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U.S.S. HUGHES (DD410)

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USS HUGHES (DD410)

Page 1 of 114 Pages

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TABLE OF CONTENTS

U.S.S. HUGHES (DD 410)

CONFIDENTIAL

SHIP CHARACTERISTICS

Building Yard: Bath Iron Works Corporation.

Commissioned: 21 September 1939.

HULL

Length Overall: 348 feet 4 inches.
Length on Waterline: 341 feet 0 inches.
Beam (extreme): 36 feet 0 inches.
Depth (molded at side, to main deck, amidships): 19 feet 7 7/8 inches.
Drafts at time of test: Fwd. 12 feet 0 inches.
Aft. 12 feet 6 inches.
Standard Displacement: 1,570 tons.
Displacement at time of test: 2,176 tons.

MAIN PROPULSION PLANT

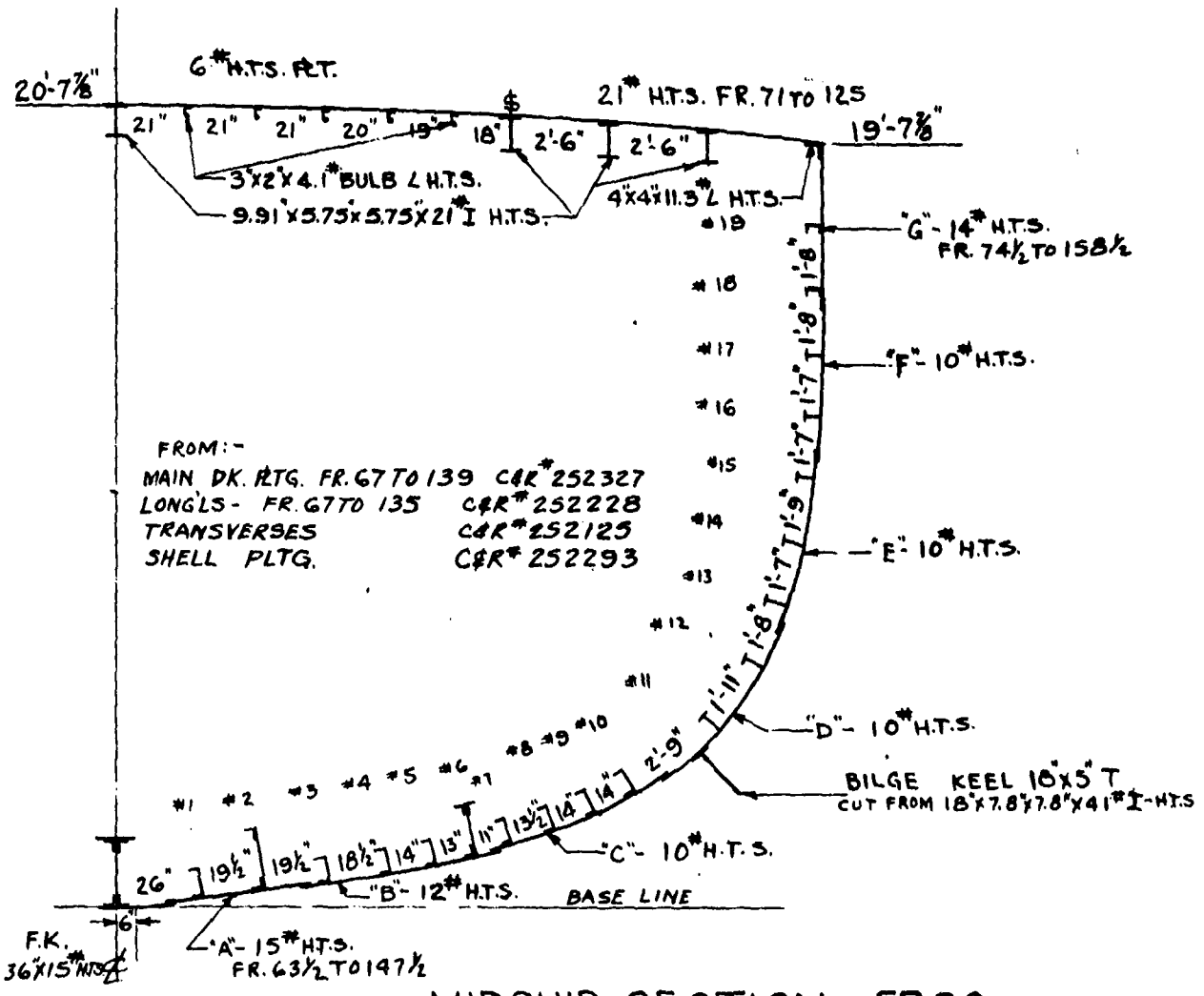
Main Engines: Two sets of Westinghouse turbines are installed, one set per shaft.
Reduction Gears: Two sets of De Laval double reduction are installed, one per shaft.
Main Condensers: Two are installed in ship.
Boilers: Three Babcock and Wilcox boilers are installed in ship. 565 psi gauge, 715° F.
Propellers: Two are installed in ship.
Main Shafts: Two are installed in ship.
Ships Service Generators: Four sets are installed in ship. Two 150 K.W. - A.C. and Two 40 K.W. - D.C. sets.

CONFIDENTIAL

C.V.K. 21"X12" H.T.S. PL
" F.P. 12"X12" H.T.S. PL
" L's 3"X3"X6.1" H.T.S. DBL T&B.
LONG'L 1-9" X 2 5/16" X 2 5/16" X 13.4" C H.T.S.
" 2 - 19¼" X 10" PT. 2½"X3"X4.5" L's H.T.S.
LONG'L 3,4,5 - 8"X2¼"X2¼"X11.5" C's H.T.S.
" 6 - 16¾" X 10" PL 3"X2½"X4.5" L's H.T.S.
" 7-8-9-10 - 8"X2¼"X2¼"X11.5" C H.T.S.

LONG'L 11-12-13-14- 6"X3.06"X5.87" T-H.T.S.
" 15-16-17 - 5"X2.69"X4.48" T-H.T.S.
" 18-19 - 5"X1¾"X1¾"X6.7" C's H.T.S.

7" KEEL BKT. EACH FRAME
7.65" WEBS SPC'D 63"



FROM:-
MAIN DK. PLTG. FR. 67 TO 139 C&R" 252327
LONG'LS - FR. 67 TO 135 C&R" 252228
TRANSVERSES C&R" 252125
SHELL PLTG. C&R" 252293

MIDSHIP SECTION FR 98

TEST A

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

There is no flooding and consequently no change in drafts or list.

(b) Structural damage.

HULL

In the superstructure, metal joinerwork is buckled and furniture and equipment are disarranged. Most watertight and weathertight doors and door frames above the main deck are distorted sufficiently to make them incapable of fulfilling their designed function and to seriously impede access to the spaces involved. The main mast is broken off just below the yard arm. The foremast is bowed forward slightly, and all connected antenna are carried away. The stack is dished but is intact. Uptakes are badly dished with some separations in the outer casing.

Damage to the hull is confined to moderate buckling of the main deck between frames 172 and 184. This is accompanied by a slight distortion of the associated transverse and longitudinal structural members and supporting stanchions.

There is no apparent damage to the compartments below the waterline.

MACHINERY

Breeching between uptakes and stack was severely dished and ruptured in places. The stack was considerably wrinkled and dished.

ELECTRICAL

No comment.

(c) Other damage.

HULL

No comment.

MACHINERY

The air casings of all boilers were blown out, damage being concentrated largely on rear casings. There was some other damage to boilers (fuel oil burners and brickwork). Structural damage occurred to the stack and the breeching between uptakes and stack. The compressed air line to the torpedo workshop was broken by the distortion of a bulkhead.

ELECTRICAL

The electric plant on this vessel suffered negligible damage. The 36" searchlight and two (2) flood lights mounted on the topside of the vessel were the only electrical equipment to be damaged by the blast.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

Heat radiation came from about 200° relative and at an elevation of about 13°. Exposed vertical surfaces have suffered much more than similarly exposed horizontal surfaces. Heat penetration on paint is only through one coat, or about 0.002 inches. Scorching on cordage is only a few hundredths of an inch deep. No structure or equipment is impaired as a result of heat.

MACHINERY

Not evidenced on machinery or in machinery spaces, except scorching of paint in exposed areas.

ELECTRICAL

The heat of the Atomic Bomb blast charred paint on exposed cable and topside electrical equipment. However, the electrical characteristics of this equipment were not impaired. The heat radiation appeared to have originated from the port quarter of the vessel.

(b) Fires and explosions.

HULL

One minor fire occurred in a mattress located on the port side of the fantail and used as chaffing gear for the stern mooring cable. The cause of ignition is believed to be direct heat radiation that penetrated the thin cotton covering and ignited the cotton batting. No damage resulted from the fire other than the burning of paint in the immediate area.

MACHINERY

Not evidenced.

ELECTRICAL

There was no electrical damage as a result of fires or explosions.

(c) Shock.

HULL

There is no evidence of shock damage.

MACHINERY

No evidence.

ELECTRICAL

The electrical equipment on this vessel was not apparently subjected to any shock.

(d) Pressure.

HULL

All of the exposed surfaces of the ship above the water-line showed evidence of blast. The pressure wave emanated from a point bearing about 200° relative and at an elevation of about 13°. The major areas of damage as a result of pressure are the after bulk-heads of the forecastle structure, the stack, the uptakes, the masts, and the main deck aft between frames 172-184. The failures consist principally of moderately dished and distorted structure, particularly doors, except in the very light plating of the uptakes where joints are opened and stay bolts have pushed through. The critical thickness of topside plating is in the neighborhood of 10# medium steel since heavier plating is apparently undamaged.

MACHINERY

Blast pressure caused all machinery damage.

ELECTRICAL

All topside electrical damage in this vessel can be attributed to the pressure of the blast. The 36# searchlight and two (2) floodlights were severely damaged by this pressure.

(e) Effects apparently peculiar to the Atom Bomb.

HULL

With the exception of radioactivity, the intensity of heat was the only peculiarity observed.

MACHINERY

Blast pressure of this magnitude at this range from an explosion appears to be peculiar to the atom bomb.

ELECTRICAL

Although many hatches and doors were dished in and torn from their mountings by the extreme pressure of the blast, the lighting fixtures and lamps within the compartments, within the immediate vicinity of this damage, were undamaged. This phenomena was probably due to the heavy and relatively slow acting blast wave which seems to be characteristic of this weapon.

III. Effects of Damage.

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

HULL

No comment.

MACHINERY

All steam power was lost because of damage to the boilers and breeching between uptakes and stack. Damage to the stack, while altering the appearance of the ship, would not impair operation. The effect of the damage on ship control was to reduce the power available to that furnished by the emergency diesel generator.

ELECTRICAL

Propulsion and ship control of this vessel was not affected by electrical damage on this vessel.

(b) Effect on gunnery and fire control.

HULL

No comment.

MACHINERY

No comment.

ELECTRICAL

Gunnery and fire control on this vessel was not affected by damage to electrical equipment on this vessel.

(c) Effect on watertight integrity and stability.

HULL

There is no evidence of flooding and since the weight of displaced topside structure is negligible, there is no apparent effect on stability. Watertight boundaries and closures below the weather deck are intact. The watertight doors on the main deck just forward of the break in the forecastle deck, port and starboard, are badly distorted, destroying the integrity of bulkhead 61 above the main deck. This could cause minor flooding in heavy seas.

MACHINERY

No comment.

ELECTRICAL

Since there was no apparent damage to cable stuffing tube areas, the watertight integrity was not affected from an electrical viewpoint.

(d) Effect on personnel and habitability.

HULL

The damage to the ships structure has little effect on personnel. The protection afforded topside personnel by splinter shields and gun tubs is inadequate. Inasmuch as there are no major structural failures in interior spaces and equipment and furniture are still intact, there is no reduction in habitability.

MACHINERY

Some casualties to fireroom personnel might have occurred from lethal gases escaping from the ruptured boilers. No flarebacks would have occurred with this type of boiler. No other casualties would have occurred among personnel below decks, but casualties among exposed personnel would have been high. Habitability would have been reduced by loss of steam power.

ELECTRICAL

There was no effect on the habitability of this vessel from electrical damage.

(e) Total effect on fighting efficiency.

HULL

The failure of the masts and consequent destruction of antenna would have rendered inoperable a considerable amount of electronic equipment. There is no effect on the structural strength. The principal effect on seaworthiness is the damage to weather doors which would permit entry of water in a seaway.

MACHINERY

The ship was immobilized. It is estimated that emergency repairs to enable the ship to steam at slow speed on one boiler could be made under war conditions in approximately five days by the ship's force,

or in 60 hours by a tender. It is estimated that at least 40 days work at a naval shipyard would be required to restore the plant to full operating condition.

ELECTRICAL

There was no effect on the fighting efficiency of this vessel from electrical damage.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

Detailed investigation indicates that the structural damage is almost entirely confined to light structure of 10# plating or less and to access closures and has occurred as a result of blast.

MACHINERY

The test demonstrated the vulnerability of the casings of these boilers to this type of attack.

ELECTRICAL

The electrical damage to this vessel was limited to the topside area, occurring primarily in those instances where there was excessive hull distortion and failure. Damage to the 36" searchlights and floodlights resulted from the pressure of the blast. It appears that this vessel was subjected to a fairly high pressure, however, very little acceleration was imparted to this vessel or its equipment. This probably accounted for the small amount of shock damage noted on this vessel.

V. Preliminary Recommendations.

HULL

The nature of damage sustained by this vessel indicates the necessity for a redesign of exposed surfaces with a view towards increasing their resistance to external pressure. Topside structure

should be faired into integral units, eliminating pockets, recesses and open passageways. The use of open, or partially protected, stations should be avoided. Access and ventilation closures should be redesigned to overcome apparent weaknesses.

MACHINERY

Boiler casings should be strengthened to increase their resistance to blast pressure.

ELECTRICAL

It is recommended that consideration be given to the elimination of the 36" searchlights on this type vessel, since these searchlights no longer are used as originally intended; i.e., in conjunction with fire control. In the event these lights must be retained, it is recommended that the use of cast aluminum equipment be completely avoided. The searchlight yoke should be strengthened considerably and made from fabricated steel. Castings should be avoided. Base mounting and kingpin arrangement appears to be a weak point in the design of this particular searchlight and should be improved. It is recommended that exposed electrical equipment be reduced as much as possible to insure maximum protection against the heat and blast of the atomic bomb. Where this equipment must be exposed, it should be adequately covered with paint to insure protection against the heat of the blast.

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.

There is no flooding and consequently no change in drafts or list.

(b) Structural damage.

In the superstructure metal joinerwork is buckled and furniture and equipment are disarranged. Most watertight and weathertight doors and door frames above the main deck are distorted sufficiently to make them incapable of fulfilling their designed function and to seriously impede access to the space involved. The main mast is broken off just below the yard arm. The foremast is bowed forward slightly, and all connected antennae are carried away. The stack is dished but is intact. Uptakes are badly dished with some separations in the outer casing.

Damage to the hull is confined to moderate buckling of the main deck between frames 172 and 184. This is accomplished by a slight distortion of the associated transverse and longitudinal structural members and supporting stancions.

There is no apparent damage to the compartments below the waterline.

(c) Other damage.

It is not evident that any of the damage sustained by the hull and its fitting would have affected machinery, equipment, or ship control, except that incurred through failure of the masts which support antennae.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Heat radiation came from about 200° relative and at an elevation of about 13°. Exposed vertical surfaces have suffered much more than similarly exposed horizontal surfaces. Heat penetration on paint is only through one coat, or about 0.002 inches. Scorching on cordage is only a few hundreths of an inch deep. No structure or equipment is impaired as a result of heat.

(b) Fires and explosions.

One minor fire occurred in a mattress located on the port side of the fantail and used as chaffing gear for the stern mooring cable. The cause of ignition is believed to be direct heat radiation that penetrated the thin cotton covering and ignited the cotton batting. No damage resulted from the fire other than the burning of paint in the immediate area.

(c) Shock.

There is no evidence of shock damage.

(d) Pressure.

All of the exposed surfaces of the ship above the waterline were subjected to blast. The pressure wave emanated from a point bearing about 200° relative and at an elevation of about 13°. The major areas of damage as a result of pressure are the after bulkheads of the forecastle structure, the stack, the uptakes, the masts, and the main deck aft between frames 172-184. The failures consist principally of moderately dished and distorted structure, particularly doors, except in the very light plating of the uptakes where joints are opened and stay bolts have pushed through. The critical scantlings of topside plating in the neighborhood of 10# medium steel since heavier plating is apparently undamaged.

(e) Effects apparently peculiar to the atom bomb.

With the exception of radio-activity, the intensity of heat was the only peculiarity observed.

III. Effects of Damage.

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

No comment.

(b) Effect on gunnery and fire control.

No comment.

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

There is no evidence of flooding and since the weight of displaced topside structure is negligible, there is no apparent effect on stability. Watertight boundaries and closures below the weather deck are intact. The watertight doors on the main deck just forward of the break in the forecastle deck, port and starboard, are badly distorted, destroying the integrity of bulkhead 61 above the main deck. This could cause minor flooding in heavy seas.

(d) Effect on personnel and habitability.

The damage to the ships structure has little effect on personnel. The protection afforded topside personnel by splinter shields and gun tubs is inadequate. In as much as there are no major structural failures in interior spaces and equipment and furniture are still intact, there is no reduction in habitability.

(e) Total effect on fighting efficiency.

The failure of the masts and consequent destruction of antennae would have rendered inoperable a considerable amount of

electronic equipment. There is no effect on the structural strength. The principal effect on seaworthiness is the damage to weather doors which would permit entry of water in a seaway.

IV. General Summary of Observers' Impressions and Conclusions.

Detailed investigation indicates that the structural damage is almost entirely confined to light structure of 10# plating or less and to access closures and has occurred as a result of blast.

V. Preliminary Recommendations.

The nature of damage sustained by this vessel indicates the necessity for a redesign of exposed surfaces with a view towards increasing their resistance to external pressure. Topside structure should be faired into integral units, eliminating pockets, recesses and open passageways. The use of open, or pa tially protected, stations should be avoided. Access and ventilation closures should be redesigned to overcome apparent weaknesses.

VI. Instructions for loading the vessel specified the following:

ITEM	LOADING
Fuel oil	15%
Diesel oil	15%
Ammunition	66.7%
Potable and reserve feed water	95%
Salt water ballast	320

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) The overall condition of the hull is good. Structural damage is relatively light. Damage to superstructure, though extensive, is not of great importance. Photos 163-17, 18, 49, 85, 84, 82, 83. Pages 50 to 55 show general exterior views.

