage is more severe on the starboard side (photos 1819-1, 2, 1908-8, pages 24, 25, and 26). The starboard shell plating, frames 45-48, is buckled from the upper deck to below the waterline (photos 1901-8, 9, pages 27 and 28).

(c) Apparent causes of hull damage in each area.

All hull damage is considered to be the result of air blast.

(d) Principal areas of flooding with sources.

No flooding occurred.

(e) Residual strength, buoyancy, and effect of general condition of hull operability.

Longitudinal strength is seriously affected by failure of the upper flange of the ships girder in way of the forward cargo hold as evidenced by deflection of the upper, main, and first platform decks, and by distortion of the hatch girders. Buckling of the starboard shell plating in way of the forward hold is further evidence of reduction in longitudinal strength.

Buoyancy is unaffected. Propulsion is not affected. Operability is seriously affected by failure of boat davits, cargo booms, radio and radar antennae, halyards, and fire control equipment. Ship control is somewhat affected by wrecking of the emergency steering station equipment at frame 90 on the signal bridge level.

B. Superstructure.

(a) Description of damage.

Bridge area, general.

The entire forward face of the bridge structure is severely dished and all bulwarks are torn or distorted, (photos 1960-3, 4, 2102-1, 2, 1903-3, 4, 5, 6, 8, 9, pages 31, 32, 33, 34, 35, 36, 37, and 38). The signal bridge and navigating bridge port wings are lifted. The signal bridge is separated 10-inches from its supporting stanchions and the navigating bridge a lesser amount (photos 1960-4, 1901-7, pages 30 and 39). Moderate dishing of weather decks and exposed bulkheads is general in all superstructure areas. Stiffness of decks and longitudinal bulkheads served to divide dishing of the bridge structure forward face (bulkhead 59) into fairly well defined panels. Decks and longitudinal bulkheads were not sufficiently rigid to totally resist distortion due to longitudinal end thrust caused by blast pressure on bulkhead 59. As a result, the plating of the signal bridge, navigating bridge, and deckhouse top is severely wrinkled and longitudinal bulkheads are buckled. The most severe wrinkling of decks and bulkheads occurs within the five frame spaces immediately aft of bulkhead 59. Further wrinkling is in evidence on the navigating deck aft of bulkhead 88, due principally to heavy dishing of the bulkhead. The dishing of decks and bulkheads exposed to the weather caused a general buckling of the triangular plate brackets connecting the deck girders with bulkhead stiffeners. The amount of bracket buckling diminishs from forward to aft and is most severe in the forward part of the superstructure. Distortion of railings and ladders in the superstructure is general. Damage to joiner bulkheads and furniture is general and is most severe in the forward part of the superstructure. Damage to light structure apparently was much reduced by having all weather access closures dogged shut before the test.

Signal bridge level

The bulwarks at frame 59 are distorted and bent aft six inches at the top edge (photo 1961-6, page 40). The port 20 mm gun bulwark failed over a two foot length in way of the deck edge weld. The entire port wing is bent upward, with a maximum lift of 10-inches at the outboard edge. In the area immediately aft of the forward bulwark, the deck is wrinkled to a maximum depth of four inches. The signal bridge deck plating, generally, is dished from 1/2 inch to 1-inch in panels defined by the centerline longitudinal and supporting transverse bulkheads underneath. The port and starboard sheet metal flag bags were blown overboard. Pipe railings are distorted (photo 2058-8, page 41). The centerline walkway connecting t e forward portion of the signal bridge level with the emergency steering station is separated from bulkhead 88 by failure of welds connecting the walkway with brackets on bulkhead 88 (photo 1904-9, page 69). Immediately aft of bulkhead 88 the signal bridge l vel is wrinkled to a depth of four inches over a fore and aft distance o four feet, due to blast pressure against bulkhead 88. At the emergency ship control station, located between frame 88 and the after stack, the master compass pedestal (wooden) is broken off by blast. The gyro repeater and telegraph pedestals are damaged. A part of this damage is due to contact with the port 24-inch searchlight. It was blown off its platform on the forward stack at frame 71 and landed on the signal bridge level at frame 90, starboard (photos 1904-6, page 52). The for rd head of the radio direction finder house is moderately dished. The sky lookout tub (7-1/2" lb. plate) at frame 100, port, is severely distorted by blast (photos 1904-8, 1962-6, 1922-3 pages 49, 127, and 129).

Stac s.

The outer casing of both stacks is severely buckled. The after stack is more severely damaged (forward stack, photos. 2058-9, 1904-4, 1961-3, 2058-10, 1904-5, 1878-6, 1817-7, pages 42, 43, 44, 45, 46, 47 and 48); after stack, photos 1904-8, 1878-4, 5, 1904-6, 1878-7, pages 49, 50, 51, 52 and 53). The searchlight platforms on the forward stack are out of line due to distortion of the stack casing in way of connections to the platform and platform bracing. The port 24-inch searchlight was blown aft, landing on the signal bridge level at

frame 90, starboard, in the emergency steering station (photo 1904-6, page 52). The reflector from this searchlight landed on the upper deck, forward. The starboard 24-inch searchlight is demolished, and its pedestal is broken (photos 1901-5, 1922-5, pages 54 and 55). The railings on both searchlight platforms are distorted by blast. The after stack is severely torn in way of the access closure on its forward face. Tears and impending tears are prominent in both stacks at the corners of rectangular coamings around closures and louvers. A portion of the inner casing of the after stack is severed with a 4" x 18" tear. The outer casing connection is torn in the deck weld (photos 1904-8, 2058-11, pages 49 and 56).

Navigating bridge level.

The port and starboard forward bulwarks of the navigating bridge are dished in about 1-inch. Both bulwarks are sheared along the vertical stiffener, located six inches outboard of the pilot house (photos. 2102-2, 1903-4, 5, 6, 8, 1904-12, 1905-1, 7, 8, 2058-6, pages 32, 34, 35, 36, 37, 57, 58, 59, 60 and 61). The deck just aft of the forward bulwarks, port and starboard, is dished a maximum of 8-inches, between frames 59 and 60, due primarily to the pushing in of the forward face of the bridge structure (photos 1905-7, page 59). From frames 60 to 65, the deck is wrinkled to a maximum depth of 3-inches. The pilot house, port and starboard bulkheads are moderately dished (photo 1905-9, page 62). The forward bulkhead is severely damaged. This bulkhead is dished to a maximum depth of 12-inches. All 3" x 4" angle stiffeners are tripped. Three stiffeners have failed in tension at mid-height in way of holes for cable clips. One vertical butt weld failed (photos 2102-2, 1903-4, 1905-2, 4, 10, pages 32, 34, 63, 64 and 65). Evidence of lack of weld penetration exists in the weld failure of the STS bulkhead. Inside the pilot house, just aft of the forward bulkhead, the deck is severely buckled and torn (photos 1905-3, 2058-3, 4, pages 66, 67 and 68). The 9" x 11" centerline "T" longitudinal under the signal bridge punched through the pilot house forward bulkhead. The outboard walkways on the navigating bridge level are dished approximately 1/4 inch between frames and the deck is dished. All pilot house instruments remain operable, although some glass is broken. Light globes are intact except where struck by flying objects. Bulkhead 88, the forward face of the 20 mm ready service room, on the navigating deck, is severely dished and buckled throughout its entire area though partially shielded from the blast by the forward portion of the bridge structure (photos 1904-9, 11, pages 69 and 70).

Superstructure deck.

Bulkhead 59, between the superstructure deck and the navigating bridge, is moderately dished. The starboard forward bulwark is dished aft. Stanchions supporting the navigating bridge are bent (photo 1903-4, 8, pages 34 and 37). The port forward bulwark is laid aft sharply and sheared along its inboard stanchion (photos 1900-4, 1903-6, 8, 9, 10, 11, pages 30, 36, 37, 38, 71, and 72). The port forward bulwark is also torn along the stiffener adjacent to the captains' cabin. The forward outboard stanchion, supporting the navigating bridge, is torn away. The next stanchion aft is separated at its upper weld connection to the navigating bridge (photos 1900-4, page 30). The sounding machine on the port wing of the superstructure deck is knocked down and demolished. The starboard longitudinal bulkhead of the division commanders cabin is severely buckled, frames 59-61 (photo 1906-1, page 73). The longitudinal bulkhead between the division commander's cabin and the captains pantry is crumpled adjacent to bulkhead 59, (photo 1906-3, page 74). Similarly, the port forward corner of the captains' pantry is crumpled by deflection of bulkhead 59 (photo 1906-2, port 75). Bulkheads and equipment in the captain-s pantry are demolished. The port longitudinal bulkhead of the captain's cabin is severely buckled and opened to the weather (photos 1903-10, 12, 1904-2, pages 71, 76 and 77). Dishing of the port bulkhead of the captain's cabin caused severe damage to the transverse bulkhead and door separating the cabin from the captain's stateroom. The deck is severely buckled between frames 59 and 60. The port and starboard wings at the superstructure deck level are dished to a 3-inch maximum, principally due to end thrust caused by the blast pressure on bulkhead 59. This effect is more severe on the port wing. The outboard walkways are deflected approximately 1/4 inch between frames and the deck house sides are dished. Connecting brackets have tripped (photo 1906-5, page 78). The sheetmetal motion picture booth at frame 107 is badly dished on all sides. (photo 1906-11, page 79).

Top of blower house.

Structure and equipment on the blower house top exhibits effects of blast pressure. This damage is confined principally to the port side, where the 40 mm director tub is slightly distorted and the life raft stowage is disarranged (photos 1900-9, 7, 1902-4, pages 80, 81 and 82).

Top of after deckhouse.

The after deckhouse top is dished a maximum of 1-1/2-inches over an area approximately 10-feet square on the starboard side, midway between the centerline and the deck edge. On the port side, the deck dished lightly between frames 142-145. On the port side forward, the house top plating is buckled downward approximately 6-inches underneath and just aft of the high director tub. This deflection is the result of a strong couple exerted by the director tub pipe bracing (4-1/2" O.D. pipe) resisting the sternward push of the blast wave on the high tub. The two forward pipe braces and the central tube to the tub are pulled out of their welds to the house top. The two after pipe brace welds are cracked halfway around their periphery on the forward side, leaving the tub structure barely self supporting, (photos 1907-1, 1961-10, pages 83 and 84). A hawser reel with line, located on the port side with a vertical axis, is blown down aft. The central support (3-1/2" O.D. pipe) tore a petal of plating from the house top. At frames 130-134, starboard, life raft supports are carried away (photos 1961-10, 1906-8, pages 84 and 85). Deck gear locker, ready boxes, and sheet metal on the after deckhouse are dished by blast. The speed light shield is blown off, but the light itself is undamaged. Smoke generators are damaged beyond use.

Masts and rigging.

The jack staff is bent to starboard and aft making an angle of approximately 45 degrees with the horizontal (photo 1921-11, page 86). The flag staff is also bent slightly. The stub mast located on the forward edge of the forward stack is bent aft. On this mast signal yardarms are badly damaged and halyards and radio antennae are down (photos 1904-7, 1922-8, pages 87 and 88). The fore topmast is bent aft sharply and slightly to starboard just above the foremast platform. The port and starboard cargo booms, stowed vertically by the foremast, are bent aft sharply just above the platform at the juncture of the upper boom sections. Absence of damage to the major portion of these cargo booms apparently is due to shielding and reflection phenomena associated with location of the booms relative to the foremast, (photos 1959-8, 1962-1, 1921-10, pages 89, 90 and 91).

The main topmast is bent aft sharply just above the main mast platform. The port cargo boom, stowed vertically by the main-mast, is bent just below the boom midsection. Similarly, the star-board cargo boom buckled sharply on the forward side just below the midsection (photos 1959-7, 1905-11, 1922-2, 1906-9, 1961-12, 1921-12 1906-12, pages 92, 93, 94, 95, 96, 97 and 98). Radar equipment on both the foremast and mainmast is damaged beyond repair. The SC-4 radar on the mainmast fell off and landed on the after deckhouse top. Halyards, radio antennae, yardarm blinker lights, anemometer, range lights, and other equipment attached to the fore and main masts are destroyed.

(b) Causes of damage in each area.

All damage in superstructure areas is considered to be due to the air blast. The effect of shielding and of restraints offered by the complexity of hull structure, greatly influenced the degree of distortion resulting from the blast pressure.

(c) Evidences of fire in superstructure.

There is no evidence of fire in the superstructure.

(d) Estimate of relative effectiveness against blast of various plating thicknesses, shaped surfaces, STS.

Light sheet metal offers essentially no resistance to blast. MS plating, up to and including 10 lbs in weight is dished where directly exposed to blast pressure. Gun tubs of 10 lb weight suffered negligible distortion.

Rails, stanchions, booms and masts do not effectively resist distortion, though having curved surfaces. Damage to these elements is an inertia effect and is due to the acceleration imparted to relatively large masses having insufficient support to prevent bending or buckling at their critical sections. Panels of STS plating apparently do not show superior resistance to dishing as evidenced by distortion of the forward face of the bridge structure. Plating of 7-1/2 lbs weight, as in super-structure weather bulkheads and stacks, appears especially vulnerable to blast pressure.

(e) Constructive criticism of superstructure design or construction including important fittings and equipment.

Superstructure plating should not be less than 10 lbs. in weight. Square corners should be eliminated as far as practicable. This applies both to deck houses and to weather access closures.

Overhangs should be eliminated.

Stacks should of less projected area, constructed of not less than 10 lb. plate, and be more securely connected to the ships structure.

Doors and door frames should be made less vulnerable to blast pressure. Bulkheads should be reinforced adjacent to door frames to more effectively resist local distortion due to effects of mass.

The design and arrangement of masts and booms should be studied for greater resistance against blast, vibration, and inertia effects. Cradling of booms requires special attention. Long spans between cradles should be avoided.

Spars, rigging, and antennae should be reduced to a minimum. Radar devices should be made retractable or should have provisions for rapid replacement of spares.

C. Turrets, Guns and Directors.

(a & b) Protected and unprotected mounts.

All guns operate satisfactorily except in alignment. One 20 mm gun is temporarily inoperative due to obstruction by a bent STS shield on the gun used for protection of the gunner. All 20mm guns had been removed except one at each corner of the navigating deck level. The forward, port, and the after, starboard, 40mm guns were removed before the test.

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preventing application of blast pressure against the relatively broad vertical inboard surfaces of the hatch girders. Similar distortion of hatch edge girders occurs at the main deck and first platform levels to a lesser degree.

It is apparent that pressure exerted athwartships by the hatch girders caused the compression buckles in the upper deck plating and tended to increase the amount of deck deflection. The vertical component of blast pressure caused dishing, both local and general. But it could not by itself, have caused buckling of the deck. It is believed that buckling due to edge compression of the deck plating was initiated prior to dishing, inasmuch as the deck, in a dished condition, could not have furnished sufficient lateral resistance to cause buckling. The more severe damage to the starboard side apparently is partly due to the reflection of pressure from the forward face of the bridge structure. The detailed pattern of the upper deck deflection is provided by the deck survey made after Test A, (photos 1961-5, 1819-4, 2101-7, 9, 1817-10, 9, 2086-9, 10, 2101-10, 1960-1, 2, 2101-12, pages 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112 and 113). The pontoon covers for the forward cargo hatch are damaged. (photos 1891-5, 6, 7, 8, 9, pages 114, 115, 116, 117 and 118).

The 5' x 7' ammunition hatch at frames 56-58-1/2 on the upper deck centerline, is severely damaged. The hatch cover was blown inward and landed at the bottom of the ammunition trunk. Blast pressure on the hatch cover and on the sides of the relatively high coaming caused the coaming to collapse inward (photos 1817-11, 1901-6, 1961-1, pages 119, 120 and 121). Pressure reflected from the forward side of the bridge structure at frame 59 probably contributed to failure of this hatch.

Upper deck damage in way of the after cargo hatch is much less than that in way of the forward cargo hatch. The upper deck is dished a maximum of 6-inches abreast the starboard side of No. 2 cargo hatch. Distortion of hatch girders occurred to a lesser degree than in the forward cargo hatch area but is in evidence at both upper and main deck levels (photos 1907-11, 12, pages 22 and 23). Shielding by the superstructure apparently prevented the after cargo hatch area from being severely damaged.

The upper deck aft of the after deckhouse is in good condition except for areas of slight local dishing. The deck is dished approximately 1-5/9 inches, frames 150-158 starboard, between the bitts and the 5 inch gun mount (photo 1908-11, page 122). A slight dish exists on the port side also abreast the gun mount. The deck is dished about 1/2 inch at the centerline abreast the after wildcat.

Bulkhead 59, between the upper and superstructure decks is dished about four inches. Upper deck longitudinal weather bulkheads, port and starboard, are lightly dished. Watertight doors and door frames generally, are dished and the dogs are bent. A number of doors exposed to blast pressure had to be opened with crowbars. Doors on the starboard side of the ship appear to be as heavily damaged as doors on the port side. The two heavy doors to the starboard side of the wardroom were blown off their hinges and into the wardroom, causing damage to furniture (photo 1959-11, page 124). The double doors to the carpenter shop, port side, frame 131, received similar damage (photo 1906-10, page 125).

The forward bulkhead of the after deckhouse is dished aft approximately 1 inch and the forward port corner is distorted (photo 1906-10, page 125).

In the main deck weather passageways, longitudinal and transverse bulkheads are dished. Doors and door frames are damaged. The port passageway area seems to have been shielded by the upper deck and consequently suffered much less damage than the starboard passageway area. The port passageway, bulkhead 122, is dished and the doors to the gear locker, outboard, and to the after troop berthing, are moderately dished (photo 1819-1, page 24). Dishing of the starboard passageway bulkhead is negligible from frame 59 to frame 67 and is severe from frame 100 to 110 and 116 to 122 (photo 1908-10, page 126). The forward bulkhead (59) is intact but the door is dished. The two doors in the starboard after bulkhead 122 are torn off their hinges. The bulkhead and door frames are severely dished (photos 1819-2, 1908-8, page 25 and 26). Recordings of scratch gages installed under the upper deck are in Appendix , page 91.

(b) Usability of deck in damaged condition.

Usability of weather decks is not seriously affected.

(c) Condition of equipment and fittings.

The boat handling gear and the cargo booms are seriously damaged (see Item B, Superstructure for boom damage). All boat davits are out of commission, except the forward starboard davit which is operable. The forward davit of the port after pair is completely out of its roller track. The after davit of this pair is distorted (photos 1962-6, 1904-10, 1922-3, 4, 1882-6, 1922-7, 1882-7, 1922-6, 1959-9, 10, pages 127, 128, 129, 130, 131, 132, 133, 134, 135 and 136). Continued rolling of the ship undoubtedly would have had a disastrous effect on the damaged port after davits and associated deckhouse structure. Damage to miscellaneous equipment exposed to air blast is as follows:

1. Bow lookout chair demolished and hawse pipe covers blown overboard.

2. Telephone handset ripped out of box on forecastle.

3. Potato locker on upper deck at frames 20-23 severely dished on all sides.

4. Hold-down bolts on starboard forward deck winch failed due to depression of the deck in way of the winch foundations (photos 1960-2, 1882-9, pages 112 and 137).

5. No. 5 cargo winch capstan shaft bent.

6. Hold-down bolts of ventilator, frame 55, upper deck, starboard, sheared off and ventilator blown overboard. Hold-down bolts loosened on port ventilator (photos 1817-10, 2101-10, pages 106 and 110).

7. Fire hose at station 01-29-2 cut off at plug and hose rack bent.

8. No. 3 davit controller box blown off bulkhead.

9. Magazine sprinkler boxes distorted and glass broken.

10. Life rafts blown about and overboard, or damaged by failing debris. Only 6 good rafts remain out of an original 46.

11. Forward port boat boom knocked out of stowage bracket.

12. All top side canvas ripped and torn. The three layers over the forward cargo hatch were shredded and blown into the hold.

13. Paravane after hold-down bands broken loose from pad eyes.

14. Three P-500 pumps demolished on deck.

15. Four steel jacobs ladders damaged beyond repair.

16. Port side debarkation net ripped and torn beyond use. (The starboard net remained intact).

17. Port 6MC bull horn blown overboard and starboard horn demolished; flood lights demolished.

18. Spare 40 MM gun barrel boxes dished in on all sides.

19. Taffrail long blown off port side and lost.

20. Several stays and guys failed in the turnbuckle bolt threads.

21. Smoke generators on after deckhouse top damaged beyond repair.

22. Both airplanes, one on the upper deck starboard abreast the after cargo hatch and the other in the after hold, are severely damaged by falling debris (photo 1961-8, 11, 1908-1, pages 138, 139 and 140).

23. Two test bombs, one 350 lb and one 500 lb were knocked clear of their stowage pad eyes on the upper deck and rolled into the depression to port and starboard of the forward cargo hatch (photos 2086-10, 1930-1 pages 109 and 111).

24. Pipe lifelines are damaged (photos 1980-8, page 141).

F. Exterior Hull. (above waterline)

(a) Condition of exterior hull plating and causes of damage.

The exterior hull is essentially undamaged except for a set of buckles in the starboard shell plating between frames 45-48 and slight waves in the plating near frame 30. The buckles at frames 45-48 extend from the upper deck to below the waterline (photos 1901-8, 10, pages 27 and 142). These buckles are associated with the failure of the ships girders as the upper deck dished and longitudinal girders distorted in this area. The cause of the damage was the air blast loading of the upper deck and vertical surfaces.

(b) Condition of exterior hull fittings and causes of damage.

Boat booms and light hull fittings are damaged by the air blast.

(c) Details of any impairment of sheer strake.

The starboard shell plate is buckled between frames 45 and 48. The sheer strake has two buckles at this location which are about 1-1/2 and 3-inches deep.

(d) Condition of side armor.

Not Applicable.

G. Interior Compartments (above w.l.).

(a) Damage to structure and causes.

In the forward cargo hatch area, the starboard side of the main deck is dished approximately 6-inches (photos 1907-5, 1891-3, 1817-12, 1907-8, 9, 2086-4,5,8, 2101-1, 2, 4, 5, pages 18, 21, 143, 144, 145, 146, 147, 148, 149, 150, 151 and 152). Stress patterns are clearly indicated in paint cracking (photos 1889-1, 1891-10, 11, 12,

2156-1, 2, pages 163, 154, 155, 156, 157 and 158). The port side has negligible dishing. This area was shielded by the semi-structural port longitudinal bulkhead of the hatch opening. The bulkhead is dished outboard approximately four inches (photos 1817-12, 2101-5, 6, 1960-5 pages 143, 152, 159 and 160).

The first platform deck to port and starboard of the forward cargo hatch is dished approximately three inches (photos 1907-5, 6, pages 18 and 19). The hatch edge longitudinal girders are deflected at the main deck level, starboard and at the first platform level port and starboard (photos 1907-5, 6, 1891-2, 3, 2101-1, 5, pages 18, 19, 20, 21, 149 and 152). Deflection of these girders severely strained the web columns at bulkheads 40 and 56 and caused web buckling in both columns and girders (photos 1907-5, 6, 1891-2, 3, 2086-8, 2101-1, 5, 1890-8, 2086-2, 1890-9, 12, 1907-10, 2086-3, 2171-11, pages 18, 19, 20, 21, 148, 149, 152, 161, 162, 163, 164, 165, 166 and 167). At bulkhead 56, starboard, the welded connection of the column to the main deck is cracked at the flange and web (photos 1890-8, 2086-2, pages 161 and 162). Bulkhead 40, between the main and upper deck is dished forward (photo 1909-3, page 168). Intermittent welds on stiffeners on the forward side are fractured (photos 2086-6, page 169). Deflection of the upper deck around frame 27, port and starboard, resulted in distortion of bulkhead 27 between the main and upper decks and severely strained the port and starboard web columns on the after side of the bulkhead (photos 2171-9, 10, pages 170 and 171). Distortion of deck beam brackets at the shell, port and starboard, is general. This effect is most severe in the cargo hatch area but extends forward to bulkhead 27 (photos 1907-8, 7, 1890-11, 7, 2101-3, pages 144, 172, 173, 174 and 175. Damage to interior bulkheads on the main deck is superficial. Bulkhead 59, starboard, is buckled adjacent to the passageway longitudinal bulkhead, and in compartments B-101-E and B-102-L.

Interior damage in the after cargo hatch area is similar but much lighter than the forward damage. The main deck to starboard of the cargo hatch is dished a maximum of 1-inch. The starboard hatch edge girder is deflected downward, (photo 1907-12, page 23, and is buckled adjacent to the supporting columns at bulkheads 108 and 124. The column webs are buckled slightly. Weld

failures occurred under the main deck in way of column web buckling (photos 1908-6, 7, pages 176 and 177). The semi-structural longitudinal bulkhead between the main and upper decks at the port edge of the cargo hatch is slightly dished outboard. Bulkhead 124, between the main and upper decks, is dished aft approximately six inches. The stiffeners are tripped. The centerline stiffener is pulled away from its intermittent welds along the upper third of its length (photo 1908-2, page 178).

In the main deck troop berthing space, frames 124 to 135, the port stanchion (3/4" O.D. pipe) is bent aft approximately 1-1/4-inches, (photo 1908-9, page 179), and the starboard stanchion bent aft approximately 2-1/4-inches. The top and bottom connections of the stanchions are intact. In the troop washroom on the main deck. The starboard bulkhead is dished approximately 3/8 of an inch between frames 164 and 158. The longitudinal bulkhead of the starboard main deck passageway is severely dished inboard between frames 100-110 and 116-122, with the most severe dishing in the after section. On the inboard side of this bulkhead eleven of the fifteen beam brackets under the upper deck are slightly buckled.

(b) Damage to joiner bulkheads and causes.

Damage to joiner bulkheads is moderate except in the bridge structure and occurred primarily in main deck areas exposed to the blast that entered the cargo hatches. This damage is confined to the port side in way of the ships office, aft, and the port passageway, forward.

(c) Details of damage to access closures and fittings.

Except for cargo hatch covers, damage to interior closures and fittings other than those in joiner bulkheads is negligible. In the after cargo hatch, the three after, main deck, pontoon type hatch covers were blown into the hold (photos 1907-12, 1908-5, pages 23 and 180). The forward pontoon is severely dished but remains in place (photo 1907-11, page 22). The two starboard hinge pins are bent and all four hinge pads are pulled out of their welds. The strongbacks 18" x 7-1/2" I-beam, 3/8" web and 1/2" flange, were blown from the upper deck level and landed in the hold. A typical shear failure at the end of a strongback is shown in photo 1908-4 on page 181. Typical

damage to hatch battens is shown in photo 1907-3 on page 182.

(d) Condition of equipment within compartments.

Berths and lockers are disarranged in both the forward and after main deck cargo hatch area (photos 2086-5, 2101-1, and 2, pages 147, 149 and 150). Disarrangement of berths is general in after troop berthing spaces on the main deck and below (photo 1908-12, page 183). Lighting fixtures in the forward cargo hatch area have damaged supports, but light globes and bulbs are, in general, unbroken. Special equipment (diesel generators, electric panels, etc.), located in the forward hold was damaged by falling hatch covers and strongbacks (photos 1960-6, 1901-1, 3, 4, pages 184, 196, 192 and 189). An airplane in the after hold was damaged in a similar fashion (photo 1961-11, 1908-1, pages 189 and 140).

(e) Evidence of fire.

There is no evidence of fire.

(f) Damage in way of piping, cables, ventilation ducts, etc..

Damage to cable and piping is, in general, slight. It consists of distortion in way of dished decks. On the fire and flushing system some pipe flanges are separated (photo 2086-3, page 166). On the main deck, starboard, in way of the forward cargo hatch ventilation ducts are collapsed and the seams are opened (photos 2086-5, 2101-1, 2, 4, pages 147, 149, 150 and 151). On the first platform level the damage is less and principally confined to separation of duct joints (photos 1907-7, 2086-7, pages 172 and 185). Similar damage to ventilation ducts occurred in the after cargo hatch area.

(g) Estimate of reduction in watertight subdivision habitability and utility of compartments.

There is no reduction in watertight subdivision. Habitability and utility of compartments exclusive of the cargo hatch areas is temporarily slightly reduced. Habitability of cargo hatch area berthing spaces is temporarily reduced due to ventilation duct damage.

H. Armor Decks and Miscellaneous Armor.

Not Applicable.

I. Interior Compartments (below w.l.).

(a, b & c) Damage to structural and joiner bulkheads, access closures and causes.

No structural damage occurred below the waterline except to No. 1 uptake in the forward machinery space. Welded seams were fractured where the vertical section rises from the boiler. These seams were rewelded and the boiler lighted off satisfactorily. Damage to this uptake is believed to have been due to blast pressure coming down the stack.

(d) Damage to equipment within compartments.

No damage to machinery or equipment occurred except that both smoke periscope mirror holders in the engine rooms fractured at the aluminum welded joints. Equipment stowed in both holds was damaged by falling hatch pontoons and strongbacks.

(e) Flooding.

No flooding occurred.

(f) Damage in way of piping, cables, ventilation ducts, etc..

No damage.

(g) Estimate of reduction in watertight subdivision, habitability or utility of spaces.

No reduction in watertight subdivision, habitability or utility.

