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AD NUMBER

AD366712

CLASSIFICATION CHANGES

TO: unclassified

FROM: confidential

LIMITATION CHANGES

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TECHNICAL INSPECTION REPORT

Classification (~~Cancelled~~) (Changed to CONFIDENTIAL)
By Authority of Joint Chiefs of Staff (~~Action 19 Apr 47~~)
By John Biggs Capt AFSWP Date 1 May 51

U.S.S. SALT LAKE CITY (CA25)

TEST ABLE

VOLUME 1 OF 2

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8738-8

[redacted]

[redacted]

[redacted]

(6) OPERATION CROSSROADS.
U. S. S. SALT LAKE CITY (CA25).
TEST ABLE. VOLUME I[u]. (8)

CONFIDENTIAL

(9) BUREAU OF SHIPS GROUP
TECHNICAL INSPECTION REP[redacted]T.

(11) 1947,
(12) 147p.

(14) XRD-25

Classification ([redacted]) (Changed to CONFIDENTIAL)
By Authority of Joint Chiefs of Staff (Action 15 APR 49)
By John Biggs Capt AFSWP Date 1 May 51

U. S. GOVERN[illegible]
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Washington, D. C. 20301

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USS SALT LAKE CITY (CA25).

Page 1 of 147 Pages

GROUP-3 1 JAN 1965
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193 600

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VOLUME II

Photographic Section - 2

U.S.S. SALT LAKE CITY (CA 25)

SHIP CHARACTERISTICS

Building Yard: New York Shipbuilding Corporation.

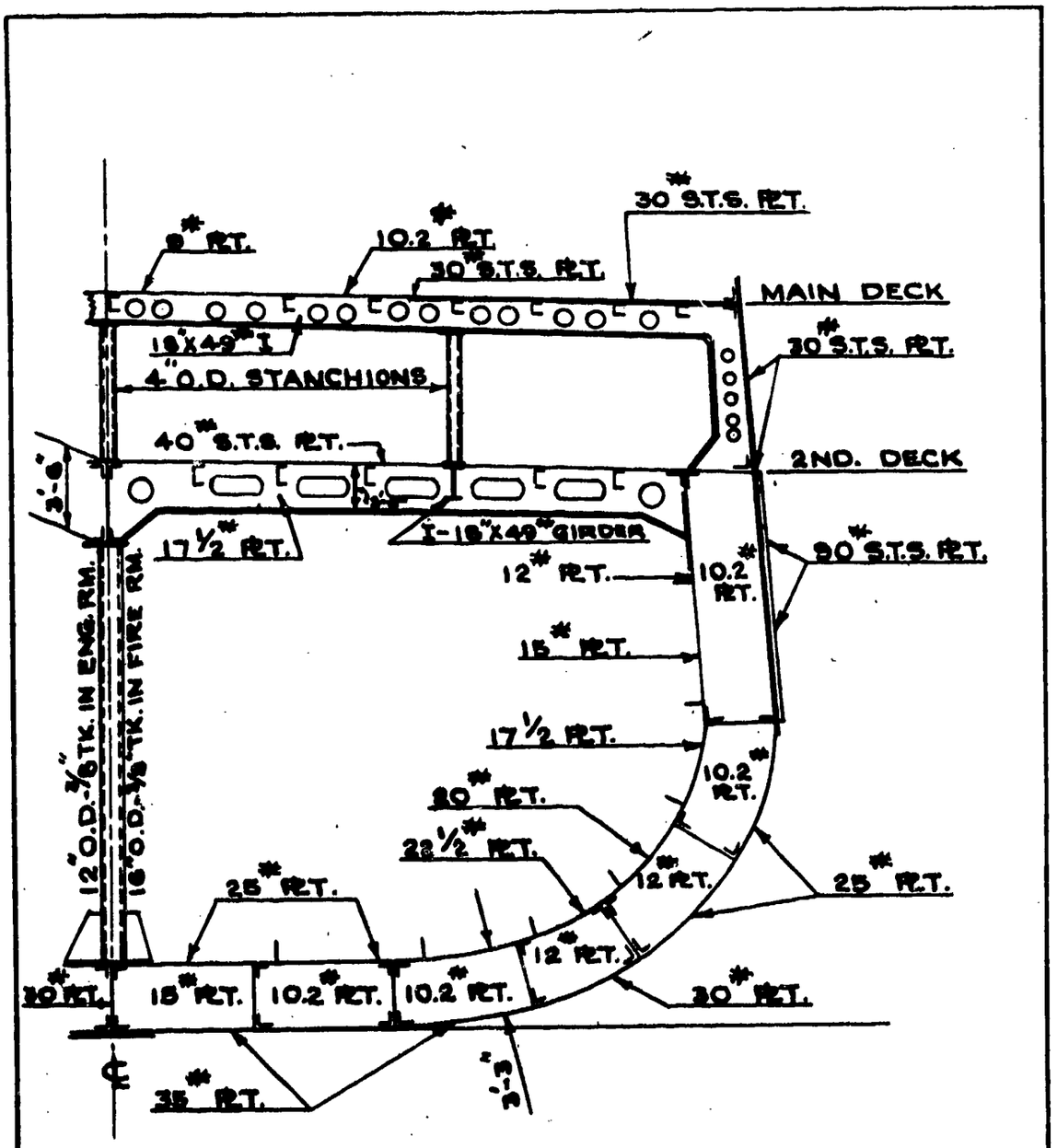
Commissioned: 11 December 1929.

HULL

Length Overall: 585 feet 8 inches.
Length on Waterline: 570 feet 0 inches.
Beam (extreme): 65 feet 3 inches.
Depth (molded at side, to main deck, amidships): 34 feet 1/4 inch.
Drafts at time of test: Fwd. 19 feet 8 inches.
Aft. 20 feet 10 inches.
Standard displacement: 9,100 tons.
Displacement at time of test: 12,060 tons.

MAIN PROPULSION PLANT

Main engines: Four sets of H.P. and L.P. turbines. One set per shaft. Type: Parson Turbines. Mfg. by New York Shipbuilding Corporation.
Reduction Gears: Four sets, single reduction. Mfg. by De-Laval.
Main Condensers: Four installed in ship.
Boilers: Eight installed in ship. Type: White-Foster. Steam press. 300 psi gauge. Temp. 422° F.
Propellers: Four installed.
Main shafts: Four installed.
Turbo Generators: Four installed in ship. 250 K.W.



TYPICAL MIDSHIP SECTION

TEST A

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The drafts of the ship are unchanged, i.e., 19' 6" forward, and 20' 6", aft. A pre-test list of 1/2 degree to port is also changed.

The flooding occurred in the inner bottom tank, C-909-F, apparently through an opened seam from the sea.

(b) Structural damage.

HULL

Light topside structure is damaged extensively. Both stacks are demolished. The principal structural damage is to the main deck. Maximum deflection of the deck is 16 3/4 inches at frame 66.

MACHINERY

Both stacks were completely severed at their bases. The forward one fell overboard, the after one fell over on the deck to starboard. There was some distortion of uptakes, especially above the main level. Casings were blown out on all boilers. A leg of the crane tripod mast was bent, probably by being struck by the after stack as it fell over. Deflection of bulkheads through which the crane control shaft passes caused it to bind. Several firemain risers and some small pipe lines were damaged by deflection of the supporting structures.

ELECTRICAL

Not observed.

(c) Operability.

HULL

The main drive and auxiliary machinery all appear to be in good condition. However, all boilersare damaged to varying degrees. None are in condition to light off. (Repairs requiring five days were necessary before boiler No. 6 could be lighted off).

Some electrical circuits above the main deck are grounded. Electrical equipment and circuits below the main deck are in good condition.

Ship control facilities are operable. The after main and AA directorscan be repaired within 24 hours, but the forward main and AA directors will require Navy Yard repairs.

Eight inch mounts 3 and 4 have no apparent damage. Mounts 1 and 2 are operable but in each, the left trunnion support is distorted and forced outward, causing misalignment of the bearing and excessive side thrust clearance. This may cause trouble under repeated firing of the guns.

Radio and radar antennae supports are extensively damaged. Enclosed electronic equipment has received minor or no damage.

MACHINERY

The casings of all boilers were blown out, the forward ones more than the after ones. Smoke indicators were damaged and moderate damage was done to the boiler brickwork. Both stacks were knocked off. Uptakes were distorted at their upper ends. Suction flappers of all forced draft blowers were bent. A large sheet aluminum dust pan under a ladder exposed to blast pressure fell on the aluminum vent cap of #3 main reduction gear, breaking the cap. A few minor leaks were started in #1 evaporating plant. The crane was damaged structurally. One motor whale boat was smashed and the engine fell out, damaging it. Several firemain risers and some small steam lines connected to radiators broke.

ELECTRICAL

Electrical damage affected ship control by the loss of engine order, steering, and shaft revolution telegraphs on the navigation bridge. Electrical power supply circuits to gunnery and fire control were not affected.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

Heat radiation came from an elevation of about 30 degrees and relative bearing of 230 degrees. Exposed paint has been charred. Manila and cotton lines are charred one thread deep.

MACHINERY

Except for blistered paint on the port side of exposed deck machinery, there was no evidence of heat on machinery or in machinery spaces.

ELECTRICAL

A wave of radiant heat struck the vessel from about 240 degrees relative bearing. The heat was of sufficient intensity to blister and char painted surfaces directly exposed, and to ignite fabric on the main deck aft.

(b) Fires and Explosions.

HULL

Minor fires occurred in exposed cotton chaffing mats on the weather deck, aft and burned the wooden deck below. On the superstructure deck, aft, straw and wood shavings from a wrecked packing case burned. No explosion occurred.

MACHINERY

There was no evidence of fires or explosions.

ELECTRICAL

No electrical equipment was damaged by fires.

(c) Shock.

HULL

Shock damaged instruments and caused failure of instrument foundations in the superstructure.

MACHINERY

No damage was found that could be attributed to shock.

ELECTRICAL

Lack of general breakage within the ship makes it doubtful if shock was present, although shattering of instrument glass on navigation bridge and spilling of mercury from both master gyros could have been caused by shock.

(d) Pressure.

HULL

Blast pressure is the major cause of damage to this ship. The principal damage is the severe deflection of the main deck between the forward and after deckhouses, and the buckling of the stanchions below. The pressure was downward and from the port quarter. Critical plating thickness seems to be about 10# plate.

MACHINERY

Blast pressure, and deflection of decks and bulkheads resulting from blast pressure, caused all damage to machinery. The blast apparently came from slightly forward of the port beam.

ELECTRICAL

A wave of pressure struck the vessel from about 240 degrees relative bearing. The pressure was sufficient to break the aluminum yokes on both 24" searchlights located above the signal bridge, and to break off both aluminum pelorus stands on the navigation bridge.

(e) Any effects apparently peculiar to the Atom Bomb.

HULL

An effect peculiar to the Atom Bomb is the radiant, directional heat.

MACHINERY

Blast pressure of this magnitude at the range of the SALT LAKE CITY from an explosion is believed to be peculiar to the Atom Bomb.

ELECTRICAL

The radiant heat is the only apparent effect peculiar to the Atomic Bomb.

III. Effects of damage.

(a) Effect on propulsion and ship control

HULL

The ship is immobilized by boiler damage.

Ship control is lost by disruption of electrical power and short circuited wiring in the superstructure.

MACHINERY

All boiler power was lost. It is estimated that 48 to 72 hours would be required for temporary repairs by the ship's

force to enable one boiler to be steamed at a low rate. No motive power would have been available until after extensive repairs to boilers, uptakes, and stacks.

The only effect on ship control insofar as machinery is concerned, would have been limitation of power. The diesel generators and emergency diesel steering equipment were not damaged and were fully operable after Test A.

ELECTRICAL

Ship propulsion was not affected. Ship control was affected by loss of engine order shaft revolution and steering telegraphs on the open navigation bridge.

(b) Effect on gunnery and fire control.

HULL

The use of AA and main battery directors is lost, some temporarily. The majority of optical equipment and all fire control antennae are disabled.

MACHINERY

No comment.

ELECTRICAL

There was no electrical damage.

(c) Effect on watertight integrity and stability.

HULL

The effect on watertight integrity and stability is negligible.

MACHINERY

No comment.

ELECTRICAL

Electrically there was no effect.

(d) Effect on personnel and habitability.

HULL

Casualties to men in exposed positions would probably have been high. Habitability, topside, would be curtailed by radioactivity. Fresh water would have to be supplied to the ship.

MACHINERY

It is estimated that there would have been a high percentage of casualties among fireroom personnel. It is not believed that any other casualties would have occurred among personnel below decks. Casualties among exposed personnel would have been high. Habitability would have been greatly impaired by loss of steam power.

ELECTRICAL

Electrical damage had no effect on personnel or habitability of the vessel.

(e) Total effect on fighting efficiency.

HULL

It is estimated that the fighting efficiency is reduced to negligible proportions. This is primarily due to loss of steam and damage to fire control equipment. This leaves only the turrets in operation by local control and power from emergency diesel generators.

MACHINERY

The effect on fighting efficiency from a machinery viewpoint was complete loss of steam power, the limitation of electric power to that furnished by the emergency diesel generators.