The principal features of hull damage are:

Buckling of main deck plating frames 172 to 184. Associated damage between main deck and first platform in this area in the nature of bracket failures and stressed deck beams indicate that the maximum deck deflection occurred at or just aft of frame 175, (photos 1898-5, 6, 4; Pages 56 to 58). A deck deflection scratch gage at frame 175, centerline, shows a relative displacement between main deck and first platform of between 5 and 6 inches with a permanent set of about 1 2/16 inches (photos 1898-4, 3; Pages 58 and 59).

The foremast is bent forward about 10° beginning at navigation bridge level, (photo 2198-4; Page 60). The mainmast is broken off just below the yard arm.

Failure of weather doors and door frames is extensive (photos 1898-2, 1; Pages 61 and 62).

(b) Damage to the strength hull is limited to the main deck area between frame 172 and 184 and to the supporting structure immediately below in compartment C-204-L. No indications of stress or strain are observed forward, aft, or below this compartment.

(c) The principal cause of hull damage was the pressure wave Some flexural vibration of the hull may have occurred. The possibility of this is evidenced by the failure of the masts.

(d) No flooding occurred.

(e) The strength of the vessel is not impaired. There is no apparent change in buoyancy. Operability of the ship is not affected by the condition of hull material, except for the weakening of the mast and loss of stays.

B. Superstructure.

(a) The pipe life rails on the after and port sides of the director platform are badly bent inboard. Other life line stanchions on the ship are bent somewhat but still carry out their designed purpose. The foremast is bent forward about 10 degree, beginning at the navigating bridge (photo 2198-4; Page 60). The two after guys have carried away due to failure of the pin securing them to the mast. All antennae attached to the foremast are down, halyards are charred and carried away.

Damage in the bridge area is principally confined to light joiner work, lockers, and doors on the port side. Lockers in exposed positions are crushed. The port flag bag is carried away (photo 2198-4; Page 60). The starboard flag bag is collapsed. The bulwark on the starboard wing of the bridge is slightly dished; three aluminum stiffeners are cracked. The curved surface at the after port corner of the superstructure deck house is dished between vertical stiffeners for the full height between decks. One port lens in the chart house is broken, and the port lens in the port door is blown in.

All weather doors on the ship with the exception of four steel doors on the navigation bridge are dished to some extent. The fifth door on the navigation bridge, which leads into a light lock at frame 62, port, is dished about 3''. Doors that have web reinforced frames appear to be only slightly dished, those that are secured to aluminum bulkheads without webbing are demolished. The most serious damage to doors occurs in way of the after bulkheads of deck houses. The hinges of aluminum door 02-67-2 in the after bulkhead of superstructure deck house are torn from the bulkhead, and the door is pushed through the frame into the passageway. The joiner door at the forward end of this passageway, frame 61, port, is torn from its hinges. The hinges of aluminum door 01-67,

located in the forecastle deck immediately beneath door 02-67-2 are also torn from the bulkhead and the door is pushed into the passageway (photo 1898-2; Page 61). The joiner doors to port and starboard, immediately forward in this passageway, are dished, and the port passageway joiner bulkhead is ruptured. Dogged door 01-61-2 at the forward end of this passageway is torn from its hinges and pushed through the joiner door at frame 60, which leads into the supply office, A-0103-L.

In the pocket formed on the main deck just forward of the break in the forecastle deck at frame 67, all the doors, port and starboard, are badly distorted. The door in the bulkhead at frame 61, starboard, is pushed through its frame and the dogged airtight door to the wardroom is dished. A leeside door, to gear locker B-101-A, on main deck at frame 70, starboard, apparently was not dogged at top. It is folded outboard from the top edge down to mid-height and has sprung out of the lower dogs (photo 1898-1; Page 62). Both hinges have punched or torn out of their connections. The damage to this door was apparently aggravated by shock or by leaving the upper portion either loosely dogged or completely undogged.

Uptakes are collapsed on all faces, with the most severe effect on the port side (photos 1900-9, 1748-2, 1747-11; Pages 63 , 64 and 83). The top of #3 boiler uptake is distorted with a maximum deflection of 14" starboard and 16" port, (photo 1898-8; Page 65). The starboard side of the outer casing is dished. The main damage was caused by the failure of the spot welding on the large center section. Lagging shook loose from the whistle and siren steam supply and drain lines (photo 1849-10; Page 66).

The stack is dished for about the top ten feet on the after port corner, (photo 1747 10; Page 67). The funnel cap is distorted in way of this damage and the top edge is pushed in. Compression wrinkles appear in the forward face of the stack (photo 1849-10; Page 66).

The door on the main deck, frame 108, port, and its frame, which was riveted to an aluminum bulkhead, are destroyed and curled inboard into the torpedo workshop B-104-E. The centerline aluminum bulkhead of the torpedo workshop is torn loose at top and bottom. The door on the main deck frame 103, starboard, leading into the general workshop is distorted and the overhead in this area is forced down slightly. Paint on the port side in this area generally is scorched.

Damage to the after deckhouse and platforms is limited to light dishing. Quick acting doors at frame 157, port and starboard, frame 142, starboard, and frame 137, port slightly dished. The after portion of the port aluminum bulkhead is dished a negligble amount. The 20MM and port 40MM gun shields are partially callops-ed, the after starboard corner of the port 40MM gun shield being dished about 12 inches over a circumferential length of four feet.

The main mast is broken off just below the yardarm.

The covers were dished and screens torn on all ventilation openings on the port side, aft. Paint in the area was generally lightly scorched on top and port surfaces.

The throat of the 36-inch searchlight mount at frame 139 is fractured and the base is partially loose on its foundation, (photos 1915-2, 3; Pages 68 and 69).

(b) The cause of damage in all cases appears to be the blast wave, which subjected the ship to a high pressure over a period of time. This pressure was apparently applied simultaneously to all surfaces, as evidenced by the dishing of lee side doors and 7-1/2 # plates of large area which were protected from reflected blast effect. A PCE speaker located on the bridge in an airtight, water-tight case is bulged outward on all sides. This is the only evidence of a rarification wave or negative pressure.

(c) There is no evidence of fire. Paint is slightly scorched, (photo 1849-7; page 70). The most badly scorched surfaces are the bottoms of the life jacket lockers which form the overhead directly above the bright aluminum deck on the forecastle, frame 67 (photo 1849-9 page 71).

(d) Light plating has resisted the blast where shielded or where supporting stiffeners are relatively closely spaced (i.e., bridge bulkheads). In other instances light plating is damaged: heat shields on ready boxes are demolished; 5# steel plating is badly dished; 7-1/2# plating is slightly dished; and 10# plating is intact. In some cases rounded surfaces are intact, while flat surfaces nearby are dished.

(e) Door frames that had web strengthening held up well and dorrs in these cases whithstood the blast as in the case of the four doors on the navigation bridge. Stronger door frames that are better secured to the bulkhead should be used with a strength member placed as close to the knife edge as possible.

Insofar as practicable exposed surfaces should be curved and recesses should be eliminated.

C. Turrets, Guns and Directors.

(a) The general condition of the three enclosed 5-inch gun mounts is good. All three guns operate normally. A few rounds of projectiles were thrown to the deck, but not damaged. Bloomers are ripped and torn off. All guns were trained on the centerline. The side panels of the gun shields are dished 1'' to 2'' with maximum deflection occurring near the door frame. The backs of the mounts are dished; the maximum deflection occurs just above the empty shell shute and amounts to about 8'' in the case of mount 2 (photos 1746-3, 1898-7, 1849-8; pages 72, 73 and 65). The shields apparently would have provided ample protection from the heat and blast wave.

(b) All unprotected mounts show slight scorching and evidence of blast. The oil buffer on 5-inch gun 3 had to be refilled. Otherwise, all guns operate normally. Crew shelters apparently provided little or no protection from the blast.

(c) The gun director is undamaged. The Mk 22 and Mk 4 radar antennae on top of the director are smashed. With the antennae disconnected, however, the director operates normally. Bloomers are blown off the range finder, but there is no apparent damage to the optical system, or to any other instrument or mechanism in the director. The Mk 51 directors are scorched but operate normally.

(d) Adequate protection from heat and blast should be provided all personnel.

D. Torpedo Mounts, Depth Charge Gear.

(a) The torpedo mounts are slightly scorched but are undamaged. The stop mechanisms and trainer's stations are undamaged. The top of the main mast fell on the after mount, but caused no damage. Spoon extensions afforded some protection from blast and scorching; however, even unprotected war heads are undamaged.

The training station should be more adequately protected from blast, heat, and radiation. It might be better located in the mount foundation or protected by shields at the present locations.

(b) The depth charge gear is in excellent condition. Paint on charges shows slight scorching.

E. Weather Deck.

(a) The forecastle deck is punctured for about four inches at frame 23, port. This was apparently caused by the impact of the corner of a gear locker which was blown from the starboard corner of the director platform. The main deck is buckled between frames 172 and 184. The maximum permanent set is about 1-9/16 inches and appears in the form of a dish at frame 175 and a bulge at frame 180.

(b) The deck is completely usable and watertight except for the small puncture at frame 23. The strength is slightly reduced in way of frame 175, due to the buckling of both the port and starboard supporting stanchions.

(c) The equipment and fittings on the weather deck are undamaged. All boats and rafts are intact.

F. Exterior Hull (Above Waterline).

The shell plating is in good condition except for local dishing which has been identified by ships force as previous damage. The sheer strake is undamaged. Flaked paint on the port sheer strake, frame 174, indicates that the plating has been stressed rather highly.

G. Interior Compartment (Above Waterline).

(a) The deflection of the main deck aft of frame 172 has caused some damage in crews space, C-204-L. The port and starboard stanchions (3-1/2" O.D.) at frame 175, are buckled forward approximately 5" (photo 1898-4, Page 58). The second deck appears to be unaffected.

Seven of the main deck longitudinals are slightly buckled in flanges and webs in way of their bracket connections to bulkhead 173. The principal main deck longitudinals under the deck stringers are undamaged (photo 1898-5; Page 56).

Web frames 175 and 179, port and starboard, are lightly buckled in webs, flanges, and main deck brackets (photo 1898-6; Page 57). There is no evidence of damage to web frames other than those at frames 175 and 179.

The deck deflection scratch gage located at the centerline of frame 175 shows a complete vibration of the main deck, relative to the first platform of between 5" and 6" with a final permanent set of about 1-9/16" (photo 1898-3; Page 59).

A tabulation of scratch gage locations and readings is included as an Appendix.

(b) All bulkheads appear to be undamaged.

(c) All accesses and closures below the main deck are in good condition.

(d) The equipment within compartments is in good condition.

(e) There is no evidence of fire in any compartment.

(f) There was no damage to piping, cables, or ventilation ducts in this area.

(g) The only reduction in watertight integrity is caused by the failure of the two doors under the break of the forecastle deck at frame 61. This would allow water washing over the main deck to enter the crews mess, A-205-L.

H. Armor Decks and Miscellaneous Armor.

Not Applicable.

I. Interior Compartments (Below Waterline).

There is no apparent damage.

J. Underwater Hull.

(a) No damage to the underwater hull has been observed.

(b) Buoyancy, operability and manuverability are unaffected by the test as far as hull and fittings are concerned.

(c) There is no known damage to shafts, propellers, struts or rudder.

(d). The keel is apparently undamaged.

K. Tanks.

(a) The tanks appear to be in good condition except for a slight bulge of less than 1/2" in the tops of tanks A-6F, A-7F, frames 56 to 66, port and starboard and tank A-8V, frames 66-67.

(b) There are no leaks or contamination of liquids.

(c) Damage to torpedo defense system.

Not Applicable.

L. Flooding.

There was no flooding.

M. Ventilation.

(a) Watertight closures in superstructure bulkheads are generally distorted throughout the ship. Rectangular ventilation ducts to machinery spaces are dished in instances where a 31" unstiffened span is used with 7# plate. An elbow in the vent system to the forward engine room is blown off. The damage to the ventilation systems is not sufficient to affect the habitability of any of the spaces.

(b) The ventilation system in the engineering spaces cannot be closed off. As a result considerable dust and dirt has blown into these spaces. There is no evidence that the ducts have conducted blast, fire, or heat to any extent.

(c) There was no progressive flooding through ventilation systems.

(d) All ventilation systems should be supplied with closures at the intersection of airtight boundaries.

N. Ship Control.

(a) There is no apparent damage to the steering gear, gyro compass, or interior communications. There is slight structural damage and some disarrangement of equipment in the bridge area due to the failures of doors which allowed the blast to enter these spaces.

(b) Signaling by flag hoist appears to be impossible since practically all flags and hoist equipment are damaged or destroyed.

O. Fire Control.

(a) The Mk. 22 and Mk. 4 antennae are badly damaged.

(b) The open 5" gun mount, torpedo mounts, searchlight, and all automatic guns and their control stations afford a minimum of protection against radiation and blast. It is probable that personnel casualties at these stations would have been severe..

(c) Adequate protective cover is needed for all fire control stations.

P. Ammunition Behavior.

Ready service stowage of ammunition at all stations during the test consisted of 2/3 wartime allowance. Main battery projectiles are knocked from their racks and one powder case is thrown out of an ammunition hoist. Apparently no ammunition has been damaged.

Q. Ammunition Handling.

The ammunition handling devices are in good condition. Apparently these have not contributed to the passing of fire or blast.

R. Strength.

There is no evidence of any reduction in strength except for the light buckling of the main deck aft of 5-inch mount 4.

S. Miscellaneous.

No comment.

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.

Breeching between uptakes and stack was severely dished and ruptured in places. The stack was considerably wrinkled and dished.

(c) Other damage.

The air casings of all boilers were blown out, damage being concentrated largely on rear casings. There was some other damage to boilers (fuel oil burners and brickwork). Structural damage occurred to the stack and the breeching between uptakes and stack. The compressed air line to the torpedo workshop was broken by the distortion of a bulkhead.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Not evidenced on machinery or in machinery spaces, except scorching of paint in exposed areas.

(b) Fires and explosions.

Not evidenced.

(c) Shock.

Not evidenced.

(d) Pressure.

Blast pressure caused all machinery damage.

(e) Effects apparently peculiar to the atom bomb.

Blast pressure of this magnitude at this range from an explosion appears to be peculiar to the Atom Bomb.

III. Effects of Damage.

(a) Effect on machinery and ship control.

All steam power was lost because of damage to the boilers and breeching between uptakes and stack. Damage to the stack, while altering the appearance of the ship, would not impair operation. The effect of the damage on ship control was to reduce the power available to that furnished by the emergency diesel generator.

(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.

Some casualties to fireroom personnel might have occurred from lethal gases escaping from the ruptured blowers. No flarebacks would have occurred with this type of boiler. No other casualties would have occurred among personnel below decks, but casualties among exposed personnel would have been high. Habitability would have been reduced by loss of steam power.

(e) Total effect on fighting efficiency.

The ship was immobilized. It is estimated that emergency repairs to enable the ship to steam at slow speed on one boiler could be made under war conditions in approximately 5 days by the ship's force, or in 60 hours by a tender. It is estimated that at least 40 days work at a naval shipyard would be required to restore the plant to full operating condition.

IV. General Summary.

The test demonstrated the vulnerability of the casings of our present boilers to this type of attack.

V. Preliminary Recommendations.

Boiler casings should be strengthened to increase their resistance to blast pressure.

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall condition.

All boilers were severely damaged and are inoperable. The uptakes are considerably damaged. The stack was considerable distorted but not sufficiently to impair operation. Several shutter vanes of the forced draft blower intakes were broken but this would not appreciably impair operation. The compressed air line to the torpedo workshop was broken incident to the failure of a bulkhead. Otherwise, there was no damage to the machinery installation.

(b) Areas of major damage.

The major damage to the machinery was confined to the boilers and uptakes.

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

All damage to machinery was caused by blast pressure.

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

All steam power was lost by severe damage to the boilers and uptakes. Thus the ship would have been dead in the water. It is estimated that approximately 5 days work by the ship's force, or 60 hours work by a tender, would be required to enable the ship to steam at slow speed on one boiler. It is estimated that at least 40 days work at a naval shipyard would be required to restore the machinery plant to full operating condition.

NOTE: After Test A, temporary repairs were made to the casings and brickwork of #1 boiler in order to steam this boiler while testing main and auxiliary machinery.

B. Boilers.

(a) Air casings.

1. The air casings of all boilers were similarly damaged. The rear casings, especially on the saturated side, were severely distorted and ruptured in numerous places. The rear casing of boiler #1 was bulged outward about 12-inches, see photos 1875-4-5, Pages 75 , and 76 . Those of boilers #2 and #3 were bulged outward about 18 inches. The inner rear casings were torn away from the structural connections on the steam drums and water drums and ruptures of the casings in the vicinity of these connections resulted. See photo 1747-5-6-7, Pages 77 , 78 , and 79 .

2. The panel joints of the outer rear casings failed by the sheets tearing adjacent and parallel to the flanges. The flanges held in all cases, see photo 1875-4, Page 75 . The tie rods between the inner and outer casings failed in two different ways. In cases where the tie rod ends were bolted to the outer casing panel sheet and this sheet was inadequately reinforced, failure occurred due to the sheet tearing around the connection; where the connections to the outer casings were reinforced sufficiently, failure occurred due to shearing at the weld between the tie rods and the angle iron which is fastened to the casing panel, see photos 1875-4-5 and 1747-5, Pages 75 , 76 , and 77 . The outer side and front casings had no failures.

3. Peep door operating gears were broken when the outer casings moved with respect to the inner casings. These failures occurred in the shutter door casings where the operating rod attached to the door. The sight glasses were not cracked.

4. On boilers #1 and #2, the outer rear angles (approximately 1-1/2 inch x 1-1/2 inch x 3/16 inch) securing the boiler casings to the ship's structure (at the bottom of the boilers) were bent outward approximately 10°. Rivets holding the boiler casings to these angles were pulled out.

5. In #2 boiler the economizer access door (in the outer rear casing), and the inner rear casing between the economizer and the steam drum were blown out.

(b) External fittings.

All external fittings were apparently undamaged except for drain lines supported by the rear boiler casing, which were distorted when the casing bulged.

(c) Fuel oil burner assemblies.

The damage to the fuel oil burner assemblies was similar on all these boilers. A few air doors carried away on #1 boiler: on boilers #2 and #3, a greater number carried away. Other air doors were distorted and could not operate properly. These air doors were repairable by the ship's force in a few hours. The oil pressure fittings of the burners were undamaged.

(d) Brickwork and furnaces.

1. The bulging of the casings resulted in the displacement of the brick walls. No anchor bolts failed and the bricks remained in place except as noted below. The plastic in the corbels cracked and in some instances fell to the furnace floor. The brick-bolts which had held the corbels stayed in place and were retaining the portion of the corbels which remained. See photos 1747-6-7, Pages 78, and 79. The condition of chrome ore in the stud tube division wall was not changed by the blast.