J. Underwater Hull.

No damage is known to have occurred to any part of the underwater hull, rudder, struts, propeller shafts, or stern tubes stuffing glands except in way of the starboard shell, frames 45 to 48, where the plating is buckled.

K. Tanks.

No damage.

L. Flooding.

No flooding occurred in this ship.

M. Ventilation (exclusive of blowers).

(a) Damage to ventilation ducts and causes.

Damage to ventilation ducts is severe in the forward and after cargo hatch areas. The most extensive damage occurs on the main deck level, abreast the starboard side of the forward cargo hatch. (photos 2086-5, 2101-1, 2, 4, 1907-7, 2086-7, pages 147, 148, 150, 151, 172 and 185). On the upper deck at frame 55, the starboard ventilator hold down bolts sheared off and the ventilator was blown overboard; the port ventilator, opposite suffered loosening of hold down bolts.

(b) Evidence that the ventilation system conducted heat, blast, fire, or smoke below decks.

None.

(c) Evidence that ventilation ducts allowed progressive flooding.

No flooding occurred.

(d) Constructive criticism.

No comment.

N. Ship Control.

(a) Damage to ship control stations and causes.

Damage to pilot house instruments is slight although the forward face of the pilot house is severely dished by direct exposure

to air blast (photos 1905-10, 2058-4, pages 65 and 68). There is no damage to equipment in the chart room, although the forward and port bulkheads are damaged (photo 1905-5, page 186). The secondary conning station located on the signal bridge level forward of the after stack suffered severe damage due partly to air blast and partly to the 24-inch searchlight which was blown off the port side of the forward stack, (photo 1904-6, page 52). Gyro repeaters, port and starboard, were blown overboard from the navigating bridge wings and from the signal bridge. The CIC, gyro compass, and interior communications equipment appears to be in satisfactory condition. The steering gear was not affected.

(b) Constructive criticism of ship control systems.

The secondary conning station on the signal bridge level should be provided with a splinter proof shield sufficient to protect instruments and personnel from blast and pressure effects.

O. Fire Control.

(a) Damage of fire control stations and causes.

The fire control station on the signal bridge is nearly 100 percent operable except for possible severance of electrical connections with other control stations. The port 40MM director on the after deckhouse top is inoperable due to severe aftward tilt of the director tub foundations (photos 1961-10, 1906-10, pages 84 and 125).

(b) Constructive criticism of location and arrangement of stations.

The commanding officer states that the forward fire control station on the signal bridge is considered to be in the best available location, particularly from an AA point of view but that the present station could be greatly improved by installation of an inverted, curved shield streamlined with the surrounding structure, for protection to personnel.

P. Ammunition Behavior.

(a) Ready service ammunition, location, protection, behavior under heat and blast.

No damage occurred to ready service boxes or to ready ammunition. Several 40MM cartridges were knocked out of stowage clips in gun tubs.

(b) Magazines; location, protection, forces involved, behavior.

No damage occurred to ammunition in clipping rooms or magazines. Two test bombs exposed on the upper deck by the forward cargo hatch were blown from their temporary moorings but were otherwise undamaged.

(c) List of stowages which are insufficiently protected and effects on ship survival of explosion of each stowage.

None.

(d) Behavior of gasoline stowage.

No damage occurred.

Q. Ammunition Handling.

(a) Condition and operability of ammunition handling equipment.

The 5-inch ammunition hoists are operable. Passing scuttles are operable in all magazines. No damage is known to have occurred to any ammunition handling device.

(b) Evidence that any ammunition handling device contributed to passing of heat fire, blast, or flooding water.

No evidence was found that devices permitted heat, fire, blast or water to pass.

(c) Constructive criticism of design and construction of ammunition handling devices.

No comment.

R. Strength.

(a) Permanent hog or sag.

No evidence exists or any hog or sag.

(b) Shear strains in hull plating.

The starboard shell plating is severely wrinkled, frames 45-48, from the upper deck to below the water (photos 1901-8, 9, pages 27 and 28).

(c) Evidence of transverse or racking strains.

Due to the fact that the ship received the air blast on the port side forward, there is possibility that wrinkling of the starboard shell plating is due to compressive stress. It appears, however, that this wrinkling is associated with the reduction in the strength at the forward quarter point due to the damaged decks and longitudinal girders in way of the forward cargo hatch at the upper, main, and first platform deck levels.

(d) Details of local failures in way of structural discontinuities.

In way of the forward cargo hatch, the upper deck is dished 20-inches, starboard, and 16-inches, port. The main deck and first platform in this area are similarly dished, though less severely. The forward cargo hatch longitudinal girders are spread, tilted, and severely deflected. The web columns at the girder ends are severely strained. Similar damage to a lesser degree, occurs in way of the after cargo hatch.

(e) Evidence of panel deflection under blast.

The most outstanding example of panel deflection in

this ship occurs in damage to bulkhead 59, the forward face of the bridge structure (photos 1960-3, 2102-2, pages 29 and 32). Dishing of weather bulkheads facing forward is severe, but diminishes in magnitude toward the after part of the vessel. Dishing of weather bulkheads facing to port and starboard is general. In some locations it is nearly as severe on the starboard side as on the port. The longitudinal bulkheads in the main deck passageways are dished, more severely on the starboard side than on the port.

(f) Turret, machinery and gun foundations.

Main and auxiliary machinery foundations were undamaged. Gun foundations were undamaged.

S. Miscellaneous.

Paint damage is confined principally to areas facing forward and to port and diminishes in severity from forward to aft and from the topmast down to the waterline. Scorching is more prevalent than blistering (photos 1960-12, 1817-8, pages 187 and 188). The entire port side shows signs of change in the color of the paint. A section of bulkhead was cut from the upper deck bulkhead frame 25 port and sent to Naval Material Laboratory for analysis of paint. The white numerals on the port bow and the yellow frame numbers along the port side are obliterated. A few athwartship surfaces facing aft have scorching about one foot inboard from the port side. General effects of paint scorching are shown in photos 1960-12, 1817-8, pages 187 and 188.

No manila lines, cables, wires, canvas or other equipment is burned. Fire hoses are darkened and frayed. Manila rope appeared dried out and wire rope boat falls appeared to have had all the grease dried out by the heat.

The commanding officer's comments on heat effects to paint is as follows:

Oil based paint appeared to be burned off more than any other. White enamel held up satisfactorily; it was only necessary to wipe off the soot and the painted bow numerals, for which this paint

was used, were as good as new. Paint with a plain white base used for numerals on frames, was burned off. This was also used on the draft numerals. Anchor black appeared as if the heat had melted some of the tar base.

The yellow chromate was burned off.

Red iron oxide, and ships own mixed red lead held up well when used as paint. The parts of the deck on which these were used lost the top blue gray deck paint from the heat, leaving only the red iron oxide and red lead underneath.

A maximum-minimum thermometer on the upper deck forward registered a temperature of 95°, indicating that the duration of the flash heat was too short to influence this instrument.

TECHNICAL INSPECTION REPORT

SECTION II - MACHINERY

GENERAL SUMMARY OF MACHINERY DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

No data taken by machinery group.

(b) Structural damage.

The outer casings of both stacks were badly crushed. The inner casing of the after stack was considerably dished and was torn open on the forward side. Supports, both internal and external, of the after stack failed, leaving the stack in place but in a precarious position. Nos. 2 and 4 (port) Welin davits received severe structural damage.

(c) Other damage.

No. 1 boiler casing seams were opened at the top where the boiler casing is welded onto the uptake. Both smoke periscope sight reflecting units were ruptured. The after stack was severely damaged. There was moderate damage to the uptakes. The forward starboard cargo winch was torn loose from its foundation. The port Welin davits (nos. 2 and 4) were severely damaged structurally. The electric controller of No. 3 Welin davit was torn loose from the bulkhead. The starboard side of the firemain loop was opened and three places just below the upper deck. There was a large amount of scattered minor damage to piping, electric drinking fountains, etc..

II. Forces Evidenced and Effects Noted.

(a) Heat.

Paint on the port side of exposed machinery was badly scorched and blistered.

(b) Fires and explosions.

No evidence.

(c) Shock.

No evidence.

(d) Pressure.

Blast pressure, and the whipping motion of the ship following the blast, are believed to have caused all of the damage to machinery. The blast came from the port side.

(e) Effects apparently peculiar to the atom bomb.

A blast pressure of this magnitude is apparently peculiar to the atom bomb.

III. Effects of Damage.

(a) Effect on machinery and ship control.

Both boilers could have continued in operation with an estimated reduction in efficiency of 50% forward, 25% aft. #1 boiler was repaired by the ship's force in about 2 hours and is now fully operable. The after stack was seriously weakened and would probably have fallen over if heavy weather had been encountered, in which case maximum load on the after boiler would be reduced to 50% or less of normal. Damage to the firemain considerably lessened the effectiveness of this system. Three of the four Welin davits were made inoperable and two are believed to be beyond repair. This reduces the ability of the vessel to lower boats by 75%.

(b) Effect on gunnery and fire control.

No comment.

(c) Effect on water-tight integrity and stability.

No comment.

(d) Effect on personnel and habitability.

It is estimated that there would have been few if any, casualties among personnel below decks. Habitability was slightly reduced temporarily by damage to piping and the general disarrangement of the ship.

(e) Total effect on fighting efficiency.

Damage to the Welin davits, reducing the vessel's ability to lower boats, would seriously reduce her efficiency as a transport in certain tactical situations. It is to be noted that if the ship had her normal complement of boats aboard, many of these would have been wrecked. It is estimated that maximum speed was reduced to about 6 knots for 2 hours, and that after temporary repairs to the forward boiler speed could be built up to about 13 knots (16 knots is designed speed). It is estimated that approximately 25 days' work at a shipyard would be required to restore all machinery to normal operating condition.

IV. General Summary.

The CRITTENDEN was apparently near the edge of the lethal range of this type of attack for vessels of her type. A slightly greater amount of damage to the boilers and stacks would have immobilized the vessel.

V. Preliminary Recommendation.

Stacks should be made more resistant to blast pressure.

Piping, especially main lines, should be so located that it is not likely to be damaged by deflection of decks and bulkheads.

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall condition.

Boiler number one was damaged but could be repaired by the ship's force within two hours. Both stacks were damaged, the after one severely. However, in an emergency both boilers could have been steamed with some reduction in efficiency. There were three failures in the firemain at flanges, and numerous failures in piping connected to the firemains. The latter are of only local significance. All Welin davits except number one were severely damaged.

(b) Areas of major damage.

Major damage was confined to areas where the direct effect of the blast pressure could be felt. Damage below decks was minor except for the firemain on the main deck starboard, and this damage was caused by deflection of the deck overhead by the blast pressure.

(c) Primary cause of damage in each area of major damage.

All significant damage was caused by blast pressure. Damage to the firemain was, in most cases, caused by deflection of decks and bulkheads resulting from the blast pressure.

(d) Effect of target test on overall operation of machinery plant.

Both boilers could have continued in operation with an estimated reduction in efficiency of 50% in the forward boiler and 25% aft. Boiler number one could have been repaired to restore full operation in approximately two hours. The after stack was seriously weakened and might have fallen over if heavy weather had been encountered. Otherwise, operation of the after boiler could be continued.

There might have been some personnel casualties in the enginerooms because of blast pressure coming through light engineroom doors. It is estimated that, under war conditions, the ship's force could make temporary repairs to number one boiler in about two hours and to the firemain and after stack within 48 hours. Three of the four Welin davits are inoperable. One of them could be repaired by a tender in about four days, the other two are beyond economical repair.

B. Boilers.

(a) Air Casings.

Boiler #1 - The vertical seams on the starboard forward and starboard after corner of the outer casings were split apart at the upper edge of the casing (where it is welded onto the uptake), the splits being about 4" long and about 1/4" wide at the upper end. The welded seam around the top of the casing, where it joints the uptake, was evidently pulled apart slightly, as a small amount of smoke came through this seam all around the casing when the boiler was first lighted off after the test. As the boiler heated up, this seam closed by expansion of metal and the flow of smoke ceased. The ship's force welded the splits in the casing.

Boiler #2 - No damage to casing.

(b) External Fittings.

Both smoke periscopes failed at the reflection unit where the periscope shaft leaves the boiler casing and is bent through 90° to the vertical. This is an aluminum casting with a threaded boss at each end, a mirror in the middle, and a piece of 1/8" glass plate mounted in the top boss. Blast pressure blew out these bosses. The periscope of #1 boiler had the boss broken all the way around. That of #2 boiler had the boss broken about 1/3 of the way around the periphery. The glass plates were undamaged. At the point of rupture the aluminum is about 1/8" thick.

(c) Fuel Oil Burner Assemblies.

No damage.

(d) Brickwork and Furnaces.

No damage.

(e) Steam and Water Drums and Headers.

No damage.

(f) Tubes.

No damage.

(g) Foundations.

No damage.

(h) Stacks and Uptakes.

Forward stack and uptakes - The outer stack casing was badly bent and crushed in. (See photo 1878-6; page 47). This does not affect operation. The inner casing is undamaged. The inner and outer casings of the uptakes are braced by staybolts. Near the bottom of the uptake there were a number of holes in the inner casing. These holes appear to have been torn in the casing by the staybolts during vertical relative motion between inner and outer uptake casings. Six holes were found in the starboard side of this casing and three in the after side. These holes are 1/2" to 3/4" in diameter. It is probable that similar holes exist farther up the casing in areas inaccessible for inspection.

After stack and uptakes - The after stack has a tear in the outer casing at bottom of the access door (forward end of stack, reached from superstructure deck) extending about 3 feet around the stack to starboard of the door opening, and about 4 inches to port. (See photos 1878-4, 5; pages 50 and 51.) From this point the outer casing is flattened and pushed in against the inner casing across the entire forward end of the stack almost up to its top. The sides and after end of the outer stack casing are badly crumpled and bent, and there are several small tears. A number of stays and braces inside the outer stack casing are broken, some are bent. (See photo 1878-7; page 53).

The galley smoke stack is a 12" brass pipe passing up between the inner and outer casings of the after stack. It was broken apart at the forward side in a horizontal line about six feet above the main deck, the rupture extending about half-way around the pipe. Above this rupture the pipe was flattened for most of its length, the walls of the pipe being now about two inches apart. The steel atmospheric exhaust pipe, outboard of the galley smokepipe and against the outer stack casing, was not damaged.

There is a tear in the inner casing about 18" long and about 8" wide at the widest point, with its axis horizontal. This tear is about 3' above the superstructure deck on the forward side of the casing, somewhat to port of the centerline. It was apparently caused by the outer casing and galley smokepipe being pushed against it.

In the uptakes of #2 boiler, ~~five~~ holes similar to those described above for #1 uptake were found. These were all on the starboard side of the uptake and were smaller than those in the forward uptake, the largest being about 1/2" in diameter. There may be similar holes higher up in the uptakes.

(3) General Notes.

When the crew evacuated the ship at 0340 on 1 July, #1 boiler was left with 450 lbs/sq. in. steam pressure and #2 with 450 lbs/sq. in. hydrostatic pressure. When the crew returned on the morning of 4 July there was no pressure in either boiler. Boiler #2 was full of water with no evidence of leakage.

Boiler #1 was tested hydrostatically after Test A with results similar to those before the test. It was lighted off on 5 July and has been in use since with no defects other than those noted above. Boiler #2 was lighted off and tested under steam (450 lbs/sq. in.) on 11 July. No defects were found other than those noted above.

Results of Hydrostatic tests on #2 Boiler.

Before Test A

Initial Pressure 450 lbs.

Time required for pressure to drop 100 lbs - - - - - 4 hours
Time required for pressure to drop to 0 - - - - - 10 hours

After Test A

Initial Pressure 450 lbs.

Time required for pressure to drop:

150 lbs. - - - - - - - - - -	5 minutes
250 lbs. - - - - - - - - - -	10 minutes
300 lbs. - - - - - - - - - -	15 minutes
325 lbs. - - - - - - - - - -	20 minutes
350 lbs. - - - - - - - - - -	30 minutes
400 lbs. - - - - - - - - - -	19 hours

Repairs had been made on this boiler between tests, such as renewing leaking gaskets. All pressure leaks were through leaking valves.

Test A had no effect on the pressure parts of the boilers on this vessel.

C. Blowers.

Undamaged. All four blowers have been operated at approximately 1/2 full load since Test A.

D. Fuel Oil Equipment.

Undamaged. All equipment has been operated under service conditions since Test A.

E. Boiler Feedwater Equipment.

Undamaged. All equipment has been operated under service conditions since Test A.

F. Main Propulsion Machinery.

Undamaged. The main turbines have been operated at no load for five hours, and have been used while the ship shifted berth since Test A. They have been operated in both directions.

G. Reduction Gears.

Not Applicable.

H. Shafting and Bearings.

Undamaged. Shafting and bearings were checked while the ship was underway.

I. Lubrication System.

Undamaged. All equipment has been operated under service conditions since Test A.

J. Condensers and Air Ejectors.

Undamaged. All condensers have been operated under service conditions with a vacuum of 29-1/2" since Test A.

K. Pumps.

Undamaged. All pumps have been operated under service conditions Since Test A.

L. Auxiliary Generators (Turbines and Gears).

Undamaged. All generators have been operated at rated load since Test A.

M. Propellers.

Undamaged. The propellers were checked while the ship was underway.

N. Distilling Plant.

Undamaged. The plant has been operated since Test A with the same capacity and quality of water as before the test.

O. Refrigeration Plant.

Undamaged. There were numerous freon leaks before Test A. They were not increased by the test.

P. Winches, Windlasses and Capstans.

1. The forward starboard cargo winch was torn loose from its foundation as shown in photograph 1882-9, page 137. All foundation bolts on the right hand side and two on left hand side are missing.

2. It is believed that the damage was caused by the deck being dished in about three feet below normal just aft of this winch. Other than the fact that the foundation is ruined, the winch appears in good condition.

3. There was no other damage to equipment under this heading.

Q. Steering Engine.

1. The wheel on after deck house steering stand was bent aft on the starboard side. Since the wheel was covered by a canvas cover, it is believed that this provided sufficient surface for the blast to inflict the damage. It is believed that had the canvas cover not been provided, no damage would have occurred to the wheel as the spokes are relatively small and offer comparatively little resistance. Similar damage has been observed on other APA's.

2. The steering engine was undamaged. Both units have been operated from all stations since Test A.

R. Elevators, Ammunition Hoists, Etc.

1. Undamaged, except for davits (see below).

2. Both ammunition hoists and the gasoline hoist have been operated under service conditions since Test A.

3. Davit #2 - The forward and after heads were bent aft. The after trackway is bent and twisted as shown in photograph 1882-7; page 133.

4. Davit #4 - Both heads were torn out of the trackway and broken loose from the strong back which was thrown inboard against the superstructure. Both trackways are twisted and bent. (See photograph 1882-6; page).

5. Davit #3 - The electrical controller was torn loose from the bulkhead. This prevents operation of the davit.

6. Davit #1 was undamaged.

S. Ventilation (Machinery).

No damage to machinery. A few vent sets are inoperable because of structural damage.

T. Compressed Air Plant.

Undamaged. The air compressor has been operated under service conditions since Test A.

U. Diesels (Generators and Boats).

No damage. The diesel generator and diesel fire pump have been operated under service conditions since Test A.

V. Piping Systems.

Damage occurred in the piping systems as noted below.

(a) Main Steam.

No damage.

(b) Auxiliary Steam.

No damage.

(c) Auxiliary Exhaust.

No damage.

(d) Condensate and Feedwater.

No damage.

(e) Fuel.

No damage.

(f) Lub Oil.

No damage.

(g) Firemain, sprinkling and Water Curtain.

1. A flanged connection in the 6" main in #1 hold, frame 40, starboard, parted. The deck to which this section is secured by hangers was pushed down about 18" in this area. The flange is about 4" aft of the forward bulkhead. All bolts except the two at the top were pulled and bent, the two bottom ones were broken. The after flange was bent. The four hangers aft of this flange each had the inboard bolt broken. The fifth flange, about 2 feet forward of the expansion joint in the after bulkhead of the hold (frame 50) was undamaged.

2. A similar failure occurred in #2 hold, frame 118, starboard, at the flange just aft of the forward bulkhead of the hold. This failure was apparently caused by hatch cover panels falling on the flange. In this case the pipe hangers aft of the parted flange were not damaged.

3. In troop compartment C-102-L, main deck, the flange in the 6" main just aft of the bulkhead, frame 140, starboard, failed. Nothing fell on this flange and the deck over it is not appreciably distorted. All except the 2 or 3 top bolts pulled loose. The after flange was pulled away from the forward one about 3/8" at the bottom, and was bent and broken away from the pipe at the weld. This failure appears to have been caused by whipping motion of the vessel after the blast.

4. At frame 17, main deck, port, a screwed union connection from the fire main to a 1-1/2" riser to the flushing system was broken. This connection was previously badly corroded.

5. At frame 40, port, first platform, the flange of a fireplug riser failed. The bolts pulled loose. The flange was not damaged. This is believed to have been caused by deflection of the bulkhead to which the riser was strapped.

6. A similar failure occurred at frame 56, port, main deck. In this case the deck 4 feet above the flange was defected.

7. There were numerous small leaks in small piping connected to the firemain. In most cases the affected fittings were already badly corroded.

(h) Condenser Circulating Water.

No damage.

(i) Drain.

No damage.

(j) Compressed Air.

No damage.

(k) Hydraulic.

No damage.

(l) Gasoline.

No damage.

(m) Other Systems.

1. All four diesel boat filling valves, in the vicinity of the Welin davits, main deck, failed. At #1 station, frame 84, starboard,

the 1-1/2 inch screwed nipple broke near the lower end of the threaded portion. At #3 station, frame 104, starboard, the 1-1/2" steel screwed fitting pulled off and the valve was blown over the side. At #2 and #4 stations there were small leaks.

2. Screwed fittings in the diesel oil lines to the galley ranges leaked before Test A. Some increase in these leaks was noted after Test A.

3. There were numerous leaks in hot and cold fresh water piping throughout the ship.

4. The diaphragm of the whistle was apparently ruptured. An attempt to blow it resulted only in blowing out a cloud of water and steam. Piping to the whistle was not damaged.

W. Miscellaneous.

Several electric drinking fountains had their casings torn off and one or two had considerable mechanical damage. Otherwise there was no damage to miscellaneous equipment. Galley, laundry, machine shop and ice cream equipment have been operated under service conditions since Test A.

TECHNICAL INSPECTION REPORT

SECTION III - ELECTRICAL

GENERAL SUMMARY OF ELECTRICAL DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

The drafts and list were not observed. No flooding occurred.

(b) Structural damage.

The ship received considerable structural damage as a result of this test. The only damage to the ship's electrical equipment due to this structural damage was a few cables cut when the bulkheads on which they were mounted gave way. Special electrical test equipment was damaged by falling hatch covers.

(c) Other damage.

Principal electrical damage consisted of the following:

1. Both 24 inch searchlights and one 12 inch searchlight were demolished.

2. Approximately six lighting and fire alarm circuit cables for both cargo holds were ruptured.

3. Two gyro compass repeaters were missing and another repeater was knocked from its stand.

4. The port 6 MC bull horn was missing.

5. The anemometer cups were blown off.

6. One boat davit controller was knocked off the bulkhead.

7. A few lamps were broken.

8. A few sound powered telephones were rendered inoperable.

9. Special Bureau of Ships, (Code 660), test material in the forward cargo hold was damaged by falling hatch covers.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Radiant heat from the port bow scorched paint on exposed electrical equipment and cables. This heat was not of sufficient duration to render any electrical equipment inoperable.

(b) Fires and explosions.

There was no evidence of fires or explosions.

(c) Shock.

There was evidence that the vessel received considerable shock since some lamps, steamtight globes and fire alarm thermostats were broken.

(d) Pressure.

This vessel was subjected to high pressures (air blast). This is evidenced by the searchlights, davit controller, and bull horn being blown from their mountings and by light metal bulkheads being carried away. Most of the electrical damage was a result of the air blast.

(e) Any effects apparently peculiar to the atom bomb.

The loss of residual magnetism of #1 Ship Service generator may have been due to an atomic bomb effect.

III. Effects of Damage.

(a) Effect on propulsion and ship control.

Electrically, the damage which occurred as a result of the test had slight effect on the operation of the ship's electrical plant. All propulsion and boiler auxiliaries were operable. Had the #1 AC ship's service generator been operating at the time of the bomb explosion, it would not have lost its residual magnetism. Since the generator could be easily repaired by the ship's force and since there is a standby generator, the temporary loss of this generator would not affect the operation of the vessel. The most serious effect on the electric plant was the loss of both 24-inch searchlights which were damaged beyond repair. The loss of a few sound powered telephones the port 6 MC bull horn, the 12" signal searchlight, and the lighting cables would slightly impair the operation of the ship. The ship could be operated almost indefinitely without these items at only slightly reduced efficiency. Temporary lights could have been rigged by the ship's force to replace those lost.

Secondary ship's control was practically demolished. This control station is seldom used except when the primary control station is inoperable. The ship could therefore, continue to operate, controlled by the normal ship's control station.

(b) Effect on gunnery and fire control.

The only damage to gunnery and fire control equipment was to that equipment secured to the masts. This consists of rad ar equipment which is covered by the electronics report.

(c) Effect on watertight integrity and stability.

Watertight integrity was not affected by damage to electrical equipment. No electrical equipment shifted sufficiently to affect stability.

(d) Effect on personnel and habitability.

The personnel on this vessel might have been affected by radioactivity, however, the extent of these effects is unknown. Disregarding radioactivity, it is considered that all exposed topside personnel would have been casualties due to the flash and air blast. There would also have been casualties around the cargo holds due to structure distortion and due to falling hatch covers. From an electrical standpoint, casualties might have resulted from electrical equipment such as the searchlights and the bull horn becoming missiles.

Electrically the only effect on habitability was the slight inconvenience due to the lighting failures.

(e) Total effect on fighting efficiency.

Due to personnel casualties and due to the damage to the vessel, its fighting efficiency was greatly reduced. Electrically, the effects were slight. Disembarkation would have been hampered by the loss of the davit controller, however, this damage could have been repaired by the ship's force in a few hours. Night cargo handling operations would have been hampered by the loss of the cargo lights. It is considered that the ship could operate electrically at approximately 90% efficiency.

IV. General Summary of Observers' Impressions and Conclusions.

This vessel received the most damage of any of the transports that survived the first atomic bomb test. Although the ship's hull received considerable damage there was very little electrical damage. Part of the electrical damage that occurred was due to the failure of associated hull equipment.

V. Any Preliminary General or Specific Recommendations of the Inspecting Group.

(a) It is recommended that consideration be given to the redesign of the 24" searchlights to give them more resistance to air

blast. This is considered necessary to give them comparable strength to other electrical equipment.

(b) It is recommended that the gimbal and binnacle pins on gyro compass repeaters be lengthened to prevent the repeaters from being freed from their mounting stands.

(c) It is recommended that consideration be given to mounting equipment such as controllers on some sort of mounting pads or straps so that some bulkhead distortion can occur without damage to the equipment.

(d) It is recommended that where possible, cable be run along beams instead of along light metal joiner bulkheads. It is considered that most of the damage to cables that occurred on this vessel could have been avoided if more consideration had been given to the routing of the cable.

(e) It is recommended that some means of p nning the 12" signal searchlights in their sockets be devised to prevent them from being jarred or blown from their sockets.

DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

A. General Description of Electrical Damage.

(a) Overall condition.

Damage to electrical equipment as follows resulted from the test:

1. Approximately six lighting cables were cut by distorted or blown-out bulkheads. Fire alarm cables in both forward and after holds were ruptured.

2. A few lamps were broken.

3. Two 24" searchlights and one 12" searchlight were demolished.

4. Two gyro compass repeaters were missing and one repeater was knocked from its stand.

5. A few sound powered telephones were inoperative.

6. The port 6 MC bull horn was missing.

7. Anemometer cups were blown off.

8. One boat davit controller was knocked off the bulkhead.

9. Special Bureau of Ships, (Code 660), test material in the forward hold was damaged by falling hatch covers.

(b) Areas of major damage.

The areas of major damage were exposed locations topside and in and around the #1 and #2 cargo holds.

(c) Primary causes of damage in each area of major damage.

The primary cause of damage to this vessel was air blast. The secondary cause was missles (such as the searchlights and hatch covers). There was also slight damage due to radiant heat and due to shock.

(d) Effect of target test on overall operation of electric plant.

1. The exciter for the #1 AC ship's service generator lost its residual magnetism and had to be flashed with a 24 volt battery before it would build up again. All other ship's service equipment was undamaged and operable so there was very little effect on the overall operation of the electric plant. The ship's force was able to readily repair the damage.

2. All electrical engine and boiler auxilaries were operable after the test.

3. All electrical propulsion equipment was operable after the test.

4. All communications equipment was operable except for the port bull horn, one 12" signal searchlight, both 24" searchlights, and a few sound powered telephones.

5. Only damage to fire control equipment was to that equipment secured to the masts. This damage was to radar equipment which is covered by the Section IV - Electronics of this report.

6. There was no electrical damage which rendered ventilation equipment inoperative. One ventilation set was rendered inoperative due to mechanical damage to the motor mounting support base.