ELECTRICAL

The fighting efficiency of the vessel was only slightly impaired by electrical damage.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

If this ship had been engaged in combat at the time of damage, its condition would be serious due to the loss of power and damage to fire control equipment. From a structural standpoint however, damage is not serious. The effect on stability and watertight integrity is negligible. The effect on longitudinal strength is slight.

MACHINERY

Stacks in good condition would probably not have been knocked off but would undoubtedly have been severely damaged. The stacks of the SALT LAKE CITY were badly corroded before Test A.

ELECTRICAL

The vessel was subjected to sufficient damaging forces for the electrical equipment to be given a fair test of its ruggedness and suitability for use under such conditions. The only exception is the weakness of cast aluminum as a material for supporting columns.

V. Preliminary General or Specific Recommendations of Inspection Group.

HULL

The overall loss in fighting efficiency which the ship has suffered could be materially decreased by changes in radar foundations and smokepipe design. Ten pound plate should be maintained as a minimum in exposed areas wherever possible. Overhangs should be avoided.

MACHINERY

Boilers, uptakes, and stacks should be made more resistant to blast pressure.

ELECTRICAL

It is recommended that cast aluminum be discontinued as a material for instrument cases and supporting columns.

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.

The drafts of the ship are unchanged, i.e., 19' 6", forward, and 20' 6" aft. A pre-test list of 1/2 degree to port is also unchanged.

The only flooding occurred in the inner bottom tank, C-909-F, apparently through an opened seam from the sea.

(b) Structural damage.

Light topside structure is damaged extensively. Both stacks are demolished. The principal structural damage is to the main deck. Maximum deflection of the deck is 16 3/4 inches at frame 66.

(c) Operability.

The main drive and auxiliary machinery all appear to be in good condition. However, all boilers are damaged to varying degrees. None are in condition to light off. (Repairs requiring five days were necessary before boiler No. 6 could be lighted off).

Some electrical circuits above the main deck are grounded. Electrical equipment and circuits below the main deck are in good condition.

Ship control facilities are operable. The after main and AA directors can be repaired within 24 hours, but the forward main and AA directors will require Navy Yard repairs.

Eight inch mounts 3 and 4 have no apparent damage. Mounts 1 and 2 are operable but in each, the left trunnion support is distorted and forced outward, causing misalignment of the bearing and excessive side thrust clearance. This may cause trouble under repeated firing of the guns.

Radio and radar antennae supports are extensively damaged. Enclosed electronic equipment has received minor or no damage.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Heat radiation came from an elevation of about 30 degrees and relative bearing of 230 degrees. Exposed paint has been charred. Manila and cotton lines are charred one thread deep.

(b) Fires and explosions.

Minor fires occurred in exposed cotton chafing mats on the weather deck, aft and burned the wooden deck below. On the superstructure deck, aft, straw and wood shavings from a wrecked packing case burned. No explosion occurred.

(c) Shock.

Shock damaged instruments and caused failure of instrument foundations in the superstructure.

(d) Pressure.

Blast pressure is the major cause of damage to this ship. The principal damage is the severe deflection of the main deck between the forward and after deckhouses, and the buckling of the stanchions below. The pressure was downward and from the port quarter. Critical plating thickness seems to be about 10# plate.

(e) Any effects apparently peculiar to the Atom Bomb.

An effect peculiar to the Atom Bomb is the radiant, directional heat.

III. Effects of damage.

(a) Effect on propulsion and ship control.

The ship is immobilized by boiler damage.

Ship control is lost by disruption of electrical power and short circuited wiring in the superstructure.

(b) Effect on gunnery and fire control.

The use of AA and main battery directors is lost, some temporarily. The majority of optical equipment and all fire control antennae are disabled.

(c) Effect on watertight integrity and stability.

The effect on watertight integrity and stability is negligible.

(d) Effect on personnel and habitability.

Casualties to men in exposed positions would probably have been high. Habitability, topside, would be curtailed by radioactivity. Fresh water would have to be supplied to the ship.

(e) Total effect on fighting efficiency.

It is estimated that the fighting efficiency is reduced to negligible proportion. This is primarily due to loss of steam and damage to fire control equipment. This leaves only the turrets in operation by local control and power from emergency diesel generators.

IV. General Summary.

If this ship had been engaged in combat at the time of damage, its condition would be serious due to the loss of power and damto fire control equipment. From a structural standpoint however, damage is not serious. The effect on stability and watertight integrity is negligible. The effect on longitudinal strength is slight.

V. Any Preliminary Recommendations.

The overall loss in fighting efficiency which the ship has suffered could be materially decreased by changes in radar foundations and smokepipe design. Ten pound plate should be maintained as a minimum in exposed areas wherever possible. Overhangs should be avoided.

Instructions for Loading the Vessel Specified the Following:

Item	Loading
Fuel Oil	Minimum
Diesel Oil	Minimum
Ammunition	10%
Potable and reserve feed water	Full load
Salt water ballast	1600 tons
Gasoline	None

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

DETAILED DESCRIPTION OF HULL DAMAGE

A. General Description of Hull Damage.

(a) Overall condition of vessel.

The smokestacks are demolished, stick masts bent, and lifelines displaced. Superstructure bulkheads and doors are distorted. Exposed ladders are twisted and displaced. The paint on exposed surfaces is scorched.

The main deck has sustained a major deflection between bulkheads 61 and 71 1/2 with resultant buckling of stanchions below. There are also areas of minor dishing aft. There is no hull damage below the second deck, except for a leak in innerbottom tank C-909-F.

General views of the exterior are shown on pages 2 to 17 , inclusive. The principal features of damage are shown on diagram, page 82.

(b) General areas of hull damage.

The general areas of hull damage are the exposed parts of the superstructure, the smokestacks and the weather deck, especially at amidships.

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

The apparent cause of hull damage is a pressure wave of fairly high intensity and a definite directional effect.

(d) Principal areas of flooding with sources.

Flooding of the innerbottom tank C-909-F, may have resulted from a flexure of the ships girder.

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

The main deck has a small tear at the aft inboard corner of the engine room starboard exhaust vent at frame 62. The major dishing and this tear impair the ships strength about 2 % in hogging and 5% in sagging. The tear can be easily repaired by the ships' force but in the present condition it is potentially dangerous as a initiation point for a progressive tear.

The amount of buoyancy lost by the flooding of the innerbottom tank is negligible. It caused no noticeable change in the ship's drafts.

Effect of hull damage on operability is negligible (for effect of damage to stacks see machinery reports). Displaced life lines constitute a personnel hazard and temporary obstruction of main deck port passageway at frame 90 impairs accessibility.

B. Superstructure (exclusive of gun mounts).

(a) On the 8" director platform the port after quadrant of the shield is dished a maximum of 24 inches. The welds at the bottoms of two stiffeners have failed. There is approximately six inches clearance between the shield and the stool at the point of minimum clearance.

On the lookout platform the after bulward is bent forward a maximum of six inches about two feet to the port of the centerline.

The searchlights on the 24 inch searchlight platform on top of the radar room at frame 46 are both broken at the base ring. The port searchlight is hanging in place and leaning against the handrail. (Photo 1869-5, page 18). The starboard searchlight has been thrown down to the navigating bridge level. In falling this has bent the handrail about eight inches.

Also on top of the navigation bridge deck house a sheet metal box at the after starboard leg of the tripod is dished on the after and inboard sides. Ladders to the lookout platform have pads to the 5 lb. plating of the top of the navigating bridge house. The port pad of both port and starboard ladders tore 6 inch by 2 inch triangular sections from the platform. Both ladders have been blown clear and fallen to levels below. The starboard handrail is bent outboard.

On the 5 inch AA director level, paint where not shielded, is scorched. The 5 inch director mount at frame 40 is scorched and the radar screen is ruined. (Photo 1719-11, page 19). Both rails of the after handrail are broken at the centerline where they were struck by ladders falling as noted above.

The bimacle platform, frames 49 to 51, has light washboard dishing. There is 1/2 to 1 inch dishing around the radar room. The after and port faces of the deckhouse also have some washboard dishing and paint scorched. The vent motor cover and a tank located on the after panel of the house have been lifted from their supports, apparently by blast. The whip antenna at the starboard, after corner of the deck house is bent sharply 85 degrees in the direction of the blast. (Photo 1869-6, page 20).

The 20MM guns at frame 47 are undamaged but their protective grease coating has been carbonized. The port side of the port gun shield has been dished about 1/2 inch at the top.

The outboard faces of the two port ready service boxes at frames 41 and 42 1/2 are dished about 1 1/2 inches. A sheet metal box screened by the gun mount is undamaged.

On the navigation bridge level the glass in the windshield forward, at frame 38, is broken and the frames are bent. (Photo 1729-8, page 21). All sides of the radio direction finder house, frames 40 1/2 to 42, are dished. The port side has a maximum dish of six inches. The bulkhead door at frame 42 is dished about 4 inches. The door will open but is no longer tight. The port bulkhead of the 40MM clipping room and the navigating officer's emergency cabin is dished from five to six inches. The paint is badly scorched. (Photo 1869-10, page 22).

The door at frame 46 port, is warped and rendered non-tight but will close. The starboard side of the deckhouse is not damaged. The bronze after bulkhead of the deckhouse is dished unevenly three to four inches on the port side and two inches on the starboard side. The door on the starboard, after diagonal corner, is dished about four inches and will not close. (Photo 1869-9, page 23). The similar door to port is dished about eight inches and the plating is torn. It will not un-dog. (Photos 1869-10, 11, pages 22 and 24).

The port flagbag is crushed and blocks the transverse passageway at frame 51. The starboard flagbag is also badly damaged and hangs over the after railing. (Photos 1869-11, 3, 4, 7, 8 pages 24 , 25 , 26, 27, and 28).

The forward face of the signal shack, frame 50 is slightly scorched. The weather tight door is no longer tight but will close. This is probably the result of blast reflection from the emergency cabins. The port and after sides (bronze) are dished about six inches. The riveted connection to the overhead beam has an incipient failure. The bronze deck plating is bulged about 1 1/2 inches in three distinct waves.

On the emergency platform the deck has washboard dishing. The port bulkhead of the deckhouse is dished over the full height a maximum of three inches (Photo 1869-7, page 27. The deck on the port side is distorted (Photo 1896-8, page 30). The after bulkhead (bulkhead 48) of the deckhouse has severe washboard dishing, especially at the lower corner panels. The average dishing is six inches on the port side and three inches on the starboard side. (Photos 1869-12 and 1896-5, pages 31 and 32). The deflection pulled the plating away from one overhead longitudinal, an inverted angle and initiated a small tear at the lower extremity. (Photo 1896-3, page 33). The foot of the starboard ladder at frame 48 is displaced. The paint on the after and port sides of the deckhouse is scorched. The paint on the starboard, after handrail is also scorched.

On the communication platform, starboard, a gun shield of 10 lb. plate is deflected outboard a maximum of four inches between frames 42 and 49. The deflection is principally in the form of a diagonal wrinkle with the high point forward. The shield is dished mildly, and the top edge scalloped, aft to frame 55. (Photo 1894-2, page 34). Stiffeners welded to the deck at frames 43, 45 and 53 have failed. Intermittent welds along the inboard face of the shield remain intact. The 25 lb. plate curved transverse shield at frame 42 is mildly twisted. The stiffener on the 25 lb. plate shield at frame 49 is badly distorted. The supporting beam under this portion of the shield is distorted and tilted. The 25 lb. after shield, frames 52 to 54 has been bent by the forward smokestack as it went overboard (Photo 1869-4, page 26). This shown by the scraped paint on the after side of the shield. The starboard deck house and deck are normal while the after bulkhead of the deck house has mild washboard dishing. The starboard ladder at frame 48 1/2 is badly damaged and is not useable. (Photo 1894-1, page 35). Paint is scorched.

On the communication platform, port, the deck is mildly wrinkled approximately two feet outboard of the deckhouse between frames 40 and 47 and paint is scorched where exposed. (Photo 1896-10, page 36). The port door to the 20 MM clipping room has been blown off. (Photo 1896-9, page 37). The side of turret #2 is scorched except for a small area that was shielded from the blast by the 20MM gun shield. (Photo 1896-11, page 38). The 30# deckhouse side plating is undamaged except for scorched paint and broken glass in air ports. The 20MM gun shield at frames 42 to 43 is bent forward at the upper inboard corner. The beam underneath is badly distorted one foot inboard of the deck edge, and the outboard connecting bolt is missing. The 10 lb. gun shield along the deck edge has mild washboard dishing aft to frame 50 but it is not as severely damaged as the starboard shield. The stiffener at frame 45 has a cracked weld at the flange connection to the deck. Between frames 50 and 55 the shield has a smooth general deflection of about 12 inches maximum at the top (Photo 1894-3, page 39). The stiffener at frame 53 is badly distorted. The after shield (25 lb. plate) at frames 52 to 54 has scorched paint but is otherwise undamaged.

On the superstructure deck, forward of frame 61, the exposed portion of transverse bulkhead 48 has an overall dish of two inches. The port deckhouse aft of this is mildly washboarded. The insulation is partially blown off these bulkheads (Photograph 1894-5, page 40). Joiner bulkheads on the port side have compression buckles between bulkheads 40 and 47 (Photo 1894-4, page 41). The deck is bulged up about 3 inches at frame 45, port. The riveted connection of the deck plating to the transverse beam below failed (Photo 1894-6, page 42).