2. The bulging of the inner rear casings resulted in a space being left between the rear walls and the stud walls of all three boilers. This space reached its maximum midway up the wall and was practically nothing at the extremities of the wall. This maximum opening at the rear wall of boiler #1 was 8 inches wide and was 10 inches wide at the rear walls of boilers #2 and #3.

3. Although bulging was not evident from the inspection of the front casings, the front walls were also found to have bulged resulting in a space with a maximum width of three inches between the front wall and the stud wall.

4. The brickwork adjacent to water drums and stud wall headers (where the inner casings ruptured and were carried away) was damaged sufficiently to require replacement. See photos 1747-6-7, Pages 78 , and 79 .

(e) Drums and headers.

The drums and headers appear to be undamaged. The pressure parts were tested hydrostatically and were found to be tight.

(f) Tubes.

External examinations revealed no apparent damage.

(g) Foundations.

All foundations were intact.

(h) Stacks and uptakes.

1. The outer stack breeching from boilers #1 and #3 was severely dished on all four faces (between top of uptakes and stack). A similar effect occurred on the port and starboard sides of this breeching connecting #2 uptake to the stack. The inner stack breechings of boilers #1 and #3 were lightly damaged on the top and starboard sides where several small ruptures occurred. The starboard side of the inner breeching from #2 boiler was similarly damaged. Failures occurred along seams and lap joints where spot welds pulled away. (See photos 1875-6, 1747-4-9-11, 1748-1, 1898-8, 1900-11, Pages 80 , 81 , 82 , 83 , 84 , 65 , and 85 .)

2. The smoke stack was dented in at the top on the after port side. The cowling was wrinkled and other parts of the smoke pipe were distorted slightly. (See photos 1747-10, 1849-10,

Pages 67 , and 66). This damage, while considerably altering the appearance of the stack, would have had no appreciable effect on operation.

C. Blowers.

1. The forced draft blowers were operated satisfactorily after Test A. Except for shutter vanes, no damage was observed.

2. Several aluminum shutter vanes in the blower discharge ducts were broken.

D. Fuel Oil Equipment.

Undamaged. All equipment was operated while the ship was underway after Test A. No abnormalities were found.

E. Boiler Feedwater Equipment.

Undamaged. All equipment was operated and performed normally after Test A.

F. Main Propulsion Machinery.

1. Undamaged. The main engines were operated for approximately 1 hour at speeds up to 10 knots and found to be in good operating condition.

2. Leads left in the bearings of the main low pressure turbine during Test A indicate motion of the rotors up to a maximum of .008 inch. Data follows:

BEARING LEAD DATA

#2 STARBOARD L.P. TURBINE - FORWARD BEARING

Forward lead	Before Test A	After Test A	Difference
Top	.014	.006	.008
Center lead			
Top	.0115	.008	.0036
After lead			
Top	.011	.006	.005

#2 STARBOARD L. P. TURBINE - AFTER BEARING

Forward lead	Before Test A	After Test A	Difference
Top	.010	.007	.003
Center lead			
Top	.014	.008	.006
After lead			
Top	.0105	.006	.0045

G. Reduction Gears.

Undamaged. The main reduction gears were operated and checked for damage while the ship was underway at 10 knots after Test A.

H. Shafting and Bearings.

Undamaged. The shafting and spring bearings were inspected while the ship was underway and found to be in good operating condition.

I. Lubrication System.

Undamaged. The entire lubrication system was checked while the ship was underway and found to be in good operating condition. Lubrication was adequate in all places.

J. Condensers and Air Ejectors.

Undamaged. The condensers and air ejectors were placed in operation prior to getting underway and operated satisfactorily during the underway period. A main condenser vacuum of 28.5 inches was maintained.

K. Pumps.

Undamaged. All pumps were tested under normal service conditions after Test A.

L. Auxiliary Generators (Turbines and Gears).

Undamaged. The ship's service generators have been operated at normal load and found to be in good operating condition after Test A.

M. Propellers.

Undamaged. The propellers were not actually inspected. While the ship was underway shifting berth, there was no indication of any change in propeller R.P.M. vs speed. There was no vibration that would indicate propeller damage.

N. Distilling Plant.

Undamaged. The plant has been in normal operation since Test A. There has been no change in capacity or quality of distillate.

O. Refrigeration Plant.

Undamaged. The refrigerating plant has been in normal operation since Test A. There is no indication of any damage or change in performance.

P. Winches, Windlasses, and Capstans.

Undamaged. Inspection reveals no evidence of damage. Operation under normal conditions is satisfactory.

Q. Steering Engine.

Undamaged. The steering engine was in use while the ship was shifting berths. There is no evidence of damage.

R. Elevators, Ammunition Hoists, Etc..

Undamaged. Ammunition hoists were in the same condition after the test as before. All equipment was operated at no load. No damage was found.

S. Ventilation (Machinery).

Undamaged. All ventilation machinery has been in operation since Test A.

T. Compressed Air Plant.

Undamaged. All air compressors were operated after Test A, each compressor at rated pressure for 30 minutes, and no damage has been found.

U. Diesels (Generators and Boats).

Undamaged. The emergency diesel generator was operated for 5 days continuous service, after Test A. Performance was normal.

V. Piping Systems.

All piping was tested at required pressures. There has been no change in its condition due to the test except the compressed air line to the torpedo shop, which broke when the bulkhead was carried away.

W. Miscellaneous.

All galley, laundry, and machine shop machinery is undamaged and operates satisfactorily.

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.

Not observed.

(b) Structural damage.

Not observed.

(c) Other damage.

The ele tric plant on this vessel was not damaged by the atomic bomb burst. The 36'' searchlight and two (2) flood lights mounted on the topside of the vessel were the only electrical equipment to be damaged by the blast.

II. Forces Evidenced and Effects Noted.

(a) Heat.

The heat of the atomic bomb blast charred paint on exposed cable and topside electrical equipment. However, the electrical characteristics of this equipment were not impaired. The heat radiation appeared to have originated from the port quarter of the vessel.

(b) Fires and explosions.

There was no electrical damage as a result of fires or explosions.

(c) Shock.

The electrical equipment on this vessel was not apparently subjected to any shock.

(d) Pressure.

All topside electrical damage in this vessel can be attributed to the pressure of the blast. The 36" searchlight and two (2) floodlights were severely damaged by this pressure.

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

Although many hatches and doors were dished in and torn from their mountings by the extreme pressure of the blast, the lighting fixtures and lamps within the compartments, within the immediate vicinity of this damage, were undamaged. This phenomena was probably due to the heavy, and relatively slow acting blast wave which seems to be characteristic of this weapon.

III. Effects of Damage.

(a) Effect on propulsion and ship control.

Propulsion and ship control of this vessel was not effected by electrical damage on this vessel.

(b) Effect on gunnery and fire control.

Gunnery and fire control on this vessel was not effected by damage to electrical equipment on this vessel.

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

Since there was no apparent damage to cable stuffing tube areas, the watertight integrity was not effected from an electrical viewpoint.

(d) Effect on personnel and habitability.

There was no effect on the habitability of this vessel from electrical damage.

(e) Total effect on fighting efficiency.

There was no effect on the fighting efficiency of this vessel from electrical damage.

IV. General Summary of Observer's Impression and Conclusions.

The electrical damage to this vessel was limited to the topside area, occurring primarily in those instances where there was excessive hull distortion and failure. Damage to the 36" searchlights and floodlights resulted from the pressure of the blast. It appears that this vessel was subjected to a fairly large amount of pressure however, very little acceleration was imparted to this vessel or its equipment. This probably accounted for the small amount of shock damage noted on this vessel.

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

It is recommended that consideration be given to the elimination of the 36" searchlights on this type vessel, since these searchlights no longer are used as originally intended; i.e., in conjunction with fire control. In the event these lights must be retained, it is recommended that the use of cast aluminum equipment be completely avoided. The searchlight yoke should be strengthened considerably and made from fabricated steel. Castings should be avoided. Base mounting and kingpin arrangement appears to be a weak point in the design of this particular searchlight and should be improved. It is recommended that exposed electrical equipment be reduced as much as possible to insure maximum protection against the heat and blast of the atomic bomb. Where this equipment must be exposed, it should be adequately covered with paint to insure protection against the heat of the blast.

DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

A. General Description of Electrical Damage.

(a) Overall condition.

The general condition of the electric plant on this vessel after the air blast was good. Damage was confined to exposed topside electrical equipment such as floodlights and searchlights.

(b) Areas of major damage.

The exposed topside area of this vessel received the most electrical damage.

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

The primary cause of damage to electrical equipment on this vessel was the extreme pressure of the air blast.

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

The overall operability of the electric plant on this vessel was not effected by the air blast.

(e) Types of equipment most effected.

Searchlights and floodlights.

B. Electrical Propulsion Rotating Equipment.

Not Applicable.

C. Electrical Propulsion Control Equipment.

Not Applicable.

D. Generators - Ship's Service.

No damage.

E. Generators - Emergency.

No damage.

F. Switchboards, Distribution and Transfer Panels.

No damage.

G. Wiring, Wiring Equipment and Wire Ways.

Most external cables on this vessel had a thick coat of paint, which was charred by the high temperature of the blast. As no topside cable damage occurred from this heat, it is considered that the necessary cable protection was obtained from the heavy coat of paint.

There was also minor cable damage due to failure of hull structure on which cable was mounted.

Recommendations:

(a) In those weatherdeck locations where it is necessary to expose cables, the cables should be adequately covered with paint to insure protection against the heat flash.

(b) Reduce the number of exposed cables as much as possible, to insure maximum protection against the heat and blast of the atomic bomb.

H. Transformers.

No damage.

I. Submarine Propelling Batteries.

Not Applicable.

J. Portable Batteries.

No damage.

K. Motors, Motor Generator Sets, and Motor Controllers.

No damage.

L. Lighting Equipment.

In those cases where doors to compartments were blown in, the door switch operating handles were broken off. It is not considered feasible to redesign the door switch to withstand such service.

The starboard floodlights mounted aft on the 0-2 deck level was demolished with the exception of pressed steel case. The mounting yoke collapsed at the base. Photograph No. 1830-12 Page 86 , illustrates the damage to this unit.

The port floodlight on the same deck level was intact, and in operating condition. However, in this case the floodlight yoke had collapsed.

Recommendations:

Instrumentation data indicates that the floodlights were subjected to an air blast of approximately 13.5 pounds per square inch. It is not considered necessary to redesign the floodlights for such service, since the loss of these units has absolutely no effect on the fighting efficiency of the vessel.

M. Searchlights.

The 36-inch searchlights, manufactured by the General Electric Company, were damaged by the pressure of the blast. The cast aluminum yoke failed where the yoke joined the base of the light. The main base casting of the searchlight also

failed. The cast frame failures permitted the light to topple over striking a railing around the searchlight platform. It is believed that the impact with the rail caused the front glass to break. The internal fittings of the searchlight were intact. The cover glass on the main and elevation indicator was completely shattered, but not blown out.

Photograph No. 1915-2 Page 68 , shows the damage to the searchlight yoke.

Photograph No. 1915-3 Page 69 , shows the damage to the main base.

Recommendation:

Instrumentation data indicates that the searchlight was subjected to an air blast of approximately 14.5 pounds per square inch. It should be noted that the Navy type steel searchlights installed on the USS DAWSON, APA79, which was approximately the same distance from the blast center as the USS HUGHES, withstood the blast in comparatively good shape.

(a) It is recommended that the use of cast aluminum equipment be completely avoided.

(b) The searchlight yoke should be strengthened considerably, and made from fabricated steel. Castings should be avoided.

(c) The base mounting and king pin arrangement appears to be a weak point in the design and should be improved.

(d) Consideration should be given to the elimination of the 36" searchlights on this type of vessel, since they no longer are used as originally intended; i.e., in conjunction with fire control.

N. Degaussing Equipment.

No damage.

O. Gyro Compass Equipment.

The lead to the dampening eliminator was pulled loose from its connection. This was probably caused by the excessive roll of the vessel. The movement of this unit is limited by the length of this lead.

Recommendation:

Lengthening of the cable to the dampening eliminator would probably eliminate the trouble experienced in this case.

P. Sound Powered Telephones.

No damage.

Q. Ship's Service Telephones.

Not Applicable.

R. Announcing Systems.

No damage.

S. Telegraphs.

No damage.

T. Indicating Systems.

No damage.

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

No damage.

V. F.C. Switchboards.

No damage.

W. Miscellaneous

No comment.

SECTION IV

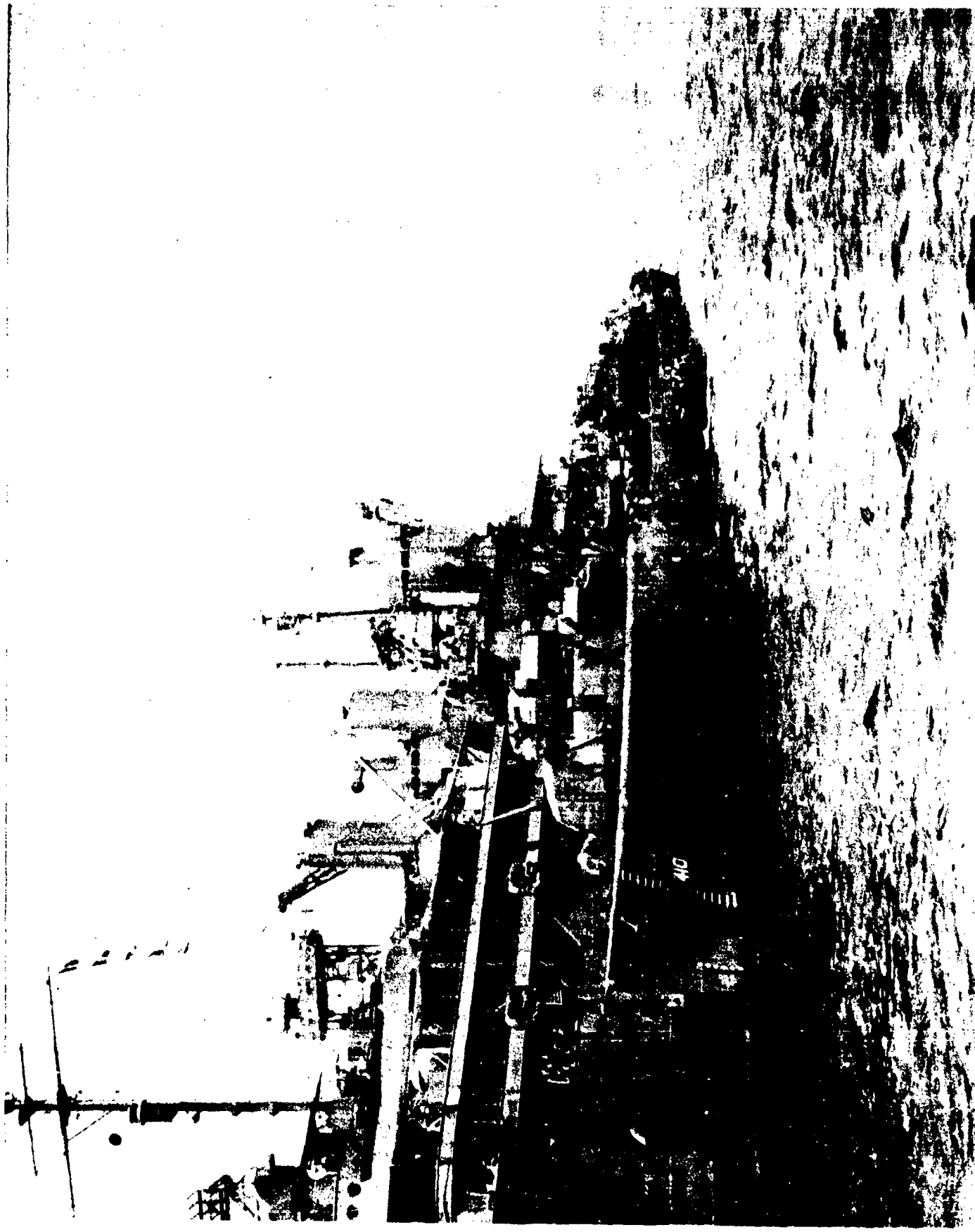
PHOTOGRAPHS

TEST ABLE

BA-CR-196-163-17. General view of port side before Test A.

BA-CR-196-163-18. General view of starboard side before Test A

AA-CR-227-49-85. Bow after Test A.



AA-CR-227-49-84. Port bow after Test A.

AA-CR-227-49-82. Port beam after Test A.

AA-CR-227-49-86. Stern after Test A.

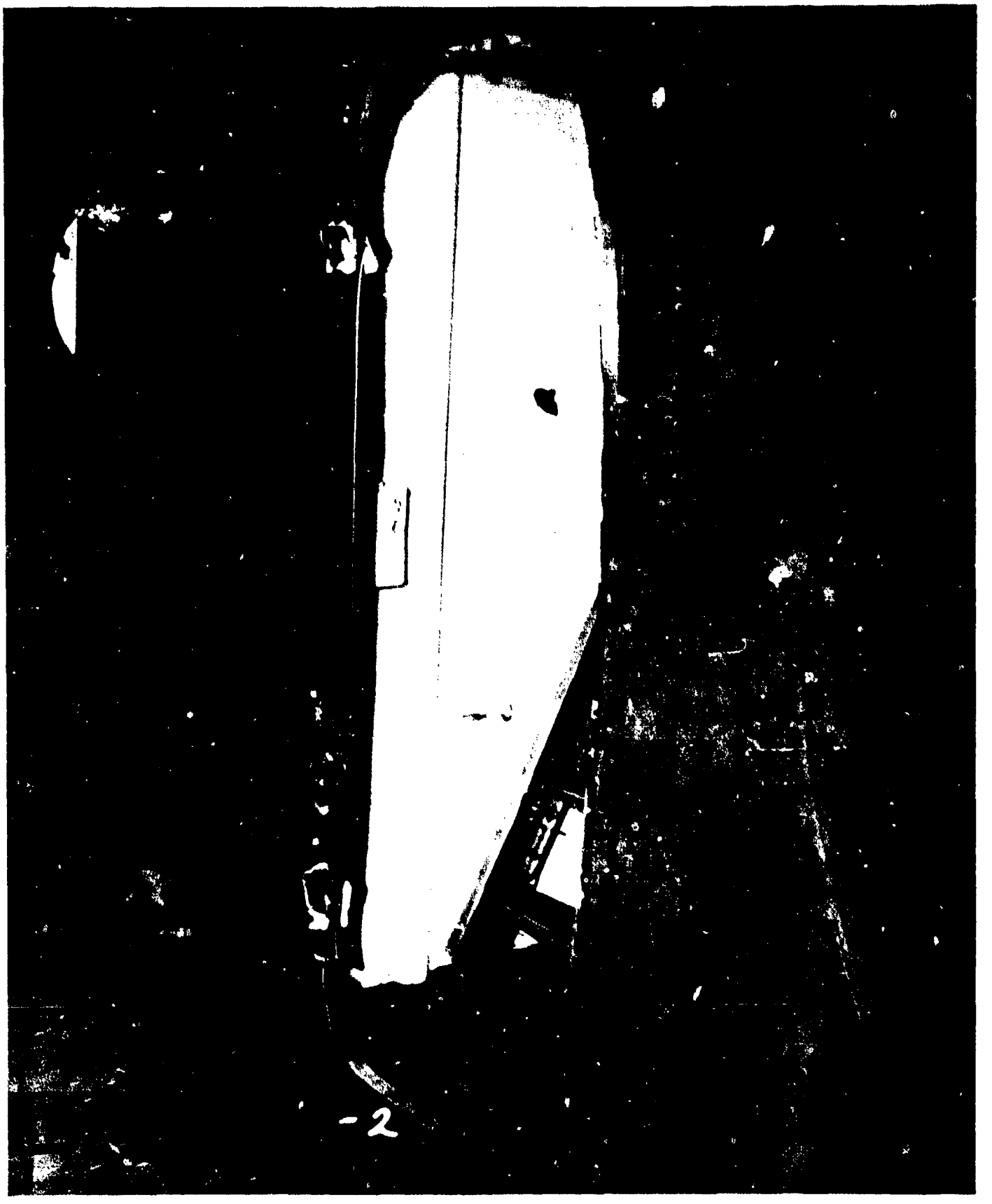
AA-CR-80-1898-5. D-204L. Damage to main deck longitudinals at after side of bulkhead 173, looking to starboard and forward.