7. The 24" searchlights were damaged beyond repair. All cargo flood lights were demolished. One 12" signal searchlight was blown over the side. Another had its bulb broken but was operable when the bulb was replaced. Some lighting circuits were damaged but it is considered that the ship's force could have jury rigged sufficient lights for temporary service without serious difficulty.

(e) Types of equipment most affected.

Searchlights and cable were the types of equipment most affected.

B. Electric Propulsion Rotating Equipment.

There was no damage to electric propulsion rotating equipment reported. All equipment operated satisfactorily after the test.

C. Electric Propulsion Control Equipment.

There was no damage reported to electric propulsion control equipment. All equipment operated satisfactorily after the test.

D. Generators - Ships Service.

(a) The 5.5 KW, 120 V. DC, Westinghouse Electric Corporation exciter for the ship's service turbo-generator set located in the #1 engine room lost its residual magnetism so that voltage would not build up when the set was started up after the test. It was necessary to flash the generator field with a 24 volt battery before the exciter would build up voltage. After the field was flashed, the set operated satisfactorily.

Comments.

The reason for this casualty is not known, it being the only casualty of this type reported on all the vessels in the test. The other two identical sets on this vessel were unaffected. There is the possibility that this casualty was a result of shock. It is considered that the casualty would not have occurred if the set had been operating at the time of the blast.

(b) The special Code 660 - 400 KW 450V AC turbo-generator set, item 12E1, installed in the forward hold was hit by falling hatch covers, see photograph 1901-4; page 189 . These hatch covers are

estimated to weigh approximately 2000 pounds each. They bent the generator frame and knocked the end bell off the exciter. See photographs 1949-6 and 12; pages 190 and 191. The set did not appear to have moved on its base and does not appear to have suffered damage from any source other than from the falling debris.

(c) The special code 660 - 60 KW, 450 VAC Diesel generator set Item 12E3, installed in the forward hold was hit by falling hatch covers. The generator frame was broken on the engine end of the set. See photograph 1901-1; page 196, showing debris on generator and cracked frame. The generator control panel which was mounted on the generator frame was knocked off and completely demolished. See photograph 1949-11; page 199, showing remains of the generator control panel. Photographs 1949-3, 4; pages 197 and 198, show the set after the debris has been cleared away.

(d) The special Code 660 - 300 KW, 120/240 VDC, Diesel generator Item 12E2, installed in the forward cargo hold was hit by falling hatch covers. See photograph 1901-3; page 192. The diesel manifold was knocked off and the generator brush cover plate was crushed down against the brush rigging. See photographs 1948-11, 1949-1; pages 193, and 194.

Comments And Recommendations.

The damage to the generator sets due to the falling hatch covers cannot be considered to be representative of what happens to generator sets during the explosion of atomic bombs since generator sets are not normally installed in cargo holds. The sets were installed for the purpose of determining how these sets of modern Navy design would compare with the normal ships generator sets. The difference in conditions caused the loose cargo hatch covers was not foreseen. Although this test gave very little information as to how these special sets stand up to the direct effects of the bomb blast, it emphasizes strongly the fact that much damage may be caused to equipment by loose gear becoming missiles. It is recommended that consideration be given to more adequate stowage of loose gear particularily spare parts.

E. Generators - Emergency.

No damage was reported to the emergency generator. This generator was running at the time of the explosion and continued to run until the set was out of fuel.

F. Switchboards, Distribution and Transfer Panels.

No damage was reported to any switchboards or to any distribution or transfer panels normally installed on the vessel.

The special Bureau of Ships, Code 660, CV9 class control bench board, Item 12E5, located in the forward cargo hold was hit by falling hatch covers. See photograph 1949-10; page 195 , showing dent in the panel. All of the equipment on the board appeared to still be in good operating condition. The voltage regulator and instrument missing in the photograph were missing before the test.

G. Wiring, Wiring Equipment and Wireways.

(a) Cable.

1. Six cables were severed when the bulkhead gave way at frame 109 on the main deck, stbd. side. These cables supplied lighting and fire alarm circuits in the after cargo hold.

2. Lighting cable frame 116 on the main deck, stbd side was severed by a missile when the hatch cover was carried away by the blast.

3. Director shield in breaking loose at frame 25 on the 02 level stbd side cut one sound powered and one call bell cable.

4. Radiant heat burned the paint off 60% of all cables on the foremast and mainmast. The armor and insulation on these cables appear very slightly affected.

(b) Wiring equipment.

1. One 10 amp S and R box located at frame 116 on the main deck, stbd side was damaged when hit by a missile. The cover was bent and screws sheared.

2. One deck riser in the navigation bridge was broken by impact from the forward bulkhead which was dished in by the blast. No damage resulted to the cable.

H. Transformers.

There was no damage reported to transformers installed on this vessel.

I. Submarine Propelling Batteries.

Not Applicable.

J. Portable Batteries.

There was no damage reported to portable batteries installed on this vessel.

K. Motors, Motor Generator Sets and Motor Controllers.

(a) The motor for the propeller type fan located at frame 58, port side, main deck was not operable since the mounting support for the motor was so twisted that the set was out of line. There was no apparent damage to the motor, however, there is the possibility that the shaft or frame was sprung due to the twisted mounting.

(b) The motor for the Welin davit located on the 01 deck at frame 105 port side had the paint burned due to the radiant heat of the blast. The motor appeared to be otherwise undamaged, however, it was not tested since the davit was smashed. See photograph 1882-6; page ..91 , showing mechanical damage to davit.

(c) The special Code 660 - 75 KW, 450 V AC, 230 V DC motor-generator set, Item 12E4, located in the forward cargo hold was hit by falling hatch covers. See photographs 1901-2; page 200, showing the set covered with debris. The commutator was scored and knocked out of true. The shaft appeared to be bent. See photograph 1949-7; page 201, showing the set after the debris had been removed.

(d) A Westinghouse Electric Corporation Size 1, 2 speed two winding class HI shockproof ventilation fan motor controller located in the 03 deck passageway at frame 93 port has its enclosure slightly bent due to the distortion of the bulkhead. The controller operated satisfactorily after the test.

(e) The enclosure door of the anchor windlass controller was dished due to the blast. This damage was insufficient to affect the operation of the controller.

(f) The General Electric Company Type Cr 5431-D31Y Welin davit controller located on the main deck at frame 105, starboard side, was knocked off the bulkhead by the blast. The four 1/2 inch mounting bolts were broken in tension. One arc chute was broken. This arc chute damage can probably be attributed to the impact of the controller striking the deck. The power and control leads to the controller were pulled in two. The controller appeared operable if the cables were reconnected and the arc chute replaced.

Recommendations.

The controller was mounted solidly on the bulkhead. The bulkhead appeared to be slightly dished. It is considered that control equipment should not be mounted solidly on the bulkhead but should be mounted on straps or on built-up pads so that some distortion of the bulkhead can occur without damage to the controller. In connection with the breaking of the arc chute, this is a commercial low shock controller. It is considered that Navy HI shockproof contactors would not have been damaged by the fall.

(g) The Cutler-Hammer, Bulletin 6968ED21, size 1, 2 speed Two winding ventilating fan controller located in the crews quarters, port side of the #1 cargo hold had its case distorted due to being hit by a water curtain value reach rod. Although the case was distorted the controller still operated satisfactorily.

(h) The controllers for the two port Welin davits had their enclosure doors dished inward due to the blast. The controllers appeared operable, however, they were not tested, due to the failure of the mechanical portion of the davit.

L. Lighting Equipment.

(a) Missiles from the forward and after cargo hatch covers in carrying away and shock being transmitted from the deck above caused considerable damage to the lamps, reflectors and fixtures in the compartments below. Approximately seven 12 inch reflectors were broken.

(b) Approximately 50% of all running and anchor lights were broken or carried away by the air blast.

(c) All four of the cargo handling lights were demolished by the air blast - two at frame 127 one port and one starboard and two at frame 59 one port and one starboard.

(d) In addition to the above the following rough service lamps were broken - One in the CIC room frame 63; 03 deck - one in the Captain's pantry frame 62; 02 deck - one in the radio direction finder room frame 80; 04 deck - others probably were broken but were replaced prior to this inspection.

M. Searchlights.

(a) The 12" signalling searchlight located on the port signal bridge was lifted out of its mounting socket and was missing. Socket appeared to be undamaged.

Recommendations.

It is recommended that these searchlights be pinned in their sockets to prevent their becoming missiles. It was noted that some of these 12" searchlights had provision for being held in place, however, the holding nut had been removed and lost in all cases noted. Since these lights are frequently moved from one location to another, a method to prevent careless loss of the holding down device should be provided.

(b) The 12" signalling searchlight located aft of the aft stack at frame 103 had the strap to which the socket was welded bent so that the light had a list of approximately 20°. The incandescent bulb was broken. The searchlight operated satisfactorily after the bulb was replaced.

(c) The port General Electric Company 24" searchlight, Navy model 93013, was carried away by the blast and landed in the Secondary Control Station on the deck below. Ref. photograph 1904-6 page 62 . The bolts holding the searchlight yoke to the flange were sheared. Ref. photograph 1876-6; page 47 , showing distortion of the searchlight mounting platform.

(d) The starboard 24" searchlight, Navy Model 93013, was smashed against the railing. See photographs, 1904-5, 1901-5 and 1922-5; pages 46 , 54 , and 55 . The glass was broken and the searchlight interior was gutted. The reflector was on the deck below approximately 50 feet forward of the searchlight and in the direction from which the blast came. The bolts holding the flange to the yoke were broken.

N. Degaussing Equipment.

The binnacle for the magnetic compass at the secondary control station carried away due to the blast or due to being struck by the falling searchlight. (See Item M). See photograph 1904-6, page 62 . The cable to the degaussing compensating coils and control box parted. The coils and control box appeared to be undamaged.

O. Gyro Compass Equipment.

(a) Both the port and starboard pelorus on the navigation bridge were damaged. The repeaters and gimbal rings were missing and the binnacle stands were bent. It is considered that the air blast dislodged the repeaters and the stands were bent when struck by the bridge shield which was distorted by the air blast. Hull photograph 1903-5; page 35, shows the starboard stand and 1903-6; page 36, shows the port stand.

(b) Hull photographs 1904-6, 8; pages 52 and 49, show the secondary control station on the 04 level and the damage to the pelorus located there. The repeater dial window was cracked, the repeater was free of the gimbal ring, the gimbal ring was loose from the binnacle and the binnacle was torn from its column. There were numerous cases on ships in this test where the repeaters and gimbal rings were dislodged by the air blast due to temporary distortion of the gimbal ring and loosened binnacle pins which are of the non-locking type, but this is the only case where the binnacle yoke was torn from the column and it is believed that this is due to the fact that only one of the six studs was in place. This tud had pulled through the flange on the stand.

(c) The glass was broken on the Dead Reckoning Tracer located in the Chart house at frame 64, centerline, on the 03 level.

Recommendation.

It is believed a great deal of the damage to the pelorus repeaters could be eliminated by lengthening the gimbal pins which hold the repeater and by the use of threaded binnacle pins with lock nuts.

P. Sound Powered Telephones.

(a) One RCA Type MI-2045-E head set was left exposed, at frame 25 on the 02 deck, starboard side. It was scorched by the radiant heat, the diaphrams were distorted by the air blast and the transmitter mouth piece was broken from impact with a director shield.

(b) One RCA Type MI-2040-A hand set located in a cabinet without a cover at frame 25, 01 deck on the port side was scorched by the radiant heat, the transmitter and receiver diaphrams were distorted and the handset bracket was bent by the air blast. Had the cover been on the cabinet, this damage would not have occurred.

(c) Telephone Jack Box at frame 59, centerline, on the 04 level, had its paint badly burned by the radiant heat. Other jack boxes in exposed locations were scorched to a lesser degree.

(d) One hand set cabinet RCA Type MI-2025 located at frame 128 01 deck on the port side was bent by the air blast and the hand set inside was rendered inoperable due to distortion of the receiver diaphram. The operability of this hand set prior to the test is not definitely known. See Hull photograph 1906-10; page 125 .

Q. Ship's Service Telephones.

Not Applicable.

R. Announcing Systems.

(a) The tripod mounted reproducer for the PAB system was damaged in falling and from being hit by a missile. One speaker magnet and diaphram assembly were destroyed due to the missile. Examination of another speaker showed the voice coil and diaphram undamaged although mounted exposed at frame 59, centerline, on the 04 level pointing directly into the blast. Minor changes in the reproducer wiring would allow operation at reduced output.

(b) The port 6 MC bull horn mounted on the port wing of the signal bridge at frame 61, 04 level was blown over the side by the blast, examination disclosed failure of the foundation welds. The foundation welds were also cracked on the starboard bull horn. Hull photographs, 1903-4 and 1959-9; pages 34 , and 135 , shows the starboard bull horn and the method used in mounting which was also used on the port. The starboard bull horn was tested and found operable.

(c) Two IMC reproducers were struck by missiles bending their horns, one located at frame 64 on the starboard side of the 03 deck and one located on the centerline frame 59, 03 level. Both reproducers were tested and found still operable. Hull photographs, 1903-8 and 4; pages 57 , and 54 , show the reproducer at frame 59 and indicate the pressure it withstood without damage to its diaphram.

(d) The intercommunication unit suspended from the overhead in the chart house frame 64, on the 03 deck, was found hanging by one of its four mounting brackets. The welds failed on the other three. The unit is still operable.

S. Telegraphs.

There was no damage to telegraphs reported on this vessel.

T. Indicating Systems.

(a) The anemometer cups were carried away by the air blast.

(b) The following "Pilot Marine Corporation Mod. SRIRA1" rudder angle indicators were damaged:

1. One located at the secondary control station had its dial window and dial broken. Its base was distorted and two of the foundation bolts were sheared when the indicator was hit by a missile. See photographs 1904-6, 8; pages 52 , and 49 .

2. One located on the bridge, frame 59, centerline, on the 03 level had its dial window cracked by the air blast.

3. One located at the after steering station, frame 140, centerline, 02 level, also had its dial window cracked by the air blast.

(c) The fire alarm circuit for the after cargo hold was rendered inoperable due to the supply cable being severed when a bulkhead gave way at frame 109 on the starboard side of the main deck.

The fire alarm circuit for the forward cargo hold was disabled due to one thermostat fixture completely carrying away leaving the cable dead ended and due to another thermostat breaking.

U. I.C. and A.C.O. Switchboards.

There was no damage reported to I.C. and A.C.O. switchboards.

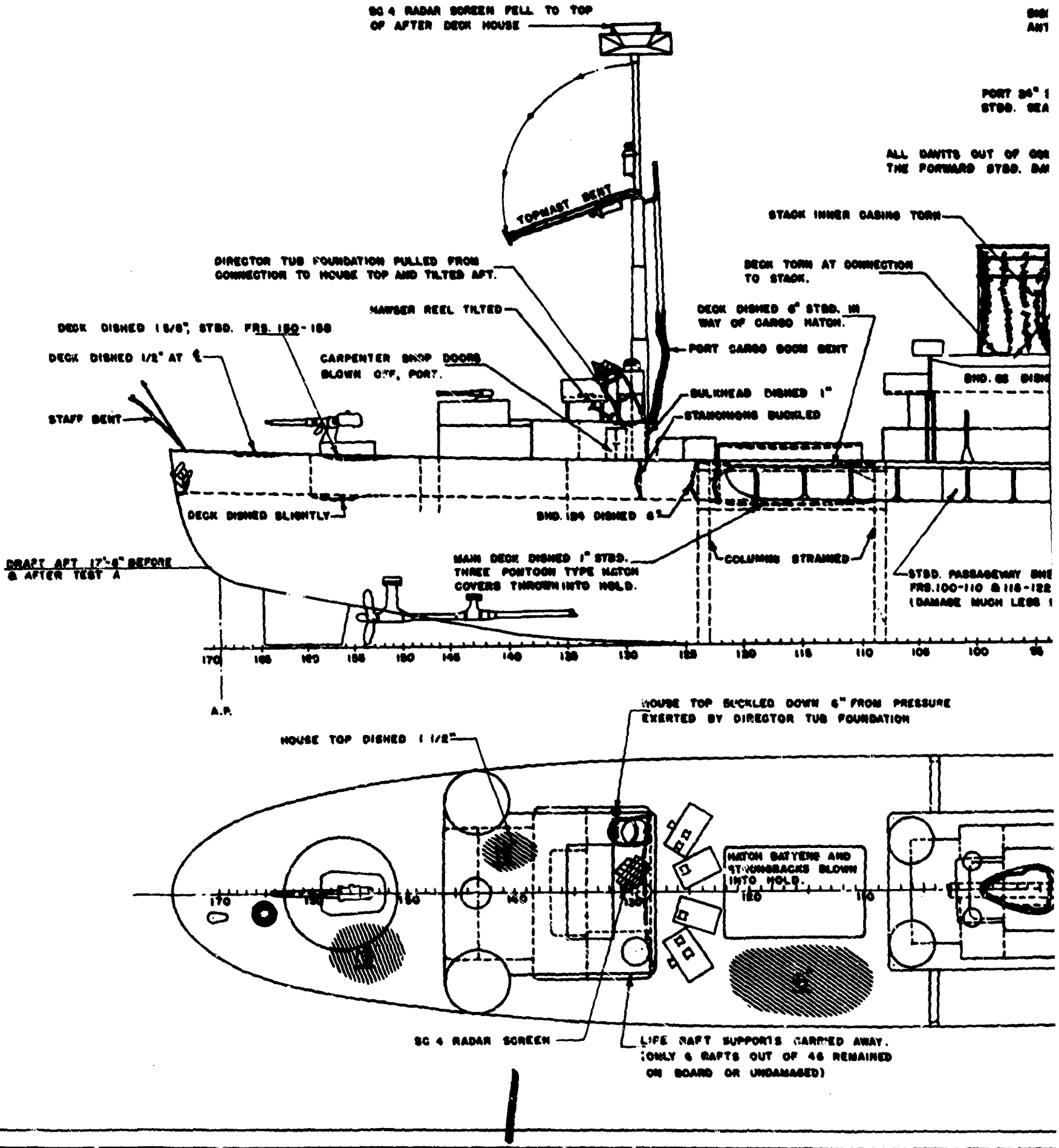
V. F.C. Switchboards.

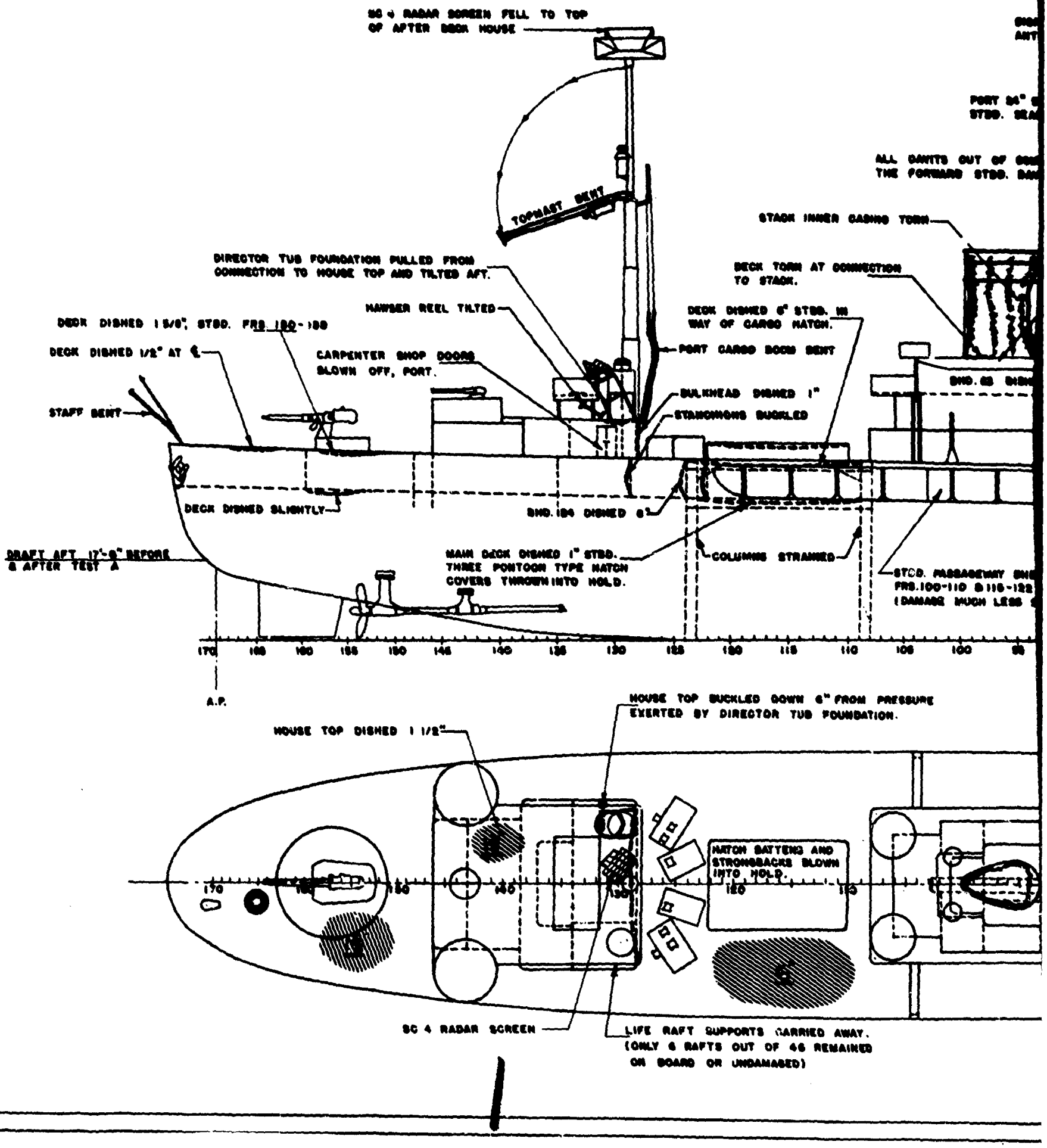
There was no damage reported to F.C. Switchboards.

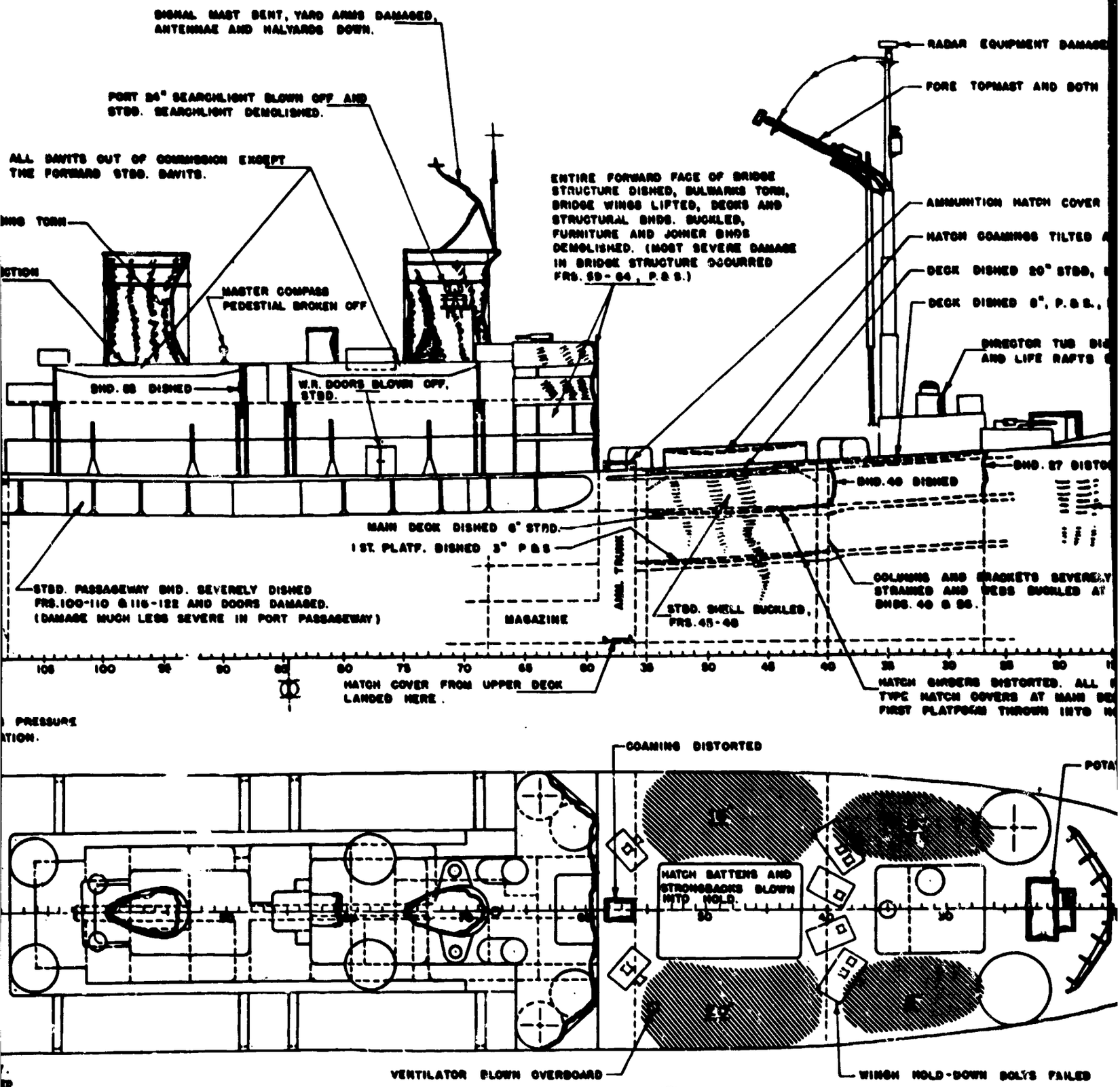
APPENDIX

SHIP DAMAGE DIAGRAM

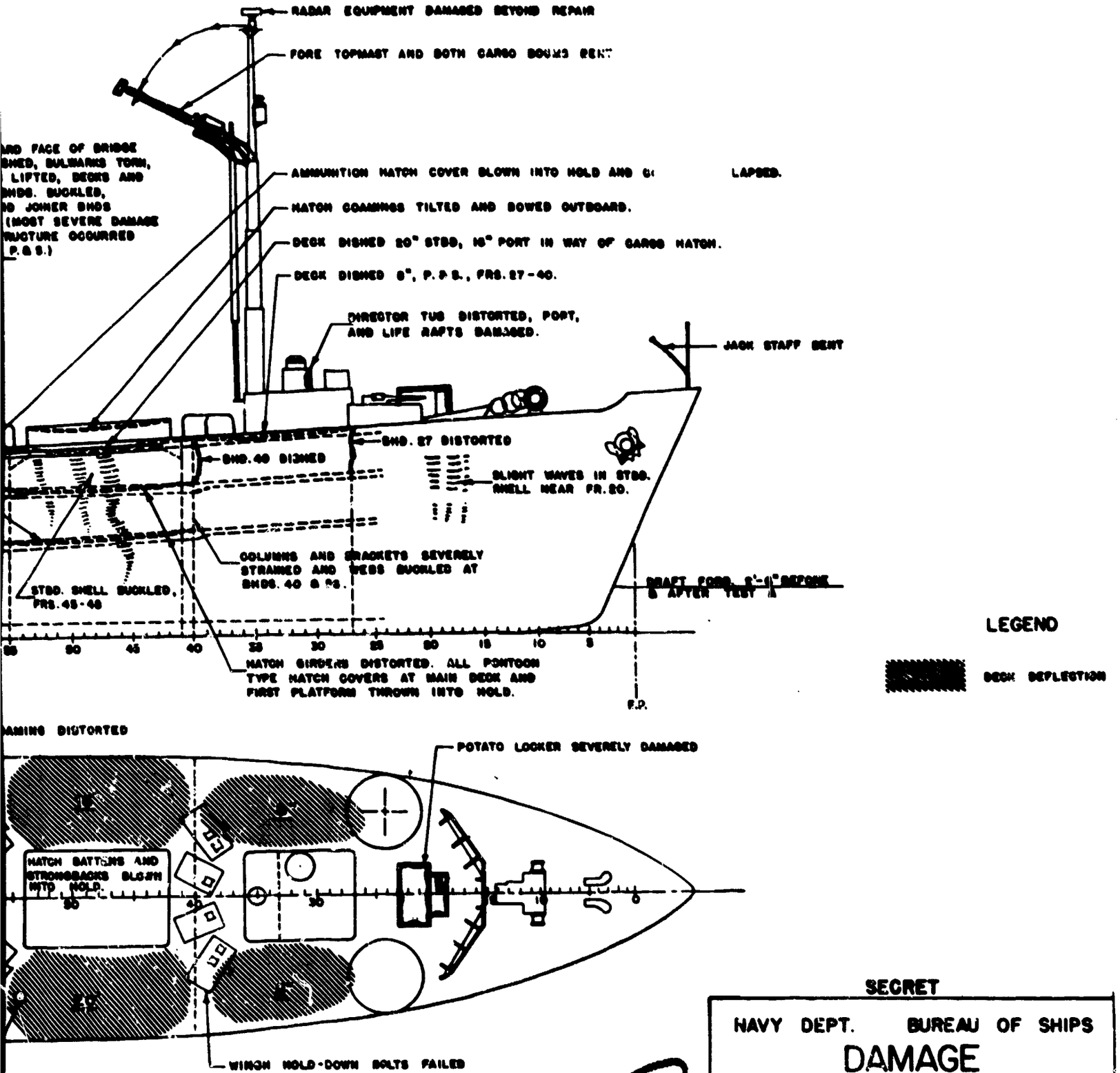
TEST ABLE


SC 4 RADAR SCREEN FELL TO TOP OF AFTER DECK HOUSE
TOPMAST BENT
DIRECTOR TUB FOUNDATION PULLED FROM CONNECTION TO HOUSE TOP AND TILTED AFT.
HAWSER REEL TILTED
DECK DISHED 1 5/8", STBD. FRS. 150 - 158
DECK DISHED 1/2" AT ℄
CARPENTER SHOP DOORS BLOWN OFF, PORT.
STAFF BENT
PORT CARGO BOOM BENT
BULKHEAD DISHED 1"
STANCHIONS BUCKLED
STACK INNER CASING TORN
DECK TORN AT CONNECTION TO STACK.
DECK DISHED 6" STBD. IN WAY OF CARGO HATCH.
DECK DISHED SLIGHTLY
BHD. 124 DISHED 6"
MAIN DECK DISHED 1" STBD. THREE PONTOON TYPE HATCH COVERS THROWN INTO HOLD.
COLUMNS STRAINED
DRAFT AFT 17'-6" BEFORE & AFTER TEST A
A.P.
HOUSE TOP BUCKLED DOWN 6" FROM PRESSURE EXERTED BY DIRECTOR TUB FOUNDATION
HOUSE TOP DISHED 1 1/2"
HATCH BATTENS AND STANCHIONS BLOWN INTO HOLD.
SC 4 RADAR SCREEN
LIFE RAFT SUPPORTS CARRIED AWAY. (ONLY 6 RAFTS OUT OF 46 REMAINED ON BOARD OR UNDAMAGED)