On the forward deckhouse above the main deck, on the port side, at frame 30, the vent duct cover is blown inboard. The screen inside the deckhouse is bulged two inches. (Photo 1861-9 and 10, pages 43 and 44). The port face of the deckhouse is mildly washboarded aft to frame 43. The door at frame 36 is dished (Photo 1861-11, page 45). Aft of this, washboarding becomes quite severe (1 1/2 inches). There is a vertical crack in an old welded seam in the side plating at frame 46. (Photo 1861-12, page 46). This starts 9 feet above the main deck and runs upward 5 feet to above the superstructure deck level.

The trunk on the after side of bulkhead 46 is badly damaged. The after face of the trunk is pulled away from the deck connection, from the port edge to the centerline stanchion. (Photos 1729-2, 3 and 1866-1, pages 47 , 48 , and 49). Connection to the stanchion also failed from the deck up to a height of 3 feet. The maximum dish of about 18 inches is at the bottom. The port face and watertight door are also badly dished. The door frame is torn at top and bottom in the after side. The plating between is folded inboard. The after face of the trunk on the starboard side is also badly dished. It is pulled away from both the overboard and deck connections for several feet inboard of the starboard face. The starboard face and its watertight door are also badly dished (Photos 1866-11, 1782-4, and 1729-4, pages 50, 51 and 52).

On the deckhouse between frames 49 and 61 the forward stack has been carried overboard to starboard. The uptakes are twisted and useless. The fidley is twisted and torn. (Photo 1869-4, page 26). There is extensive failure of riveted seams by rivets tear-

ing through the edge of the plating. The forward bulkhead of the deckhouse has washboard dishing of up to two inches magnitude. The door on the port side of this bulkhead is dished about 4 inches. (Photo 1866-4, page 53). The door just to the port of the centerline is dished 3/4 of an inch and the starboard door is dished 1 1/2 inches. The port bulkhead is slightly scorched but otherwise undamaged except for a 12 inch tear at frame 50 in the plating below the air intake louvres. The transverse bulwark at frame 61 is 5 feet high. It is washboarded the entire width. The 9 inch coaming at the entrance is twisted out of line three inches. The starboard exhaust ventilating trunk (engine room) frames 61-62, is mildly dished on the port and after faces. The entire trunk is torn from the deck by pulling the 3/4 inch rivets through the bounding angle. (Photo 1894-12, page 54).

The mast at frame 88 1/2 is bent forward and to starboard in a smooth curve. The horizontal displacement of the top is estimated to be 15 feet. (Photo 1868-8 and 1729-10, pages 55 and 56).

On the after searchlight platform there are 36 inch searchlights at frame 83 1/2 port and starboard facing aft. The port searchlight is undamaged. The lens of the starboard light is shattered. The deck plating is undamaged. Two signal flag boxes at frame 89 are knocked over and wrecked with the contents strewn on the deck.

The equipment in the secondary conning station is scattered. One table leg has been broken, apparently by shock. The radio room equipment is undamaged except for one broken table leg and a bent cantilever type telephone support. These are also apparently the result of shock. Equipment in the after fire control tower, frame 98 to 103 is not visibly damaged.

The port bulwark, frames 83 to 90, at the radio room level has been blown against the side of the housing and is bent and torn. Light flat bar stiffeners on the outboard side buckled and were ineffectual. The bulwark aft is blown in at a 60 degree angle on the port side. This dwindles to a minor dish at the starboard extremity.

The starboard bulwark, although shielded from direct blast is deflected 4 inches to starboard. The forward bulkhead (bulkhead 83) of the secondary conning station although shielded, has an overall dish with the maximum of 2 inches being near the port bulkhead. The port plaing has a 1/2 inch dish with and in way of the door frame at frame 85. Paint on the port side of the house is blistered.

On the director platform, the door in the port bulkhead of the plotting room has been blown inboard one inch past the door frame and is jammed shut. Paint on the bottom of the director platform is flaked off extensively. This is apparently due to shock rather than heat.

The number 2 stack is broken and knocked down onto the deck at an angle of approximately 80 degrees relative to the ship's centerline. Riveted seams failed extensively by rivets tearing through edges of the plating and by rivet shear. (Photos 1719-10, 1868-10 and 12, pages 57, 58 and 59). In falling, the stack struck and bent the starboard after leg of the tripod support for the seaplane crane at frame 75 1/2. The leg is bent about 10 degrees, but the crane remains operable. (Photos 1869-4 and 1719-10, pages 26 and 57).

On the superstructure deck the incinerator uptake at frame 82 1/2 has been pulled loose from the incinerator and the lagging knocked off the lower two feet of pipe. The riveted connection to the deck of the after leg of the port, longitudinal, partial bulkhead from bulkhead 88 forward failed as a result of vertical tension. The port edge of bulkhead 88 is also pulled up 2 inches from the deck. This failure extended inboard nearly to the ships centerline with diminishing separation. On the starboard side of the centerline, bulkhead 88 has a compression buckle at the deck which increases in severity towards the starboard partial longitudinal bulkhead. The after leg of this is also buckled at the deck. This would indicate that the after part of the structure of the secondary conning station, generator room, radio room and 36 inch searchlight platform, has been tipped to starboard by the blast.

At frame 89, there are single 4 inch pipe stanchions immediately port and starboard of the centerline for support of the overhanging spotters platform. The port stanchion pulled away from

the deck. The starboard stanchion deck connection is intact and the deck pulled upward in a local bulge. The damage to these two stanchions is apparently the result of blast reflected from the deck and bulkhead 88 combined with the tipping of the entire after part of the structure as described above.

The 5 inch ready service lockers forward of frame 92 are structurally intact. The light outer plating of the sun shield is distorted and seams have failed. But the doors and inner shell are undamaged.

The ladder to the director platform on the forward leg of the supporting tripod has pulled up tearing out patches of the deck plating. The ladder is deflected to starboard. The stays are badly distorted but intact. The ladder at frame 101 to the port side of the director platform has been blown entirely loose and is lying twisted and distorted on the deck. (Photo 1868-6, page 60). The ladder on the starboard side is bent sharply forward at the bottom of the director platform. At the forward extremity of the platform, it bends sharply down and to port. The lower end is left hanging in the air at the ships centerline 6 feet above the superstructure deck.

The bulwark along the port side between frames 196 and 100 is deflected 10 inches to starboard at the top, near the after unsupported end. The forward end is welded to the engine room exhaust cowling.

The 20MM clip room between frames 100 and 102, starboard, is undamaged except for scorched and blistered paint.

The deck plating has localized buckles of approximately 2 inches magnitude between frames 92 and 104. In way of one buckle at frame 93 near the centerline, a welded seam failed for a length of 6 inches. The deck below turret number 3 is dished about 1 inch between frames. Paint on the deck is blistered and scorched where exposed to the blast.

In the deckhouse above the main deck between frames 71 1/2 and 113, considerable damage occurred. In the emergency radio room, frames 71 1/2-73, the batteries and other gear have been thrown about. The forward bulkhead of the carpenter shop, bulkhead 74, port side, is dished aft about 1 inch. The door is dished but operable. The inboard longitudinal bulkhead of the carpenter shop is deflected outboard to port, 11 inches at the top. The overhead connection has failed. This connection consists of welded seams to filler plates between the transverse beams. This was reinforced by a light angle along the outboard side of the seam with the upper flange welded to the lower face of the transverse beam flanges. It is this seam that has failed. The angle and filler plates have also been blown to port. This longitudinal bulkhead extends aft to bulkhead 92 and is the port bulkhead of the port passageway. It is dished to port a maximum of 21 inches at the top, in way of the vegetable preparing room where the overhead connection is to a narrow strip of wire mesh bulkhead.

The lack of restraint at the overhead connection in way of the vegetable preparing room has resulted in a failure of the welded overhead connection aft of frame 89. Eleven inches aft of frame 89, the failure entered the bulkhead plating at a 45 degree angle. The plating is torn for 11 inches. The after extremity of this longitudinal bulkhead is at the open transverse bulkhead 92. Blast attacked through this open bulkhead and blew the longitudinal bulkhead inboard and forward, pivoting about its connection the stanchion at frame 90. All other connections failed. It came to rest athwartships, across, and entirely blocking, the passageway with the after extremity 5 feet forward of bulkhead 90 (Photo 1868-4, page 61).

The compartment between bulkheads 90 and 92 is the garbage grinder room. A stack of six garbage cans have blown against bulkhead 92. This and the blast knocked bulkhead 90 forward four feet. The overhead and outboard connections failed. (Photo 1782-5, page 62).

The starboard longitudinal bulkhead of the port passageway is undamaged aft to frame 84 where both sections of the divided door into the officer's galley, C-103-L, have been torn off by the blast and blown forward along the passageway. One door struck the battery box at frame 80 on the starboard bulkhead of the passageway. This battery supplies emergency power for the 5 inch guns. The battery box is crushed and the battery smashed. One of the doors also punctured the port longitudinal bulkhead, making a triangular hole 3 inches on a side. The doors came to rest on the deck at frame 75. At frame 87 the plating is weakened by a 26 by 29 inch cutout, (engine room air supply). This allowed a local deflection of approximately 1 inch. The 5 lb. coaming has a crack 1 3/4 inches deep.

The officer's galley and crew's galley are in one compartment, C-103-L, between the port and starboard passageways and bulkheads 83 and 88. The equipment is strewn about. Transverse beams at frames 85 and 86 show strain by cracked paint 6 feet to starboard of centerline. The buckle is barely discernable by eye.

The inboard (port) bulkhead of the shipfitter's shop, starboard outboard compartment, between bulkheads 74 and 81, is deflected outboard at the overhead five inches. (Photo 1867-1, page 63). The overhead connection failed. It is the same as that of the carpenter shop bulkhead described above. Equipment and gear adjacent to this bulkhead in the shipfitter shop and in the passageway is displaced and thrown on deck. (Photos 1867-1 and 2, pages 63 and 64). This bulkhead is also the starboard bulkhead of the starboard passageway aft to frame 92. It is dished to starboard about 1/2 inch at mid-height, aft to the divided door into the issue room (starboard side) at frame 86. The lower section of this is dished five inches, and the upper , one inch. Centered at frame 88 is also an area of dishing with a longitudinal extent of 84 inches and a maximum dish of four inches.

The boat engine repair room, extreme starboard compartment, between bulkheads 88 and 92, has an access in bulkhead 92 through a sliding door. This has been blown loose and partially into the compartment. It is bent approximately 20 degrees on a diagonal

line. A system of 1 inch by 1/8 inch flat bar stiffeners on the after side was ineffectual. (Photo 1867-3, page 65).

Transverse bulkhead 97 and its watertight door are dished aft. (Photo 1867-4, page 66). The port side of the deck housing between bulkheads 97 and 104 is dished between frames, a maximum of two inches. The door at frame 99 is dished. The paint is scorched and blistered. The comparable bulkhead to starboard is undamaged except for slightly scorched paint.

Securing screws for the air port in the port side of bulkhead 104 are missing. Immediately outboard of the port an old weld between the deck housing and the ventilation duct failed. (Photo 1868-1, page 67).

The port bulkhead (angled) between transverse bulkheads 104 and 113 is mildly dished between frames. The doors at frames 110 and 112 are dished. The comparable bulkhead to starboard is undamaged except for slightly scorched paint.

The overhead in the crews washroom, D-102-C is dished about 2 inches. (Photo 1868-2, page 68).

(b) Causes of damage in each area.

Damage in most areas is directly attributable to the air blast. Damage to the port bulkhead of the port passageway on the main deck is due partially to reflected blast wave from the inboard bulkhead and partially to a funnelling effect in the passageway.

Damage to the airport in the port side of bulkhead 104 is apparently due to defraction of the blast wave.

(c) Evidence of fire in superstructure.

Immediately aft of turret number 3 on the superstructure deck are several wrecked wooden packing cases. These had contained some straw and wood shavings. The wrecking resulted in a considerable amount of highly inflammable debris on the deck. A fire had started and burned for several minutes, judging by the amount of charred wood. It did not spread, perhaps because of the rain after the test. Near the center of the remnants of the fire is a scuttled 5 gallon can. (Photo 1868-6, page 60). If this had contained gasoline, there may have been a strong enough concentration of vapor to ignite from the flash.

(d) Estimate of relative effectiveness against heat and blast.

Very light plating such as that of the stack, and bulwarks is extremely vulnerable to blast damage. Resistance to damage however, increases rapidly with an increase in plating thickness.

Plating of 15 lbs. and heavier is undamaged even in exposed locations.

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

An enclosed access should be provided to the after fire control station.

Overhangs should be avoided.

C. Turrets, Guns and Directors.

(a) Protected mounts.

1. General condition, including operability, if known.

Eight inch mounts 3 and 4 received no apparent damage and their operability is not affected. Mounts 1 and 2 are also operable but the left trunnion support in each case is distorted and forced outward, causing misalignment of the bearing and excessive side thrust clearance. This condition may cause trouble after repeated firing of the guns.