AA-CR-80-1898-6. C-204L. Damage to web frame 179, starboard, first platform. Looking aft in crews quarters.

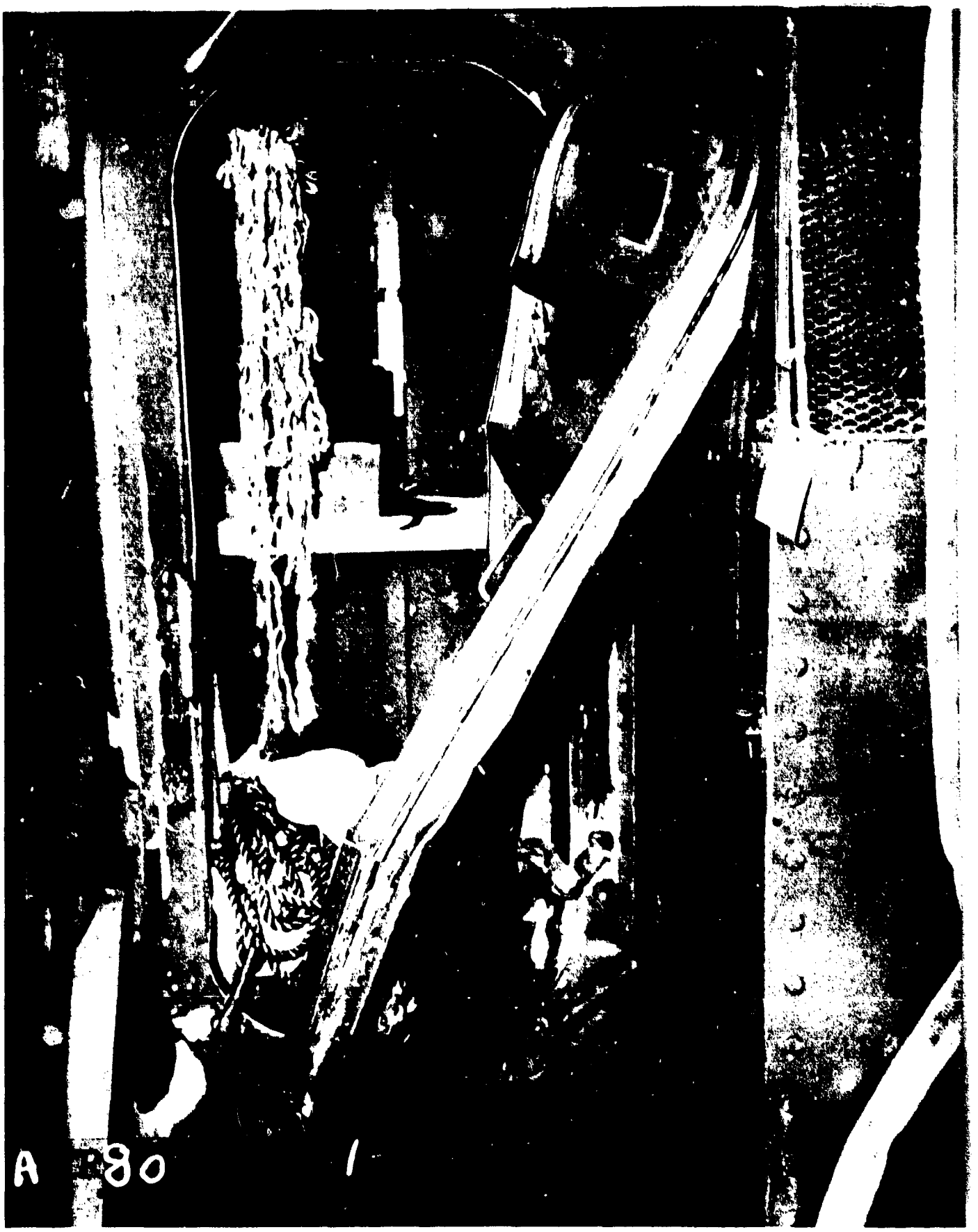
AA-CR-80-1898-4. C-204L. Buckled stanchions at frame 175 between main deck and first platform. Looking to port in crews quarters.

AA-CR-80-1898-3. C-204L. Deck displacement scratch gauge located at frame 175, centerline, between main deck and first platform.

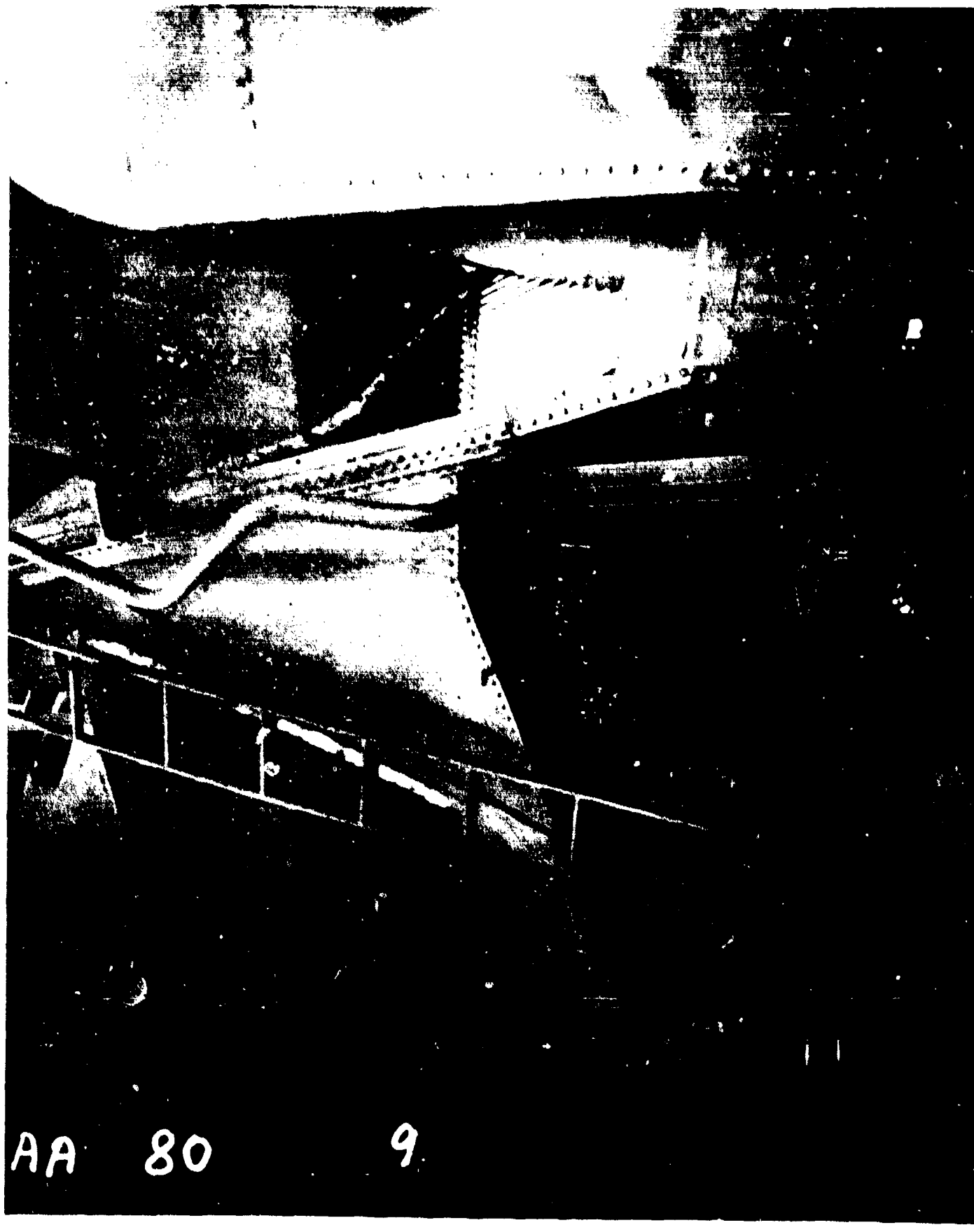
AA-CR-100-2198-4. Looking up, to starboard, and slightly forward to bend in foremast.



AA-CR-80-1898-2. Damage to door frame in transverse bulkhead 67, centerline, forecastle. Access to passage A0106T. View looking forward and to port.



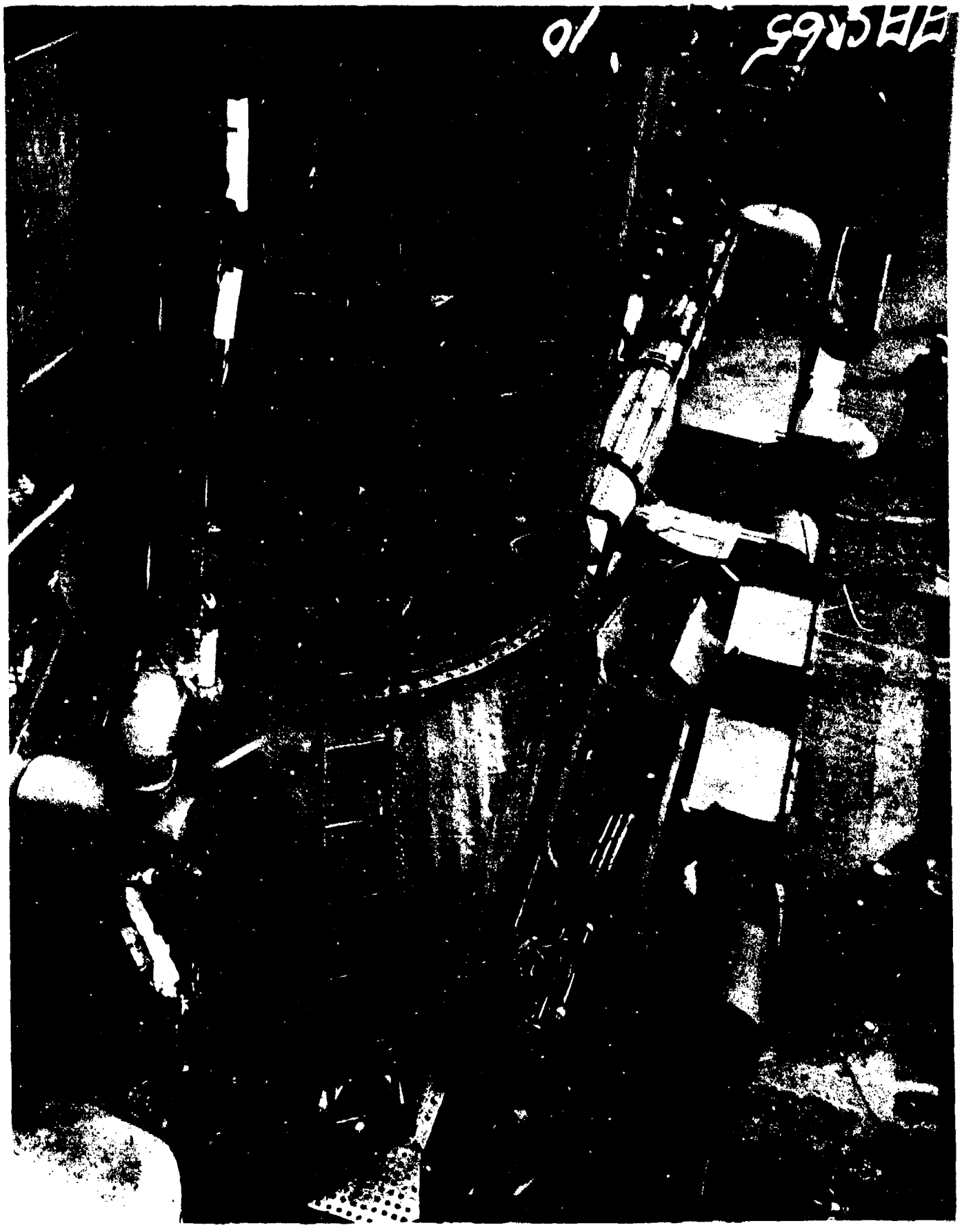
AA-CR-80-1898-1. Damage to door of deck gear locker B-101-A. Main deck, frame 70, starboard, looking inboard.



AA-CR-80-1900-9. Looking forward and to starboard at damage to port side of forward uptake. Note failure in stack breeching.

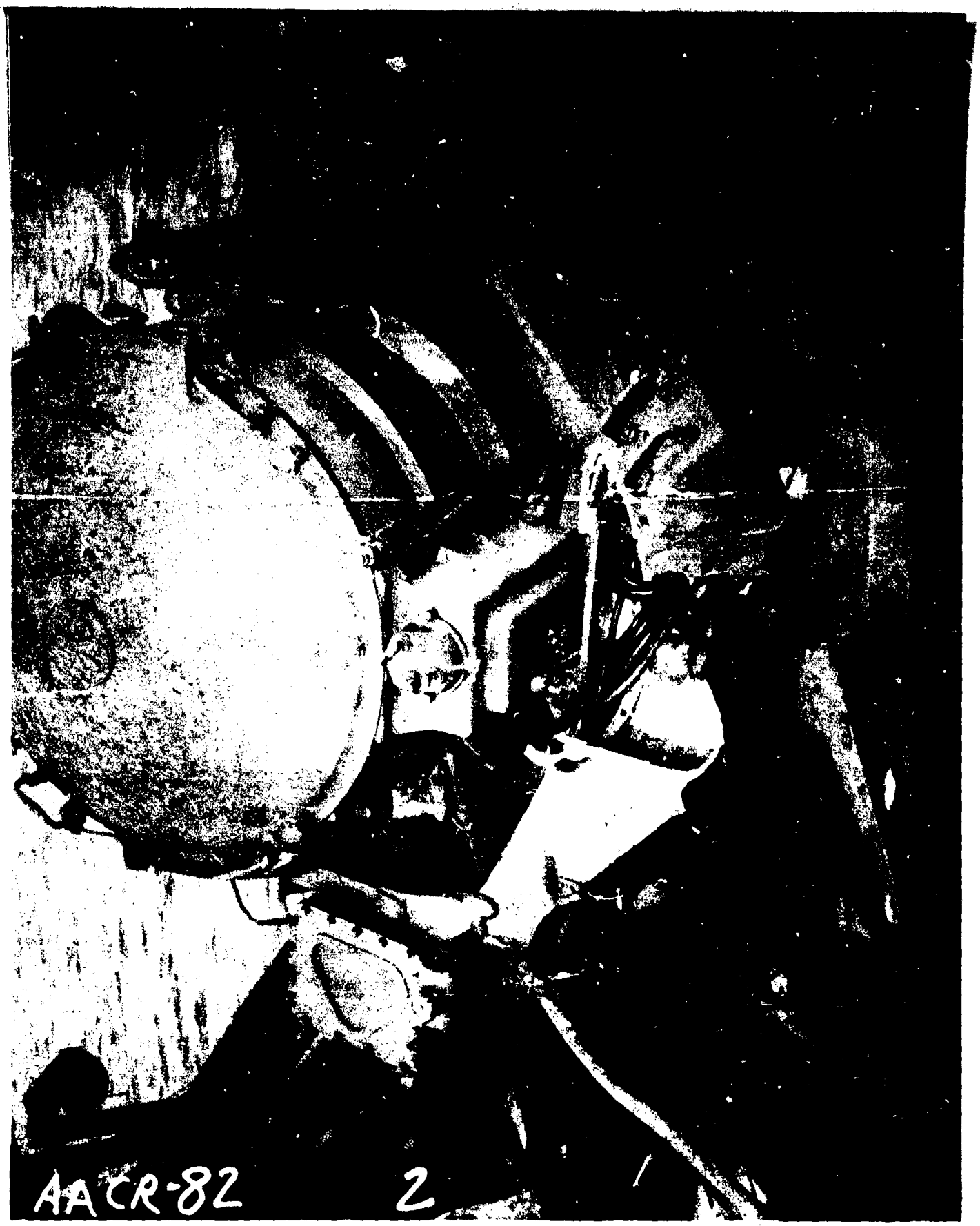
AA-CR-68-1748-2. Damage to starboard uptake of boiler 3.

AA-CR-80-1898-8. Looking forward and to port at damage to top of uptake breeching from boiler 3.