SC 4 RADAR SCREEN FELL TO TOP OF AFTER DECK HOUSE
TOPMAST BENT
DIRECTOR TUB FOUNDATION PULLED FROM CONNECTION TO HOUSE TOP AND TILTED AFT.
HAWSER REEL TILTED
DECK DISHED 1 5/8", STBD. FRS. 120 - 138
DECK DISHED 1/2" AT ℄
CARPENTER SHOP DOORS BLOWN OFF, PORT.
STAFF BENT
DECK DISHED SLIGHTLY
DRAFT AFT 17'-8" BEFORE & AFTER TEST A
A.P.
MAIN DECK DISHED 1" STBD. THREE PONTOON TYPE HATCH COVERS THROWN INTO HOLD.
BHD. 184 DISHED 6"
PORT CARGO BOOM BENT
BULKHEAD DISHED 1"
STANCHIONS BUCKLED
DECK DISHED 6" STBD. IN WAY OF CARGO HATCH.
COLUMNS STRAINED
STACK INNER CASING TORN
DECK TORN AT CONNECTION TO STACK.
ALL DAVITS OUT OF
THE FORWARD STBD.
PORT
STBD.
BHD. 63 DISH
STBD. PASSAGEWAY
FRS. 100-110 &
(DAMAGE MUCH
HOUSE TOP DISHED 1 1/2"
HOUSE TOP BUCKLED DOWN 6" FROM PRESSURE EXERTED BY DIRECTOR TUB FOUNDATION.
HATCH BATTENS AND STRONGBACKS BLOWN INTO HOLD.
SC 4 RADAR SCREEN
LIFE RAFT SUPPORTS CARRIED AWAY.
(ONLY 6 RAFTS OUT OF 46 REMAINED ON BOARD OR UNDAMAGED)


SIGNAL MAST BENT, YARD ARMS DAMAGED, ANTENNAE AND HALYARDS DOWN.
PORT 24" SEARCHLIGHT BLOWN OFF AND STBD. SEARCHLIGHT DEMOLISHED.
ALL DAVITS OUT OF COMMISSION EXCEPT THE FORWARD STBD. DAVITS.
ENTIRE FORWARD FACE OF BRIDGE STRUCTURE DISHED, BULWARKS TORN, BRIDGE WINGS LIFTED, DECKS AND STRUCTURAL BHDS. BUCKLED, FURNITURE AND JOINER BHDS DEMOLISHED. (MOST SEVERE DAMAGE IN BRIDGE STRUCTURE OCCURRED FRS. 59 - 64 , P & S.)
MASTER COMPASS PEDESTAL BROKEN OFF
BHD. 68 DISHED
W.R. DOORS BLOWN OFF, STBD.
RADAR EQUIPMENT DAMAGE
FORE TOPMAST AND BOTH
AMMUNITION HATCH COVER
HATCH COAMINGS TILTED
DECK DISHED 20" STBD,
DECK DISHED 8", P. & S.,
DIRECTOR TUB DI
AND LIFE RAFTS
BHD. 57 DISTO
BHD. 40 DISHED
MAIN DECK DISHED 6" STBD.
1 ST. PLATF. DISHED 3" P & S
AMM. TRUNK
STBD. PASSAGEWAY BHD. SEVERELY DISHED FRS. 100-110 & 115-122 AND DOORS DAMAGED. (DAMAGE MUCH LESS SEVERE IN PORT PASSAGEWAY)
MAGAZINE
STBD. SHELL BUCKLED, FRS. 45-48
COLUMNS AND BRACKETS SEVERELY STRAINED AND WEBS BUCKLED AT BHDS. 40 & 56.
HATCH COVER FROM UPPER DECK LANDED HERE.
HATCH GIRDERS DISTORTED. ALL TYPE HATCH COVERS AT MAIN DE FIRST PLATFORM THROWN INTO H
PRESSURE ATION.
COAMING DISTORTED
HATCH BATTENS AND STRONGBACKS BLOWN INTO HOLD.
VENTILATOR BLOWN OVERBOARD
WINCH HOLD-DOWN BOLTS FAILED

2



SECRET

NAVY DEPT. BUREAU OF SHIPS

DAMAGE TEST A

U.S.S. CRITTENDEN APA 77

APPENDIX

SHIP MEASUREMENT DATA

TEST ABLE

APPENDIX

SHIP MEASUREMENT DATA

A. General Considerations.

A deck survey method was developed to determine the twist and longitudinal bending of each target vessel's hull girder resulting from an air or underwater burst of the atomic bomb. The procedure is as follows:

1. Select transverse sections. The maximum number of transverse sections used on any ship was six.

2. At each transverse section, select stations at which rod readings are to be taken. Center punch these stations in the deck. A minimum of five stations were used at each transverse section.

3. Establish throughout the length of the ship, by use of a surveyor's transit, a reference plane approximately parallel to the deck.

4. Take rod readings at every station on each transverse section.

5. Plot rod readings relative to a straight line representing the reference plane.

(a) Readings at each transverse section are plotted in order to obtaine the configuration of individual sections and also to establish the relationship between sections.

(b) Readings at desired distances from the centerline are plotted in order to establish sheer lines. On most ships the actual readings are corrected for changes in sections resulting from local damage.

6. Repeat steps 3, 4 and 5 after the test using the stations established in steps 1 and 2.

7. Superimpose the after test plots on the before test plots in order to compare the conditions existing at the times of the two surveys.

The reference planes used in the before test and after test surveys are not necessarily parallel. Their relationship can not be accurately determined because bench marks established before the test may be affected by local damage or by changes in hull alignment. Therefore it is possible only to determine relative movement of any one section. The reference planes are disregarded after completion of the initial plots.

Twist of the hull girder is determined by superimposing one after test transverse section on the similar before test section and comparing and configurations of the remaining sections. Hog and sag is determined by superimposing before and after test plots of sheer.

The camber curves indicated in all plots are faired lines and do not show local deformation which may exist between the five station points.

B. Measurements.

1. The before test survey of the upper deck of the USS CRITTENDEN was conducted at Pearl Harbor Navy Yard on March 16, 1946, and the after test survey was conducted at Bikini Atoll on July 11, 1946. Both surveys were conducted as outlined in paragraph "A". Superimposing the plots of the two surveys indicated no change in the ships girder.

2. Local deformation of the upper deck and main decks occurred in way of the forward cargo hatch and in way of the after hatch at the main deck level. These deformations were recorded and shown on pages 87 through 90 . Although the coaming around the forward cargo hatch moved downward a maximum of 6-inches it remained a boundary for the dishing of the deck plating between the coaming and the port and starboard deck edges, see page 88 . The port and starboard deck edges remained unchanged. As shown

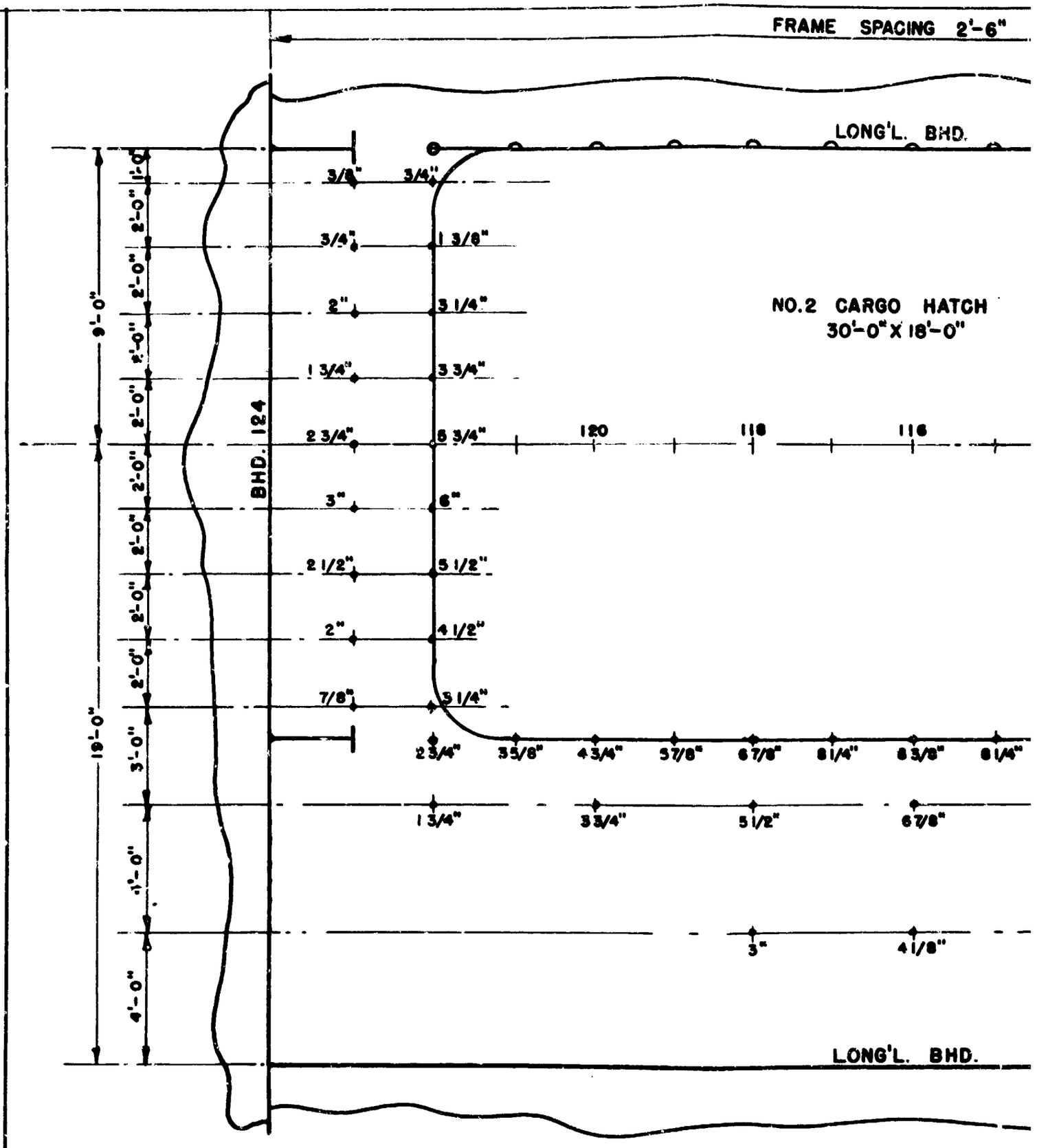
on pages 8[illegible], and 9[illegible], the upper deck also dished, a maximum of 10-inches, between frames 30 and 40. It is evident that the dishing of the upper deck would have been continuous had not the ridgity of transverse bulkhead 40 below divided this area. The superstructure bulkhead at frame 59 formed the aft boundary for the upper deck dishing around the forward cargo hatch.

2. The main deck between frames 40 and 56, compartment A-104-L, was dished a maximum of 26-inches. This is a greater deflection than recorded on the upper deck, maximum of 22-inches. As shown on page 9[illegible], the starboard side of the main deck was dished considerably more than the port side. This difference is accounted for by the two longitudinal bulkheads, forming the passage A-104-LT, retarding the blast, the starboard side was open to the blast.

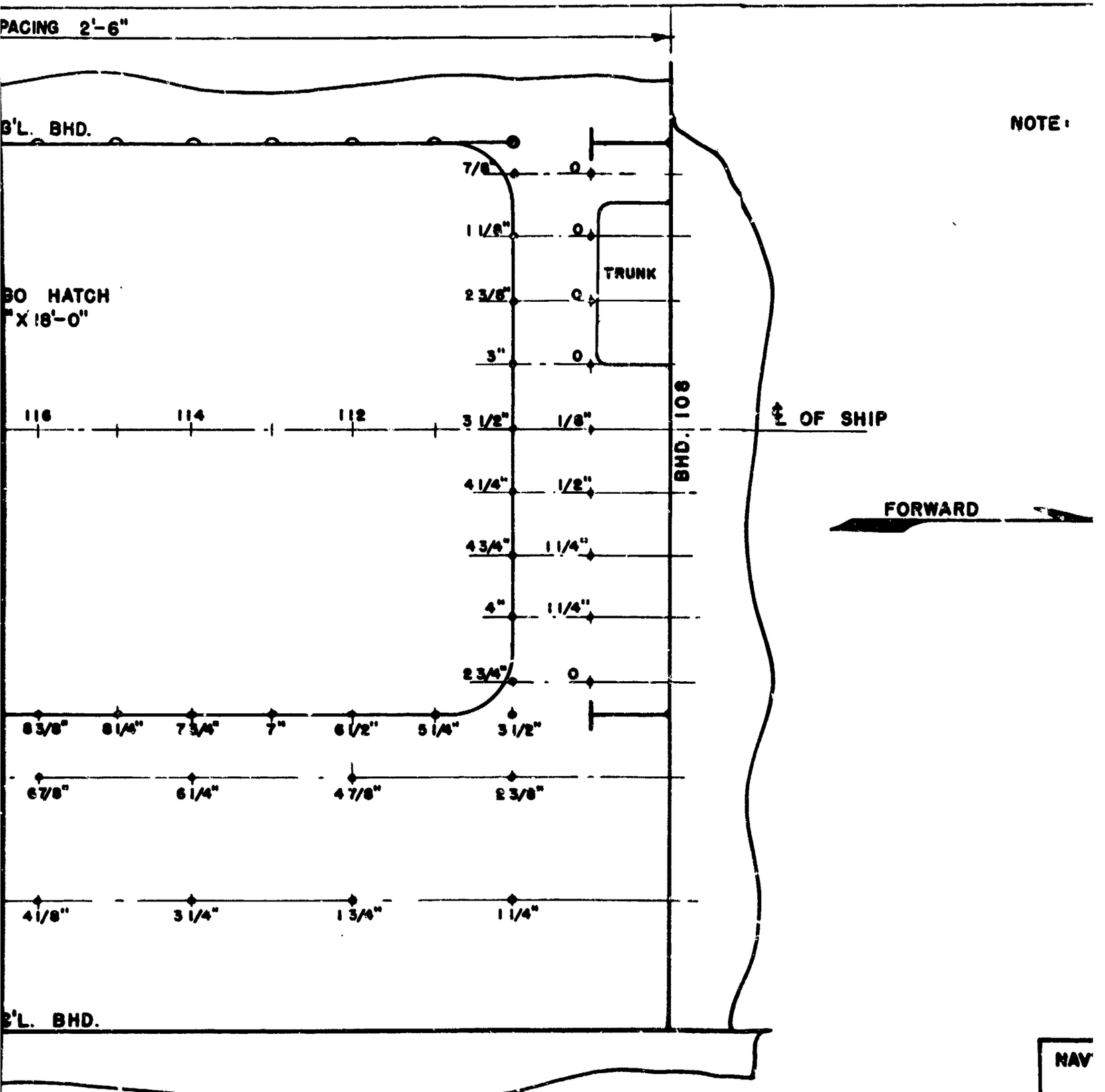
3. Dishing of the main deck aft between frames 108 and 124, compartment B-102-L was not as serious as that recorded in way of the forward cargo hatch. A maximum of 8-3/8" deflection was recorded at the starboard side coaming of the cargo hatch near frame 116, page 87. The position of the main dishing is located similar to the dishing recorded in the forward compartment to starboard.

C. Deck Deflection Scratch Gages.

Six gages were installed to record movement of the upper deck. Locations and readings of these gages are tabulated on page 91.



MAIN DECK
PLAN VIEW



DECK

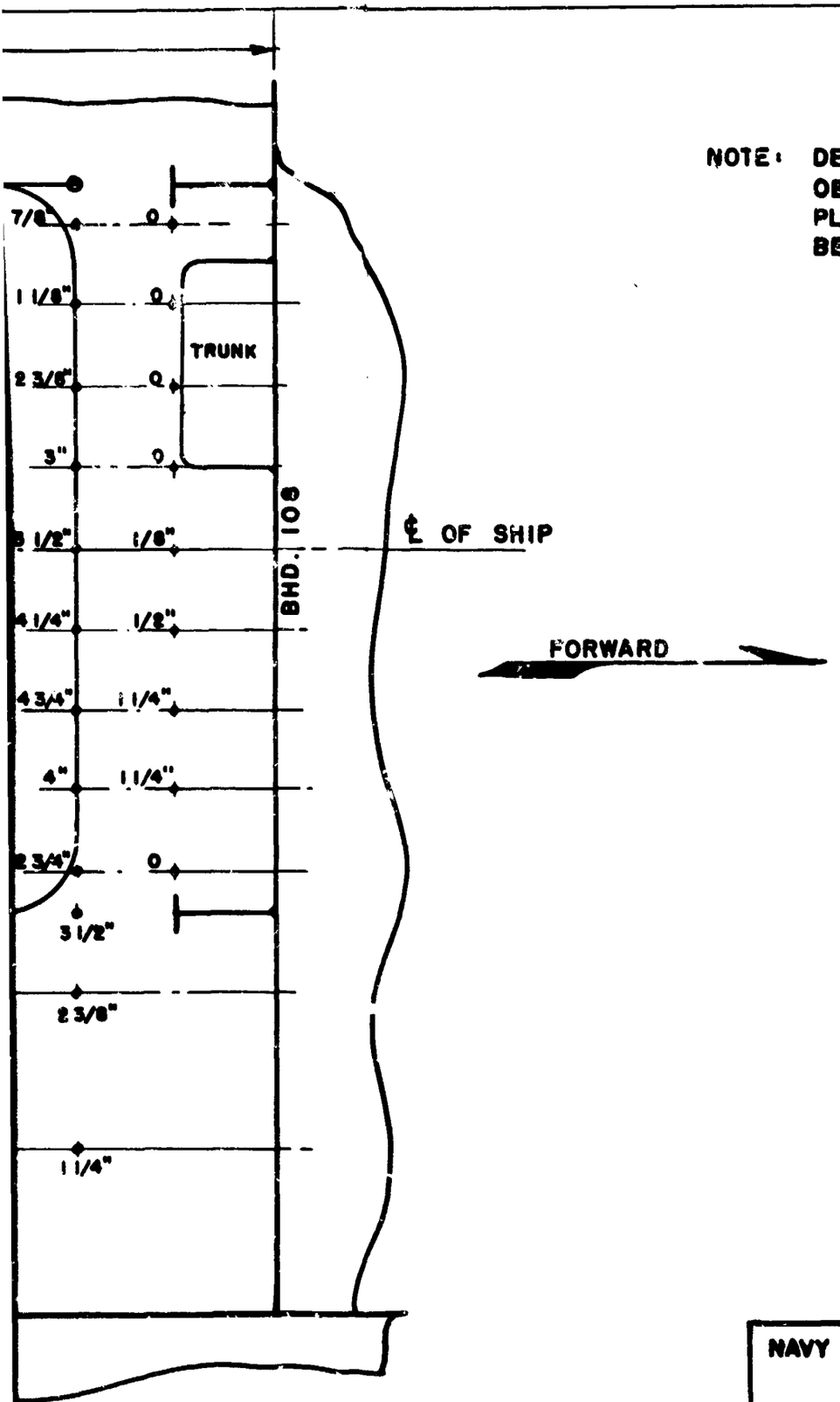
VIEW

2

NAV

U.S.

NOTE: DECK DEFLECTION MEASUREMENTS OBTAINED BY MEASURING TO DECK PLATE FROM CHALK LINE STRETCHED BETWEEN BHDS. 108 AND 124.