The pressure wave approached the ship from the port quarter and apparently caused a sharp violent movement to starboard of the bow of the ship and mounts 1 and 2. The inertia of the slide and guns transmitted a force to the side of the left trunion supports. This force effected bending of the left trunnion support between the shelf plate at the bottom and the tie rod at the top. In mount 1 this caused a permanent deformation, which resulted in an excess thrust clearance of 3/8 inch. In mount 2 this excess was 5/16 inch. Further evidence of the bending of the trunnion support is seen in the clearances between the cap square and the support. This should normally be a tight fit. In the case of mount it has opened up to .033 inch, at the bottom and .010 inch

at the top on the outboard side, while on the inboard side it remained tight. (Photos. 1915-6, 7, and 8; page 69 , 70 ,and 71).

Damage to the trunnion brackets would have been greater but the slide was restrained from transmitting all its inertia to the bracket by coming in contact with the gun port plating. The slide jammed against the side plate of the gun port and placed a strain upon the angle connecting the side port plate to the bottom port plate. (Photo 1915-4; page 72).

The structural brackets on the outboard side of the trunnion support at the shelf plate show evidence of the strain placed upon it. The paint is cracked at faying surfaces of the angles and plates and one bolt failed on the bracket in mount 2. (Photo. 1915-5 and 8; pages 73 and 71).

All of the 5/8" bolts connecting the gun port seal retainers on the left side of mounts 1 and 2 are sheared off. Several bolts connecting the gun port seal retainer on the right side of mount #1 are also sheared off. (Photo. 1915-9; page 74).

Most of the sight port doors are difficult to open as a result of the blast.

The paint is badly blistered from radiated heat on the left sides of mounts 1 and 2 and on the right sides of mounts 3 and 4. There is no evidence of heat or flame having entered any of the mounts although mount 2 and 4 were in condition "Yoke" and had all four doors open. (Photo. 1728-10; page 75).

2. Effectiveness of installed turrets or shields.

The shields as installed on these mounts appear to be adequate protection for the mounts under conditions of this test. The trunnion supports are definitely weak against side thrust but the ship could most likely have continued firing with all main battery guns for a considerable time. A navy yard availability would have been required

eventually for repair of the damage.

(b) Unprotected mounts.

1. General condition, including operability, if known.

No damage.

2. Effectiveness and sufficiency of crew shelters.

The splinter shields provide inadequate protection for the crew from the shock wave and radiated heat of the atomic bomb.

(c) Directors and rangefinders. (In 8" mounts).

1. General condition, including operability, if known.

The rangefinders in mounts 1 and 4 are operable at reduced efficiency.

2. Condition of instruments therein.

The instruments in the range finders of mounts 1 and 4 were slightly damaged and misaligned from shock of low order.

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

The trunnion supports for the 8" guns are made of castings bolted to the gun girders. They are inadequately braced for side thrust. This type of construction is now obsolete. In present practice the trunnion blocks are forgings welded to the gun girders and braced with welded brackets. This is one of the most important structural parts of a mount or turret and the test has proved that too much emphasis can not be placed on providing adequate bracing for side loading. They must not only be designed to carry side loading induced by the normal roll of the ship but must be capable of withstanding a certain amount of shock.

D. Torpedo Mounts, Depth Charge Gear.

Not applicable.

E. Weather Deck (Main Deck).

(a) General condition of deck and causes of damage.

The wood deck covering is slightly scorched where not shielded from the blast. (Photos. 1729-12 and 1730-1; page 76 and 77).

The most severe damage is major dishing between frames 61 and 71. The maximum permanent set is 16 1/4 inches. (Photos. 1866-5, 7, 8 and 2104-3; pages 78 , 79 , 80 , and 81). This deflection is the result of the large panel area without the shielding and stiffening provided by deckhousing. Transverse girders are on every third frame only. These are in turn supported only by 4 inch stanchions at the quarter-breadth points and a centerline stanchion at frame 65.

There is some minor dishing aft with nodes at frames 124 and 136. Deflection at these frames are 3 3/8 inches and 4 1/8 inches respectively. (Photos. 2085-10, 11 and 12; pages 82, 83 and 84).

Sections of cotton mattress, chafing mats and cordage on the deck aft ignited and burned through the wooden deck covering. (Photos. 1867-7, 1729-11 and 1867-9; pages 85 , 86, and 87).

(b) Usability of deck in damaged condition.

The deck, although dished, is intact except for a small tear at the engine room exhaust vent, starboard side, frame 62. It is entirely usable except for the port passageway which is temporarily blocked at frame 90.

The decks strength in tension is essentially unimpaired, but the dishing of the well deck has resulted in some loss of strength in compression.

(c) Condition of equipment and fittings.

The 3 inch mooring shackle at the forward buoy is bent and cracked. The starboard riding shackle is slightly bent.

A firehose has been blown out of its stowage on the starboard side at frame 29 and laid out to port under mount 1. (Photo. 1861-8; page 88).

One of the 3 life rafts stowed atop mount 1 is missing. A second is broken in three pieces which have fallen to the main deck just forward of the turret. (Photo. 1861-4; page 89).

The seaplane stowed atop the starboard catapult foundation, frame 63, is missing. One seaplane wing float and an elevator are on the deck forward of mount 1 near the starboard lifeline. (Photo. 1861-4; page 89).

The 26 foot motor whaleboat at frame 97, port side is almost completely demolished. The davits are not noticeably damaged. (Photos. 1868-5, 1869-1, 1719-4, 1867-12 and 1868-3; pages 90, 91, 92, 93 and 94).

The similar boat in the starboard side has been holed from underneath. The cause of damage is not apparent but it appears to have been done by some missile. (Photo. 1867-5; page 95).

A life raft has been blown from the deck housing at frame 94 onto the boat but has caused no structural damage. The rafts lower platform is missing. (Photos. 1867-5 and 1869-2; page 95 and 96).

The similar life raft, port side, also tore loose from its lashings.

Both balsa wood float rings are intact but scorched.

Life lines are blown down. (Photos. 1861-6 and 7; pages 97 and 98).

F. Exterior Hull. (Above w.l.).

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

The port shell between the main and second decks is dished about 1/4 inch between frames 128 and 131.

Other damage to the hull plating consists only of scorched and blistered paint. This is confined to the port side and is more evident aft than forward.

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

All hull fittings are apparently undamaged.

(c) Details of any impairment of sheer strakes.

The shear strakes are undamaged.

(d) Condition of side armor belt.

The armor belt is undamaged.

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

(a) Damage to structure and causes.

The inboard bulkhead of the port passageway, frames 55 1/2 to 62 is bulged outboard a maximum of 8 inches. (Photo. 1894-11, page 99).

The principal structural damage is in C-201L, frames 60 to 72, beneath the main deck. Stanchions are buckled badly. The stan-

chion connections to the overhead transverse girders are intact. The lower flange of the girders have been badly twisted in way of the stanchions. (Photos. 1894-8, 2102-3, 1894-7, 2102-8, 7, 2098-3, 2102-12, 10, and 11; pages 100, 101, 102, 103, 104, 105, 106, 107, and 108).

In C-202-L, between bulkheads 85 and 104, deflection of the main deck has caused buckling of stanchions at frames 94 and 97. (Photos. 2098-7, 10, 9 and 8; pages 109, 110, 111, and 112).

In D-201-L, the longitudinal bulkhead, frames 104 to 109, port, has a slight compression buckle.

In D-203-L, frames 113 to 132, light stanchions are buckled at frames 116 to 125. (Photos. 2098-1, 2085-1, 2098-12 and 2085-3; pages 113, 114, 115 and 116).

In D-204-L, the weld has failed between the center-line longitudinal bracket and transverse girder 135. (Photo 1782-7; page 117). The stanchion at frame 137, port, has buckled. (Photo 2085-7; page 118).

All the above damage is directly attributable to deflection of the main deck.

(b) Damage to joiner bulkheads and causes.

The joiner bulkhead at frame 70 is crushed. The doors leading to the crew's washroom, C-201-L are sprung. (Photos. 1894-10, 2098-4 and 6; pages 119, 120 and 121).

In compartment D-203-L, the transverse joiner bulkhead at frame 128 has a slight compression buckle in way of the door frame on the port side. (Photo 2085-5; page 122).

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

At frame 95, the engine room ventilation uptake door is sprung and slightly dished.

(d) Condition of equipment within compartments.

Equipment within the compartments is undamaged.

(e) Evidence of fire.

There is no evidence of fire.

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

Supports failed for a hot water pipe at frame 65, near the centerline, permitting the pipe to sag approximately four feet. (Photograph 1894-8, page 100).

The ventilation trunk at frame 62 is separated. The port section is hanging nearly to the deck. (Photograph 1894-7, page 102). The transverse beam at frame 68 in deflecting downward has crushed a large vent duct immediately forward of the blower on the starboard side. (Photograph 1894-9, page 123).

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

Watertight subdivision is essentially unimpaired. Compartment C-201-L is not entirely tight because of the small tear in the main deck. Compartment A-203-L, second deck between bulkheads 36 and 48, could also receive some water via the main deck and a torn access trunk at frame 47, centerline.

Habitability is unimpaired.

H. Armor deck (Second Deck).

(a) Damage to armor deck and causes of damage.

The armor deck is undamaged.

(b) Protection afforded spaces below.

Complete protection is afforded to spaces below the armor deck where the armor deck gives complete coverage.

(c) Condition around openings.

There is no damage around openings.

(d) Condition of connections to vertical armor.

Connections to the vertical armor are undamaged.

I. Interior Compartments (Below W.L.).

(a) Damage to structure and causes.

Bulkhead 104 has a slight compression wrinkle on the port side below the second deck. This is apparently the result of a slight movement inboard of the shell.

Frame 105 is cracked through the inboard flange at a joggle in way of a lapped seam in the shell plating, 3 1/2 feet above the 1st platform.

Bulkhead 109 has a vertical compression wrinkle adjacent to the port shell above the 1st platorm.

The webs are tripped at frame 110 in both port and starboard sides above the 1st platform. The transverse beam has a permanent set downward of 1/2 inch.

At frame 125, the second deck has a set of 1/8 inch. This deck had moved downward 5/8 inches and recovered 1/2 inch. Frames on both sides have worked slightly. The bases of the stanchions on the 1st platform are slightly crushed below the seam. The 2nd deck is not armored in this area.

(b) Damage to joiner bulkheads and causes.

There has been no damage to joiner bulkheads.

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

There has been no damage to closures.

(d) Condition of equipment within compartments.

One locker in D-310-L, 1st platform, between bulkheads 119 and 130, has been thrown onto the deck. This locker had not been secured as others adjacent to it had been. Doors of adjacent lockers are open, however.

(e) Flooding.

There has been no flooding.

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

Piping, cables, ventilation ducts, and shafts are in normal condition.

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

There has been no reduction in watertight subdivision. Topside damage to ventilation duct openings has slightly impaired the efficiency of the ventilation system. Habitability and utility of spaces has been unimpaired.

J. Underwater Hull.

(a) Interior inspection of underwater hull.

The portion of the underwater hull that has been inspected from the interior of the ship shows no sign of any damage. However, inner bottom tank C-909-F, immediately to starboard of the centerline, between bulkheads 66 and 71, has a small leak from the sea.

(b) Effect of damage or buoyancy, operability, maneuverability.

Operability, and maneuverability have not been affected. The effect on buoyancy is negligible.

(c) Any known or suspected damage to shafts, propellers, struts, rudders, or external keels.

There is no damage known or suspected to shafts, propellers, struts, rudder, or external keel.

(d) Details of impairment to keel structure.

There is no known or suspected damage to the keel structure.

K. Tanks.

(a) Condition of tanks in areas of damage.

The only damage to tanks is a small leak from the sea in C-909-F. This is an inner bottom tank immediately to starboard of the centerline between bulkheads 66 and 71.

(b) Contamination of liquids.

Only C-909-F would have been contaminated with salt water.

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

None.

L. Flooding.

Innerbottom tank C-909-F immediately to starboard of the ships centerline between bulkheads 66 and 71 is flooded from the sea. The before test sounding showed 2 inches of fuel oil. After test soundings showed the tank filled with oil and salt water. There is no other flooding. Drafts are not noticeably affected.

M. Ventilation (Exclusive of Blowers).

(a) Damage to ventilation systems and causes.

Ventilation ducts and closures have generally suffered little damage except where directly exposed to the blast and in areas where deflection of the weather deck ruptured or distorted the duct work beneath.

The intake screen in the deck house, main deck, frame 30, has bulged outward about 3 inches. (Photograph 1861-10, page 55). The closure to the ventilation intake trunks, from the weather deck to the superstructure deck level at frame 30, has been blown inward by blast (Photograph 1861-9, page 43). The starboard vent closure at frame 30 has been blown away by the blast. Ventilation duct panels are bulged and loosened below the superstructure deck.

The blower shield on the main deck, frames 46, port, has been buckled by the blast. The weld joining the shield to the deck house is cracked for a length of 12 inches. The blower shield on the main deck at frame 46, starboard, has been blown away from the deck house and downward at an angle of 90° from its original vertical position. These shields were welded from one side only, which is probably the reason for their poor performance.