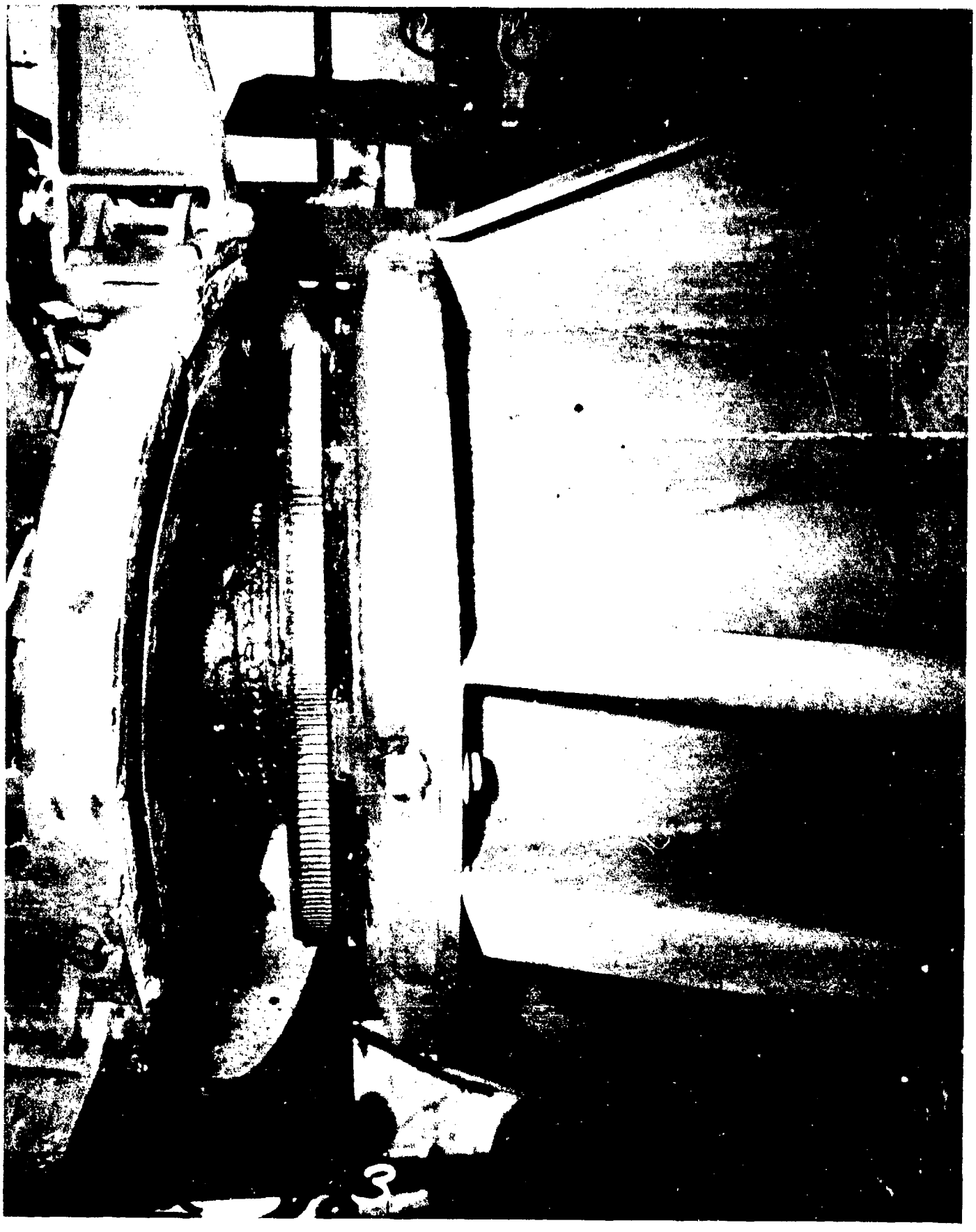


AA-CR-65-1849-10. Compression wrinkles in forward port quarter of stack.

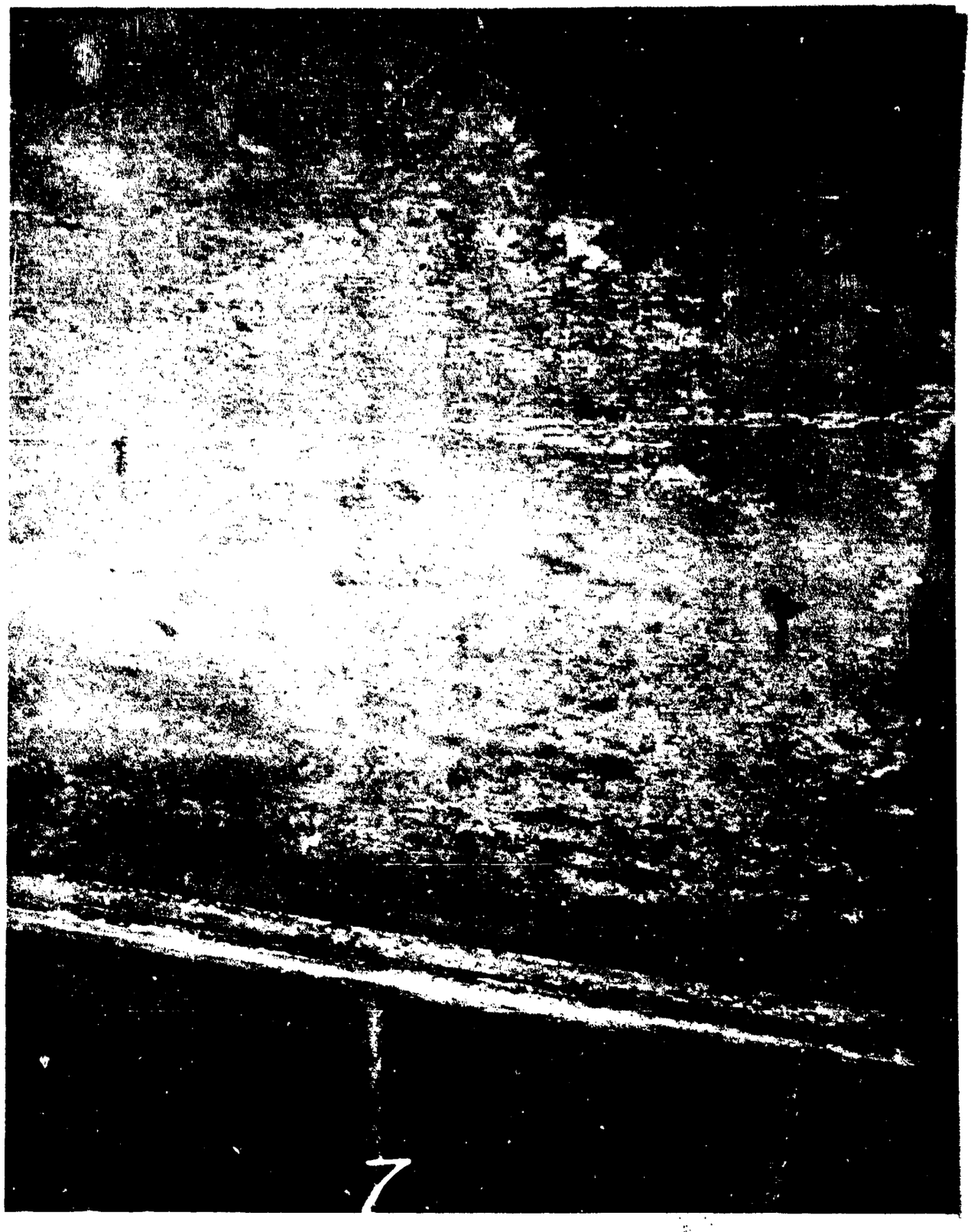
AA-CR-68-1747-10. Port after sector, of stack, looking forward and to starboard.



AA-CR-82-1915-2. Damage to cast aluminum yoke of starboard 36'' searchlight, frame 139, looking forward and to starboard.

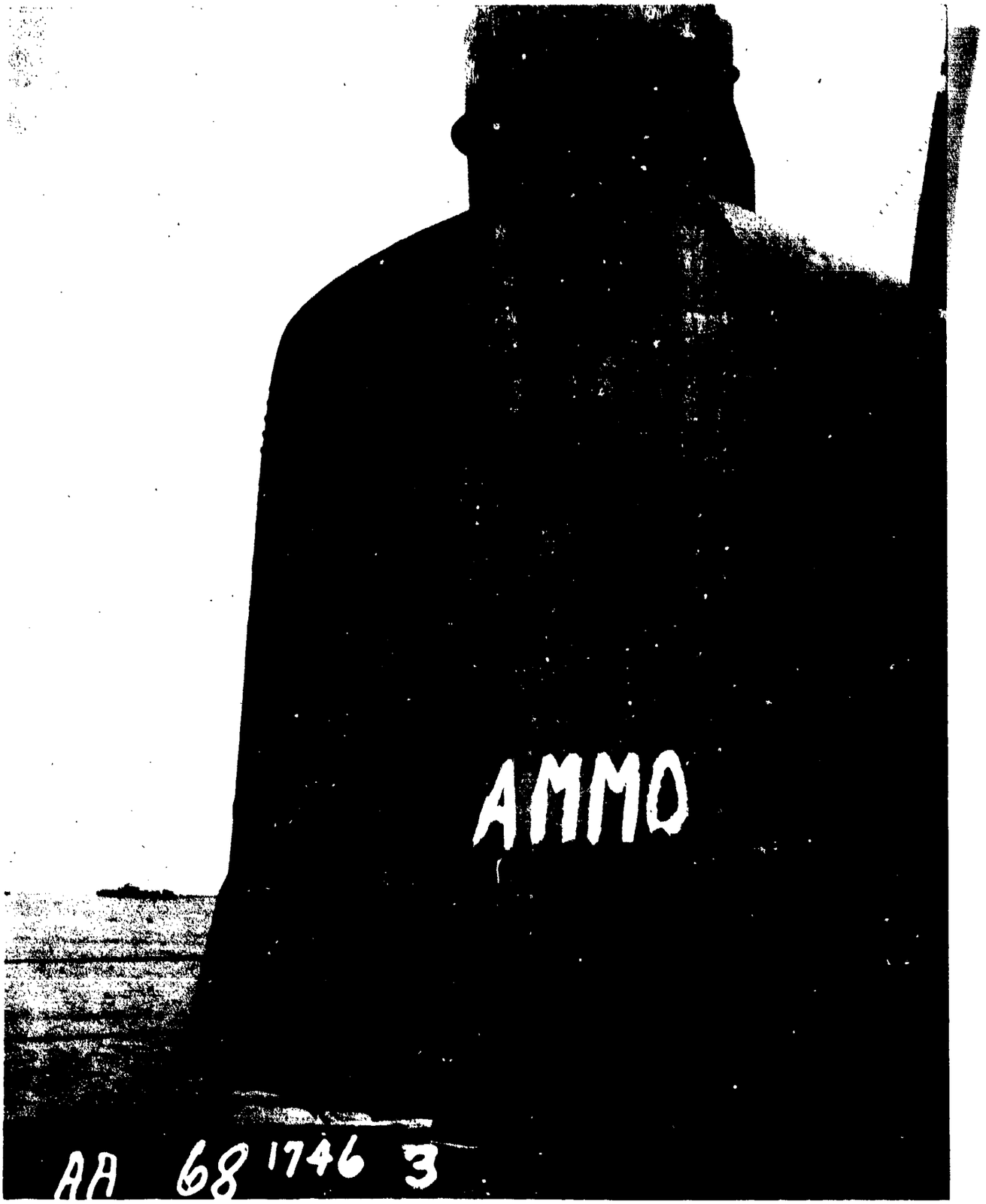


AA-CR-82-1915-3. 36" searchlight mounted at frame 139, shows damage to the base mounting arrangement. Picture taken looking to starboard.

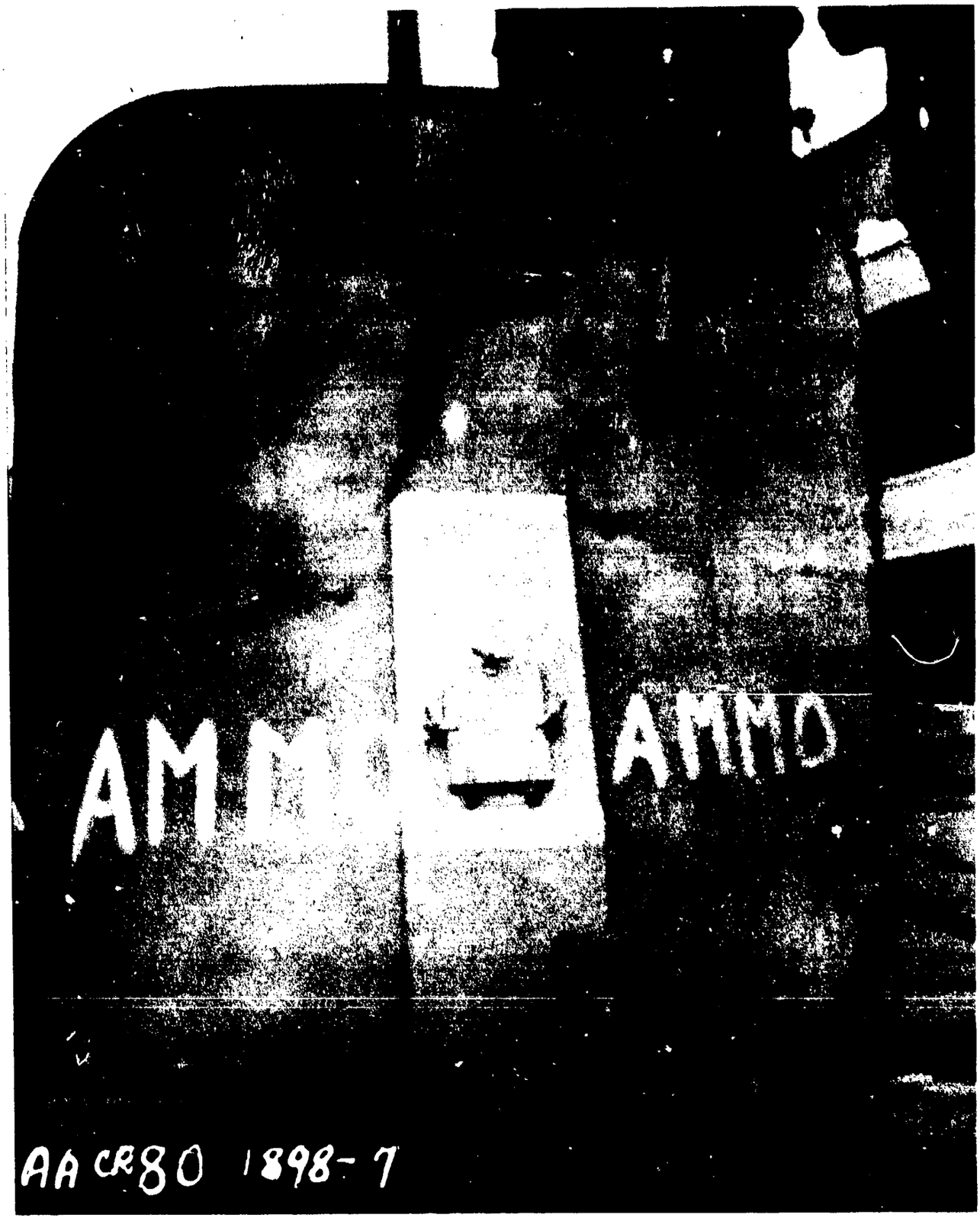


AA-CR-65-1849-7. Typical blistering of paint on deck house bulkhead. Frame 160, Port.

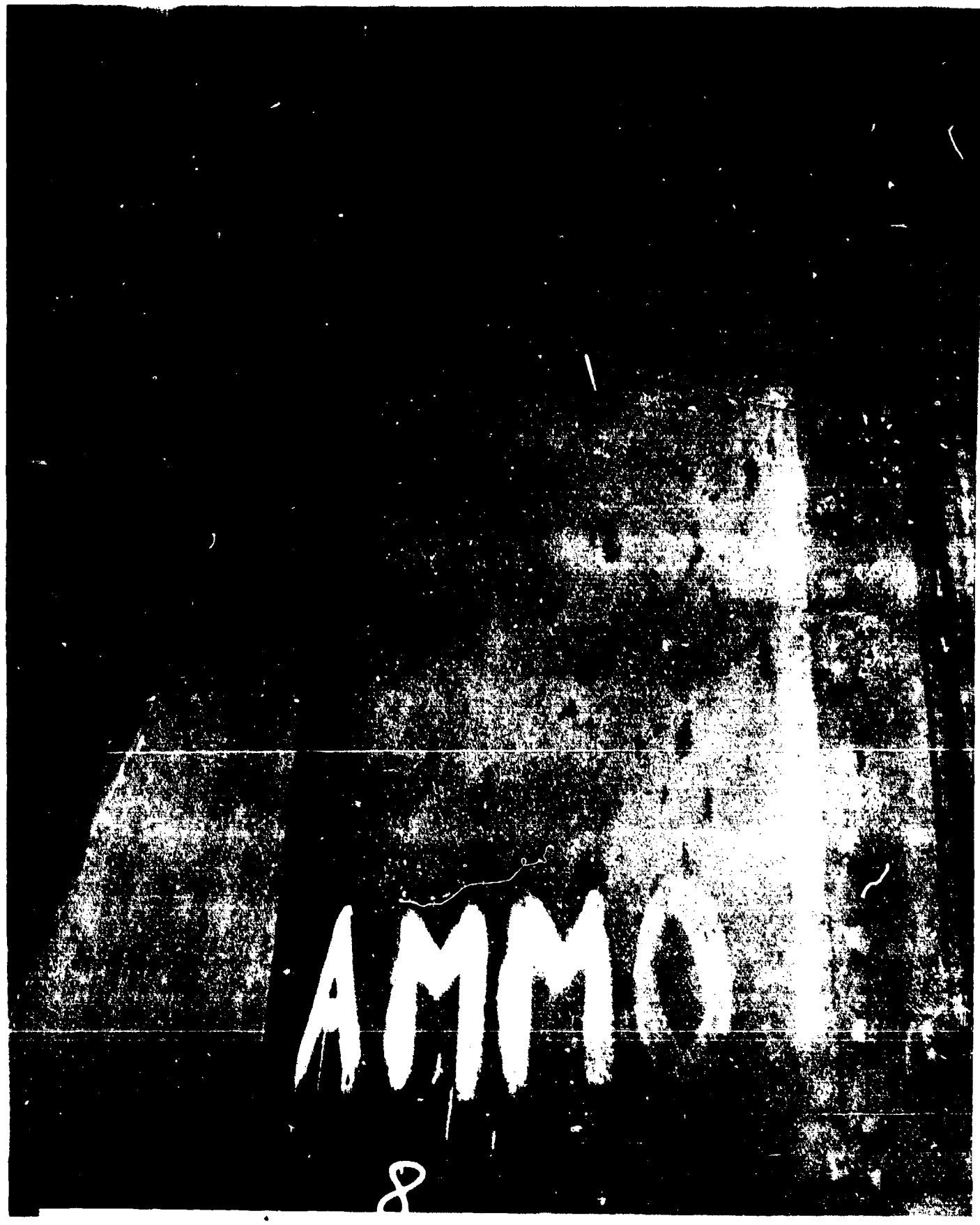
AA-CR-65-1849-9. Scorched paint on bottom of life jacket lockers, forecastle, frame 67. Heat was apparently reflected from aluminum deck plating below.