SECRET

NAVY DEPT. BUREAU OF SHIPS

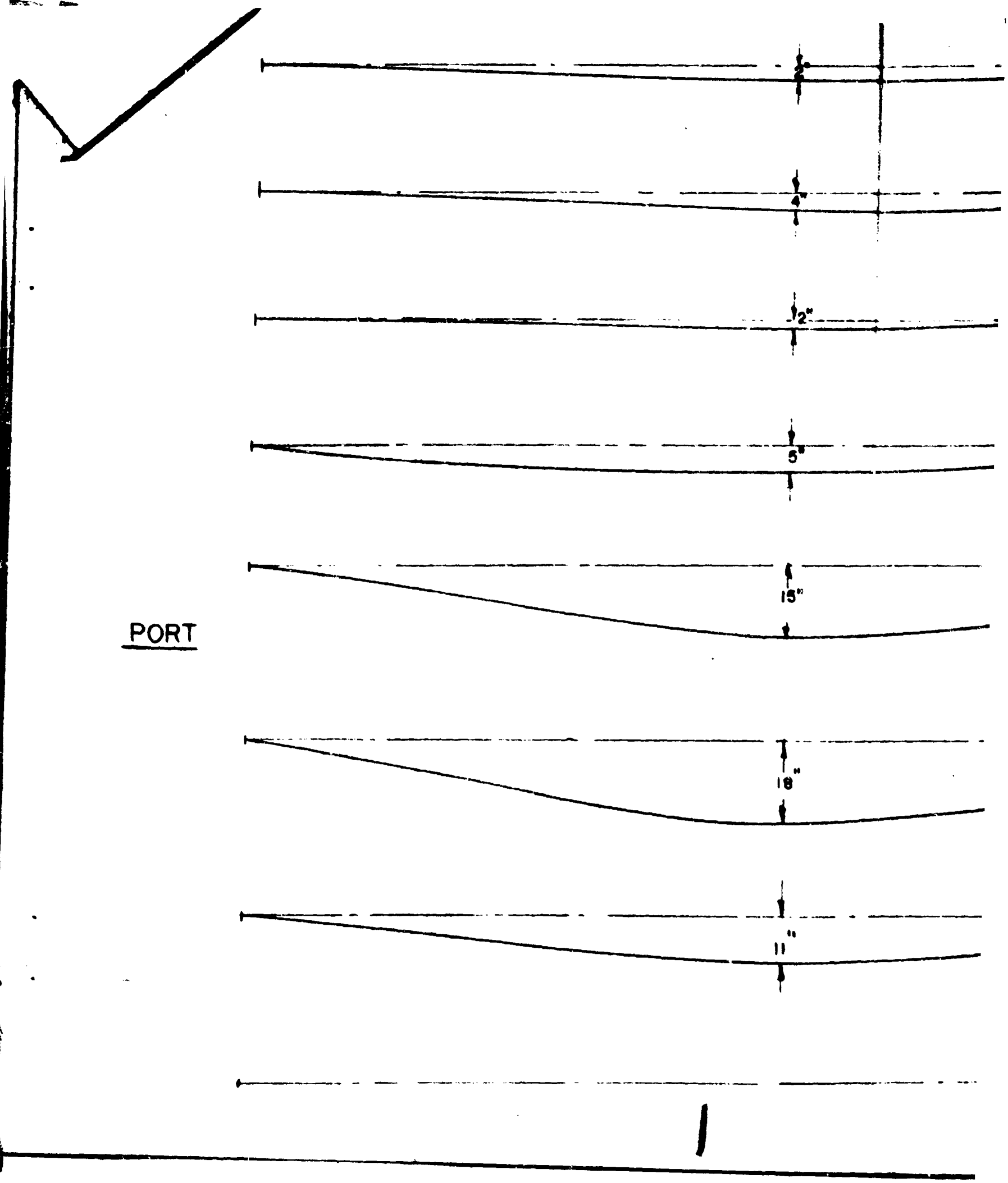
DECK DEFLECTION

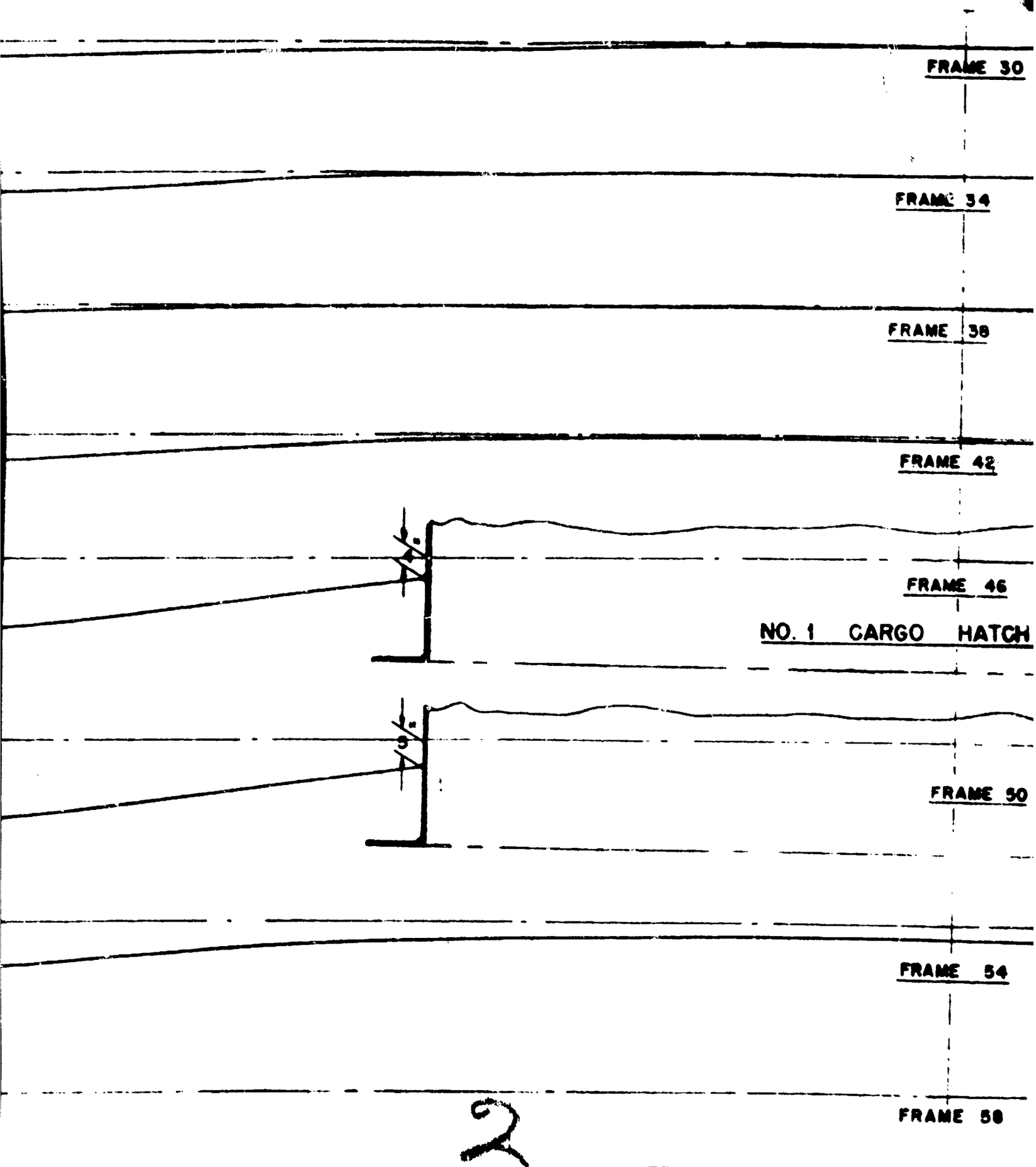
MAIN DECK, AFT HOLD

TEST A

U.S.S. CRITTENDEN APA 77

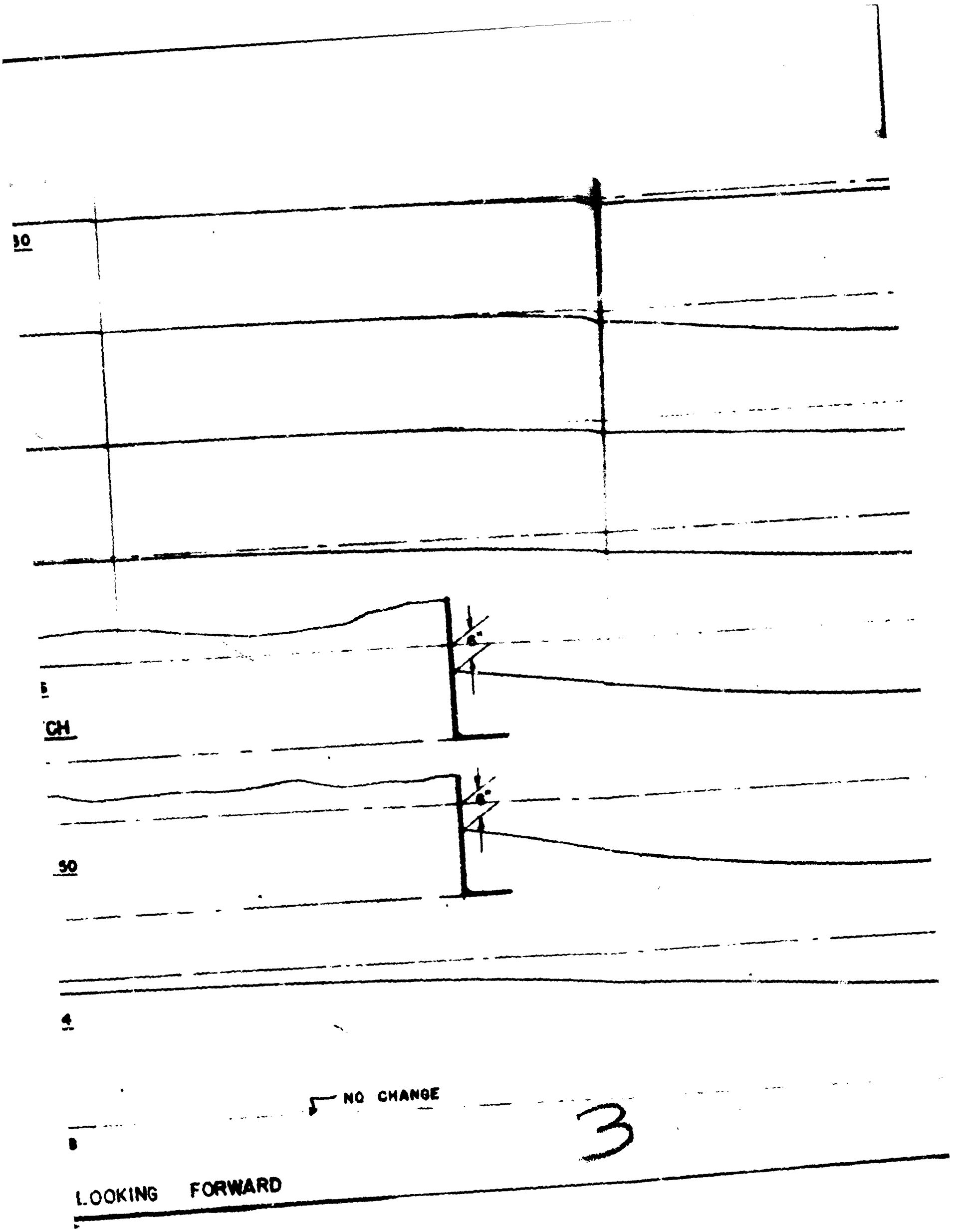
2 3

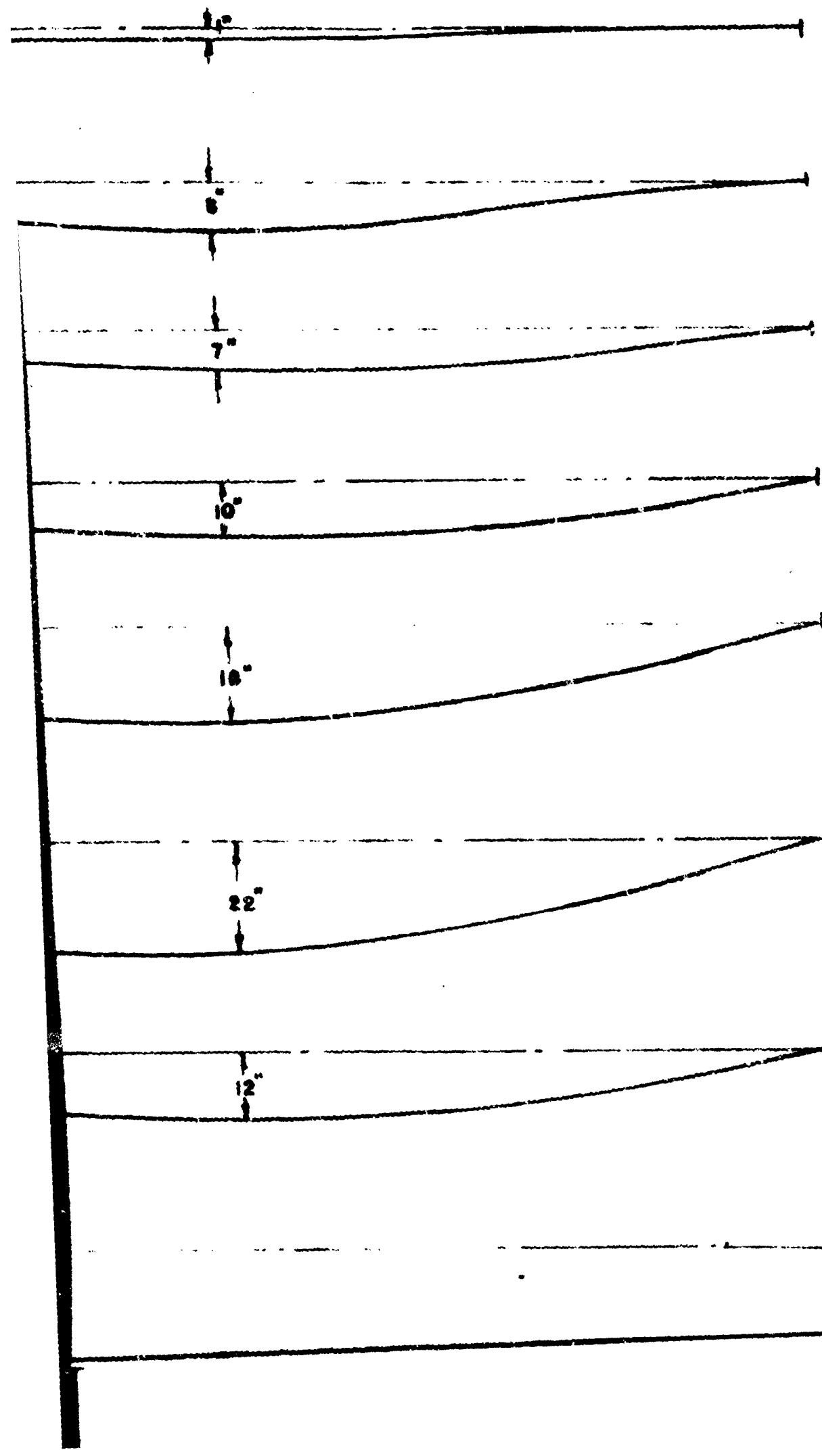

4"
2"
5"
15"
PORT
18"
11"



2

TRANSVERSE SECTIONS — 1.0


30
5
CH
30
4
NO CHANGE
3
LOOKING FORWARD

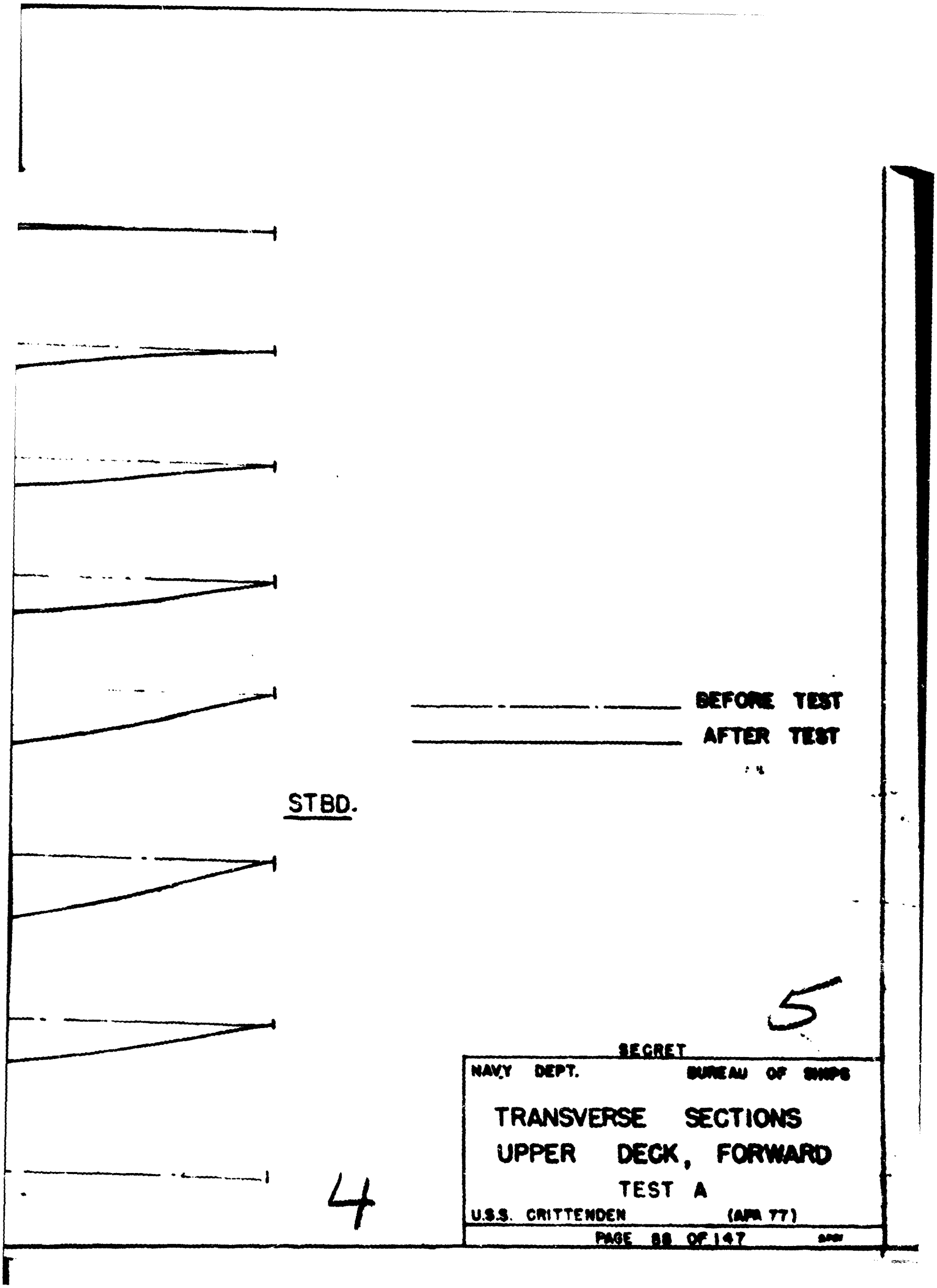


NAVY DEPT.

TRANSVE
UPPER

U.S.S. CRITTEN

4



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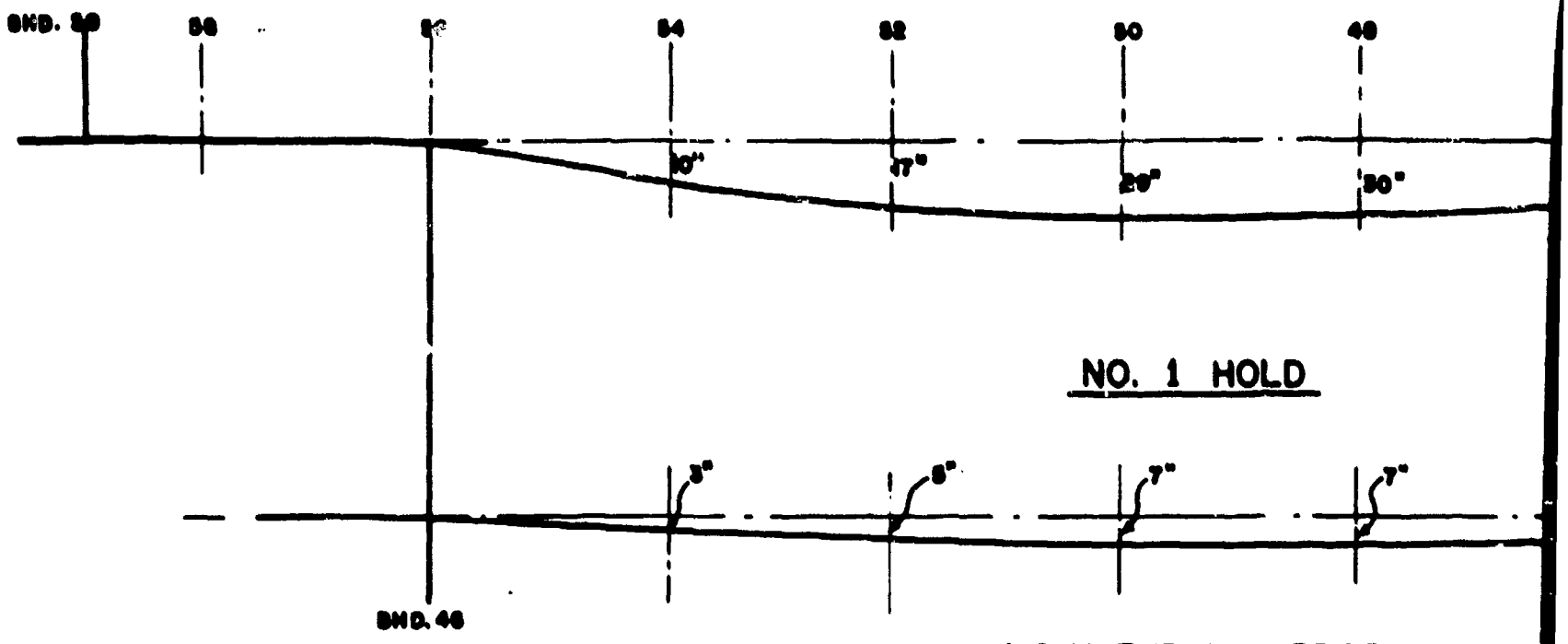
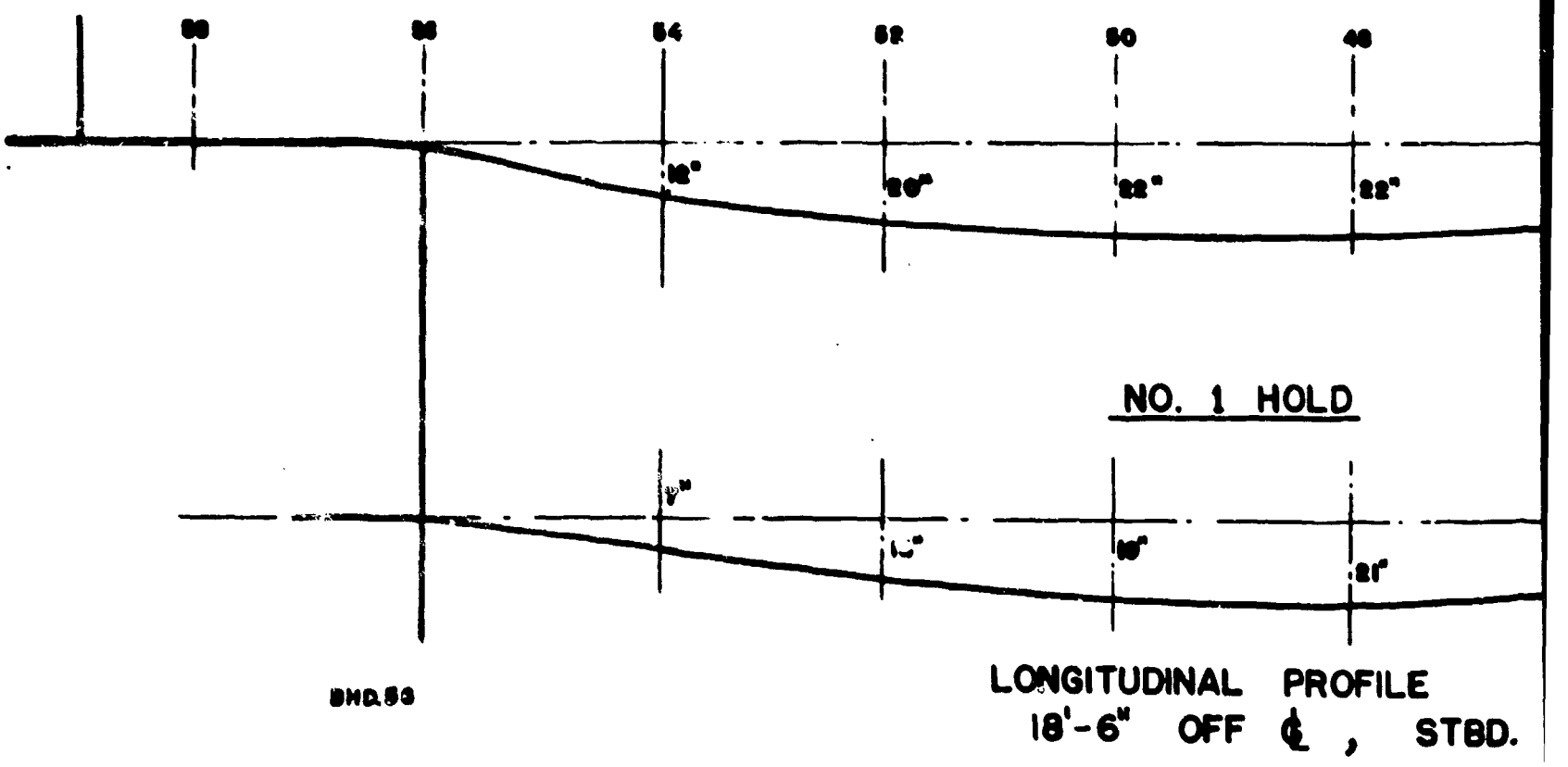
NAVY DEPT. BUREAU OF SHIPS

TRANSVERSE SECTIONS
UPPER DECK, FORWARD
TEST A

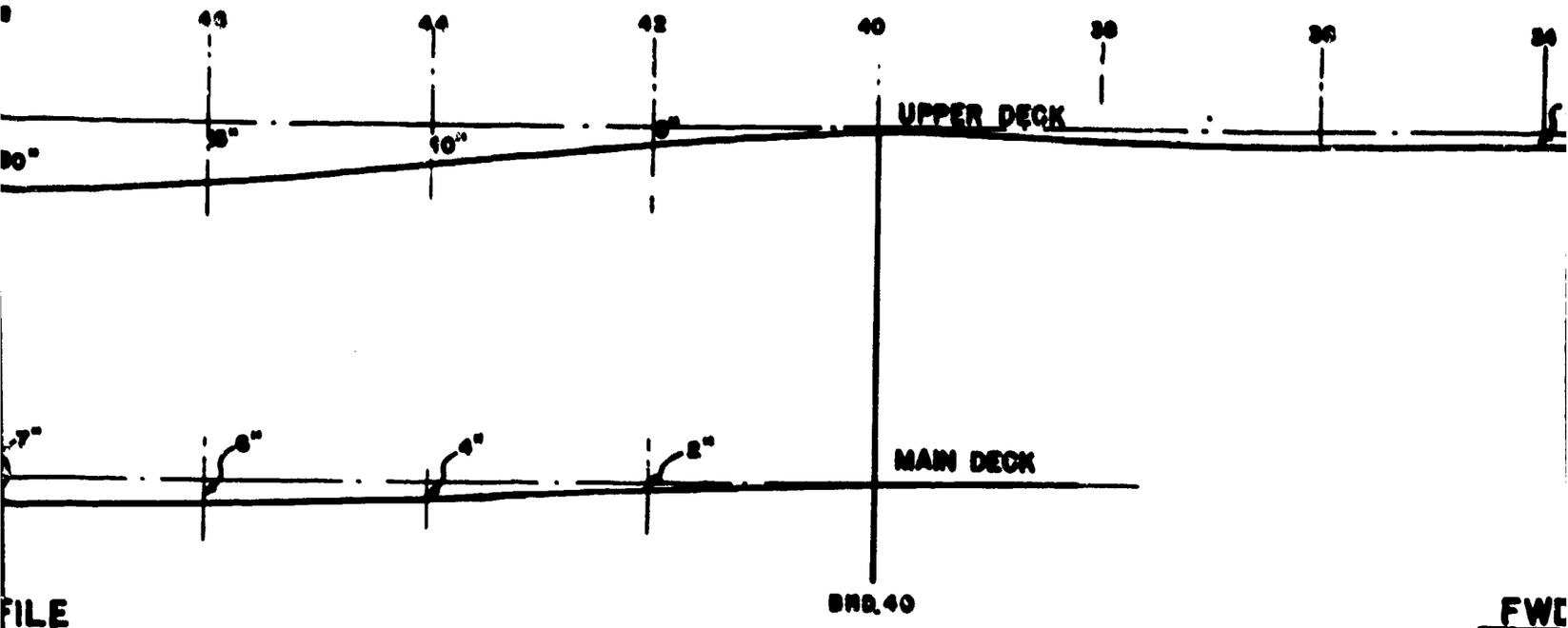
U.S.S. CRITTENDEN (APA 77)



LONGITUDINAL PROFILE
18'-6" OFF ℄ , PORT

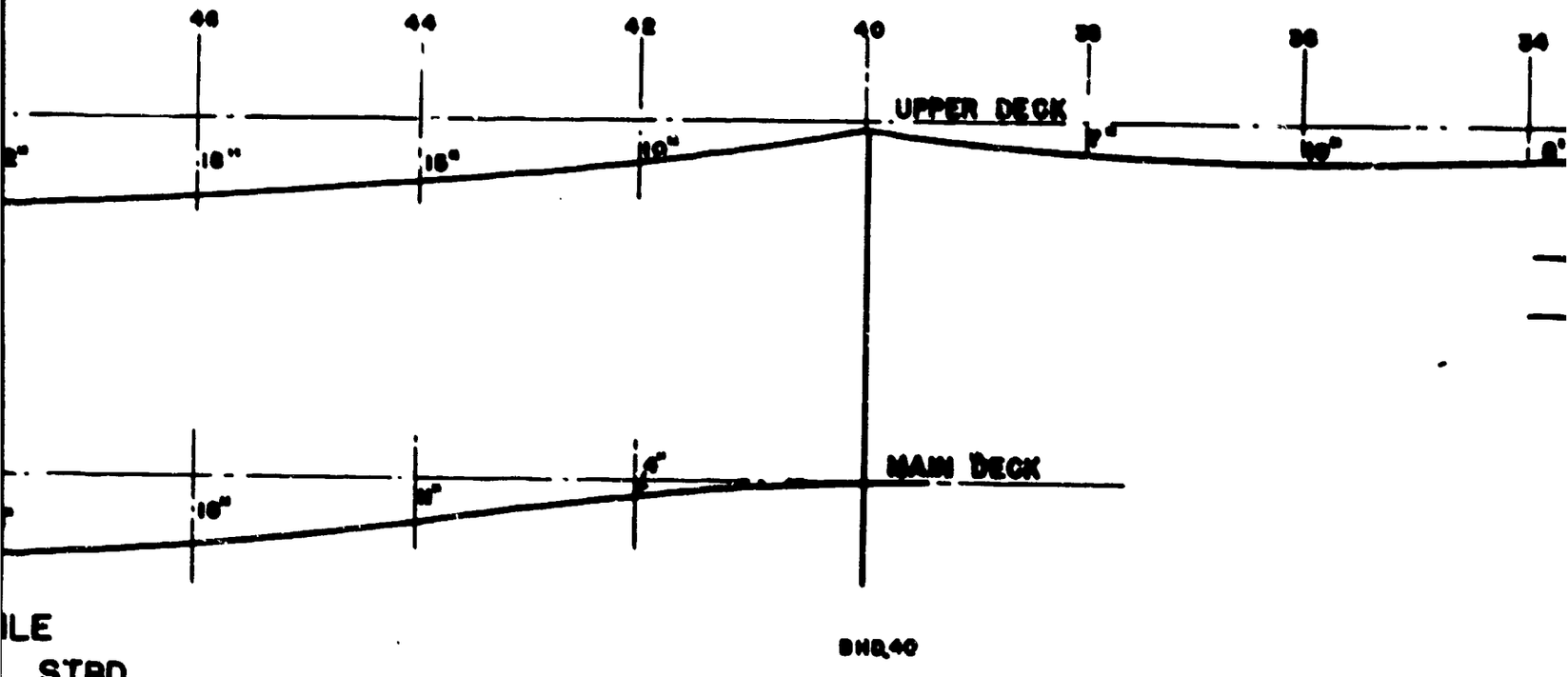


LONGITUDINAL PROFILE
18'-6" OFF ℄ , STBD.



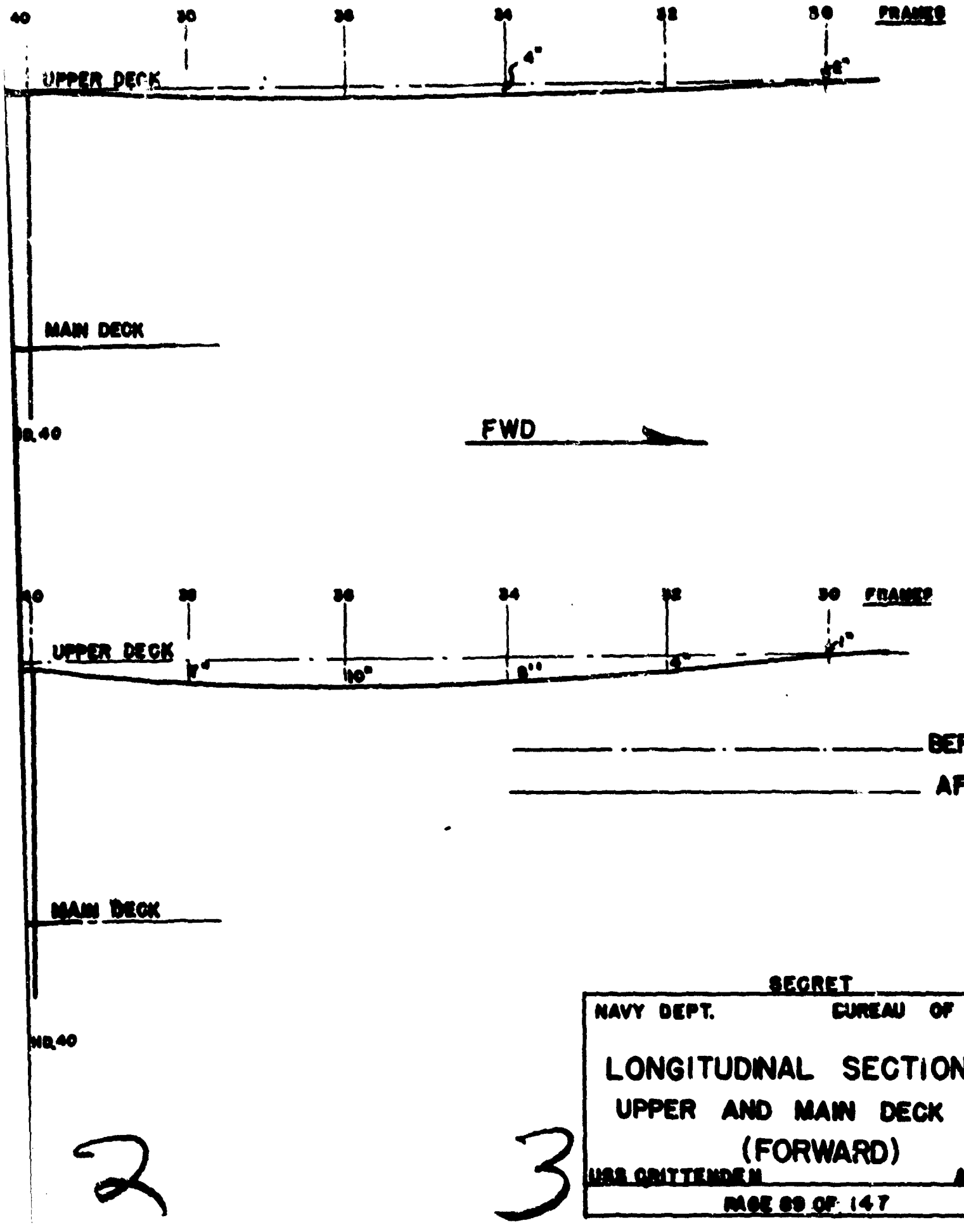
FILE
RT

FWD



ILE
STBD.