Blast entered the engine room vent trunks, both port and starboard at frame 61 and caused minor damage to lagging on pipes in way of these vents in the engine room.

The vent shafts at the after parts of the forward engine room were shielded from the blast by the hoods and the after superstructure. In compartment C-201-L, on the 2nd deck at frame 63, the weather deck deflected downward approximately 15 inches breaking in the athwartships ventilation trunk. The port section is hanging down nearly to the deck (Photograph 1894-7, page 102).

At frame 66 in the same space another transverse ventilation trunk is bent downward approximately 15 inches but is apparently still operable.

At frame 68, starboard side, a main deck transverse beam has crushed the vent duct just forward of the blower. (Photograph 1894-9, page 123). Habitability is unimpaired.

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

There is slight discoloration of paint on engine room ducts, indicating that heat or blast was conducted through the ducts. There is also evidence of blast through natural exhaust trunks. This is shown by warped and ruptured aprons under ladders on these trunks.

(c) Evidence that ventilation system allowed progressive flooding.

There has been no flooding through the ventilation system.

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

Engine room exhaust vents should be fitted with protected blowers rather than vulnerable straight vent trunks.

N. Ship Control.

(a) Damage to ship control stations and causes.

There are numerous grounds in topside, exposed circuits. These have resulted from burning of cables and from cutting or snapping of cables by other damaged structure and gear in the superstructure areas.

Wiring is in good condition below decks.

In the bridge area one gyro repeater bracket and both alidade stands are broken. Also all glass and plexiglass covers on instruments are shattered. (Photographs 1729-8, page 2[illegible] , 1729-7, page 124 , and 1729-6, page 125).

(b) Constructive criticism of ship control systems.

Important wiring circuits should be afforded adequate protection.

Cast iron foundations should be eliminated.

Better protection should be provided for ship control personnel on the bridge.

O. Fire Control.

(a) Damage to fire control stations and causes.

1. Directors and elevated control positions.

All directors are temporarily inoperative. The after main and A.A. directors could be repaired to normal operation within 24 hours. The forward main and A.A. directors are moderately damaged and would require a navy yard availability for repairs.

The plexiglass windows are broken in both A.A. directors. The doors and hatches are slightly sprung in the forward A.A. director. One door is badly caved inward and another sprung in the after A.A. director. The paint is scorched on the exterior surface of all main and A.A. directors.

The range finders in both A.A. directors are inoperable due to jamming of shafting and gears. However, the range finder optics are apparently undamaged.

The damage to the directors was caused by the pressure wave and resulting low arder shock. No damage other than scorched paint was caused by heat or fire.

2. Plot rooms and protected spaces.

Not applicable.

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

The fighting efficiency of the ship was reduced about 50% as a result of damage to fire control instruments. Personnel in open stations, and not protected with enclosures, would have been casualties and have caused a further in efficiency until they could be replaced.

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

No constructive criticism can be offered regarding the location of the stations. All stations should be provided with shields for protection of personnel against blast and heat. Directors should be shaped to provide a maximum of strength against blast pressures, eliminating large flat areas where ever practical. Plating should be as heavy as weight considerations will permit.

P. Ammunition Behavior.

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

Satisfactory, except that the sun shield on ready service boxes for the secondary battery, 40mm and 20mm guns are damaged from the blast.

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

Satisfactory. There was no rise in temperature within the magazines as a result of the bomb.

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

All stowages appear to be sufficiently protected although ready service boxes for the A.A. battery on the top side are rather lightly constructed and susceptible to blast damage. Any explosion in these stowage would only cause local damage and not greatly threaten the survival of the ship.

(d) Behavior of gasoline stowage facilities.

Not affected.

Q. Ammunition Handling.

(a) Condition and operability of ammunition handling device.

Ammunition handling equipment is in good condition.

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

There is no evidence that any ammunition handling devices contributed to passing of heat, fire, blast, or flooding water.

(c) Constructive criticism of design and co structure of ammunition handling device.

No comment on design of ammunition handling devices.

R. Strength.

(a) Permanent hog or sag.

The general downward set of the main deck amidships and aft, and the leak in C-909-F may indicate a small permanent sag.

(b) Shear strains in hull plating.

There are no noticeable shear strains in the hull.

(c) Evidence of transverse or racking strains.

There is a slight dish of the port shell at the after quarter between the main and second deck and the main deck is sagged. This may be indicative of a transverse strain although there is no corresponding deformation to the starboard shell.

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

The main deck has a slight tear at the edge of the engine room exhaust bent, starboard, at frame 62. (Photograph 1894-12, page 54).

(e) Evidence of panel deflection under blast.

See Item E (a) for principal example.

(f) Turret, machinery and gun foundations.

Turret, machinery, and gun foundations are in good condition. The anchor windlass operates more easily than before the test.

S. Miscellaneous.

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

Heat damage by radiation is almost entirely directional. There is no deflection of the path noticeable where the structure has straight lines. In three places where the structure is curved there is blistering and scorching of paint as if the heat had been carried by an eddy current for a distance of 10 inches.

In 90% of the places where damage by heat radiation is discontinuous, a sharp deliniation between damaged and undamaged areas is apparent.

(b) Other miscellaneous affects or condition noted during inspection.

Recent coats of paint (3 or 4 thicknesses) are blistered and paint underneath is undamaged. This is probably the thickness effect, but may be the result of a change in binders and pigments.

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.

Both stacks were completely severed at their bases. The forward one fell overboard, the after one fell over on the deck to starboard. There was some distortion of uptakes, especially above the main deck level. Casings were blown out on all boilers. A leg of the crane tripod mast was bent, probably by being struck by the after stack as it fell over. Deflection of bulkheads through which the crane control shaft passes caused it to bind. Several firemain risers and some small pipe lines were damaged by deflection of the supporting structures.

(c) Other damage.

The casings of all boilers were blown out, the forward ones more than the after ones. Smoke indicators were damaged and moderate damage was done to the boiler brickwork. Both stacks were knocked off. Uptakes were distorted at their upper ends. Suction flappers of all forced draft blowers were bent. A large sheet aluminum dust pan under a ladder exposed to blast pressure fell on the aluminum vent cap of #3 main reduction gear, breaking the cap. A few minor leaks were started in #1 evaporating plant. The crane was damaged structurally. One motor whale boat was smashed and the engine fell out, damaging it. Several firemain risers and some small steam lines connected to radiators broke.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Except for blistered paint on the port side of exposed deck machinery, there was no evidence of heat on machinery or in machinery spaces.

(b) Fires and explosions.

There was no evidence of fires or explosions.

(c) Shock.

No damage was found that could be attributed to shock.

(d) Pressure.

Blast pressure, and deflection of decks and bulkheads resulting from blast pressure, caused all damage to machinery. The blast apparently came from slightly forward of the port beam.

(e) Effects apparently peculiar to the atom bomb.

Blast pressure of this magnitude at the range of the SALT LAKE CITY from an explosion is believed to be peculiar to the Atom Bomb.

III. Effects of Damage.

(a) Effect on machinery and ship control.

1. All boiler power was lost. It is estimated that 48 to 72 hours would be required for temporary repairs by the ship's force to enable one boiler to be steamed at a low rate. No motive power would have been available until after extensive repairs to boilers, uptakes, and stacks.

2. The only effect on ship control insofar as machinery is concerned, would have been limitation of power. The diesel generators and emergency diesel steering equipment were not damaged and were fully operable after Test A.

(b) Effect on gunnery and fire control.

No comment.

(c) Effect on watertight integrity and stability.

No comment.

(d) Effect on personnel and habitability.

It is estimated that there would have been a high percentage of casualties among fireroom personnel. It is not believed that any other casualties would have occurred among personnel below decks. Casualties among exposed personnel would have been high. Habitability would have been greatly impaired by loss of steam power.

(e) Total effect on fighting efficiency.

The effect on fighting efficiency from a machinery viewpoint was complete loss of steam power, and limitation of electric power to that furnished by the emergency diesel generators.

IV. General Summary of Observers' Impressions and Conclusions.

Stacks in good condition would probably not have been knocked off but would undoubtedly have been severely damaged. The stacks of the SALT LAKE CITY were badly corroded before Test A.

V. Preliminary Recommendations.

Boilers, uptakes, and stacks should be made more resistant to blast pressure.

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall condition.

All boilers were made inoperable by the test. The forward stack was blown overboard, the after stack was severed near its base and fell on the deck. The crane was made inoperable by structural damage. Intake flaps of all forced draft blowers were bent. There was some minor damage to piping.

(b) Areas of major damage.

Major damage to the machinery installation was confined to boilers, stacks, and uptakes.

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

The primary cause of the damage was the blast pressure which carried away the stacks and entered the boiler furnaces through the uptake openings.

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

All steam power was lost. All machinery below decks could have been operated had steam been available. The diesel driven generators and electrical equipment operated with power from these generators could have continued in operation. It is estimated that from 48 to 72 hours would have been required before steam could have been raised on one boiler.

NOTE: After Test A, temporary repairs were made to the casings of Nos. 5 and 6 boilers and a temporary stack was rigged to permit the limited steaming necessary to test out the main and auxiliary machinery.

B. Boilers.

(a) Air Casings.

1. The casings of all boilers were damaged similarly but to varying degrees. Those in the forward fireroom was damaged more than those in the after fireroom. Boiler #4 (in the forward fireroom) suffered the greatest damage. (See photo 1877-8, page 126). All failures occurred at the panel joints by bolt heads or nuts pulling through the flanges. The holes were enlarged by the passage of the bolt heads. The flange sheets did not shear in way of the bolt holes in most cases.

2. In the packed panels, the inner sheets bulged outward, forcing the outer sheets away from them and allowing the packing to fall out. The retaining sheets of these panels are thin and were inadequately fastened to the adjoining flanges. (See photos 1876-12, 1877-1, pages 127 and 128).

3. The casings around the water drums were pulled out of their original positions (forward at the boiler fronts and aft at the rears), being distorted in the vicinity of the drums. See photo 1877-2, page 129). Distortion of casings and motion of the casings away from the drums also occurred at the steam drums. (See photos 1877-3 and 4; pages 130 and 131).

4. Failures of casings occurred at the panel joints of the outboard casings just above the access doors. (See photos 1878-1,2,3, and 1877-5, pages 132, 133, 134 and 135). Inboard and rear casings showed evidence of having bulged to a greater degree than that existing at the time of inspection. They were apparently distorted and then came back somewhat toward their original positions when pressure was relieved by the rupture of the outboard casings. It is believed that the adjoining boiler casings supported the inboard casings and thus the only failures were on the outboard side. The heavier construction of the front burner plates precluded failure at the burner fronts.

5. Front and rear casings which did not show external signs of such motion were found to have moved to a considerable extent when the brickwork was examined. See comments under paragraph (d-4), Brickwork, below.

(b) External Fittings.

1. Pressure fittings appear to be undamaged. Hydrostatic tests of all boilers after Test A revealed no defects in these fittings.

2. Smoke indicator reflecting units were damaged by the cover glass being blown against the mirror or by the reflecting mirror supporting piece being blown out when the locking screw distorted, swinging on the hinge and breaking the mirror on impact.

3. No thermometers or gages appeared to be damaged.

(c) Fuel Oil Burners.

1. All pressure connections and valves appear to be undamaged. Air doors and operating gear may have been slightly warped by pressure on the furnace side, but in general the oil burners were operable or could be easily repaired.

2. The burner barrels had not been locked in position before the test. All were found either lying on the floor plates or almost out of the boiler.

(d) Brickwork and Furnaces.

1. The side walls and floors were in generally good condition after the test. There were small cracks at the side walls and running fore and aft in the centers of furnaces, indicating that some dishing of the floors may have taken place. Front and rear walls show evidence of having been blown outboard. There were cracks in back walls near floors and side walls and horizontally across the side walls. The bricks at the peaks of the back walls were dislodged or loosened.

The walls bulged outward with maximum deflection at the center. The front walls show no perceptible bulging but appear to have moved outward as flat units. Corbels at the tubes have broken away exposing the front casings in way of the tubes and leaving a space between the front wall and the first tube. (See photos 1877-9, 10; pages 136 and 137). This space varies from 2 to 8 inches between boilers. It is greatest on #4 boiler, which was most severely damaged, and least on #6 boiler.

2. It has been suggested, and is considered entirely possible, that the steam drums of these boilers were pushed downward by the blast. The motion was taken up by the tubes which sprung back into their original position when the blast subsided. If this happened, the motion of the tubes would have added to the effect of the motion of the walls in breaking the corbels at the front wall.

3. The corbels of these boilers are relatively large. Therefore, when they were broken off, a large space was left between the wall and the tubes. This makes the relative movement of the front walls appear to be greater than it actually is.

4. Plastic fronts on these boilers were cracked in some places.

5. It is considered that the brickwork withstood the blast very well but the supporting casings were weak and carried the brick with them as they were pushed out.

(e) Steam and water drums.

A hydrostatic test of all boilers revealed no defects in the boiler pressure parts except for boiler #8. In this boiler, one tube failed when a hydrostatic test was attempted after Test A. Otherwise, the hydrostatic pressure system of this boiler appeared to be intact. In view of the performance of tubes on other boilers on this vessel and other vessels having similar or worse overall boiler damage, it is the opinion of the inspectors that the tube was at the point of failure before the test. Its failure is not attributed to Test A. Boilers #5 and #6 were steamed after the test.