AA-CR-68-1746-3. No. 1 mount, dishing of rear plating.



AA-CR-80-1898-7. Damage to back plating of No. 1 gun mount.

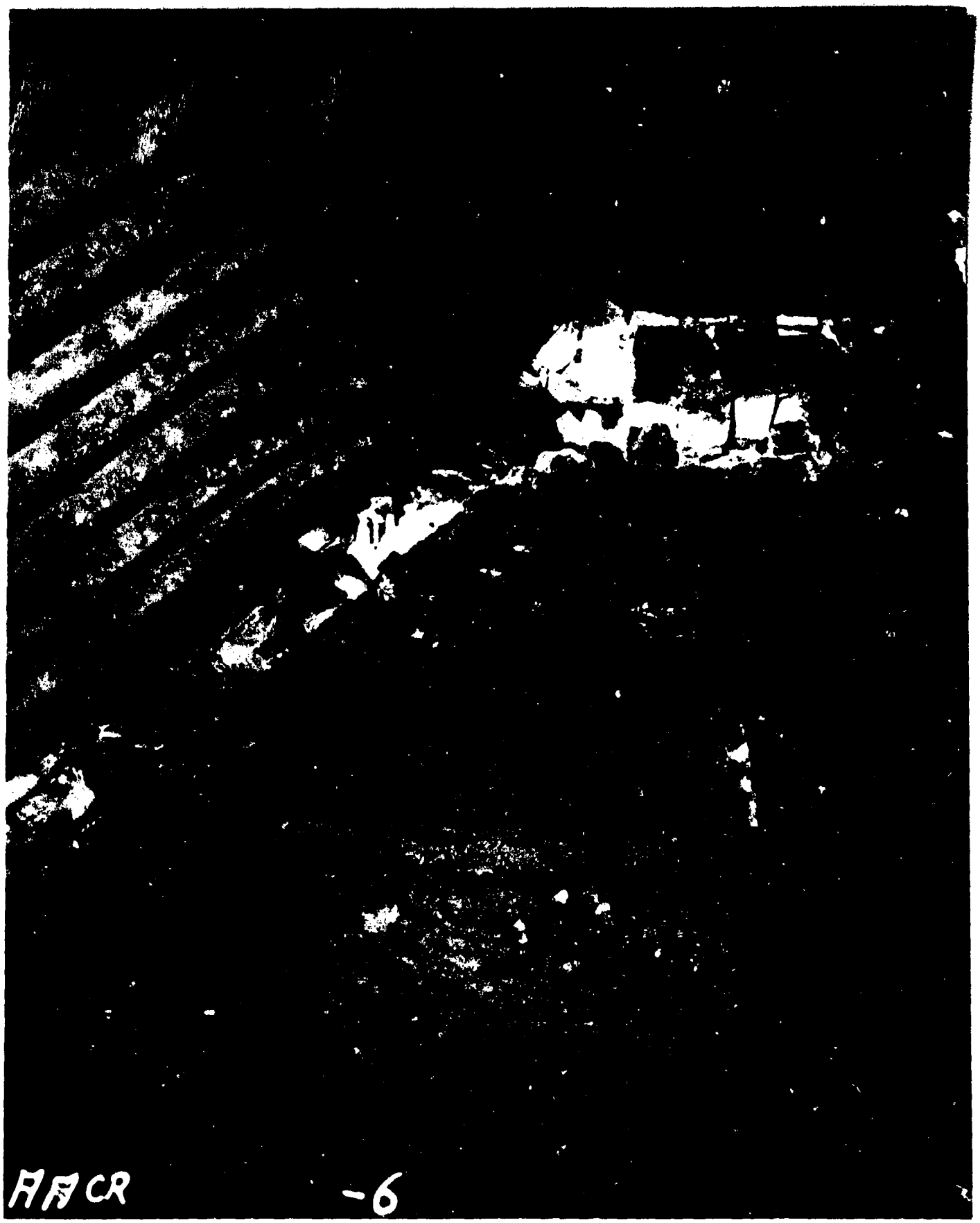


AA-CR-65-1849-8. Blast damage to back of gun mount 4.

AA-CR-62-1875-4. No. 1 boiler near casing tie bars, and ruptures in outer casing.

AA-CR-62-1875-5. No. 1 boiler rear casing tie bars, and ruptures in outer casing.

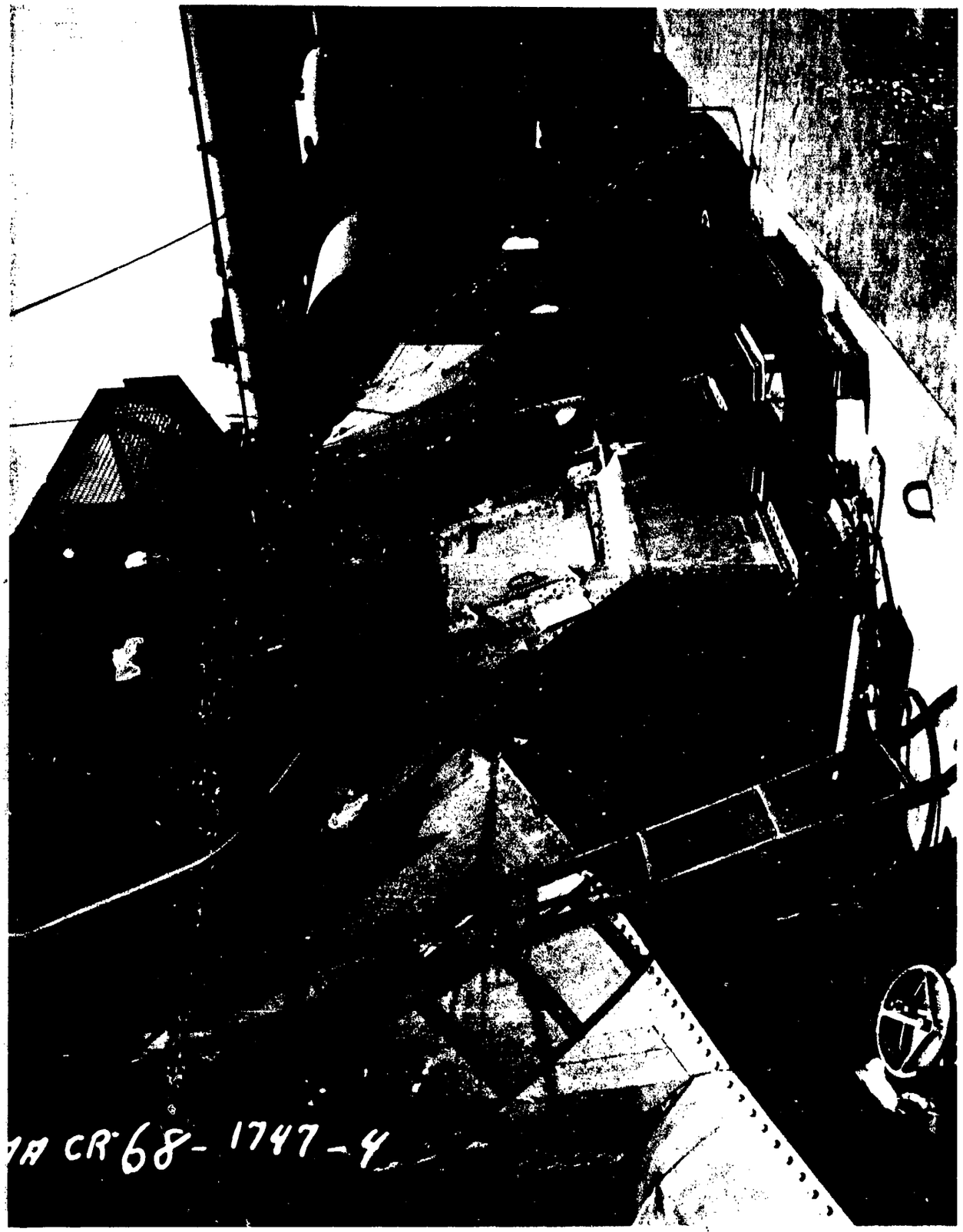
AA-CR-68-1747-5. Ruptured inner and outer casing under steam drum rear of No. 2 boiler.



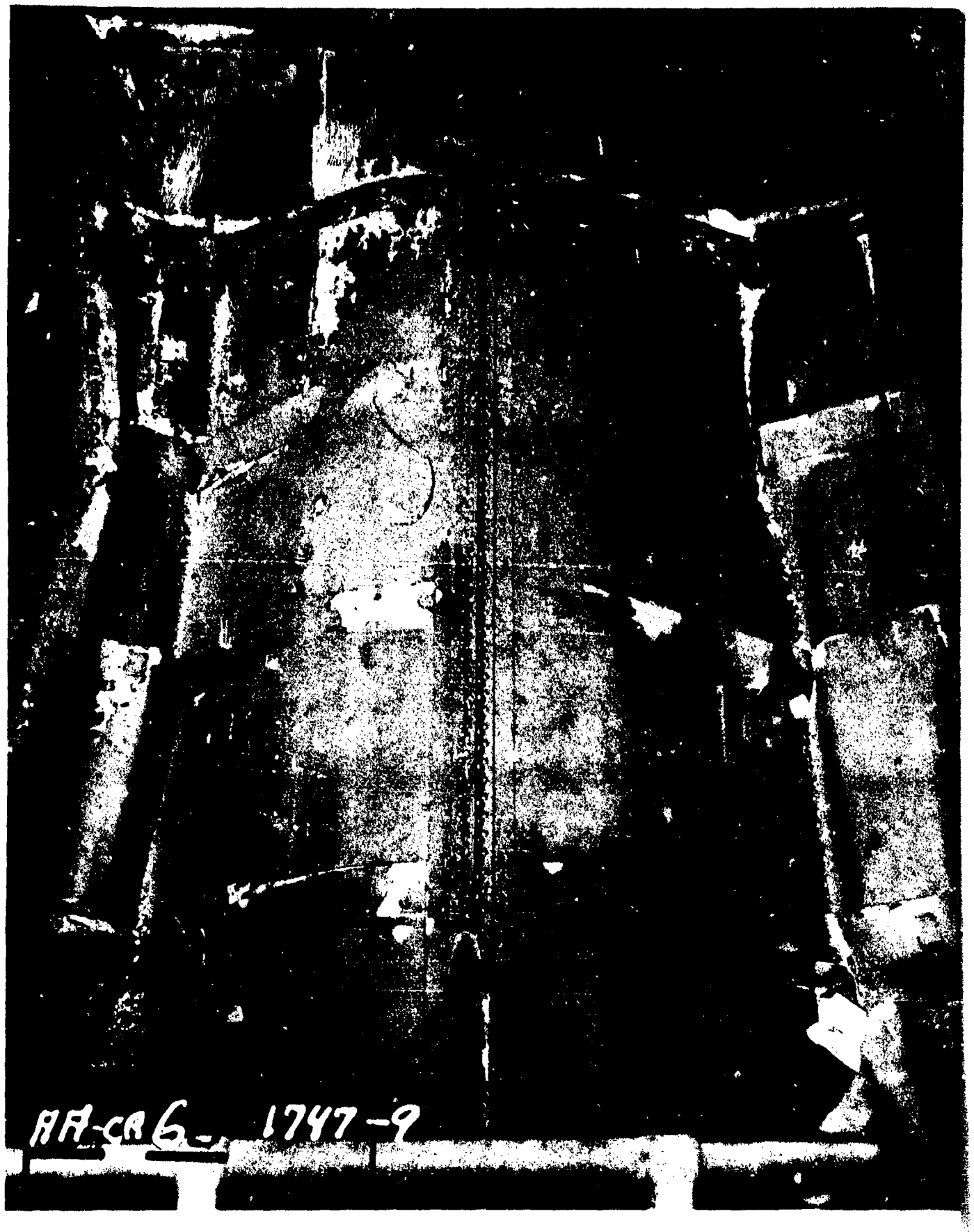
AA-CR-68-1747-6. Inside of fire walls of No. 1 boiler.

AA-CR-68-1747-7. No. 1 boiler, inside of fire box.

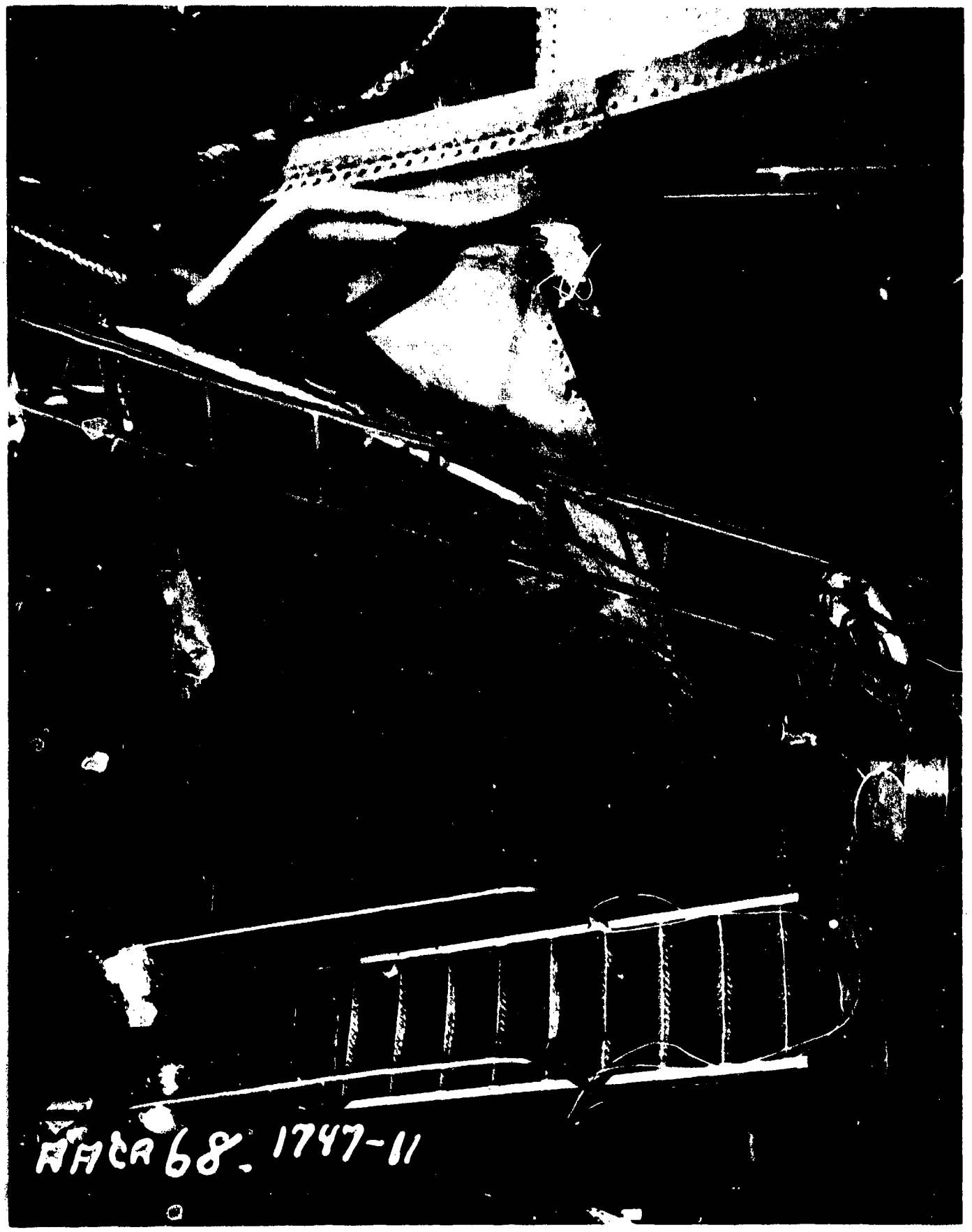
AA-CR-62-1875-6. Bottom of outer casing, forward uptake, No. 1 boiler.



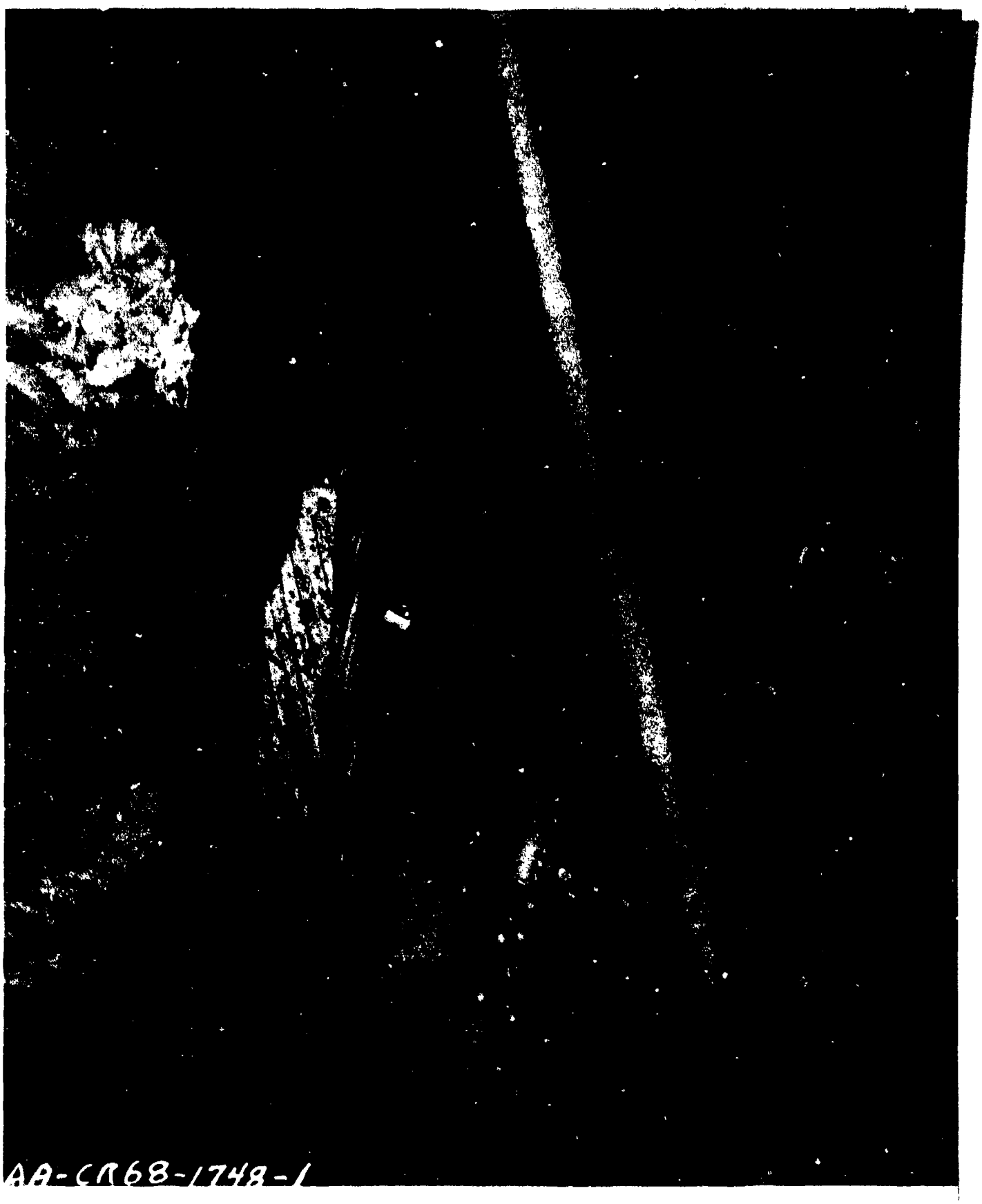
AA-CR-68-1747-4. Breeching, forward and center leg, port side.