2



SECRET

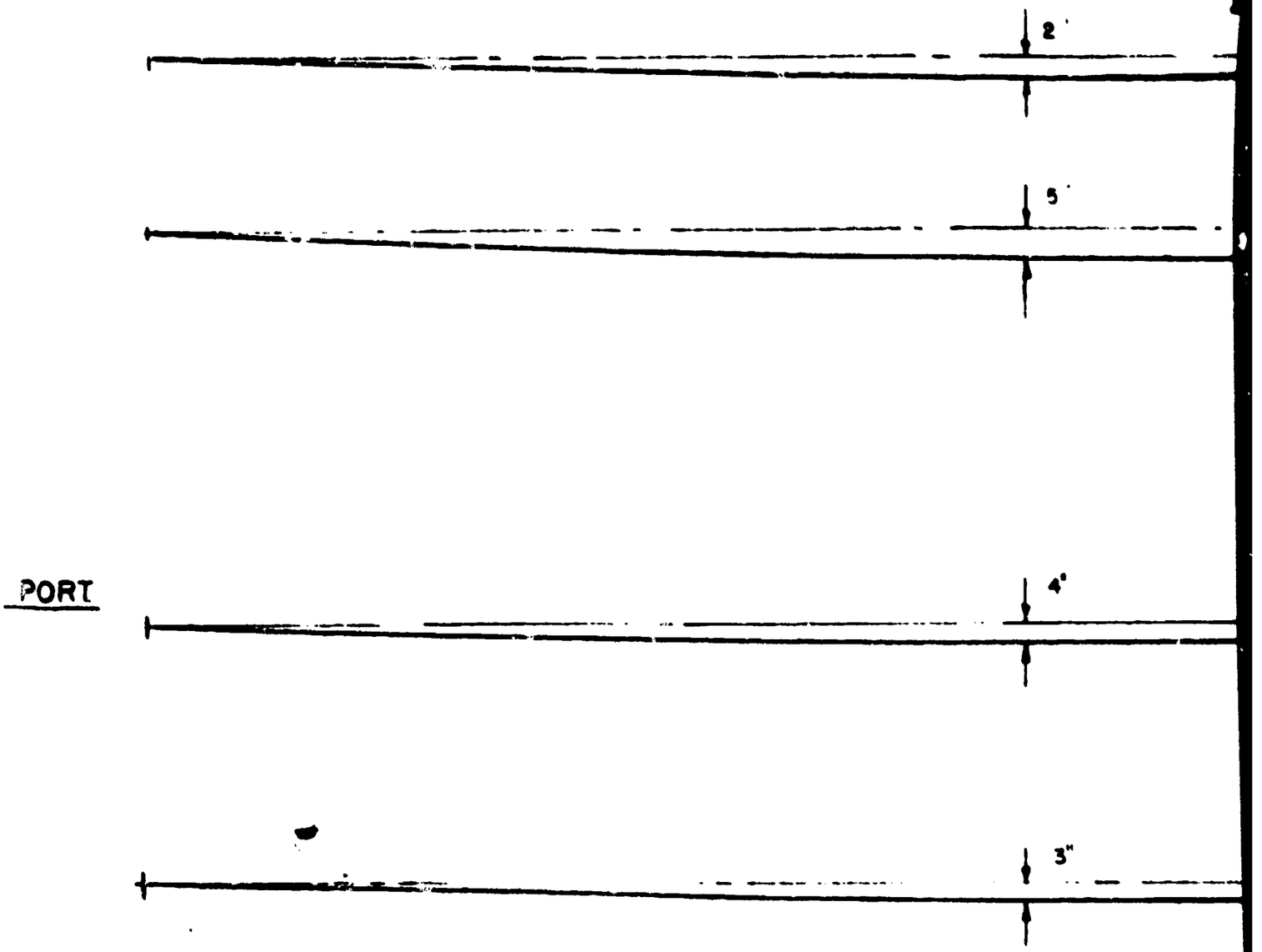
NAVY DEPT. BUREAU OF SHIPS

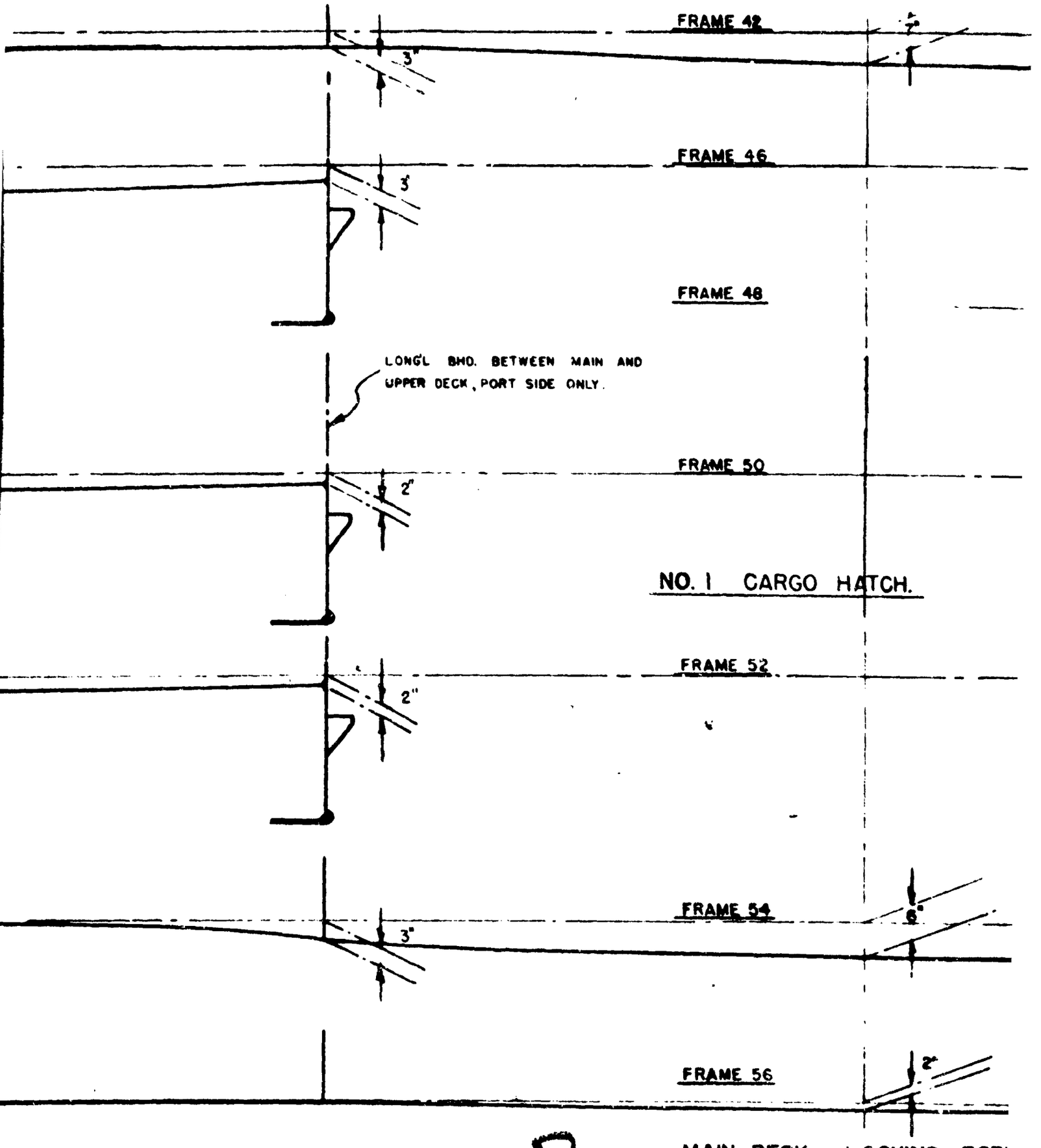
LONGITUDINAL SECTIONS
UPPER AND MAIN DECK
(FORWARD)

USS CHITTENDEN APA (77)

PAGE 69 OF 147 SSW

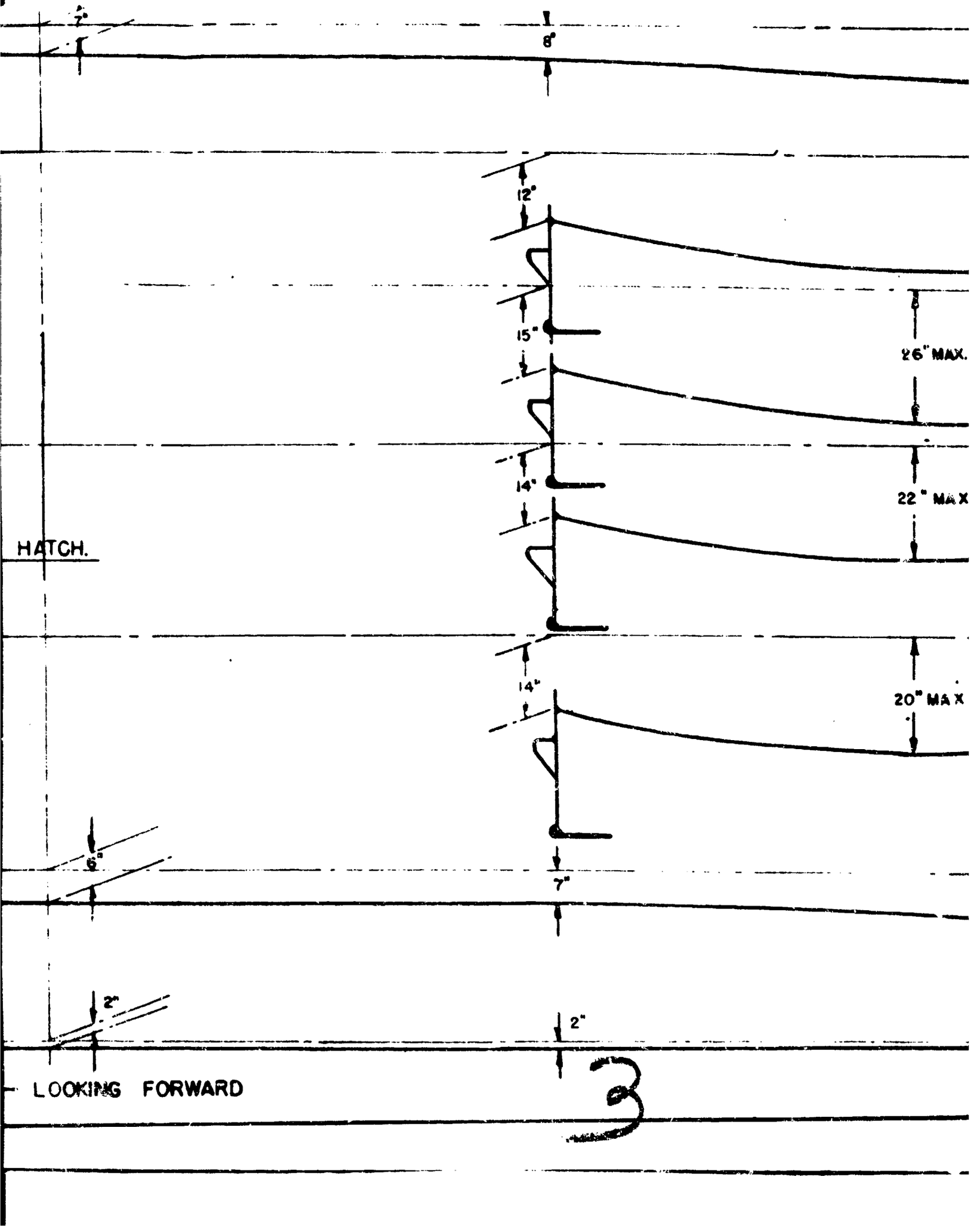
2 3

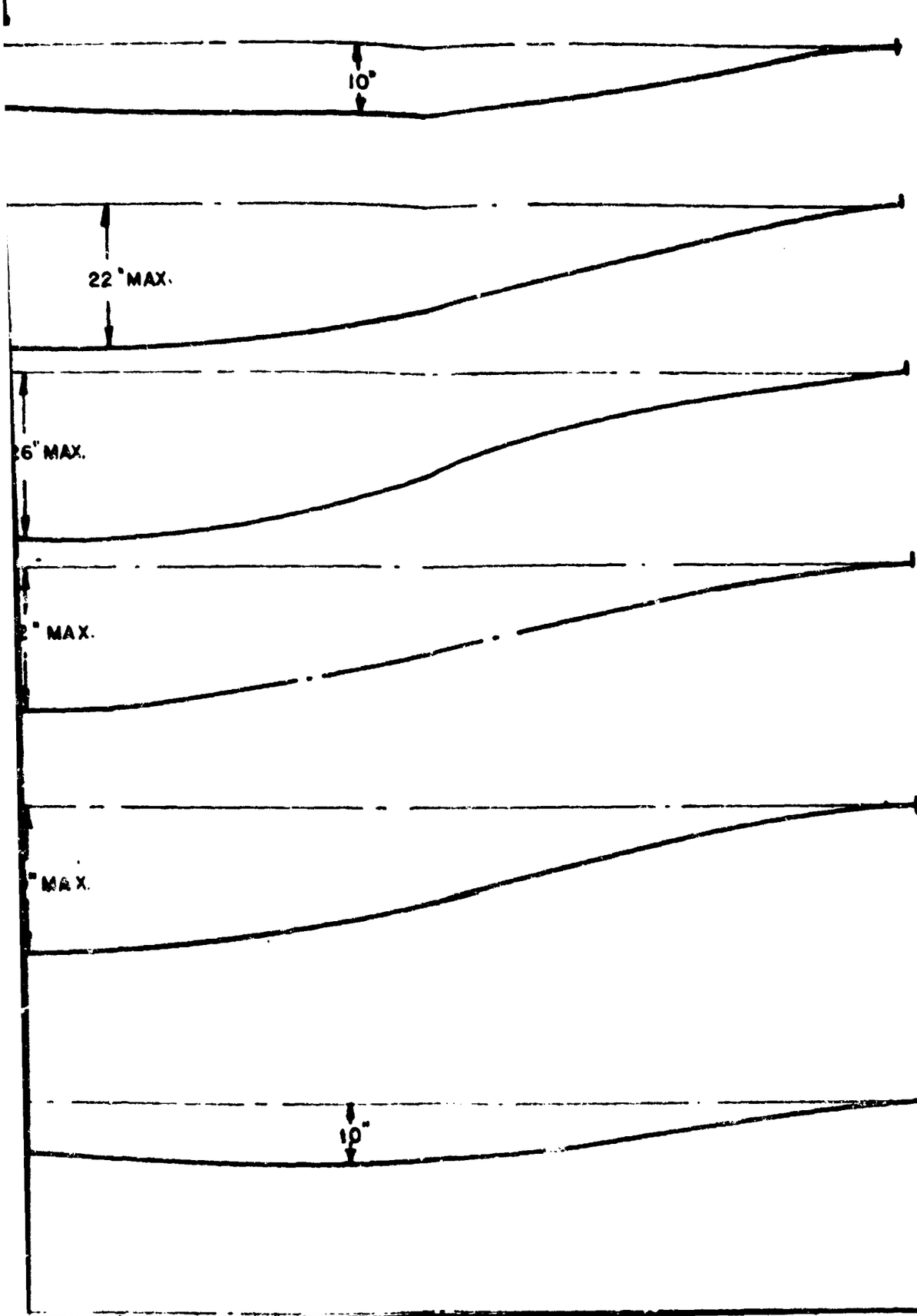

2'
5'
PORT
4'
3"



2

MAIN DECK— LOOKING FOR


2"
8"
12"
15"
26" MAX.
14"
22" MAX
HATCH.
14"
20" MAX
6"
7"
2"
2"
LOOKING FORWARD
3

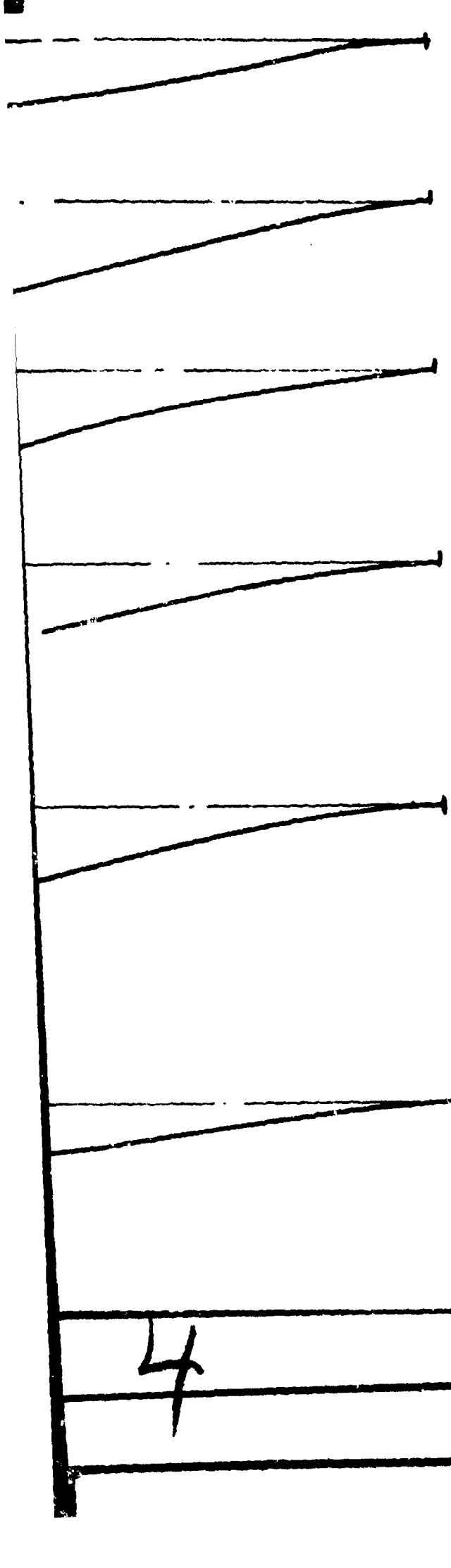


STBD.

NAVY DEPT.

TRAN
MAIN

USS CRITTI



SECRET

NAVY DEPT. BUREAU OF SHIPS

TRANSVERSE SECTIONS
MAIN DECK, FORWARD
TEST A

USS CRITTENDEN (APA 77)

DECK DEFLECTION GAGES

SHIP USS CRITTENDEN (APA 77) TEST A

LOCATION			MAXIMUM	MAXIMUM	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄	COMP.	EXP.	DISTANCE	EXP. / COMP.	
22 1/2	MAIN	℄	0—0—2	NONE	NONE	NONE	NONE
48	"	PORT 9'0"	0—1—6	0—0—4	0—0—12	COMP.	REMOVED TO WHARTON FOR INSPECTION
48	"	STBD 9'0"	NONE	0—5—4	0—5—4	EXP	TUBLER PIPE BENT BEYOND REPAIR UNABLE TO READ
48	"	PORT 21'0"	1—4—20	0—0—6	1—0—4	COMP.	"
48	"	STBD 21'0"	2—0—0	0—3—6	0—3—6	EXP.	"
129	"	℄	0—1—16	0—0—8	0—1—0	COMP	NONE
							ONLY GAGE ON FR. 22 1/2 & FR. 129 IN SHAPE FOR TEST BAKER

NOTE: READING ARE IN FEET, INCHES AND THIRTY—SECONDS OF AN INCH.

APPENDIX

COMMANDING OFFICERS REPORT

TEST ABLE

REPORT # 11

COMMANDING OFFICERS REPORT

PART A - GENERAL SUMMARY

I. Target Condition After Test.

(a) Draft forward 9 - 6 Draft aft 17- 6 List: None
General areas flooding - none.

(b) Structural damage.

Superstructure: Both topmasts bent backward and slightly to starboard, at point just below crow's nest. The forward topmast is bent 80 degrees, the after topmast 110 degrees. The forward side of the mast is broken at each bend. All radar gear, navigational lights, electrical circuits, radio antennas, and phone circuits on both masts broken, carried away, or damaged beyond repair. Forward stay has broken and carried away from foremast, leaving only two stays on each side of mast.

Booms secured to the masts are bent and distorted beyond repair or safe use. All rigging and ground tackle strained, broken, distorted, or otherwise damaged beyond repair. Replacement would be necessary if the ship were to operate.

Davits are bent or distorted beyond safe use except the forward starboard davit is now in operation. Wire on this davit requires renewal.

Smokestacks are badly dished in and distorted in various sections; guys and stays carried away. #2 stack is in worse condition with part of inside stack severed and closed off by the outside shell plating. On the forward (#1) stack the signal mast with antennas, siren diaphragm, and 24" searchlights have been demolished. Whistle has been repaired and is operable.

Liferafts carried away overboard or flung about upper deck of ship. Less than half the original 46 rafts remain in useful condition; remainder lost overboard.

Cargo hatches are distorted at coamings, which are bent outboard. This permitted all hatch covers and pontoons to fall down on gear below, seriously damaging one plane in after hold and electrical test equipment in forward hold. Only one hinged pontoon and I beam remained at #2 hatch, in position.

Watertight doors, ports, and hatches about the ship are generally distorted, except the battle ports. Doors and hatches topside are dished in, dogs bent, or frames distorted. Crowbars was necessary to open many outside doors. Airplane on starboard side #2 was damaged beyond repair. Both planes jetisoned.

Bulkheads topside are all dished in at varying degrees. Principally around doors, and on forcs'le. Forward topside structures suffered most damage particularly at frame 59. This latter bulkhead was dished in toward aft to about 18". The bulkhead was broken in several locations, notably in the pilot house where a welded seam was split open vertically for about six feet with about three inches split. Bulkheads below decks and inside the upper superstructure were only slightly damaged. The most serious damage being around number one and two cargo hatches where sheathing, furniture, bunks, and lockers were thrown around and in many cases blocking the passageways.

Decking topside was pushed downward by the pressure, buckling supporting I beams, and distorting piping. Here again most the damage was suffered around number one hatch with a slight amount aft around #2. No breaks were observed in the decks although several places seemed to have experienced considerable movement up and down.

Hull above the water line appears to be in good condition. Inside inspection has todate revealed no damage to the interior of the hull. The results of the pressure can be observed on the outside hull at frames 10 - 20 portside between the upper and main decks. There are dents in the starboard bow at frames 40 - 45 but a close examination indicates that these must have been caused by tugs of the boarding parties. The inside plating and frames are also distorted by these outside dents. No leaks in the hull can be found as a result of the test.

Ventilators as a whole received little damage. The ventilation system in #1 and #2 holds received the ost damage and is out of operation. The ventilation system throughout the rest of the ship is operable.

(c) Operability.

In general all machinery on the ship is operable except deck winch #6 which has bent shaft, and davit winches #2, 3, and 4. Gasoline hoist in number 2 hold is out of order.

Electrical equipment is operating and satisfactory except the davits and winches noted above, and the circuits to the both masts.

Ship control equipment is satisfactory except as noted under Navigation.

Fire control equipment is satisfactory except those few items listed in the detail part of the report.

Gunnery equipment is operating satisfactorily except the alignment of the guns and minor detailed deflections listed in the more specific damage section of this report.

Electronics equipment is operating satisfactorily except for the fathometer, and the radar. Radar on both mast and and connections thereto were demolished. CIC equipment is being tested and so far appears operable provided it had the complete equipment to fill out the set.

Navigation equipment for conning the ship was little damaged. The following gear remains: One standard compass, one steering repeater in pilot house, one on bridge, and one topside on signal bridge. The stand on the outside of the bridge is so bent that the accuracy of the bearings might be questioned, but rough checks indicate it is not out more than a degree. Gyro error obtained and checks.

(d) Heat.

No excessive heat was recorded. Traces of excess heat (which was apparently very short duration) was noted on the side of the ship towards the blast, the masts, and certain forward parts of the superstructure that were exposed direct-to the rays. This is covered more in detail under Part II. The maximum and minimum thermometers outside the magazines showed no change in their normal readings, except the after magazines which, due to no ventilation slightly exceeded their normal readings. This was the result of the sun heat.

Fires; no trace of any fire could be observed.

Personnel casualties - none.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Effects of heat were noticed, starting at the waterline to the top of both masts. The effects became progressively worse as their altitude increased. At the ships bow very little heat effect was observed below the hawsepipes. Commencing with the upper deck, paint was blistered and removed in spots. This ranged from a very slight area on the starboard bow to an increasing area around to port. The entire port side showed signs of a change in color of the paint. The numerals (white) on the bow were obliterated by burned paint and soot, and the frame numbers (yellow) were similarly eliminated. The heat blast appeared to have struck the ship at the water line from an angle of about 20 degrees on the port bow, and expanded rapidly as it rose to the upper decks. The starboard side of the ship was clear of heat evidence except for the unshielded small amount on the bow, and a part of the forward bridge structure at bulkhead 59. There was no evidence of heat inside the ship.

Significant behavior of equipment; no manila lines, cables, wires, canvas or other equipment appeared to have burned. A small amount of manila left exposed on the forecastle seemed to have changed color a little but no trace of burning could be found; merely

a darker color. Fire hoses were also darkened. Some fire hoses (exposed) were badly frayed as if they had whipped up and down in their brackets. Also some were blown off at their connection to the fire plug. The metal connection remained but the hose was gone, as if torn lose. The most appreciable results of any heat were observed on the forward side of the foremast and the bridge superstructure forward. Equipment on those locations showed the same amount of heat effect.

(b) Fires and explosions.

None.

(c & d) Shock and pressure.

It is difficult to determine whether most of the damage received was actually the result of shock or pressure. My own opinion is that pressure was the predominant cause, and any results of shock might have been due to fracture or sudden distortion to other structure. Exposed instruments such as those on the forward bulkhead of the pilot house, were not seriously damaged. The glass on one instrument was broken due to distortion of its face, but all instruments are operating. The heavy glass ports were fractured and held in place by their battle ports, but even the light glass in the forward part of the ship were undamaged except by structural causes when something hit them, flying debris, etc. The 24" searchlight that was blown off the forward stack was a result of blast effect. Both searchlights on #1 stack were demolished. The general direction of the blast or pressure appeared to be from the port bow. There seemed to be, however, a distinct difference between what appeared to be instantaneous blast or pressure, and a more steady pressure that was exerted on the outside structure. As an example, the port searchlight was blown 50 feet through the air, but a chair in the Captains cabin which is many times lighter than the searchlight, but protected from the blast, was squeezed so quickly by the closing of the corner of the bulkhead that the chair was not moved more than an inch. The original estimate that the blast and heat must have been about 45 degrees on the port bow has been revised. It is believed that it must have been about 25 degrees on the port bow and that the ship swung around by the blast, presented more of its port side to

the remainder of the explosion. It appears quite significant that the superstructure of the ship was fractured in several places, mostly at frame 59, in the bridge structure. Maximum damage occurred between frame 35 to 59. Very few fractures were observed elsewhere. This same section of the bridge, bulkhead 59, experienced irregular tearing of the forward metal shield on both wings of the bridge. The metal was ripped down its vertical depth to the deck and the shield itself almost flattened out to the deck, almost horizontally. At this location the tact and seam welding (apparently machine work) held better than the metal itself. At a few places electric fans and similar objects fell off the bulkheads. Lockers and bunks were knocked loose, magazine sprinkler control boxes damaged, and some medical first aid lockers damaged. This might have been due to either blast or shock but the shock results were far in the minority.

(e) Effects apparently peculiar to the Atom Bomb.

The most noteworthy observation to make was the seeming lack of concussion effect. No electric light globes could be found inoperative except those damaged as described above. Light bulbs two feet from bulkhead 59 were undamaged. Two raw eggs on the wardroom pantry shelf were undamaged, but the electric fan right above them was knocked off the bulkhead. Whereever the ship was well closed up, the effect of the bomb was minimized. Glass ware was undamaged except where it received the full force of the blast such as the glass ports in the pilot house.

The boilers and engines are undamaged. The bricks in the incinerator were knocked loose and the incinerator is out of order. Pressure generated by the explosion appeared to exert a downward and sidewise force simultaneously, which increased in intensity as it rose but decreased in intensity as it expanded towards the stern of the ship. When shielded by another piece of structure, the result of the explosion was greatly lessened. As an example; the forward part of number 1 stack was moderately damaged, being protected by the 03 structure, but #2 stack was severely damagedits entire height, where it had no protection from the blast. Low heavy objects (like deck winches) did not seem to suffer. A cargo net hanging over the port side was demolished whereas the same type and in th same place on the starboard side was undamaged and is still in use.

All topside watertight doors show about the same pressure effects on the same levels. Although the starboard side was the protected side, the doors on that side were damaged as much, if not more than those on the port side. The two heavy doors to the starboard side of the wardroom were blown off their hinges. Similarly two WT doors on the main deck aft, starboard side, were blown off their hinges also. The two heavy doors to the carpenter shop, port side aft, received the same damage. It was quite evident that whereever structural strength was lacking (such as around doors and hatches) the material suffered severe damage. Boat gripes (wire wrapped with canvas) were themselves wrapped around their davit strongbacks several times. Ladders were twisted once or even twice, around themselves; that is, the lighter ladders like the one on #2 stack, etc. Canvas covers, and tarpaulins were ripped and torn beyond repair. This gave the effect of damage received from a typhoon. A hollow piece of pipe about 3" in diameter, was observed to be bent 180 degrees by the blast and then another turn of about 150 degrees almost back on itself. There was no other object near it that could have caused the same degree of distortion. The force of the blast was sudden and swift; the pressure almost equally so.