(f) Tubes.

See comment under (e) (Steam and Water Drums) above.

(g) Foundations.

The foundations were intact.

(h) Stacks and uptakes.

1. The forward stack carried away and fell overboard. Both inner and outer stacks sheared off at uptake connections, just below 01 deck level. (See photos 1877-11, 12, pages 138 and 139). Plates sheared at bolt holes. The uptakes were moderately distorted as the stack carried away but below decks the uptakes are undamaged. The stack was broken clean away and none of it remained. The tops of the uptakes were badly corroded indicating a condition of the forward stack similar to that described below for the after stack.

2. The after stack carried away and fell on the deck to starboard. Both inner and outer stacks sheared off just above 01 deck level. The outer stack plates sheared at the bolt holes. The base of the inner stack was rusted before the test to such a degree that no appreciable amount of good metal remained. Upper uptakes and lower portions of the stack were severely distorted, but uptakes below the main deck level were undamaged. (See photos 1729-9, 1868-10, 11, pages 140, 58 , and 141).

(i) Condition after test.

1. All boilers were made inoperable. If the boilers had been in operation with burner air doors open, the degree of damage would have been less, but it is considered that sufficient damage to casings would have resulted to make the boilers inoperable.

2. It is believed that a majority of personnel in both firerooms would have been killed by flarebacks. Personnel on upper levels might have survived if no lethal gases were drawn in by forced draft blowers.

(j) Cause of damage.

1. Air blast passed through uptakes and then built up pressure in furnaces, pushing out front and rear walls and rupturing casings. The smoke pipes had hoods (deflectors) on the forward portion which would probably have acted as a scoop if the blast had come from astern. It is considered that this would have increased the effect of the blast on the boilers if the blast had come from astern.

C. Blowers.

1. The suction flappers were bent by the blast pressure coming down the intake trunks. This was quickly repaired by the ship's force, however, the blowers could not be operated until these flappers were straightened.

2. There was no other damage to forced draft blowers, all of which have been operated under service conditions since Test A.

D. Fuel Oil Equipment.

1. No damage. All fuel oil equipment has been operated under service conditions since Test A.

BEARING LEAD DATA

#4 MAIN ENGINE - L.P. TURBINE FORWARD BEARING

Forward Lead	Before Test "A"	After Test "A"	Difference
Port	.020	.0095	.0105
Top	.024	.014	.010
Stb'd	.015	.0075	.0075
Center Lead			
Port	.0165	.013	.0035
Top	.0235	.017	.0065
Stb'd	.011	.010	.001
After Lead			
Port	.020	.009	.011
Top	.0275	.019	.0085
Stb'd	.016	.0065	.0095

#4 MAIN ENGINE - L.P. TURBINE AFTER BEARING

Forward Lead			
Port	.027	.0125	.0145
Top	.033	.016	.017
Stb'd	.0205	.0065	.014
Center Lead			
Port	.0225	.0135	.009
Top	.0335	.017	.0165
Stb'd	.022	.008	.014
After Lead			
Port	.021	.013	.008
Top	.036	.0155	.0205
Stb'd	.028	.0125	.0155

BEARING LEAD DATA

#4 MAIN ENGINE - H.P. TURBINE FORWARD BEARING

Forward Lead	Before Test "A"	After Test "A"	Difference
Port	.0215	.0095	.012
Top	.041	.015	.026
Stb'd	.0175	.0095	.008
Center Lead			
Port	.021	.011	.010
Top	.0275	.015	.0125
Stb'd	.019	.0125	.0065
After Lead			
Port	.0215	.011	.0105
Top	.0285	.0145	.014
Stb'd	.020	.0135	.0065

#4 MAIN ENGINE - H.P. TURBINE AFTER BEARING

Forward Lead			
Port	.0195	.013	.0065
Top	.029	.016	.013
Stb'd	.0175	.015	.0025
Center Lead			
Port	.0185	.012	.0065
Top	.030	.017	.013
Stb'd.	.0195	.014	.0055
After Lead			
Port	.016	.012	.004
Top	.029	.016	.013
Stb'd	.021	.016	.005

E. Boiler Feedwater Equipment.

No damage. All feedwater equipment has been operated under service conditions since Test A.

F. Main Propulsion Machinery.

No damage. The main turbines have been jacked over the spun in both directions since Test A. There has been no change in dummy micrometer readings.

Leads left in the bearings of one low pressure turbine during Test A, indicate a maximum motion of .020 inch of shaft journals.

G. Reduction Gears.

1. The sheet aluminum dust pan under a ladder was knocked off by the shock and fell on the aluminum vent cap of #3 main gear casing. The cap was broken. A careful inspection disclosed no particles in the gear and there was no indication of any foreign body in the gear when the turbine was jacked. It is believed that particles from the broken vent cap fell into the lub oil sump.

2. All gears have been inspected while the turbines were being jacked over one revolution. They appear normal.

3. Lubrication is normal.

H. Shafting and Bearings.

No damage. Shafting and bearings have been inspected while the turbines were being jacked and spun.

I. Lubrication System.

No damage. The lubrication system has been operated under service conditions since Test A.

BEARING LEAD DATA

#4 REDUCTION GEAR - L.P. PINION FORWARD BEARING

Forward Lead	Before Test "A"	After Test "A"	Difference
Port	.025	.013	.012
Top	.035	.0175	.0175
Stb'd	.0195	.010	.0095
Center Lead			
Port	.024	.0125	.0115
Top	.0355	.0175	.018
Stb'd	.0195	.010	.0095
After Lead			
Port	.019	.0095	.0095
Top	.035	.0185	.017
Stb'd	.019	.0095	.0095

#4 REDUCTION GEAR - L.P. PINION AFTER BEARING

Forward Lead			
Port	.0185	.013	.0053
Top	.028	.020	.008
Stb'd	.021	.0135	.0075
Center Lead			
Port	.018	.018	.000
Top	.027	.0175	.0095
Stb'd	.017	.011	.006
After Lead			
Port	.021	.016	.005
Top	.0265	.016	.0105
Stb'd	.017	.008	.009

BEARING LEAD DATA

#4 REDUCTION GEAR - H.P. PINION FORWARD BEARING

Forward Lead	Before Test "A"	After Test "A"	Difference
Port	.013	.009	.004
Top	.0235	.014	.0095
Stb'd	.023	.015	.008
Center Lead			
Port	.014	.010	.004
Top	.0255	.0135	.012
Stb'd	.027	.014	.013
After Lead			
Port	.015	.011	.004
Top	.027	.017	.010
Stb'd	.020	.012	.008

#4 REDUCTION GEAR - H.P. PINION AFTER BEARING

Forward Lead			
Port	.022	.0115	.0105
Top	.0305	.017	.0135
Stb'd	.024	.017	.007
Center Lead			
Port	.0175	.007	.0105
Top	.029	.0165	.0125
Stb'd	.0245	.0135	.011
After Lead			
Port	.020	.008	.012
Top	.029	.0165	.0125
Stb'd	.024	.013	.011

J. Condensers and Air Ejectors.

No damage. All condensers have been operated under service conditions since Test A.

K. Pumps.

No damage. All pumps have been operated under service conditions since Test A.

L. Auxiliary Generators (Turbines and Gears.

No damage. The turbo-generators have been operated under service conditions since Test A.

M. Propellers.

No damage. Propellers have been sighted through the water and checked while the turbines were being jacked and spun.

N. Distilling Plant.

1. No. 1 evaporating plant was in poor condition before the test. Its condition was not appreciably changed by the test, although a few leaks were started which were easily repaired by the ship's force.

2. No. 2 plant was undamaged and operated normally immediately after the test.

O. Refrigeration Plant.

No damage. The refrigerating plant has been operated under service conditions since Test A.

P. Winches, Windlasses, and Capstans.

1. The anchor windlass, capstan, and boat winches were undamaged and have been operated under service condition.

2. The warping winches were not operated after Test A, but appear to be undamaged.

Q. Steering Engine.

No damage. Both steering units have been tested from all stations.

R. Elevators, Ammunition Hoists, Etc..

1. All ammunition hoists were undamaged and have been operated under service conditions.

2. The crane is inoperable because of structural damage. A leg of the crane tripod mast was bent. It is believed that this leg was struck by the after stack as it fell over. The control shaft was binding against deflected bulkheads through which it passes.

S. Ventilation (Machinery).

The exhaust fan (propeller type) in the crew's galley, main deck, frame 95, is inoperative. Blast pressure entering the duct bent the propeller blades. There was no other damage to ventilation machinery.

T. Compressed Air Plant.

No damage. The air compressors have been operated under service conditions since Test A.

U. Diesels (Generators and Boats).

1. No damage occurred except to one motor whaleboat engine. The boat was smashed by blast pressure and the engine dropped out. The following equipment has been operated under service conditions since Test A:

Two emergency diesel generators.
One diesel fire pump.
One diesel engine for centering the rudder in emergencies.

V. Piping System.

(a) Main steam - no damage.

(b) Auxiliary steam - some small steam lines to and from steam radiators were broken at points where the structure to which they were attached failed. There was no other damage to piping, all of which has been tested at normal operating pressures.

(c) Auxiliary exhaust - no damage.

(d) Condensate and feedwater - no damage.

(e) Fuel and feedwater - no damage.

(f) Lub oil - no damage.

(g) Firemain, sprinkling and water curtain - several fire main risers broke at points where the supporting structure failed. A 3-inch vertical branch line to a fire main riser, 2nd deck, frame 72, amidships, broke in two because of deflection of the deck above. The effect of the above failures would have been to cut off water from the affected fire plugs. All of them could have been isolated. There was no damage to the fire main.

(h) Condensers - no damage.

(i) Drain - no damage.

(j) Compressed air - no damage.

(k) Hydraulic - no damage.

(l) Gasoline - no damage.

(m) Other systems - no damage.

W. Miscellaneous.

1. Galley and scullery equipment were undamaged and operated normally after the test.

2. Machine shop and laundry equipment and electric water coolers were undamaged and have been operated under service conditions since Test A.

TECHNICAL INSPECTION REPORT

SECTION III - ELECTRICAL

GENERAL SUMMARY OF ELECTRICAL DAMAGE

I. Target Condition After Test.

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

Not observed.

(b) Structural damage.

Not observed.

(c) Other damage.

Electrical damage affected ship control by the loss of engine order, steering, and shaft revolution telegraphs on the navigation bridge. Electrical power supply circuits to gunnery and fire control were not affected.

II. Forces Evidenced and Effects Noted.

(a) Heat.

A wave of radiant heat struck the vessel from about 240 degrees relative bearing. The heat was of sufficient intensity to blister and char painted surfaces directly exposed, and to ignite fabric on the main deck aft.

(b) Fires and explosions.

No electrical equipment was damaged by fires.

(c) Shock.

Lack of general breakage within the ship makes it

doubtful if shock was present, although shattering of instrument glass on navigation bridge and spilling of mercury from both master gyros could have been caused by shock.

(d) Pressure.

A wave of pressure struck the vessel from about 240 degrees relative bearing. The pressure was sufficient to break the aluminum yokes on both 24'' searchlights located above the signal bridge, and to break off both aluminum pelorus stands on the navigation bridge.

(e) Any effects apparently peculiar to the Atom Bomb.

The radiant heat is the only apparent effect peculiar to the Atomic Bomb.

III. Re sults of Test on Target.

(a) Effect on propulsion and ship control.

Ship propulsion was not affected. Ship control was affected by loss of engine order shaft revolution and steering telegraphs on the open navigation bridge.

(b) Effect on gunnery and fire control.

There was no electrical damage.

(c) Effect on watertight integrity and stability.

Electrically there was no effect.

(d) Effect on personnel and habitability.

Electrical damage had no effect on personnel or habitability of the vessel.

(e) Total effect on fighting efficiency.

The fighting efficiency of the vessel was only slight-

ly impaired by electrical damage.

IV. General Summary of Observers Impressions and Conclusions.

The vessel was subjected to sufficient damaging forces for the electrical equipment to be given a fair test of its ruggedness and suitability for use under such conditions. The only exception is the weakness of cast aluminum as a material for supporting columns.

V. Any Preliminary General or Specific Recommendations of The Inspecting Party.

It is recommended that cast aluminum be discontinued as a material for instrument cases and supporting columns.

DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

A. General Description of Electrical Damage.

(a) Overall condition.

The overall condition of the ship's electrical equipment was good.

(b) Areas of major damage.

Damage was confined almost entirely to the weather deck area.

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

Blast force directly on equipment and collapse of supporting structure are the major causes of damage.

(d) Effect of target test on overall operation of electric plant may be summarized as follows.

1. The ship's service generator plant was not affected.

2. The engine and boiler auxiliaries were not affected.

3. Communications were unaffected except for the damaging of a few general announcing speakers and telephone jack boxes.

4. Fire control circuits were not affected although some fire control insturments were disabled.

5. Ventilation was not affected by electrical failure although two blower sets failed mechanically.

6. Lighting was unaffected except for a few broken lamps.

(e) Types of equipment most affected.