AA-CR-68-1747-9. Top of breeching from after torpedo tubes.



AA-CR-68-1747-11. Forward breeching, port side, center of stack.



AA-CR-68-1748-1. Stack base from starboard.

AA-CR-80-1900-11. Top of after breeching.

AA-CR-82-1830-12. Floodlight mounted on the starboard side of superstructure deck at frame 69. Shows damage to the floodlight. Picture taken looking to starboard.

APPENDIX

SHIP MEASUREMENT DIAGRAM

TEST ABLE

SHIP MEASUREM ENT DATA

The readings of deflection scratch gages installed to measure movement of the weather deck are on page 89.

SECRET

DECK DEFLECTION GAGES

SHIP DD 410 TEST A

LOCATION			MAXIMUM	MAXIMUM	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄	COMP.	EXP.	DISTANCE	EXP. / COMP.	
9 1/2	MAIN	℄	1/4"	0	0	0	
20	MAIN	℄	1/2"	0	0	0	
32 1/2	MAIN	℄	0	0	0	0	
159 1/2	SECOND	℄	0	0	0	0	
172 1/2	SECOND	℄	0	0	0	0	
175	SECOND	℄	2 1/2"	0	1 9/16"	COMP.	

APPENDIX

COMMANDING OFFICERS REPORT

TEST ABLE

COMMANDING OFFICER'S REPORT

PART A - GENERAL SUMMARY

I. Target Condition After Test A.

(a)

Draft	Fwd.	Aft
Before	12'6''	13' 0''
After	12'6''	13' 0''
List	Before 2 Degrees Starboard	After 2 Degrees Starboard

There was no flooding in this vessel.

(b) Structural Damage.

The mast was bent forward about 12 degrees. The after stays were broken at the shackle. All halyards were down, and all antennaes were broken. CRS doors in superstructure aft, at break in deck on both sides, and 8 in midships deck house on both sides were smashed in or sprung. The only ports damaged were two in the pilot house. The downward component of force applied to blast tower just aft of #4 gun mount, caused compression of the main deck and distortion of longitudinals, crinkling of frames in after living compartment. Three tanks tops bulged slightly (less than 1'' max). There was no other damage to hull.

(c) Operability.

All machinery was in normal operating condition. The main engine leads on forward and after bearings of LP turbine in forward engine room showed about .005 compression. Leads taken after test were normal, and machinery operated in normal manner, Compression was slightly greater on the starboard side.

Inner boiler casings were ruptured and bulged. The uptakes were ruptured and dished. Brick work was damaged. Forward and rear walls were pulled away from stud wall, and the inner casing was pulled loose from mud and steam drums. The brick work was still secured firmly to casing, but the entire assembly was laid back on a slant amounting to 6 to 10'' at the top.

There was no electrical damage of any note. Several light bulbs were broken by flying missiles.

Ship control was unaffected. Fire control antennae on main director were demolished. The Searchlight was demolished. All other fire control gear was in normal operating condition. Except for frozen filters on MK14 sights, sights operate normally.

Gunnery: Gun shield on #4 and #2 and #1 5'' gun mounts were dished. #4 shield was distorted on the after side. All guns operate normally in manual and in power.

Electronics: SC antenna is missing, but otherwise gear works normally. SG operates normally. All radio antennae on the mast were bent and/or twisted but operating. All other radio receiving and transmitting antennae were broken. The gear itself is all in normal operating condition with no broken tubes or evidence of damage. The MK22 modulating unit in the director was damaged and had to be replaced. One tube in the director was knocked out but not broken. No other damage occurred to director radar.

(d) Heat.

There is evidence of flash scorching of fantail, midships and forecastle except where shielded. The overhead of the forecastle deck aft of superstructure directly over the bright sheet aluminum is blistered and charred. One mattress used as chaffing gear on the fantail burned up and manila lines, fur specimens were slightly singed. Magazines, ready box and handling room maximum thermometers show negligible change in normal temperatures. Rubber, canvas gun bloomers, cotton hoses, and paint were scorched.

Fires: One chaffing mattress on fantail burned up. There were no other fires. It is estimated that about 20% of personnel topside would have been killed or seriously injured due to jar in being thrown to deck or against bulkheads and from missiles. All hands topside not protected with flash clothing might have suffered flash burns. All would have been scared, deafened and blinded. Radio activity might have caused considerably greater casualties topside, but not prior to completion of operation. Men below decks and in gun mounts would have suffered less than 5% casualties. This command knows very little about radio activity and it's effects. However, animals seem to have lived for a considerable while and though there may be lingering death, all information we have indicates personnel could have continued to fight the ship. The blast was a build up pressure to a maximum estimated as not greater than 15 pounds per square inch and then a gradual receding. This would have knocked personnel around, but would not have produced concussion or internal injuries directly.

II. Forces Evidenced and Effects Noted.

(a) Heat was from about 195 degrees relative or about 280 degrees true. It extended from bow to stern showing greater intensity at extreme bow, extreme stern and amidships. The areas between were less affected. All scorching showed evidence that heat was of flash nature. Rubber, canvas, paint and manila lines were scorched. Paint was blistered on the overhead of the forecastle deck directly above the bright aluminum non-skid deck aft of superstructure.

(b) Fires and Explosions.

One mattress used as chaffing gear on fantail burned up.

(c) Shocks: None.

(d) Pressure was in general from aft, but it affected both near and far sides of the ship almost equally. The gun shields on 5" guns, top of amidships deck house after part of superstructure (particularly at the break in the deck) and boiler casings were areas

most affected. Wherever the force was pocketed, it took the path of easiest resistance and smashed WT doors. The mast was bent forward 12 degrees and antennae stays and halyards were torn down.

Failures in almost every case were as from a big push, the weaker parts being pushed in, the slightly stronger withstanding the blast. Rivet Aluminum door frames were sheared and quick acting doors were blown in, but suffered less damage than dogged, light weight doors. Heavier doors were uneffected.

(e) Any effects apparently peculiar to the Atom bomb: The main apparent difference is the lack of normal pressure vacuum effect. Everything damaged was pushed in. There appears to have been no shock wave. Merely a build up of a pressure wave which died off gradually. Light bulbs, tubes and gauges were not broken, and there was no evidence of inertia damage.

III. Results of Tests on Target.

(a) Effect on propulsion and ship control: The only damage was to the boilers, all three of which were put out of commission by bulging the inner casing and laying it back 10" from mud and steam drums, and causing the brick work to open up leaving gap between forward and after walls and stud wall. All machinery and ship control was otherwise normal.

(b) Effect on gunnery and fire control: The MK22 and MK4 antennae were damaged and unusable. The filter on MK14 sights were frozen. Otherwise all fire control and gunnery equipment operated normally.

(c) Effect on WT integrity and stability: WT doors in superstructure and midships deck house were demolished, damaged and dished. WT integrity below weather deck and stability were unchanged.

(d) Effect on personnel and habitability: It is estimated that about 25% topside and 5% below decks would have been immediate personnel casualties. The effects of radio activity would undoubtedly have killed others in time. Living conditions were unchanged.

(e) Total effects on fighting efficiency: The ship was immobilized due to boiler casualties but otherwise was able to perform all functions. The boilers could have been steamed using closed fire room as an emergency measure.

IV. General Summary.

Damage other than to the boilers was slight. If the ship had been headed in a direction such that the main force of the blast had not gone directly down the stack, it is felt that the fighting efficiency would have been impaired no more than by a near miss if as much.

The roll of the ship as recorded by the inclinometer on the bridge, was 34 degrees to starboard and 13 degrees to port, indicating considerable breaking effect by the blast on the return roll.

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

WT doors must be of greater strength and door frames should be welded rather than riveted and supported by strength members as close to knife edge as possible. At least three hinges would add some strength. Some method such as a check or flapper valve in the stack to close when subjected to greater pressure than in the furnace should be employed. This valve on closing would cause flare back and might extinguish fires if the duration of the blast were long enough, but it is felt that the flare back would be less than if full effect of the blast were received in the fire box. There is a possibility, the flare back would be between boiler casings and might not seriously injure personnel in fire room. There should be two stacks with easily operated stack cover on boilers not in use. Door frames that had been strengthened by webs every six inches or so held up well and the doors were only dished slightly. This system is recommended as it is believed all doors would have withstood the blast if the frames had been so strengthened.

COMMANDING OFFICER'S REPORT

PART C - SECTION 1 - HULL

A. General Description of Hull Damage.

(a) Overall condition of the vessel was good. There was relatively light structural damage with rather extensive superficial topside damage.

(b) Hull damage was confined to compartment C-204-L.

(c) Hull damage was caused by dishing in of main deck #4 gun mount and forward of the blast tower. It is the opinion of this command that this buckling was due to the downward component of the force acting on the blast tower which was facing aft and which is itself an extremely heavy contraption for which no additional strengthening or support of the deck was added. The only hull damage below the main deck occurred in the compartment immediately below. The frames in the compartment were crinkled slightly at the web. Stanchionswere bent and the scratch gage showed that the deck was compressed a maximum of 5 9/32" and that it settled with a permanent compression of 1 3/32". Damage was strictly limited to the one compartment, C-204-L. There is absolutely no evidence of any stress or strain below, forward or aft of this compartment.

(d) There was no flooding at all.

(e) Residual strength of the hull other than the weakening of the mast and loss of stays which will be mentioned in next section.

B. Superstructure.

(a) Description of Damage:

1. Damage to bridge area was principally to light joiner work, lockers, and doors on the port side. Flag bag and lockers on exposed positions were demolished and blown inward.

The guard rails were deformed and paint slightly scorched. The mast was bent forward about 12 degrees. The two after guys tore loose when the pin securing them to the mast carried away. The after side of the mast shows tension and the forward side, compression. The bend is uniform. The antennae on top of the mast was blown off, and all horizontal radio antennae was broken. All halyards were burned and blown off.

2. Midship deckhouse and stack showed marked damage. Uptakes were collapsed by the pressure on both sides, top, and bottom, and the stack proper was dished on the port after quadrant, with compression wrinkles in the forward side. The funnel cap was uniformly crinkled on all sides and the top edge pushed in. The door in the port bulkhead of the midship deckhouse and it's frame which was secured to aluminum bulkhead were torn off and blown into the torpedo shop. The inboard aluminum bulkhead of the torpedo shop was blown free shearing rivets along three edges, and forced into the electrical shop. The starboard door was dished in and deformed, apparently from distortion of bulkheads and structural members. In this case bulkheads door frames, etc. were all steel. The overhead in the machine shop was forced downward and retains some deformation. Paint on port side of this general area was scorched. The main mast was broken off just below the yardarm.

3. After deck house and tower: Damage to this portion of the ship was limited to two doors port and two doors starboard, slightly dished, one bulkhead on the after port side (aluminum) dished a negligible amount. The gun shield around the port 40mm mount was partially collapsed as was the shield aft of the 20mm mount. The searchlight was demolished. Paint in this general area was scorched lightly on top and port side surfaces.

(b) Causes of damage in all areas was due to a pressure wave estimated as somewhat less than 15 lbs. per square inch. This pressure wave appeared to be a built up pressure which died off gradually leaving no evidence of shock or vacuum effect. There was one instrument, a PCE speaker located on the bridge level in which the air tight, watertight case was bulged outward on all sides. All

other evidences indicate only application of pressure on outside which collapsed doors.

(c) There were no evidences of fire in the superstructure. Paint is slightly scorched, the most scorching being on the overhead directly above the bright aluminum deck just aft of superstructure or forecastle deck.

(d) Light plating often resisted the blast where shielded (ie, ready boxes which are shielded by heat shields - these in some cases were blown off, but apparently they protected the ready box proper enough to prevent dishing) or where backed by structural members placed relatively close together (ie, bridge bulkheads). In other cases, 5 lb. steel plate was badly dished, 7-1/2 lb. plate slightly dished, 10 lb. plate intact. Rounded surfaces resisted blast while flat surfaces nearby were dished. Mild steel doors on bridge and the few other cases in which mild steel and STS were used for similar purposes, the mild steel held up about the same or a little better than the stainless, but was much thicker and heavier.

(e) Constructive criticism of superstructure design or construction: It is recommended that door frames be made stronger and be better secured to bulkheads with strength members as close as possible to the knife edge. It is felt that if the frames had held up, the doors would not have been demolished. The superstructure must be rounded so as to produce a streamlined effect, and all recesses in deck and superstructure should be eliminated as far as possible. The pressure wave appeared to be in the form of a big wind which flowed around some objects but when pocketed would blast out through the weakest section, in most cases the doors. Door frames that had web strengthening held up well and doors in these cases withstood the blast.

C. Turrets, Guns and Directors.

(a) Protected mounts: The general condition of the three enclosed 5" gun mounts was good. The after side of #4 gun shield was distorted due to compression. Other sides of this shield and sides and rear of guns #1 and #2 were dished slightly. All guns operate

normally. The gun shields would have provided excellent protection for personnel and did protect the mechanisms inside. A few rounds of projectiles were thrown to the deck but not damaged. Bloomers were ripped and torn off.

(b) Unprotected mounts: #3 5" gun and all automatic weapons showed slight scorching and evidence of pressure wave. The oil buffer on #3 5" gun had to be refilled. Otherwise all guns operated normally. Crews shelters would have provided little or no protection against the wave. The pressure itself was not sufficient to cause injury to personnel. The impact of the pressure wave, while not a shock effect, would have knocked men down at which time shelters would have provided some small protection. However, dark glasses, ear plugs and flash proof clothing would have been essential. Some type of head gear such as boxers practice helmet might have proved beneficial.

(c) Director and range finders: The director itself was unharmed. The radar antennae on top of the director, MK22 and MK4, were smashed, but when the antennae were disconnected the director operated normally. Bloomers were blown off the range finder but there was no damage to optics or any other instruments or mechanisms in the director. MK51 directors were scorched but operated normally.

(d) Constructive criticism of design or construction of mounts, directors, etc. Radar antennae must be strengthened. The only antenna to survive the blast intact was the SG. Wires on frame antenna were all demolished. Protection of personnel against radiation, flash burn, light and noise are considered important, as these are the main dangers that affect the efficiency of the crew. Personnel so far away as to scarcely feel the blast would have been deafened, blinded and flash burned, and it is assumed, affected by radio activity though perhaps not immediately. The 20mm has almost outgrown its usefulness; and against an enemy carrying atomic bombs, it is felt that lightly enclosed 40mm mounts will offer the best solutions. All mounts should be rounded or streamlined to reduce effect of pressure wave which showed a marked tendency to dish any flat surface encountered and to flow around curved or streamlined areas.

D. Torpedo Mounts. Depth Charge Gear.

(a) Torpedo mounts: The mounts showed signs of a flash scorching effect but were undamaged. Stop mechanisms and trainers stations were untouched. The top of the main mast fell on the after mount but did not damage it. Spoon extensions offered some protection from blast and scorching, but even where unprotected the warheads were undamaged. The air flasks were amply protected. They lost no pressure other than normal.

Constructive criticism: The training station would be better located in the mount foundation or a modern ball turret protection in present location as operators might well have been blown off mount and seriously injured. There is no special protection offered depth charges and apparently none needed. No recommendations in regards to location, design or construction of DC or racks.

(b) Depth charge gear was in excellent shape. Paint on charges showed slight scorching but charges were undisturbed and stowage unharmed.

E. Weather Decks.

(a) General condition of the weather deck is excellent. There is a small tear about 4" long in the forecastle deck where a life jacket stowage box from the director deck was blown off and landed on a corner on the forecastle deck. The deck aft is dished downward slightly as noted in Item A, due to downward component of force applied on blast tower. The extreme bow and stern are deeply scorched. Midship section is slightly scorched.

(b) The deck is completely usable and not affected by conditions noted above.

(c) The equipment and fittings on weather decks are untouched.

1. Mooring and towing fittings intact.

2. Boats, rafts and gear: Untouched.

F. Exterior Hull.

(a) Exterior hull plating and fittings intact except for slight scorching of paint from forecastle aft on port side with burning taking place where paint had been chipped and flakes of paint were exposed. The sheer strake was untouched and no side armor is provided.

G. Interior compartments above water line.

(a) The only damage to the structure was to door frames and the main deck aft, as explained in Items A and B, and in the torpedo and electrical work shop as noted in B (a) 2.

(b) Joiner bulkheads were injured by outer doors tearing loose and being blown inward.

(c) All exposed weather deck doors were dished to some extent. Those that had web reinforced door frames only slightly dished, those that were secured to aluminum bulkheads without the webbing were demolished. The doors that were demolished showed a failure of the frame and knife edge allowing the doors to give way ripping out hinges, badly distorting doors, dogs, frames and knife edges.

(d) The equipment within compartments was untouched except in isolated cases where door failure caused flying missile hazard and by light locks, rivets, etc.

(e) There is general evidence of scorching, but the only fire was a mattress used as chaffing gear on the fantail which caught fire and burned up.

(f) Damage in way of piping, cables, ventilation ducts, etc. was minor. One section of vent duct in the starboard bos'ns locker was split and one elbow in the engine room vent system was blown off and one heating coil plate in superstructure knocked off, but in general the only interior damage to this type of equipment was from flying missiles and this was very limited. One mushroom vent duct which was secured with two bolts only was knocked off its foundation slightly.

(g) There was very little reduction in watertight integrity as all of the doors that were demolished were above the main deck level and compartments in this sector had very poor watertight integrity to start with. No below deck spaces were impaired even slightly. The compartments are all completely habitable although the absence of light tight doors would require use of red lights only at night. Utility of compartments after debris had been cleared up was unaffected. The two doors in the break of the deck being demolished it is possible for considerable water coming from aft to wash straight down into the after mess hall. These openings are being shored shut with the best of the damaged doors to prevent any such flooding during Baker Day.