III. Results of the Test on the Target.

(a) Effect on propulsion and ship control.

Effect on propulsion and ship control was negligible. The ship got underway twice after the explosion, to shift berths and was able to use own engines without difficulty. Necessary navigational aids were the only equipment missing. Secondary control station midships has a few instruments damaged, such as the compass, repeater, and telegraph to pilot house, which was caused by the falling searchlight from #1 stack. The amount of boiler power might be reduced by part of the uptake in #2 stack being closed off, but that could be easily corrected. At present, with minor structural repairs, the ship would experience no difficulty in steaming both of its engine rooms and equipment.

(b) Effect on gunnery and fire control.

Guns are operative except for minor damage caused locally, as listed in the detailed damage report. Except for misalign-

ment they could be operated with little difficulty. Magazines and ammunition are undamaged except for the bulkheads and doors of the clipping rooms which are dished in like all other topside doors and bulkheads. Test bombs were knocked out of their location on the focsle, but were undamaged. Test ammunition, including rockets, were undamaged. Fire control equipment is all operative except as noted above, plus certain phones and connections blown overboard or otherwise damaged beyond use by debris or structural effect. Three of the four legs supporting the after director tower were pulled loose from the deck. Circuits to the fore and maintops were demolished. Smoke generators on the after deck house were damaged beyond repair.

(c) Effect on watertight integrity and stability.

Watertight integrity of the hull has not been effected. On and above the main deck, however, the watertight integrity has been seriously affected. All doors, hatches, and openings topside require repairs to make them watertight; particularly Nos. 1 and 2 holds. For test B as many as possible of these places will be shored up to prevent a large accumulation of water from breaking through. Most of the battle ports appear to be satisfactory and can close sufficiently tight to prevent flooding. Some ports on the main deck, inboard were blown out, but the overhang of the ship should assist these somewhat. Holes in bulkhead 59 will have to be welded closed. In rough weather the ship would not be safe for operation in its present condition, as it would be subject to progressive flooding. Once flooded its stability would be affected. With no boats on board the stability would be improved, but the masts and stacks must be reguyed, and sections cut off, to prevent their falling over and affecting the stability. Loose and damaged davits on the port side should be removed as a serious of rolls would break them loose with disastrous effects. Considerable weight was removed from #1 and 2 hatches when it was necessary to jetison the damaged pontoons and hatch covers. The test electrical equipment in number 1 hold still furnishes a little ballast. The ship at present has 100% ammunition and fuel. As the fuel is used up the stability will naturally be more sensitive at sea. The cargo booms will require more secure fastenings because the old brackets supporting them have been broken and all running gear is inoperative. With their present damage it would

be better to jetison the booms if it were not desired to take any chances with their carrying away and affecting the stability. Separate recommendations are being submitted, if it is desired to sail the ship back to a shipyard, in order to make it seaworthy with a minimum amount of work.

(d) Effect on personnel and habitability.

With the present low personnel allowance, and the excess troop passenger spaces available, the destruction of lockers and bunks has not seriously affected the habitability, although it has inconvenienced the personnel. All living spaces (except one compartment outboard of #2 hold) had to be abandoned around #1 and 2 holds. For normal peace time allowance of personnel, and as a passenger carrier, the habitability of the ship would not be satisfactory without replacement of lockers and bunks, and structural repairs. The use of cots is possible in emergency but they are not a satisfactory substitute for bunks on this type of ship due to its roll and pitch. The sanitary system is now working but for two days after return to the ship trouble was experienced with the flushing system due to separation of pipes at the flanges, etc. The same thing occurred to the fire main. After cutting out certain sections and blanking off the flanges, habitability was eventually established two days after reboarding. An additional feature that had to be considered in this climate was the icebox situation. Considerable trouble had been experienced with the ice boxes since departure from Pearl. Whether any damage to them resulted from the A test is questionable, but the situation was worse on the return to the ship because the whole plant had not been operated for four days. The tender is now attempting to rectify the trouble. Pending work completion on the ice box, supplies were obtained in small quantities from the evacuation ship BEXAR.

The effect the bomb would have on personnel is purely conjecture. Based on an observation as to what it did to equipment, etc., it is safe to guess that personnel casualties would have been heavy, especially those topside or exposed. Persons inside the ship would possibly escape danger, except from flying debris. Those exposed would experience several types of damage; blown overboard,

burned, or struck by debris, etc., for it would seem that when life rafts can be knocked around the topsides and blown overboard, human being would experience similar fate unless protected by superstructure. Personnel on the fantail might survive without damage, even though the flagstaff was bent downwards about 30 degrees. Food and water were found not to be contaminated.

(e) Effect on fighting efficiency.

It is estimated that the fighting efficiency of the ship would have been reduced as follows; (note that this does not include radiological effects. These would add to the loss.).

50% of the armament would require immediate repairs. although minor repairs, they would require man power.

50% of the personnel topside would be serious casualties. 20% more would suffer casualties around the interior of the ship and in exposed places shielded from the bomb blast.

25% maneuverability of the ship would be lost. Maximum speed would be limited to ten knots instead of sixteen. It is believed further that if boats had been carried on board all of them would have been damaged beyond ready availability. Possibly one or two might have survived serious damage. This opinion is based on what happened to the davits. As far as fullfilling its mission as an Attack Transport, it is considered that the ship would be useless except as a hotel until its rigging, booms, hatches, and davits were cleared of debris and rigged ready for safe operation. This would also require satisfactory jury rigged antennas, halyards, rigging, etc. With a wartime allowance repairs might be satisfactorily accomplished within three days; one day being required to clear the ship of debris in order to get through passageways, etc. Another day to restore living conditions such as plumbing, fresh water, fire main, etc., and a third day to clean up. From the radiological viewpoint additional days might be required. This is a most important feature when it is realized that this ship remained hot for four days before it could be boarded. Rain washed down the decks and the radiological material collected in practically every wrinkle in the decks. This required washing down frequently to clear the decks.

IV. General Summary of Observers Impressions and Conclusions.

The CRITTENDEN at the time of the test, was anchored in berth 159 BIKINI with 105 fathoms of chain to the port anchor and 45 fathoms of chain to the starboard anchor with a tight moor. The GILLIAM was 400 yards on the starboard or port bow (depending on on the wind) and the CARLISLE was on the starboard beam when the wind was from 085 true. Distance to the CARLISLE was also about 400 yards. From comparison of damage to nearby ships it must be assumed that the bomb hit within 700 yards of the ship in the direction of the GILLIAM. If the ship was headed about 110, which seemed to be true wind that date, then the bomb dropped about 30 degrees on the port bow. The mission of the ship as result of the A test has been nullified as an attack transport until repairs can be effected, especially to booms, davits, and hatches, including the winches operating with same.

V. Preliminary General or Specific Recommendations.

This part can be briefly divided into personnel and material.

(a) Personnel.

Those topside that are required for ship control, gunnery and deck operations must be reduced to a minimum number. All exposed personnel must try to keep themselves shielded by bulkheads or heavy machinery when warned of an attack. If debris can be avoided a position prone on the deck should be the best defense against being swept off one's feet. Protective clothing should be worn to avoid receiving the radiological dust that appears to settle over the ship. Ports and all air openings practicable should be closed, similar to a gas attack. The safety precautions laid down for tests A and B appear to be a good guide for personnel expecting atomic bomb attack.

(b) Material.

It is recommended that the topmasts (foremast and mainmast) be designed with reduced heights for this type of ship. If the radar equipment were to be placed where the booms end when

secured in an upright position, it is believed that sufficient results will be obtained by the radar.

Stays and Guys held up well except for one or two. Those that did carry away did so at the turnbuckle threaded bolts. This indicates that stronger bolts would have held. No fracture of wires or cables was observed.

Life Rafts broke loose from their holding down clamps or bridles and ended up all over the ship or overboard. A wider(and metal) band or strap would have held up much better and would not have cut into the life rafts themselves.

Topside parts, especially the superstructure of the ship must be streamlined. Eliminate square corners where possible. It is particularly noticeable that no gun tubs received damage except one. Eliminate breaks in the superstructure of the ship. Join up sections where possible. As an example, the forward deck structure on the focsle of this ship had all four bulkheads pressed in (Spud locker). The next deck structure aft also had all bulkheads pushed inward. It was difficult to force open the door to the clipping room. If these two structures had been joined there would have been two less bulkheads damaged, besides according a stronger structure.

Deck and bulkhead plating should be thicker. Where 3/16" is used it should be increased to 1/4" and where 1/4" is used it should be increased to 5/16". These ships are extremely light anyway, too much so for their mission; a few extra pounds of heavier sheet plating would improve their condition all around.

Piping: Use less rigid connections at the flanges; particularly for flushing water and the fire main. If necessary use the same system for suspension of piping as is used for the steam line in the engine rooms.

Davits are weak and easily distorted. Any single one or combination of the following suggestions could be used: Use of hinges to lower the davits down flat in order that they will not be subjected to the blast. Build davits into the streamlining of the ship. Use hydraulic system for raising and lowering davits out of the skin of the ship.

Do away with davits and substitute cranes two aft and two forward, so they can plomb the two cargo hatches and at the same time handle the boats. This would do away with the present boat booms and davits which now require considerable rigging and work and which were damaged badly during the attack.

Door frames; were exceptionally weak for the attack, and should be strengthened.

Canvas covers; remove all covers before an attack as they become very radio active. Use metal coverings over canvas hoses. Use stronger metal boxes over magazine sprinkling system.

SECTION III

PART C - INSPECTION REPORT

SECTION A - HULL

A. General Description of Hull Damage.

(a) Overall condition of vessel.

Fair; the hull appears to be seaworthy, the superstructure, masts and stacks are not seaworthy. The tops of the cargo holds are not seaworthy for rough weather. The engineering plant is satisfactory. The ship can operate in normal weather conditions.

(b) General areas of hull damage.

None except a few dents on starboard side between frames 20 and 45, just below the upper deck beading. Other damage to the hull is not noticeable.

(c) Apparent causes of hull damage.

A very slight showing of the frame work on the port side forward might indicate a small pressure effect from the blast. The indentations on the starboard side between frames 20 and 45 might have been caused by the boarding party tugs, or by the pressure exerted on the port bow by the blast. There are indications that it might be due to both.

(d) Principal areas of flooding.

None.

(e) Residual strength, etc.

No apparent change. It will be difficult to determine this until the ship encounters rough weather.

B. Superstructure (exclusive of gun mounts).

(a) Description of damage (giving important dimensions).

1. Bridge area: entire forward bulkhead (frame 59) pushed aft, except at deck, about 18" beginning at the 02 deck for a distance of 2' at the 02 deck. The worse section is the forward part of the pilot house; here the plating at the welded seam just to the right of the ship's centerline is ruptured vertically for a distance of 6' and about 3" wide. Both wings of the bridge structure on the 02 and 03 decks have their forward plates ripped vertically downward to the deck and are forced aft and horizontal to the deck. Gyro repeater stands on both wings of the navigating bridge were badly distorted and off their centerline. The repeaters themselves were blown overboard. The sounding machine on the wing of the 02 deck was knocked down and demolished (portside of ship). Cargo lights located on the forward part of bulkhead 59 were demolished. All except one glass port in the pilot house were demolished or damaged beyond repair. All instruments on the inside of the pilot house and on the forward bulkhead were, however, undamaged and the clock was still running on arrival of the first boarding team ABLE. The fathometer was out of order. There was no way to determine if the remote PPI scope was operative, due to damaged masts. The fathometer was later repaired by ship's force so it could be used in an emergency. Electric lights on the overhead were undamaged. Also on the wings of the bridge superstructure the stanchions supporting the 20mm guns on the 03 deck, and the stanchions supporting the 02 deck were severed. Temporary makeshift stanchions have been installed as an emergency measure to prevent the wings of the 03 deck from dropping. All doors and bulkheads around the bridge superstructure have been dished in or distorted depending upon the amount they were exposed to the blast. Both doors to the pilot house cannot be closed without forcing shut. The lower port ladder aft of the bridge structure is undamaged. The ladder from the 01 to the 02 deck was blown down. The ladder from the 02 to the 03 deck was loosened. Temporary emergency cabin (constructed out of sheet metal) blown overboard (portside). Port forward corner of Captain's cabin on 01 deck broken and fractured; exposed to outside of weather conditions. Captain's pantry badly damaged as

well as equipment therein. Forward part of Division Commander's cabin also damaged, but not as much as other side. Bulkhead 59 on 03 deck pushed in and backwards. Splinter shield in front of Fire Control station is fractured at centerline. Both signal flag bags demolished and blown overboard. CIC room undamaged. Chart house undamaged. Radio room suffered only one antenna switch casualty. Switch was knocked off overhead.

2. Amidship Deckhouse and Stacks: No severe damage was suffered by the amidship section of the superstructure, except the usual dishing in of the doors and bulkheads. This also applies to the Radio direction finder shack. Overhead of the midship section above compartment B-0309M is badly distorted by the downward pressure. Frame 88 bulkhead is particularly pushed in, leaving door badly jammed to clipping room. The port after lookout tub forward side has been pushed in. Rails (hand) around 03 deck are badly bent. The following special damage to the midship control station was noted: Compass binnacle dismounted by blast and falling searchlight (from #2 stack). Rudder steering indicator damaged beyond repair. Course steering indicator satisfactory. Engine order telegraph seems satisfactory. Gyro repeater stand and repeater damaged and may be repaired if required.

Stacks: Both badly damaged; #2 stack is the worse damaged. #1 smokestack forward part is pushed in about 1' for about a height of 10 vertical feet at about 4' above deck, the metal in forward part of stack is fractured for about 6". Port side of stack under searchlight platform is pushed inward about 1'. Searchlight (port) is blown off platform and demolished light landed about 50' farther aft at midship control station. After part of stack (streamlined part), is squeezed together until two lower blower vents are almost together. Starboard searchlight is still on its platform, but demolished; its reflector landed on forecastle. Signal mast and yardarms bent backward 90 degrees and resting on top of stack. Damaged beyond repair. Halyards and radio antennae demolished. #1 stack still has two guys supporting it, but stack would fall if ship rolled. Inside of stack not badly damaged. Whistle still operates but siren diaphram broken. Forward stack casing opened at welded seams just above boiler in #1 Engine Room. Ship's force rewelded on reboarding ship in order that boiler could be steamed. Top of smoke-

stack not damaged, #2 smokestack, forward part, is pushed back in and aft about 5', and fractured across the bottom of stack. Various fractures also occurred in the welded seams joining stack and deck 03, superstructure. Entire stack leans aft and to starboard, being held up at present by two guys. After section (streamlined part) of stack is squeezed together similar to #1 stack. Stack badly distorted in all sections. Inside part of stack is exposed to weather, with part of outside shell severing the inside uptake. Galley uptake (charley noble) severed at 03 deck and exhausts, with main uptake, into incinerator room. Incinerator bricks broken and incinerator out of order. Ladder on port side of #2 stack twisted around itself once and bent beyond repair. If subjected to the rolling of the ship, #2 stack would carry away. It is believed that boiler power of #2 boiler might be affected unless stack obstruction is removed. At present boiler can be used for auxiliary purposes.

3. After deck house: Forward bulkhead is pushed in about 1' and badly fractured and distorted, particularly at forward port corner. 40mm gun director tub tower port side, is severed from three of its forward supporting legs, and pushed over and aft about 30 degrees. Decking on after deckhouse is bent and dented in a few places, from the blast but nothing of particular note. Ready boxes, spare 40mm gun barrel boxes, and other light sheet metal objects are all dented inward from pressure. Screen speed light shield knocked off light but light itself undamaged. Smoke generators damaged beyond use, unless rebuilt. All radio antennas and insulators broken. Radio 3 however, is undamaged. All connections with mainmast are down. Large doors to carpenter shop (portside) in after deckhouse, are blown off. Other doors and bulkheads affected similar to rest of ship but on a diminished scale. Empty oil drums in stowage are all caved in.

(b) Causes of Damage in each area: These can be subdivided into the following important headings.

1. Blast: Instantaneous damage such as caused holes to be torn in the sheathings, bulkheads, etc., to rip canvas, and blow a searchlight fifty feet from its position. This effect was very noticable on exposed objects without adequate protection around them.

2. Pressure; a rapid sidewise and downward force exerted on the ship topside, and increasing in its effect with altitude. Subsequently a bending or distortion of other parts of the ship resulted from the transmission of the pressure through intermediary points, such as piping, bulkheads, beams, etc.

3. Debris; flying objects which struck other objects and parts of the ship causing damage to those parts, or to the flying objects themselves.

4. Heat; effects were very light and not generally noticeable except on the forward part of the masts' and sides of the ship, as well as part of the superstructure, where it blistered paint, left shaddows, or otherwise left its mark. Some of the plastic name plates over doors were melted where exposed to the direct rays of heat; others were undamaged.

5. Radioactivity; Geiger counter showed that the worse effects were on the topside of the ship where the particles of radioactive matter settled in dips, hollows, and breakers in the plating. The ship was considered to "hot" to reboard for 4 days after the test. When boarding was finally accomplished, it was necessary to wash away all spots where the water had drained and collected, leaving later a dried residue of radioactive matter. It was two days before these places lost their "hot" characteristics; ie: 6 July. Where holes were blown in the superstructure, and in #1 and 2 cargo holds, radioactive matter entered the inside of the ship. This was a very negligible quantity, however.

(c) Evidence of fire.

None.

(d) Estimate of relative effectiveness against heat and blast,of:

1. Various plating thicknesses: Light sheet metal (particularly inside sheathing) was damaged severely. Heavier metal such as 1/4" plating, was damaged only by blast when the plating was exposed to the burst or pressure. Also if the plating constituted a flat surface it suffered more than when in a spherical or circular shape. One exception were the life line stanchions, jackstaff, flagstaff, and signal mast which were all bent by the explosion in spite of

the little surface they presented. The thicker the metal the better it withstood the blast.

2. Various shaped surfaces; Round surfaces escaped major damage. Gun and lookout tubs were in general undamaged. Only one lookout tube suffered damage, the metal sides being pushed in. This was on the 03 superstructure and near #2 stack where the worse effect of the blast appeared to be felt. Flat surfaces invariably suffered result of both pressure and blast whether exposed or not.

3. STS compared with MS: Assuming the gun tub splinter proof metal is specially treated steel, and that lookout tubs are mild steel, it can be stated that STS steel is superior to the MS steel under atomic pressures and blasts. No damage occurred to the various splinter shielding.

4. Aluminum materials; only two of these were observed damaged. These were the top right angle mirror holder sections of the smoke periscopes in the engine rooms. Both fractured at the aluminum welded joints. Considering their state of protection in the spaces, it would appear that aluminum welds would not be satisfactory as withstanding atomic blasts.

(e) Constructive criticism of superstructure design or construction; including important fittings and equipment;

It was noted generally that frames around doors, hatches, and the athwartships bulkheads, the topmasts, and the stacks, all of which suffered the most damages, would require reenforcing if it is desired to withstand the effects of the blasts. Whereever a fore and aft frame support was used the bulkhead forward of that support seemed to withstand the pressure or shock. This was especially true at bulkhead 59 topside where the greatest pressure was exerted and that bulkhead there were no fractures or serious distortions where the bulkhead was strengthened by a fore and aft stiffener. Exposed fittings were generally unsatisfactory if of weak construction. One example was the bracket which held the wing (STS) metal shields on the 20mm guns and used for the protection of the gunner. The shields withstood the blast but the bracket weakened and bent, when

pressure was exerted on the shields. This bent one shield back (which would have killed the gunner) and temporarily made the gun inoperative. A considerable number of brackets on bulkheads were rusted and promptly carried away as a result of the blast. The desire to keep down topside weights is recognized, but the atomic bomb will mean that more thought and care must be put into stronger and more durable metals.

C. Turrets, Guns, and Directors.

(a) Protected mounts.

1. General condition, including operability; gun protection for personnel on this ship consists of splinter proof shields or gun tubs. The 40 and 20mm guns or mounts were not damaged except the 20mm gun mentioned above. When the ship was "stripped" at Terminal Island Naval Shipyard, the forward port and after starboard 40mm guns were removed. Also all 20mm guns were removed except one on each corner of the 03 superstructure. All these guns will operate if necessary, and have not been damaged sufficiently to preventtheir use. The actual firing of the guns can not be tested of course until an opportunity is offered, but with the exception of their alignment no difficulty is anticipated. Gun sights require checking.

2. Effectiveness of installed turrets or shields; the splinter protecting shields or gun tubs resisted all damage except as otherwise noted above. It is considered that the present installations are satisfactory except for minor alterations as will be proposed later in this report.

(b) Unprotected mounts; the 5''/38 AA gun is the only unprotected gun on the ship.

1. General conditions including operability; the 5'' AA gun was partly shielded from the blast, due to the gun's position close to the after deckhouse superstructure which partly shielded it. The gun accordingly received no damage. Canvas in the vicinity, however, was ripped to pieces. The flagstaff aft of the gun was bent 30 degrees lower than its previous position. To all intent and purposes and without any opportunity to test the firing of same, it is considered that this gun will operat satisfactorily at the present time.

2. Effectiveness and sufficiency of crew shelters; these are considered insufficient for the atomic bomb attack. Gun crews particularly must have better protection from blast and radiological materials, or mater. Other persons can run for shelter when warned of an air attack which migh mean an atomic or other type of bombing. If the gun crews are to remain on their stations, modification in our present protective devices is required.

(c) Rangefinders and directors.

1. General condition and operability; as a result of the test it is believed that the directors are satisfactory except in alignment and that the rangefinders are operable. The following minor defects exist: Mk14 mod 8 sights require adjusting and overhaul by a firecontrolman. The director tub (40mm) for gun #44, is out of alignment and hence so is director. The test blast knocked the tub stands off 3 of their supports close to the deck with the result that the tower is leaning aft from the vertical about 25 degrees. Battery for the rangefinder was torn loose.

2. Condition of instruments; same as above.

(d) Constructive criticism of design or construction of mounts, directors, foundations, etc.

As mentioned above, their appears to be a decided need for more protection to exposed personnel, and improved mechanical devices to secure parts to mounts, etc. The side shields splinter protection) on the 20mm guns should be rounded off instead of being flatwings. The 40mm and 5" guns should have STS splinter shields of spherical (or at least some curved surface) surfaces. It is not considered that a splinter proof tub around the 5" gun is practicable, nor is it necessary. A turret mount might help, but this gun is so well protected by the after superstructure that it is not believed advisable to add more unnecessary weight. More emphasis must be placed on a better welding adhesion for brackets and legs supporting tubs or other objects to prevent their being severed by the atomic blast. If a light strong splinter proof metal can be produced, it is considered that such a metal or plating would be highly desirable

to install around the gun, either in a dome arangement, turret type, or merely a surface so curved as to minimize the effects of the blast. It must be remembered that with the atomic bomb the danger from shell fire, bombs or shrapnel is far less than radiological effects or blast of the atomic bomb.

D. Torpedo Mounts - Depth Charges Gear.

None.

E. Weather Deck.

(a) General conditions of deck - causes of damage.

The most severely damaged weather decking was that forward of frame 59, particularly that section on both sides of the focsle between frames 33 and 59. This deck has been pushed downward about 18" with the maximum dent at about frame 55. The following damage on the focsle, although not to the decking, will illustrate the force of the blast and pressure to which the decking was subjected. Jackstaff bent aft 45 degrees, metal speciman and forward anchor light bracket blown clear of ship. Lookout chair in bow, demolished. Forward guy to foremast (jackstay) carried away at bolt into turnbuckle. Paint was blasted off the blast tower, forward side of foremast, and other exposed higher surfaces on the focsle. Small 5 gallon test tin and 55 gallon test drums were collapsed. Hawse pipe covers blown clear of ship. Life buoys and rafts scattered about the focsle and over the side. Most damage to rafts was caused by canvas straps carrying away and broken gratings with loss of emergency gear; paddles broken, etc. Dent in topside of anchor windlass control bos. Windlass operates. Ladder on forward side of spud locker bent to starboard. Sound telephone on bulkhead ripped out of box. Swab rack aft of blast tower, split a little but usable. Life raft grating just behind swab rack suffered worse damage with broken grating. Top of hatch to forward fire pump room dished in. Door and gratings (metal) blown off after side of spud locker. Metal box inside was crushed. Locker itself has all bulkheads pushed in from pressure. The after-section of shield around 40mm tub port side was scorched inside the tub. Top of hatch to paint locker trunk dished in.

Door 01-27-1 jammed inward. Forward bulkhead to 40mm clipping room also dished in. One foamite can on bulkhead #27 knocked off rack and demolished. Door to A-0102 (companionway) dished in and name plate over door burned off. Door just forward of this was blown off hinges. Fire hose at cut-out I-27-2 (fire station 01-29-2) blown off at plug. Spare piece of hose was scorched beyond safe use. Hose holden bent. Ventilator cover 01-32-2 dished in. After ladder port side forward deckhouse (from forecastle to top of house) bent aft. Metal rack on bulkhead for helmet stowage, crushed together. After holding down straps on both paravanes carried away, but paravanes remained bolted to deck and were undamaged. Spare 40mm gun barrel metal boxes were bent inward on all sides. Port life line stanchions bent aft and inboard. Two guys or stays to foremast still remained on each side. Port boat boom broken loose from securing bracket. Steam tight globe broken but inside electric light bulb still intact. Starboard boom appears satisfactory except where hit by tug. Army portable announcing equipment stowed on 03 deck, was blown down on to the forecastle, (1 box only). #1 and #2 hatch coaming badly distorted, bent outwards. Test bombs located port and starboard sides at frames 45 and 40 respectively, were undamaged except torn loose from securing padeyes. Fins on bombs slight bent from rolling around deck. Holding down bolts on starboard forward deck winch sheared off at base due to depression made in deck. Both boat skids #1 hatch damaged. Starboard one was blown out on deck. Port ventilation frame 55 (pl-55-2) was sheared off at deck, leaving hole into #1 hold compartment. Starboard ventilator undamaged except where holding down bolts loosened. Troop ammunition hold hatch cover to trunk A-405M was blown in and ended up in bottom of trunk. Similar action had happened to all hatch covers and pontoons to the cargo hatches. All other weather decks sustained only minor damage. #2 hatch and the topside superstructure of the 03 deck are the main exceptions, particularly above B-0309M. The chief cause of damage to the decks was principally the pressure, and partly as a result of the transmission of stresses through frames, etc.

(b) Usability of decks in damaged condition.

They are usable; however, the forecastle deck and top of B-0309 are considered to be the most hazardous for rough weather because the structures and their deformations have not been tested subject to normal sea conditions.

(d) Condition of equipment and fittings.

1. Mooring and towing fittings; Satisfactory.

2. Boats and boat handling; unsatisfactory. Only one davit is operable (starboard forward davit), and its durability is questioned until a satisfactory test can be conducted. Falls will require overhaul. Two boats could be carried at this davit if to much operation is not required. Other davits and boat booms are not operable. The starboard after davit might be made operable with minor repairs to electrical apparatus and safety test made on davit. The starboard davits would require considerable overhaul with crane services. They are distorted and the after one has collapsed and fallen out of its tracks. It is supported by the superstructure bulkhead at present, and blocks the passageway along the 02 deck port side. One boat which was carried on the evacuation ship still remained operable. All other boats were turned into the boat pool BIKINI.

3. Airplane handling gear, etc.; only boat booms used on this type ship and they are not operable.

4. Barriers, arresting gear, etc.; does not apply.

F. Exterior Hull (above water line).

(a) Condition of exterior hull plating and causes of damage; as described in preceding items, the hull exterior appears to be in good condition. The only damage that could be ascertained was a trace of pressure indication on the port side where faint outlines of the ship's frames and strakes may be observed. This can only be observed under close scrutiny. On the starboard side there are two separate indentions, one of which appears to have been the result of boarding tugs coming alongside, and the other which might be from the same causes or from the result of the bow of theship being forced to starboard. I am inclined to favor the tug causes because there are no other indications to show that this damage is a result of the test. Both indentations are between frames 20 and 45, and along the main deck strake, although the damage is vertical.

(b) Condition of exterior hull fittings.

None observed.

(c) Details of any impairment or sheer strakes.

None observed.

(d) Condition of side armor belt.

Does not apply to this ship.

G. Interior Compartments (above water line or armor deck).

(a) Damage to structures and causes.

The primary damage resulted around #1 and 2 hatches. Other miscellaneous damage was of minor nature and is detailed as follows in later sections of this report. The damage to the hatch coamings was indirectly responsible for much more interior damage than would normally have been expected. When the downward pressure was exerted on the cargo hatches, it was strong enough to double in two of the hatch covers. These gave way and their weight, plus the instantaneous pressure on the decking, forced the hatch coamings to bulge and this in turn permitted the hatch pontoons below them, to fall to the bottom of the hatches. In number 1 hatch the debris damaged the test electrical equipment installed at PEARL. In number 2 hatch the airplane was demolished. The distortion of the main deck around these two hatches damaged considerable amount of sheathing and miscellaneous equipment. The dropping of the hatch and pontoon covers left the compartments adjacent to them wide open and exposed to the blast of the bomb. Accordingly more damage resulted inside the ship than would have been the case if the ship had remained closed up. The same remarks apply to the troop ammunition hatch just aft #1 hold.