The only direct failures of electrical equipment was the collapse of cast aluminum searchlight and alidade columns. Some wireways and local fittings failed because of supporting structure collapse.

B. Electric Propulsion Rotating Equipment.

This item does not apply to the vessel.

C. Electric Propulsion Control Equipment.

This item does not apply to the vessel.

D. Ship's Service Generators.

1. The ship's service generators were examined after the able test and then operated to supply normal load. No damage has been found to any of the four machines.

2. No recommendations are made.

E. Emergency Generators.

1. The two diesel emergency generators were started up after the able test and supplied the vessel with power for several days until the main machines could be operated. No damage was revealed by the operation or by inspection.

2. No recommendations are made.

F. Switchboards and Distribution Panels.

1. The ship's service switchboards were examined and energized to supply normal service after the A test. Distribution panels were inspected and used for regular supply. No damage to any board or panel was found except a distortion at the frame and crushing of a pancake resistor on the battery charging switchboard on main deck at frame 48, centerline. The damage resulted from pres-

sure by dished in bulkhead.

2. No recommendations are made.

G. Wiring, Wiring Equipment and Wireways.

1. The only able test wiring failures that occurred on the ship were due to collapse of the supporting structure.

2. A vertical, five-layer wireway in the engine room ventilation supply trunk, main deck passage, port side, Frame 87 had the hangar supports bent 30° forward, at right angles to the cable run: by the force of the blast coming forward in the passage and into the vent entrance grill. The cables for a distance of about five feet were tightly bowed between hangars by the blast but had no visible damage even though the installation was an old one.

3. On the outboard side of the port main deck passage at frame 85, three cables running from the overhead to the bulkhead parted when the bulkhead moved outboard about two feet. The same movement broke a cable at frame 87 and pulled another from a fused switch box.

4. A small wire run along the top of the bulkhead on the outboard side of the main deck passage, frame 80 to frame 83 was pulled free of clips and open hook supports when bulkhead collapsed outward. The cable was not visibly damaged except for chafting. This cable run was not installed in accordance with any navy plan; it was a ship's force installation.

5. The wire group running up the starboard forward leg of the secondary conning tower at frame 82, was broken by the tearing loose of the leg from the superstructure deck.

6. Cables running up the main mast were pulled out of several boxes due to tension when the mast was bent.

7. Cables to boxes on forward bulwark of aft searchlight platform were broken or pulled loose by the forward collapse at the bulwark.

8. Two small armored cables up the port quarter face of the mainmast were heated until the sheath exuded thru the armor. Other cables running parallel were not so affected. Several cables on the mast were severed by missiles.

9. A round cast aluminum 10 wire connection box on the inboard bulkhead of the port passageway, second deck frame 56, was snapped off the bulkhead by the blast. The bulkhead was adjacent to the forward uptake and was bulged outboard about 12'' by the blast. The box had been secured by screws through only two of the three feet and those two feet were broken off. The box was not forced off by the buckling of the bulkhead, but snapped off by the shock.

10. Cables running from the deck to the bulkhead on the inside of door, main deck, frame 47, just starboard of centerline, were sheared off at deck by bulkhead collapsing inward.

11. The well deck was forced downward about 18'' without damage to any wireways attached to the under side. In general, wireways withstood the test very well.

12. No recommendations are made. Ref. Photos 1894-7, 2098-6; pages 102 and 121.

H. Transformers.

1. No damage to transformers resulting from the 'A' test was found by inspection or by operation.

2. No recommendations are made.

I. Submarine Propelling Batteries.

1. This item does not apply to the ship.

J. Portable Batteries.

1. A six volt 100 A.H. gun firing and sight light battery was crushed by a flying missile. This battery was located

in a metal box, inboard of port passageway frame 83, main deck.

2. The starting battery in the #2 whaleboat was shattered by blast.

3. No other portable batteries were found to be damaged.

4. No recommendations are made.

K. Motors, Motor Generators and Motor Controllers.

1. A Westinghouse controller for hull ventilation, class 8585 AFN S.O. 3B9642 spec 17-C-17, mounted on forward side of bulkhead 72, centerline, second deck, was undamaged by the blast, although the bulkhead supporting it was creased deeply by the collapse of the deck overhead and one weld pad for the box was pulled from the bulkhead. There was no visible evidence of great shock on this controller.

3. No recommendations are made.

L. Lighting Equipment.

1. The only damage to lighting equipment found after the Able test was the breaking of a few lamps throughout the vessel. There were not enough failures in any one location to make certain that shock instead of missiles or reboarding activitities caused the damage.

2. Phenolic lamp receptacles, type 9-S-4665-L located on the underside of the main deck in the midship section where the blast had pushed the deck down about two feet, were not damaged, nor was any cable pulled from them. There is no evidence that there was any great shock however, despite the displacement.

3. No recommendations are made. Ref. Photo. 1894-7, page 111.

M. Searchlights.

1. Both of the ship's 24" signal searchlights located on top of the Radar room were wrecked by the 'A' test. The port light, Model 44056, had both of the cast aluminum trunnion arms broken off at the base and the light was thrown in board against the guard rail of the platform. The front door was not damaged but had been forced inward as shown by the bent retaining clips. The radial signal shutter blades were all sprung from the outer bearing sockets, although the inner bearings and gear mechanism were intact and operable. The iris shutter was inoperable and the elevation lock, grain lock and elevation rack were all broken. The lamp mechanism had no apparent damage, the carbon feed rods were in good order and the lamp mirror was undamaged although the rear door was dented in by falling against the guard rail. The lamp had been trained and locked 20° off the port bow. The blast appeared to come from the port quarter twisting the light to port and forcing it inboard against the guard rail.

2. The base casting below the trunnion arms of the starboard 24" signal searchlight broke completely under the force of the blast and the light fell to the signal bridge two levels below. The force of the blast and the impact of the fall smashed the light. Both doors and the dome glass were broken as were the shutters, the locks, the elevation rack and the shutter operating mechanism. The carbon feed rods appeared in good order but the lamp mechanism was inoperable.

3. Both 36" searchlights at frame 86 on the searchlight platform were disabled by the blast although neither light was displaced. The port light had no damage to the front and rear doors, the dome glass, the base and the arc lamp feed rods. The iris shutter was open at the time of the blast and was snapped out of the bearing ring. The carbon feed mechanism was unaffected, the battle order indicator was not damaged, but the shutter operating mechanism was inoperative.

4. The starboard 36" light had the same damage as the port light except that the front dome glass was broken and the iris shutter was forced back into the lamp mechanism.

5. The 12″ signal searchlight on the forward port wing of the signal bridge and the socket knocked loose by the blast, and the lead burned and pulled loose. The socket had not been properly mounted.

A 12″ signal light stowed on the after searchlight platform had one trunnion arm bent and the glass broken by the swinging of the barrel by blast pressure. However, this is not valid blast damage as one trunnion lock was loose, allowing the trunnion to swing free. A companion light was undamaged.

6. The failure of the bases of both 24″ searchlights indicate that cast aluminum is not suitable as a material for supporting columns exposed to the blast. The similar failure of the two aluminum alidade columns on the vessel indicates that the general design and proportioning of such cast aluminum supports is not consistent in strength with the remainder of equipment so exposed. Ref. Photo 1729-6, page 25.

N. Degaussing Equipment.

1. The degausssing machines and controls were inspected after test able and operated satisfactorily.

2. The only damage to degaussing equipment found was the melting out of solder on one joint of the type "K" compass compensating coil set on the standard compass, and the charring of the surface on one of the leads to the coil set. The seam opened was on the top edge of the oval coil unit and faced the blast.

3. A compass compensating coil set, fabricated so that the soldered seams inward would have increased resistance to the heat of the blast.

O. Gyro

1. The test caused both of the Arma Mk VIII mod. 3A master gyro compasses to spill a considerable amount of mercury into the bottom at the binnacles. The compasses had no visible damage, but though not tested with the mercury loss, would

probably have had a permanent error. The ship's force cleaned the mercury from the forward compass and restored it and the compass tested out satisfactorily.

2. The Arma Mk. V mod. 8 gyro repeater on the starboard wing of the signal bridge was snapped out of the inner trunnion bearing, elongating the inner gimbal ring and allowing the repeater to fall to the deck.

3. A second Mk V mod. 8 repeater on the aft side of the port forward wing screen on the navigation bridge, had the cast aluminum trunnion arm column snapped off allowing the repeater to fall to the deck.

4. The cover glass on an Arma Mk VI mod. O repeater on the navigation bridge next to the repeater just above; was broken, but the instrument itself was undamaged.

5. Two Mark XXXII Mod. O Sperry self synchronous alidades mounted one on either side of the pilot house on the bridge were broken off by the able test. The starboard unit broke across the column at the top of the access door, the port unit broke across the column at the bottom of the access door. Neither repeater unit appeared damaged although both had been thrown to the deck. The failure of units on both sides of the ship indicated that shock and not blast probably caused the failure, which was in both cases a breaking of the aluminum column at an opening in the column.

6. The glass on the dead reckoning tracer in the C.I.C. was smashed by a missile but the mechanism was unhurt.

7. All repeaters were found to follow properly when tested on the master.

8. The failure of the Mk V Mod. 8 repeater column and the failure of both alidade columns, supports the belief expressed in Item M, "Searchlights", that such cast aluminum items are unsuitable.

9. The lack of damage to the gyro repeaters, even when the supports failed, indicates a ruggedness desirable for the application. Ref. Photos 1729-8 and 6; pages 21 , and 125 .

P. Sound Powered Telephones.

1. No sound powered telephone headsets or handsets were found to have been damaged by the "A" test. Jack box failures, principally the pulling out of leads, occurred only where supporting structure had deformed. Stowage box failures were similarly due entirely to structural failures.

2. No recommendations are made.

Q. Ship's Service Telephones.

1. The automatic telephone board showed no damage and functioned properly after the "A" test. About four stations were disabled by leads pulling free due to structural damage. A bell unit located in the pilot house received missile damage.

2. No recommendations are made.

R. Announcing Systems.

1. A 17 MC class L and S speaker manufactured by RCA, located on the port wing of the navigation bridge, was knocked out of housing, rupturing the cone. A similar speaker on the starboard wing remained in place but the cone was broken. A second similar speaker on #17 starboard 5" battery had the internal leads torn loose.

2. A 10 circuit intercommunication unit NT-101 serial 3336 made by Webster, installed on the port forward windscreen of the navigation bridge, had one angle mounting bracket partially closed by the shock force and had three indicator light bull's eyes missing, even though the unit is full shock mounted. A similar unit on the starboard windscreen was not affected.

3. The general announcing amplifier and three transmitting stations, the 17MC amplifier, all speakers and intercommunication units were found satisfactory except as noted above. Ref. Photos 1729-7,8; pages 124 and 21 .

4. The 17MC class L and S speaker as installed here, has too light a front cover for the weight of the speaker unit installed. The failure indicates that vibration revolved the cover until the keyhole, slots cleared the screw heads and the cover and a positive cover lock would make the unit more rugged.

S. Telegraphs.

1. Glass covers and dials on the engine order telegraph in the pilot house, the two on the starboard side of the navigation bridge, the rudder angle telegraph and the smoke telegraph located on the navigation bridge cracked or shattered and were blown in by the blast. All selsyn units operated properly in test but the gear train between the handle and selsyn in the smoke telegraph was pulled open.

2. A more rugged type of transparent dial is needed for exposed indicator and telegraphs. A heat resistant plastic, or heavy annealed glass are possible materials. Ref. Photos 1729-7 and 8; pages 124 and 21 .

T. Indicating Systems.

1. The wind direction and wind intensity transmitters on the yardarm of the main topmast were bent over 90° on the supports. No close examination of the units was possible.

2. There was no other damage found in any other indicating system on the ship.

3. No recommendations are made.

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

1. No damage was caused to the I. C. and A. C. O. switchboards by the "A" test. All boards operated satisfactorily after the blast.