H. There is no armor on board.

I. Interior Compartments below water line.

(a) There was no damage to below deck spaces except in compartment C-204-L where the overhead was dished downward, frames crinkled and stanchions bent as explained in Item A. No reduction in watertight subdivision, no flooding or other damage. Equipment in these compartments intact. Three midships fuel tanks had the tops dished upward slightly less than 1/2''.

J. Underwater Hull.

(a) Underwater hull was untouched.

(b) Buoyancy operability and maneuverability as affected by under water hull was undamaged.

(c) The ship got underway and shifted berths after repairs had been made to number one boiler, shafts, propellers, struts, rudder, and external keels are all undamaged.

(d) No damage to keel structure.

K. Tanks.

(a) Tanks in general were undamaged. The following tanks were dished upward a slight amount less than 1/2''. A-6, A-7 and A-8V.

(b) There was no contamination of liquid and no leaks.

(c) There is no torpedo defense as such in a destroyer, but tanks, bulkheads, and hull were untouched.

L. Flooding.

(a) There was no flooding whatsoever.

M. Ventilation.

(a) Damage to ventilation was slight. Vent system in Bos'n locker on main deck starboard side was split, an elbow in vent system of forward engine room was blown off. Vent system in engineering spaces was not closed as closures are not available. The inspection plate on a vent heater was blown off in the superstructure and one mushroom vent duct was disloged on the midships deck house. This duct was not properly secured originally. There was no detrimental effect on habitability.

(b) Ventilation systems in engineering spaces deposited dust and dirt in their areas, but in general heat blast fire or smoke conducted below by vent systems was negligible. As far as radio activity is concerned this command has no information.

(c) No flooding occurred. Therefore no progressive flooding.

(d) Some type of closure on engineering vent systems would have been desirable.

N. Ship Control.

(a) Bridge area was slightly damaged. Doors were dished and flagbags, rails, lockers, were demolished. One port in chart house was smashed. Port in port door was blown in. All signal halyards were burned and blown off. Mast was bent forward about 12 degrees. After guys of mast were broken at shackles. CIC was relatively undamaged. Metal door areas blown in due to blast. No material or operational damage to steering gear, gyro compass or interior communications.

(b) The lay out and arrangement of ship control system satisfactory and this command has no suggestion to make with the exception that visual signaling by flag hoist was completely demolished and it is felt that flags in the flag bag might have caught fire. The signal searchlight was dished in but still functioned normally. Personnel on the signal bridge would have been badly mauled by the blast.

(c) More adequate protection should be provided to secondary conn as exposed personnel on this station would have been injured and exposed to radio activity. The equipment however was intact. The bridge would have provided some protection for personnel stationed there but the number completely exposed should be reduced to a low minimum.

O. Damage to Fire Control Stations.

(a) The 5'' gun director and the MK22 and MK4 antennae badly damaged, however the gear inside the director was not damaged. Personnel casualties due to the pressure wave would have been low. Those due to radio activity unknown. The MK51 director stations, the automatic weapons positions and the crew on the open 5'' gun mount would have suffered some casualties from the blast and apparently 100% casualties from radio activity. There is no material damage to any of these stations. The filters on the MK14 sights were in some cases frozen, but all fire control equipment except for the two antennae were in excellent condition. Plot and protected spaces were absolutely untouched. In fact some of the gear worked better than before the test.

(b) All automatic weapons and control positions for same, searchlight, open 5'' gun, torpedo mounts, do not have protection for the crew. The equipment in these locations was undamaged, but the operating crews would have suffered some casualties from being blown about by the pressure wave and would have suffered 100% casualties from radiation, flash burns, blindness and deafness. Some method of protecting all exposed personnel is apparently the only solution. The pressure of the blast wave was not sufficient to cause damage to the human body and the wind would have knocked men down causing some

casualties but the brilliance of the light, the deafening effect of the noise would have caused a lot of panic and temporary casualties to all of exposed men, and the radio activity would have caused a high percentage of deaths at a later date or so we have been led to believe.

P.

(a) Ready service ammunition was in normal stowage at all stations in amounts equal to 2/3 of wartime allowance. Main battery projectiles were knocked off their racks when shield bulkheads were dished in and brackets broken. One powder case was thrown out of ammo hoist. 40mm and 20mm ammo was exposed except that usual amount of 40mm placed in 40mm shield stowage was not in place. No ammunition other than noted above was even slightly disturbed and no ammunition suffered any damage as a result of the blast. Paint was slightly scorched on depth charges but charges like the rest of the ammo were unharmed.

Q. All ammunition handling devices operate normally. None of them contributed in any way to the effect of the blast.

R. Strength.

(a) There was no evidence of a permanent hog or sag to the ship. The momentary whip was negligible. There is no evidence of shear strain transverse or racking strain, panel deflection or damage to any foundations of machinery, guns or any other equipment except the searchlight which was demolished.

(b) The main deck aft of #4 gun mount which is itself aft of the main keel, was sagged or dished downward. This was between the #4 gun mount and the blast tower and as mentioned before is believed due to the downward component of force applied to the tower. There was no additional bracing supplied for the tower which is of heavy construction.

S. No Comment.

COMMANDING OFFICEP'S REPORT

SECTION II - MACHINERY

After a complete inspection and operational test it has been shown that the machinery damage sustained from the atomic bomb test (Able) was very minor. The greatest damage was inflicted on the boilers and then limited to such items as brick work, inner and outer casings, uptakes and stack. The cause of the damage was due to the pressure wave in the air casing and firebox, entering from the outside through the force draft blower system and the stack. As to the continuance of operation, the problems to be overcome are these: Since the air casing was blown open, air pressure to the registers for proper combustion would be lost. How could this be overcome? This is within capacity of ships force, but requires time. It is obvious from observation of the ruptured and punctured air casing (all three boilers) that the plant could no longer be operated as an open fireroom unless emergency repairs to casings were effected. It is believed that this problem could be solved by securing the fireroom hatches and ventilation discharge ducts and running both forced draft and electric ventilation blowers. In this condition the whole fireroom would be under pressure with the only outlet being through the air registers resulting in a sufficient amount of air for combustion. This method has been partially used many times in lighting off a cold plant where there was no steam to run the steam driven forced draft blowers. The ventilation blowers having an electric drive receiving their power from the emergency diesel generator are operated with the fireroom hatches and vents secured developing enough air pressure to light off, about 3/4" of water. With the inner casing broken open there is a possibility of the fireroom becoming contaminated with combustion gasses to the extent where the operating personnel would be required to withdraw from their stations. It is felt that emergency operation could have been continued. After the test, #1 boiler receiving minor repairs, enough to light off and test the machinery. The inner casing was jacked back into place to the point where it could be welded to the mud drum. The outer casing was patched and replaced with sections taken from the air casing of boiler #2. There still exists a

gap of 8" between the stud tube wall and the rear wall. This condition allows hot gasses to flow from the saturated side to the superheat side passing over the superheated tubes. To protect the superheater tubes from burning out a continuous flow of steam is allowed to pass through them by leaving the high pressure drain on the superheater outlet open to the surge tank. We have been operating for a period of one week under these conditions and have gotten underway and shifted berths. From all this it is believed that the ship could have remained operating long enough to return to base with or without repairs that have been made.

BOILER #1

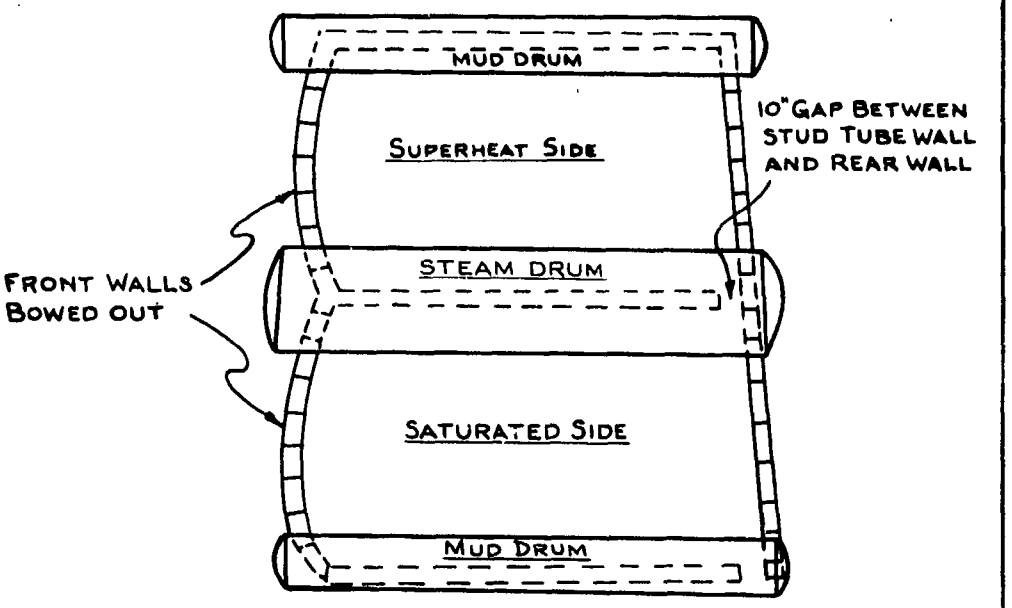
B. Boilers (S-51).

(a) Air casings in back bulged out about 12" with cracks and holes throughout rear section. All supports were torn loose from the inner casing. Damage too great for an air test. After repairing the air casing, air pressure test gave identical results to that of before test Able. Blowers running at 2,000 RPM developed 1.2"H_2O. The rear inner casing was blown out and torn away from the steam and starboard mud drum, developing a gap between the stud tube wall and the rear firebox wall of about 8", however, the brick did not separate from the rear inner casing wall and the anchor bolts held tight. The bricks and inner casing laid back as one unit. Several bricks along the upper edge of the rear wall did fall down. The front inner casing wall was bowed out creating a gap of three inches between the stud tube and the front wall. The diagrams on the following page explain the existing conditions. The cause of damage was the pressure entering the firebox and air casing through the stack and air casing ducts.

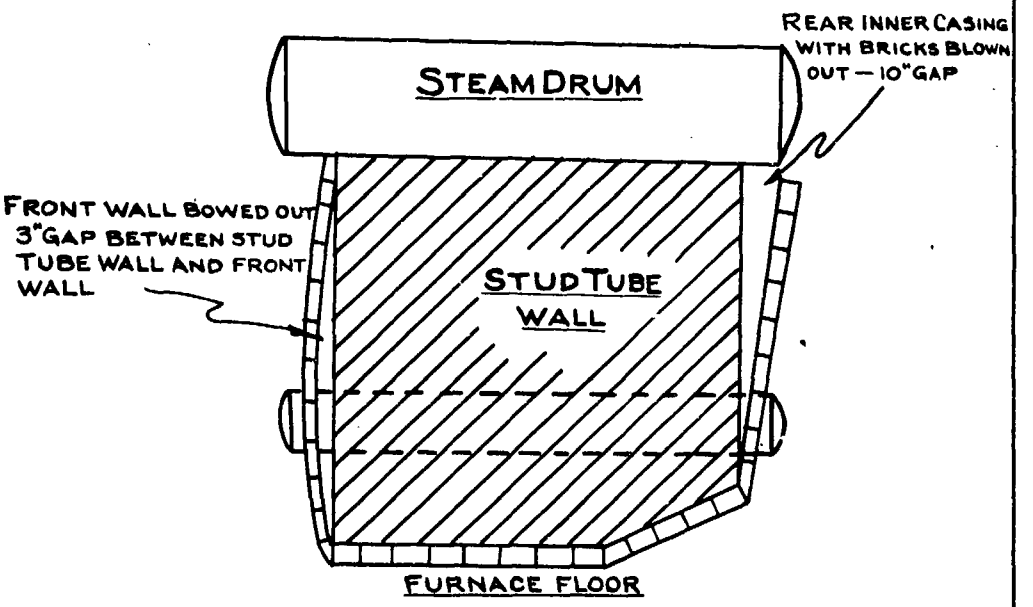
(b) External Fittings - All these fittings were tested and inspected revealing no signs of material or operational damage.

(c) Fuel Oil Burner Assemblies - Upon examination, it was found that the flaps were knocked out of all the registers. Some were bent, making the unit jam so it would not function.

(d) Brick Work and Furnaces - This was discussed along with air casings.



TOP VIEW



SIDE VIEW

TEST A

(e) Steam Water Drums and Heaters - These units were examined for cracks and found to be undamaged. They received no material or operational damage. The boiler was subjected to a hydrostatic test of 600 # revealing no change in condition as that before Test Able.

(f) Tubes - The tubes were inspected visually and gone over with a straight edge. There were no signs of leaks, warping or sagging of tubes. The lenses in all the smoke indicators were broken. All the boilers were damaged in exactly the same way and very closely to the same extent.

C. Blowers (S-53).

(a) Turbines - Examination and operation revealed no material or operational damage, the blowers could be rolled over by hand. All gages were intact and in operating condition.

(b) No material or operational damage. Running at 2000 RPM developed an air pressure of 1.2' H_2O identical to the results obtained before Test Able. Blowers # 3, 4, 5 and 6 could not be tested for air pressure since the air casing on these boilers are blown out. However, they operate giving normal speeds, pressures and temperatures.

(c) Foundations were found undamaged on all blowers.

(d) External fittings found undamaged.

(e) Shutters - Inlet flaps on blowers #3 and #4 were found to be broken.

D. Fuel Oil Equipment (S-55).

(a) Examination and operation revealed no material or operational damage to the heaters, strainers, manifolds or fittings.

F. Boiler Feed Water Equipment (S-56).

(a) - (d) No material or operational damage.

F. Main Turbines (S-41).

(a) No material or operational damage.

(b) No indication of damage to the bearings. However, the leads left in the forward and after bearing of the low pressure turbine (forward engine room) showed indications that the rotor was deflected or sprung at the time of the test but did not remain in that position but returned to it's normal position. The below readings show this to be the case.

Forward Bearings	Before Test Able.	After Test Able	New Leads After Test
Fwd lead	.014	.006	.014
Middle lead	.0115	.008	.0115
After lead	.011	.006	.011
After Bearings			
Fwd lead	.010	.007	.010
Middle lead	.014	.008	.014
Aft lead	.0105	.006	.0105

Operation of the main turbines showed no signs of misa lignment or binding. Couplings and fittings undamaged.

G. Reduction Gears (S-42).

No damage to foundations, gears, bearings, couplings or fittings found on examination and operation of unit.

H. Shafting and Bearings (S-43).

(a) Upon examination and operation there were found no signs of misalignment, undue noises, binding, whipping, leaks or heating up of bearings.

I. Lubrication Systems (S-45).

No material or operational damage found upon examination and operation.

J. Condensers and Air Ejectors (S-46).

No material or operational damage.

K. Pumps (S-47).

No material or operational damage.

L. Generators and Gear (S-61).

No material or operational damage.

M. Propellers (S-44).

No material or operational damage.

N. Distillery Plant (S-58).

No material or operational damage.

O. Refrigerating Plant (S-59).

No material or operational damage.

P. Winches and Windlass (S-20, 26).

No material or operational damage.

Q. Steering Engine (S-22).

No material or operational damage.

R. Ammunition Hoists (S-78, 73).

No material or operational damage.

S. Ventilation Machinery (S-38).

No material or operational damage.

T. Air Compressors (S-49).

No material or operational damage.

U. Diesel Generator (S-50).

No material or operational damage shown under five hour test load. Temperatures and pressures normal.

V. Piping.

The only piping that showed signs of damage due to the test was a section of piping in the compressed air system that was carried away when the bulkhead between the torpedo shack and the electric shop blew out. The other systems showed no new leaks after the test. No damage to personnel would result.

W. Miscellaneous.

All machinery undamaged.

COMMANDING OFFICER'S REPORT

SECTION III - ELECTRICAL

The overall condition showed no change due to the test and continual operation is definite.

No material or operational damage to generators, switches, switchboards, wireways, transformers, batteries, rotating equipment, control equipment, lighting equipment, portable batteries, degaussing equipment, sound powered telephones, ship service telephones, announcing systems, was found upon inspection and operation.

The only damage found in the electrical equipment was as follows:

A. Battery Charger.

The external cable to the boat battery charging outlet was broken when the bulkhead between the torpedo shack and the electric shop carried away.

B. Gyro Compass.

The lead to the dampening eliminator was pulled loose from it's connection. This was caused when the ship took a roll of 34 degrees to Starboard. This unit is on trunions and it's movement was limited by the length of this lead. A longer lead would correct this.

C. Searchlights (S-66).

36" The unit would not operate. The front glass was broken, drum wells broken, shutter operating mechanism smashed so it wouldn't operate, elevation rack broken, trunion yoke bent forward and broken, elevation lock broken.

12" Floodlight front door and glass broken, elevation lock smashed, yoke trunion bent and broken, bulbs broken.

COMMANDING OFFICER'S REPORT

PART C - SECTION IV - ELECTRONICS

A. General Description of Electronics Damage.

(a) In general all electronic equipment itself was undamaged. However, antennae were either broken or bent out of shape. Major damage was suffered by the SC and MK4 antennae. The SC antennae is missing and MK4 antenna is damaged beyond repair. Primary cause was the blast effect and pressure created. MK4 radar would be operable except for the aforementioned antenna. As a result of this, no echoes could be obtained. MK22 radar was inoperative due to damaged modulator unit which was jammed forward from its original position. MK22 antenna driver arm is broken loose so that antenna swings freely. SC radar is operable but antenna does not train in horizontal plane due to bending of mast.

Radio equipment suffered no damage except for antennae being blown down. TBS, sonar, loran, and all other electronic equipment were undamaged. The whip antennae showed definite advantages over horizontal antennae which were all broken possibly due to bending of mast. Whip antennae was in some cases broken but were in all cases operable.

Screen antennae were useless, but solid antennae such as used on the SG was untouched.

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

TRC

4 April 1997

MEMORANDUM TO DEFENSE TECHNICAL INFORMATION CENTER
ATTN: OMI/Mr Bill Bush

SUBJECT: Declassification of Documents

The following is a list of documents that have been declassified and the distribution statement changed to Statement A, Approved for Public Release.

XRD-41, AD-366731
XRD-42, AD-366732
XRD-40, AD-366730
XRD-39, AD-366729
XRD-38, AD-366728
XRD-34, AD-366720
XRD-13, AD-366725
XRD-8, AD-366699
XRD-5, AD-366697
XRD-6, AD-366698
XRD-21, AD-366708
XRD-27, AD-366714
XRD-22, AD-366709
XRD-26, AD-366713
XRD-28, AD-366715
XRD-29, AD-366727
XRD-36, AD-366722

If you have any questions, please call me at 703-325-1034.

Ardith Jarrett

ARDITH JARRETT
Chief, Technical Resource Center