(b) Damage to bulkheads (joiner) and causes.

Very few places were observed with this type of damage. Most of it was distorted metal due to transmission of the stresses through some other medium.

(c) Details of damage to access closures and fittings.

This damage has been described in general throughout this report, but certain details are being added. All watertight doors exposed to the blast were pushed inward and all those on the exposed part of 01, 02, and 03 decks had their frames so distorted that it was impossible to open the doors without the use of a sledge hammer, crowbar, or beam. None of the doors when once opened could be closed. Two doors remained closed. Ventilation damage will be covered later. Escape hatches were similarly treated as for the watertight doors.

(d) Condition of equipment within the compartments.

Equipment was damaged whereever it was subjected to unrestricted pressures. Lightweight sheathing around #1 and 2 hatches was bent, fractured, separated and otherwise distorted. Likewise the lockers, bunk stanchions, magazine sprinkler boxes, first aid boxes, and furniture. Most of the damage was done by the movement of the decks and bulkheads, the remainder by debris. The two large doors on the starboard side of the wardroom were hurled into the wardroom and cut off one of the tables as well as banging up the furniture pretty generally. Even office equipment in the damaged parts received its share of damage. The ship's offices suffered considerable damage but not enough to prevent their use. However, here like in other places, the damage was received where closures had been opened by the explosion, this seemed to let in the blast of air that did the damage.

(e) Evidence of fire.

None.

(f) Damage in way of piping, cables, ventilation ducts, etc.

On first boarding the ship it was observed that several pipe connections had been broken. As soon as pressure was placed on the fire main and flushing system, a considerable amount of water started leaking at various connections. Flanges were tightened with a little success but several large ones could not be

repaired. In such cases the particular section was blanked off or by-passed. Eventually the only section that was cut out was on the starboard side of #1 hold where the fire main had been forced apart due to distortion of the overhead. At present the system operates satisfactorily at anchor but it is doubtful as to how much vibration it would stand at sea.

Electric cables were in general, undamaged. Cables running up the foremast and mainmast were the only ones damaged severely. Others had a few loose connections as a result of equipment being displaced etc. A detailed report of these will be found under the electrical section.

Ventilation ducts as a whole acted very satisfactorily. The ducts around #1 and 2 holds were the only portion of the system that were badly damaged. The most severely damaged part of the system occurred on the main deck port side at frame 56 where the entire blower trunk and vent duct was blasted wide open. On both sides of the hatch the ducts were knocked down and no ventilation operates on that section of the deck. Topside on the upper deck, the same vent trunk was struck hard enough to knock out its bolts to the decking but sufficient number held to keep the trunk upright. On the other side of the deck the trunk was blown overboard. At present the ventilation system is adequate for present operations. Although distorted, the system around #2 hold is operable.

(g) Estimate of reduction in watertight division, utility, etc.

None estimated at present.

H. Armor Decks.

Not applicable for this type of ship.

I. Interior Compartments (below water line).

(a) Damage to superstructure and causes.

Not applicable to compartments below water line.

(b) Damage to joiner bulkheads and causes.

None.

(c) Details of damage to access closures and causes.

None.

(d) Condition of Equipment within compartments.

Satisfactory, except as noted in other subheads.

(e) Flooding.

None.

(f) Damage in way of piping, cables, and vent ducts.

None below water line.

(g) Estimate of reduction in watertight subdivision and utility of spaces.

No change.

J. Underwater Hull.

(a) Interior inspection of underwater hull.

Results satisfactory.

(b) Effect of damage on buoyancy, operability, maneuverability, etc.

None observed and none considered likely.

(c) Any known or suspected damage to:

1. Shafts and propellers. None.

2. Struts. None.

3. Rudder. None.

4. External keel. None.

(d) Details of impairment of keel structure.

None observed.

K. Tanks.

(a) Condition of tanks in areas of damage.

None observed and none believed damaged.

(b) Contamination of tanks and liquids.

1. Extent and cause if known. None.

2. Effect on ship's operability. None.

(c) Damage (known or suspected) to torpedo defense system.

None.

L. Flooding.

(a) Description of major flooding areas.

None.

(b) Sources of flooding.

1. Opened boundaries. None.

2. Damage or poorly designed system, such as access closures or fittings, ventilation ducts, piping, wiring, etc. None.

(c) List of compartments believed to have flooded slowly so as to be susceptible to damage control.

None.

M. Ventilation (exclusive of blowers).

(a) Damage to ventilation system and causes.

1. Ducts. It is noteworthy that no damage occurred to ventilation ducts anywhere in the ship except near the cargo hatches where the system was exposed to the blast by the opened hatches. Even though doors to the blower rooms were dished in, and hatches and doors to compartments similarly affected throughout the ship were likewise under pressure, no part of the system was affected in these sections of the ship. In the spaces around number 1 hold the ducts that were protected with lagging suffered the least damage and could have been used again had not the unlagged sections been badly distorted or demolished by falling debris. The only ducts that were exposed to the outside blast and damaged, were those vents on the focsle aft frame 55 and the one on the main deck outboard and aft of the garbage grinder compartment. The latter can be reassembled when time permits. The vent on the port side of the focsle can be welded when the bolts carried away, but the ducts in the compartment below are demolished. The vent on the starboard side of the focsle at frame 55 was blown overboard and left only the opening in the deck. Its counterpart in the compartment below was also destroyed. Vents (particularly vertical ones) exposed topside should be secured better at the deck.

2. Closures. the same comment as above as above applies to the closures.

3. Effect on habitability. The only effects were those around #1 cargo hold. In confined atmosphere, such as rough weather in the tropics, the lack of ventilation in that area would be noticeable. At present its effect is negligible.

(b) Evidences that ventilation system conducted heat blast, fire, or smoke below decks.

None could be observed.

(c) Evidence that ventilation system allowed progressive flooding. None.

(d) Constructive criticsm of design and construction of system.

Vents and trunks exposed to the outside explosions should be secured by better means to the hull or deck or bulkheads. Ducts through compartments should be lagged as well as possible, everywhere, and not secured to too many places that might be subject to distortion or pressure.

N. Ship Control.

(a) Damage to ship control stations and causes.

1. Bridge area.

Although the forward bulkhead of the bridge structure was badly damaged, it seems remarkable that the instruments suffered so little. Two days after rehabilitation, all ship control instruments were tested and the ship actually turned over its screws with all hands stationed at their underway stations, and no difficulty with ship control was experienced. No repairs were necessary to accomplish this. The only ship control instruments, in the bridge area that were damaged were the two gyro repeaters in the ends of the bridge wings. Both stands of these instruments were knocked off the centerline and the repeater connections and repeaters damaged beyond repair. Above the bridge on the 03 deck, the single repeater at the fire control station remained operative even though it was near a bulkhead that was split by the force of the blast.

2. CIC room.

No damage was observed; radar however was inoperative due to connections with masts being severed.

3. Gyro-Compass.

No damage; and is operative.

4. Steering gear.

No damage; and is operative.

5. Interior communications.

Satisfactory for ship control.

(b) Constructive criticism of the ship control system.

1. Layout and arrangement.

Considered satisfactory, except as in comments below.

2. Location with respect to protection.

It will be noted that the comments above applied to the bridge area only. As regards the midship secondary control station on top the superstructure of the 03 deck, it is considered that this station should have more protection. This is not recommended so much for protection of personnel as for both personnel and equipment. It is difficult to determine what damage resulted to this station directly from the explosion because the 24" searchlight landed in the middle of it. From a close analysis it seems that more damage was caused by the searchlight as all instruments were demolished except two. It is therefore recommended that a small weight splinter proof shield be installed around this equipment so as not to block the conning view, but sufficient to protect both personnel and equipment from direct blast and pressure effects. The smoke stacks provide some protection except from the beam. This control station at present is inoperative. The control station on the after deck house is still operative as it was protected by the smoke pot stowage and other shields around that area, such as gun tubs, etc. It seems unusual that the after station was not affected when the smoke generators just a few feet aft were piled up in one corner and damaged beyond use. No additional protection is considered necessary for the after station.

O. Fire Control.

(a) Damage to fire control stations and causes.

1. Directors and elevated control stations.

The fire control station on top of the bridge structure was not badly damaged, and is almost 100% operative except that there is no way at present to determine if the severance of the connection with the fore and main tops is having any effect on communications with the other stations. Due to all the connection boxes etc., being on the forward bulkhead which was split by the blast, a few repairs were necessary, but nothing of a serious nature.

2. Plot rooms and protected spaces.

Not applicable.

(b) List of stations having insufficient protection and estimated effect on fighting efficiency of the loss of each.

The fire control station on this ship is only slightly protected by bulkhead 59. If this station is eliminated there is no other suitable station available to operate, as control personnel at this post would suffer severe casualties unless more protection is provided from blast and radioactivity.

(c) Constructive criticism of location and arrangement of stations.

The location is considered to be in the best available spot, particularly from the AA control viewpoint. However the present station could be greatly improved by the addition of a parabolic or similar type (invertedaft) metal shield installed in sections around the control station and on top of the present shield so as to provide protection to the entire human body, and still retain the clear visual overhead and surrounding view. The curve of the additional protection could be fitted in with the streamlining recommended for topside superstructures.

P. Ammunition Behavior. Note: This ship carries 100% ammunition.

(a) Ready service ammunition, location, protection, behavior, and heat and blast effect.

1. Main battery.

Not applicable.

2. Secondary battery, 5''/38 AA.

No damage to ready service boxes or ammunition. One s.p. sample broken in 5'' powder box.

3. 40mm, 20mm, and other.

40mm (gun 41) ammunition in rack around inside of gun tub was shaken up a little. One cartridge knocked out of holding down clips on rack, and was lying flat on its side in same rack. Canvas cover torn off. A few other cartridges knocked loose from clips but did not change position. This gun was forward on the starboard side and partly shielded from the blast. 40mm (gun 44) starboard side aft; ammunition undamaged and not moved. Canvas cover torn off tub.

20mm ammunition in ready boxes undamaged. Canvas protective covers torn off all boxes. Boxes dished in a little from pressure. No other caliber guns are installed.

(b) Magazines, location, protection, forces involved, behavior.

1. Main battery powder and projectiles.

Not applicable.

2. Secondary battery.

5'' AA in c-305-306M. One 5'' projectile on deck in C-305M where it had fallen. Powder cans in C-306 were

shaken up but had not fallen out of racks. No damage to ammunition.

3. 40mm; 20mm; others; doors of 40mm magazines.

A-0101M clipping room had door forced in and jammed and thermometer broken. Ammunition not damaged or disturbed. Likewise there was no damage in A404M, C-0104M, C-302M. 20mm magazines; both doors jammed on B-0309M clipping room. Forward bulkhead was dished in aft thus displacing ammunition cans on back side thereof. No damage to ammunition. Sprinkler system damaged due to distortion of overhead. One 20mm magazine fallen to flooring of deck. No damage to C-0104M (clipping room), or C-302M small arms ammunition stowage.

(c) List of stowages which are insufficiently protected and efforts on ship survival of explosion of each stowage.

None.

(d) Behavior of gasoline stowage facilities.

Satisfactory.

Q. Ammunition Handling.

(a) Condition and operability of ammunition handling devices.

1. Main battery hoists.

Not applicable.

2. Secondary battery hoists.

5'' hoist operable and no damage.

3. Passing scuttles.

Operable in all magazines.

4. Bomb and torpedo elevators.

Not applicable.

(b) Evidences that any ammunition handling devices contributed to passing of heat, fire, blast or flooding water.

None.

(c) Constructive criticism of design and construction of ammunition handling devices.

None considered necessary or desirable as all such devices work satisfactorily.

R. Strength.

(a) Permanent hog or sag.

1. Hull evidence.

None visible to the naked eye. It is possible that the engineers who made the original measurements may have found either or both after the test.

2. Superstructure expansion joints, etc.

Only one observed was the one on top of the 03 superstructure deck, amidships. This is not a true expansion joint but illustrated the amount the deck moved fore and aft, about six inches.

3. Local evidences of longitudinal stresses.

Traces were evident in the deck plating around #1 hatch particularly. Also the paint on the pontoons in the hatches, and the beams that fell into the hatches showed the stress marks in the painted surfaces. These were photographed by the various boarding members of DSM.

(b) Shear strains in hull plating.

None observed.

(c) Evidences of transverse or racking strains.

None observed except for the possibility of the indentations on the starboard bow at frame 30 to 45 being caused by same.

(d) Details of any local failures in way of structural discontinuities.

It is difficult to determine which failures were caused by which causes. As an example; was the failure of the smoke stacks due to structural failure of the stack, or was the failure a simultaneous one caused by the blast. Actually no failure of materials could be definitely traced to structural failures.

(e) Evidence of panel deflection under blast.

None observed.

(f) Turret, machinery and gun foundations.

No turrets, machinery and gun foundations unaffected, according to available measurements. See engineering report for additional information.

S. Miscellaneous.

(a) Evidence of heat damage variations under various colors of camoflouge painting.

Oil based paint appeared to be burned off more than any other. White enamel held up satisfactorily. It was only necessary to wipe off the soot and the painted bow numerals (for which this paint was used) were as good as new.

Paint with a plain white base used for numerals on frames, was burned off. This was also used on the draft numerals. Anchor black with an asphalt base appeared to the naked eye as if the heat of the blast had melted some of the tar base. The yellow zinc chromate was burned off. Red iron oxide, and ship's own mixed redlead held up well when used as paint. The parts of the deck on which these were used, lost the top bluegray deck paint from the heat, leaving only the red iron oxide and redlead underneath. On the superstructure the heat left shadows on the paint where the areas were shielded. Description of the loss of paint on the masts, etc., was described in the first part of this report.

(b) Other miscellaneous effects or conditions noted during inspection.

As a matter of record it should be reported that three canvas tarpaulins were used on each of number 1 and 2 cargo hatches for the test. These tarps were securely fastened in three thicknesses in the usual manner over the hatch covers. The reboarding parties found these covers torn in small pieces lying at the bottom of the hatches and mixed in with the debris.

Boat gripes and safety lines were found wrapped around the davit strongbacks. Metal jacobs ladders left over the side of the ship had been whipped to pieces as well as any ropes or lines that were left hanging and exposed.

Wire that remained wrapped with canvas or otherwise covered during the test was in good condition later. Exposed wire, however, such as boat falls etc., seemed to have all the grease extracted from the wire by the heat. The same appeared to be true of any exposed manila rope, which looked dried out.

SECTION B - MACHINERY

A. General Description of Machinery Damage.

(a) Overall condition.

Satisfactory; no specific damage observed.

(b) Areas of major damage.

None.

(c) Primary causes of damage in each area of major damage.

None.

(d) Effect of target test on overall operation of machinery plant.

None.

B. Boilers.

No damage.

C. Blowers.

No damage.

D. Fuel Oil Equipment.

No damage.

E. Boiler Feedwater Equipment.

No damage.

F. Main Turbines.

No damage.

G. Reduction Gears. Note: None on main turbines of this vessel. The following data is for turbo generator sets.

No damage.

H. Shafting and Bearings.

No damage.

I. Lubrication System.

No damage.

J. Condensers and Air Ejectors.

No damage.

K. Pumps.

No damage.

L. Aulliary Generators, (Turbine and Gears).

No damage.

M. Propellers.

Topside inspection only, available. Propellers appear satisfactory and undamaged.

N. Distilling Plant.

No damage.

O. Refrigeration Plant.

No damage.

P. Winches, Windlasses, and Capstan.

(a) Foundations and Bodplates.

No damage except to those of number 1 cargo winch, forward. This winch has all but four bolts missing, sheered off by the deck being distorted underneath the winch. The latter is therefore inoperative.

(b) Motors.

No damage.

(c) Brakes and brake lining.

No damage.

(d) Gearing.

No damage.

(e) Hydraulic systems.

None.

(f) Drums, bearings and shafting.

Number 5 cargo winch has bent shaft on capstan. Boat winches 2, 3, 4, can not be tested due to condition of davits and falls.

(g) Fittings, wildcats, valves, etc.

In general all fittings etc., appear to be intact except the controller box of #3 boat davit which was blown off bulkhead.

Q. Steering Engine.

No damage.

R. Elevators, Ammunition Hoists, Etc.

(a) Machinery foundations.

No damage.

(b) Motors and gearing.

No damage except to package gasoline hoist. This motor is not operating. Time and personnel shortage has not yet permitted a thorough check to determine the difficulty. No outward evidence of damage exists, and it may be electrical trouble.

(c) Hydraulic systems.

No damage.

(d) Guide rails, dredger chains, etc.

No damage.

(e) Elevator platforms.

No damage.

(f) Brakes and brake lining.

No damage.

(g) Control systems and follow-up gear.

No damage.

(h) Miscellaneous.

Hoist in B-03-9M sprinkling system is distorted so that hatch cannot be opened all the way.

S. Ventilation (Machinery).

(a) Fans and motors.

Damage to only one as covered below.

(b) Foundations and mountings.

Fan and motor at frame 58 port side was damaged by blast. Foundation was distorted on exhaust blower, and sheathing around blower ripped off. Ducts torn down and system is inoperative.

(c) Heaters.

No damage observed although no test has been available.

(d) Miscellaneous.

No observed damage to valves and thermostats, or other connections.

T. Air Compressors.

No damage.

U. Diesels (Generators, and Boats).

No damage.

V. Piping.

(a) Main steam.

No damage.

(b) Auxiliary steam.

No damage.

(c) Auxiliary exhaust.

No damage.

(d) Condensate and feedwater.

No damage.

(e) Fuel and feedwater.

No damage.

(f) Lub oil.

No damage.

(g) Firemain, sprinkling and water curtains.

No damage in Engineering spaces; No sprinkling or water curtain system is in the Engineering spaces. Water curtain control damaged in compartment #1 hatch port side, bulkhead 58 as covered in first part of report.

(h) Condenser circulating water.

No damage.

(i) Drain.

No damage.

(j) Compressed air.

No damage.

(k) Hydraulic.

No damage.

(l) Gasoline.

No damage and none on board.

(m) Other systems.

Diesel oil not damaged.

W. Miscellaneous.

(a) Machinery not included in the above groups.

1. Uptakes: Upon reboarding, #1 uptake in the engine room was found to have fractured at the welded seams around the horizontal part where the vertical section rises from the boiler. This damage was definitely caused by the blast. The seam was rewelded and the boiler lighted off satisfactorily.

2. Smoke periscopes: damaged by the blast as covered in the section under aluminum.

SECTION C - ELECTRICAL

A. General Description of Electrical Damage.

(a) Overall condition.

Generally very satisfactory, with not much damage, except as noted below.

(b) Areas of major damage.

Superstucture decks, masts and holds.

(c) Primary causes of damage in each area of major damage.

Combined pressure and blast. Minor damage was caused by distortion of connections as a result of the blast and pressure.

(d) Operability of the electric plant.

Ship service generator plant: No. 1 ships service generator lost its residual magnetism; reason unknown. It required 24 volts to reestablish same.

Engine and boiler auxiliaries: No damage.

Electrical propulsion: No damage.

Communications: generally satisfactory; minor damages received. One bull horn on port side at bridge, blown overboard. Both 24" searchlights demolished. One 12" searchlight blown over the side.

Fire control circuits: No damage except to those originally secured to the masts. These have been domolished.

Ventilation: One panel and motor damaged at frame 58 main deck, port side by #1 hold. Set inoperative.

Lighting: In general undamaged, Navigation light circuits and fixtures damaged on masts. #2 cargo hold lighting system ruptured at branch box frame 110 main deck, starboard side.

(c) Types of Equipment most affected.

Switchboards and switch gear: No damage.

Rotating machinery: No damage.

Motor controllers: Only one damaged was #3 Welin Davit control panel. This was found lying on the main deck port side, near original bulkhead position. Supply cable had been jerked out but otherwise the control panel appears operable. See #6 under subheading (d).

Cables and supports: A few were broken on each mast. One cable ruptured between control panel and #2 welin davit. Cable in area #2 hold ruptured.

B. Electric Propulsion Rotating Equipment (Propulsion Motors, Generator, Submarine Auxiliary Generators, Exciters, Motor Gen. Sets).

No damage.

C. Electric Propulsion Control Equipment (Propulsion Control Cublicles, Transfer Switch Panels, Controllers, For. Motor Gen. Sets).

No damage.

D. Generators - Ships Service.

No damage.

E. Generators - Emergency.

No damage.

F. Switchboards - Distribution and Transfer Panels (Ships Service, Emergency, Battery Charging, Lighting and Test Switchboards, Power and Lighting Distribution Panels, Submarine Torpedo Heating and Hydrogen Burning Panels: Transfer Panels, Degaussing Panels:

No damage.

G. Wiring, Wiring Equipment, and Wireways.

No damage.

H. Transformers (Lighting and I.C.).

No damage.

I. Submarine Propelling Batteries.

Not applicable.

J. Portable Batteries.

No damage.

K. Motors, Motor Generator sets, and Motor Controllers (Motor and Controllers For Engine Room Auxiliaries, Steering Gear, Deck Auxiliaries, Air Condition, Refrigeration, Ventilation, Distilling Equipment Motor Generator Sets For Lighting: Welding Degaussing Battery Charging, Interior Communications Etc.

(a) Rotating Equipment.

Framework and mounting: Mounting for ventilation motor distorted at frame 58 main deck port side.

Commitator or ship rings: Does not apply.

Brushes and brush rigging: Does not apply.

Bearings: No damage.

Speed regulators: Does not apply.

(b) Control equipment.

Framework and mounting: Mounting for #3 welin davit broken at bolts, and panel cover is slightly distorted. Mounting for ventilation motor controller and cover distorted.

Electrical connections and wiring: No comment.

Contactors switches and relays: No damage.

Rheostats and resistors: No damage.

Insulating materials: No damage.

Pilot circuit devices: No damage.

Brakes: No damage.

L. Lighting Equipment.

(a) Lamps (Rough service high impact and fluorescent lights).

Several rough service lamps were broken in the forward part of the ship. It is difficult to determine the cause for the breakage as some was due to distortion of the bulkheads, transmission of the blast and pressure, etc. As most of the breakage occurred around #1 and 2 cargo holds, it must be assumed that the same force which broke sheathing bent beams, etc., also demolished lamps.

(b) Reflectors.

Same remarks as above apply.

(c) Fixture mounts.

Very little damaged.

(d) Shock mounts (U strap type and plate type).

No damage.

(e) Pendent lamp holders.

Do not apply to this ship.

(f) Lamp globes.

Only three broken due to falling debris etc.

M. Searchlights (36", 24", 12" and 8").

(a) Framework and mountings.

Framework and mountings on both 24" searchlights were destroyed beyond repair, by the blast. The port 24" was blown 50' aft and clear of its searchlight platform. The mounting on #3 12" signal light was bent from the blast. #1 twelve inch signal light was blown overboard.

(b) Front glass.

Glass broken on both 24" searchlights. Other 12" undamaged, except as noted above.

(c) Shutter and operating mechanism.

Demolished on the 24" lights.

(d) Locks and brakes.

Jammed and inoperative on #1 24"; demolished on the other.

(e) Arc lamp feed rods.

Broken on both 24" lights.

(f) Incandescent lamps.

No damage, except one lost.

(g) Rheostats.

No damage.

N. Degaussing Equipment.

(a) Compass compensating coils and control boxes.

Magnetic compass at secondary control station was dislocated, breaking cable to compensating coils.

(b) Connection boxes.

No damage.

(c) Heading switches and relays.

No damage.

O. Gyro Compass Equipment.

(a) Master.

No apparent damage received.

(b) Repeaters.

Port and starboard wing (bridge) bearing repeaters were blown overboard by the blast. Stands were bent out of alignment with center line. Repeater at secondary control station was damaged and hanging by its cable; Zeke and inner gimbal ring distorted.

(c) DRT and DRA.

No damage observed but instruments have not been tested under simulated operating conditions due to lack of available opportunity.

P. Sound Powered Telephones.

(a) Headsets.

None damaged except those in masts at lookout stations.

(b) Handsets.

One on forward bulkhead superstructure on focsle, damaged when ripped out of box.

(c) Jack and switch boxes.

No damage.

(d) Stowage.

No damage.

Q. Ships Service Telephones.

Do not apply to this ship.

R. Announcing Systems.

(a) Portable (PAM and PAB).

No damage.

(b) Amplifier racks.

No damage.

(c) Control racks.

No damage.

(d) Transmitting station.

Decimeter broken at fire control station.

(e) Reproducers.

No damage.

(f) Inter communicating units.

No damage.

Note: The loss of the port bullhorn and inoperative status that circuit was covered in previous item. Starboard bullhorn is operable.

S. Telegraphs.

No damage.

T. Indicating Systems.

Anemometer indicator on starboard wing of bridge demolished. Instrument itself damaged when mast bent over. Circuit broken to topmast. Rudder angle indicator at secondary control station damaged; face and meter smashed when searchlight hit same.

U. I. C. and A. C. O. Switchboards.

No damage.

V. F. C. Switchboards.

No damage.

SECTION D - ELECTRONICS

A. General Description of Electronic Damage.

(a) Overall condition.

The general condition of all Electronics gear can be described as satisfactory except for radar. No severe damage was experienced by radio equipment except the antennas. The loss of the two radars on both topmasts, makes the radar inoperative.

(b) Areas of major damage.

Topside wherever equipment was exposed; such as all antennas, and the masts.

(c) Primary cause of damage in each area.

The force of the blast did considerable whipping of all wires, and ropes. This plus the falling topmasts, was sufficient to sever all wire antennas. The metal antennas were distorted by the blast or by falling debris. Radar equipment was damaged by both the blast and the falling topmasts also.

(d) Operability of Electronic equipment..

By means of jury rigged antenna, the radio equipment can be operated provided not too much power or antenna length is required. The radar is not and connot operate due to the gear on the topmasts having been damaged beyond repair or use. The fathometer was damaged and did not operate for awhile. Repairs by the technician were successful, however and it now operates. Whether it will continue to do so is a matter of conjecture.

Radar: The SC-4 assembly mounted on the maintopmast was bent back by the blast and when the mast (top section) was forced back to a 120 degree angle the radar antenna dropped off and landed on the after deck house. The SG-1 antenna mounted on the foretop was similarly treated except that the radar antenna is still secured, although part of it is missing. All circuits to

the topmasts have been severed and sections are missing. The BN IFF and the ABK antennas broke loose from their coaxial cables and at present are very insecurely mounted. The VD remote PPI unit in the wheel house was knocked loose from its base, but appears to be undamaged, although there are no facilities to test same due to the loss of the antennas.

Radio: All receivers are operable. All transmitters will operate if provided with proper antennas. Three transmitters will contain bad tubes, (1 each). The SCR-624 receiver mounted on the forward bulkhead of the wheelhouse, was knocked loose by the blast on bulkhead 59, but can be repaired.

Sonar: The ship has no sonar equipment, the nearest thing to that type being the fathometer. The NMC fathometer chassis was knocked loose from its support by the distortion of the forward bulkhead in the pilot or wheel house. Its source of power was also severed. Repairs have since made it operable.

Loran: Ship has no Loran gear.

Other apparatus: Radar control rooms appeared to be intact and could undoubtedly operate if the facilities were available.

(c) Types of equipment most effected.

The most exposed equipment, irrespective to type, was the most affected. In this case it was the radar antenna on each topmast, and the radio antennas connected with the masts and signal yardarms. The manner in which the other electronic gear withstood the blast is considered to be a very creditable showing.

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Defense Special Weapons Agency
6801 Telegraph Road
Alexandria, Virginia 22310-3398

TRC

9 April 1997

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
ATTENTION: OMI/Mr. William Bush

SUBJECT: Declassification of Reports

The Defense Special Weapons Agency (formerly Defense Nuclear Agency) Security Office has reviewed and declassified the following reports:

+ ST-A

AD-366748	XRD-65
AD-366747	XRD-64
AD-366746	XRD-63
AD-376826	XRD-60
AD-376824	XRD-58
AD-376825	XRD-59
AD-376823	XRD-57
AD-376822	XRD-56
AD-376821	XRD-55
AD-366743	XRD-54
AD-376820	XRD-53
AD-366742	XRD-52
AD-366741	XRD-51
AD-366740	XRD-50-Volume-2
AD-366739	XRD-49-Volume-1
AD-366738	XRD-48
AD-366737	XRD-47

TRC 9 April 1997

SUBJECT: Declassification of Reports

AD-366736	XRD-46
AD-366735	XRD-45
AD-366723	XRD-37
AD-366721	XRD-35
AD-366717	XRD-31-Volume-2
AD-366716	XRD-30-Volume-1
AD-366751	XRD-68-Volume-2
AD-366750	XRD-67-Volume-1
AD-366752	XRD-69
AD-366744	XRD-61.

All of the cited reports are now **approved for public release. Distribution statement "A"** now applies.

Ardith Jarrett

ARDITH JARRETT
Chief, Technical Resource Center

Completed
9 Aug 2000
B.W.