V. F. C. Switchboards.

1. No damage was caused to the F. C. switchboards by the able test. All boards operated satisfactorily after the blast.

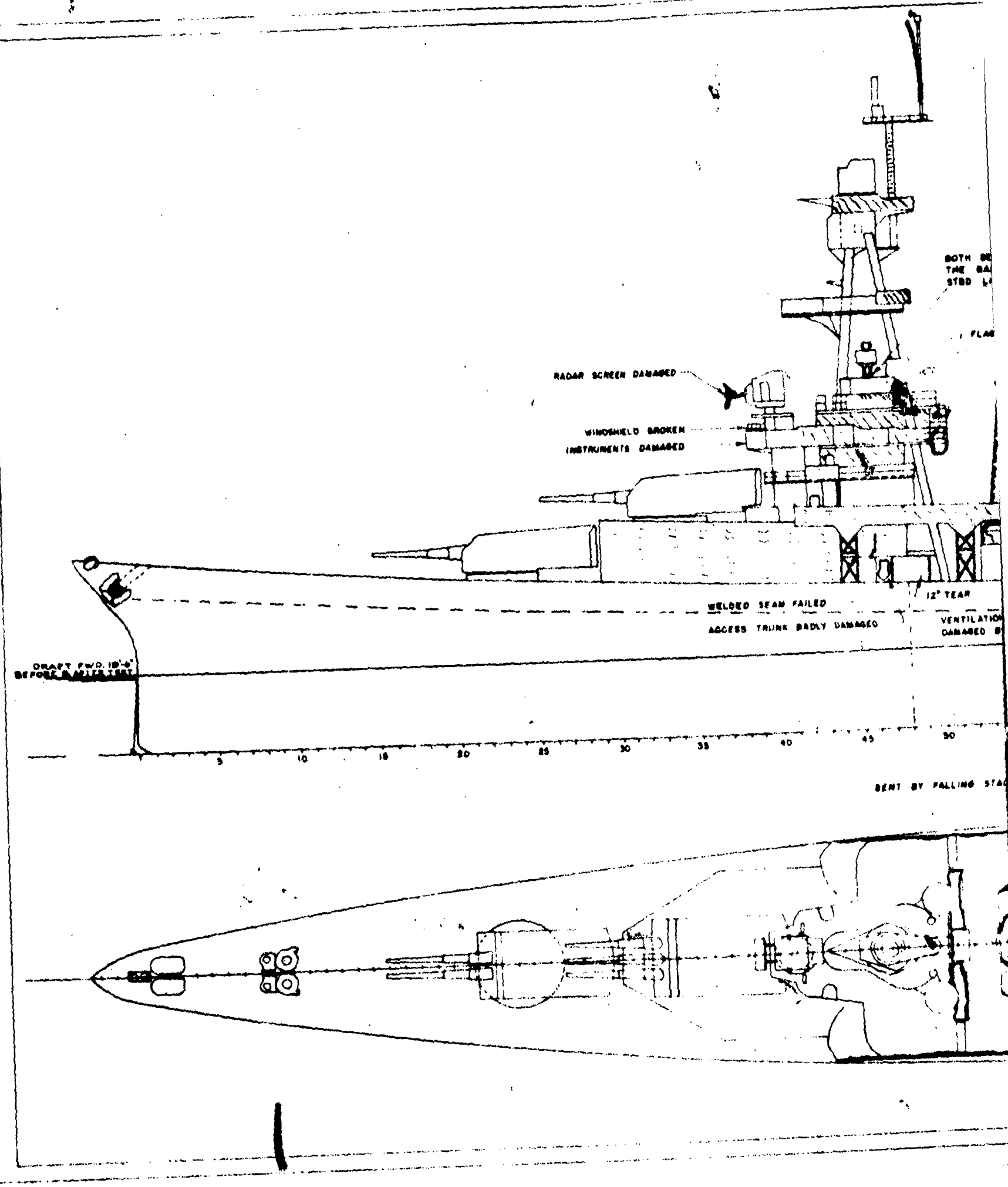
W. Miscellaneous (Code 660 Material).

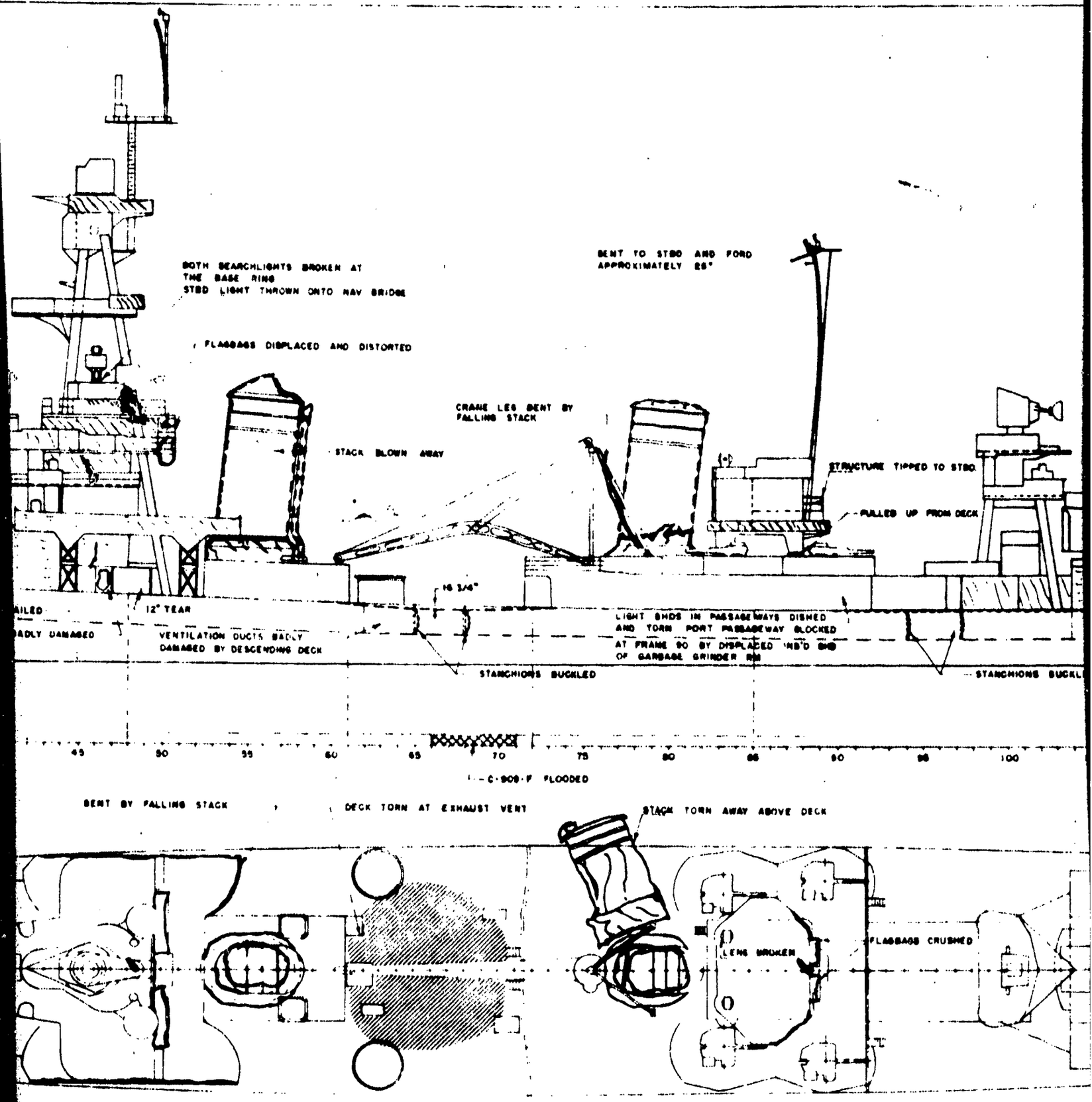
1. A quantity of special electrical equipment was installed on the vessel by the Bureau of Ships Code 660, to determine the characteristics of this material when subjected to the Atomic Bomb blasts. The "A" test had no effect whatsoever on any of this equipment.

APPENDIX

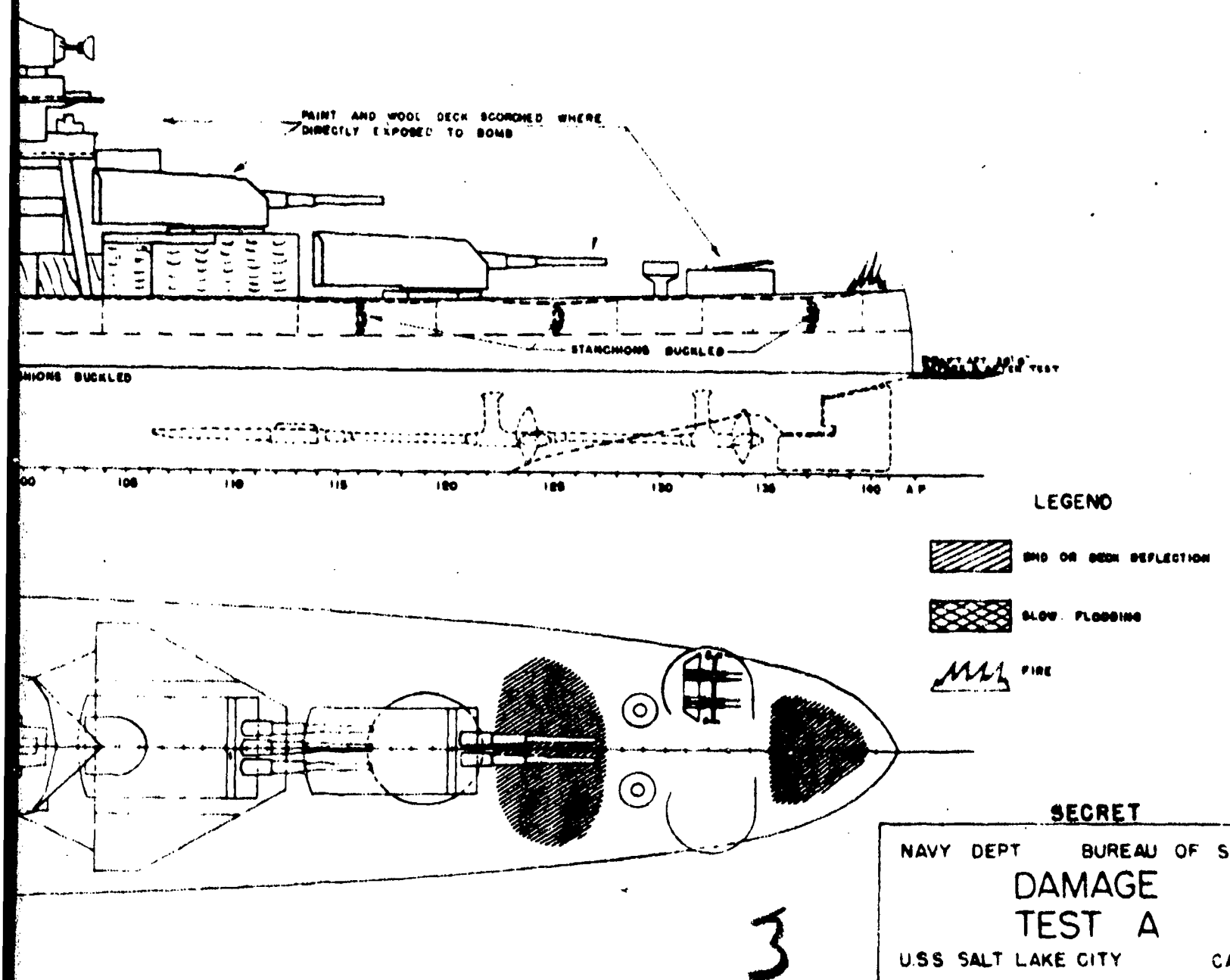
SHIP DAMAGE DIAGRAM

TEST ABLE


RADAR SCREEN DAMAGED
WINDSHIELD BROKEN
INSTRUMENTS DAMAGED
WELDED SEAM FAILED
ACCESS TRUNK BADLY DAMAGED
12" TEAR
DRAFT FWD. 18'-6"
5
10
15
20
25
30
35
40
45
50


BOTH SEARCHLIGHTS BROKEN AT THE BASE RING
STBD LIGHT THROWN ONTO NAV BRIDGE
FLAGBAGS DISPLACED AND DISTORTED
BENT TO STBD AND FORD APPROXIMATELY 25°
CRANE LEG BENT BY FALLING STACK
STACK BLOWN AWAY
STRUCTURE TIPPED TO STBD
PULLED UP FROM DECK
16 3/4"
12" TEAR
VENTILATION DUCTS BADLY DAMAGED BY DESCENDING DECK
LIGHT SHDS IN PASSAGEWAYS DISHED AND TORN PORT PASSAGEWAY BLOCKED AT FRAME 90 BY DISPLACED
OF GARBAGE GRINDER RM
STANCHIONS BUCKLED
STANCHIONS BUCKL
45
50
55
60
65
70
75
80
85
90
95
100
C-909-F FLOODED
BENT BY FALLING STACK
DECK TORN AT EXHAUST VENT
STACK TORN AWAY ABOVE DECK
LENS BROKEN
FLAGBAGS CRUSHED

2



3

SECRET

NAVY DEPT BUREAU OF SHIPS

DAMAGE TEST A

U.S.S SALT LAKE CITY CA 25

#73A

APPENDIX

SHIP MEASUREMENT DIAGRAM

TEST ABLE

APPENDIX

SHIP MEASUREMENT DATA

A. Deck Survey Data.

(a) No accurate deck survey data was obtained on this vessel after test A. However, indications are that no significant change in alignment occurred.

B. Scratch Gages (pages to 90).

The scratch gages on this vessel were installed between the main and second deck. As the second deck is the armor deck and was apparently undamaged, the gage records have been interpreted as indicating movement of the main deck. These gages indicate a downward movement of the main deck throughout the ship with permanent set averaging approximately half of the maximum movement.

C. Deck Deflection Data (pages 91 to 92).

Special measurements were taken to determine the deflection of the main deck in the well deck area and at the stern. To obtain the actual contour of the deck, a horizontal plane was established using a surveyor's transit. Rod readings were taken as necessary. A plot of the deck edge rod readings indicated no change. Therefore, it was possible to superimpose several sections for comparison purposes holding deck edge stations as fixed points. To obtain the actual amount of deflection, the original design camber and the damage contour have been indicated.

DECK DEFLECTION GAGES

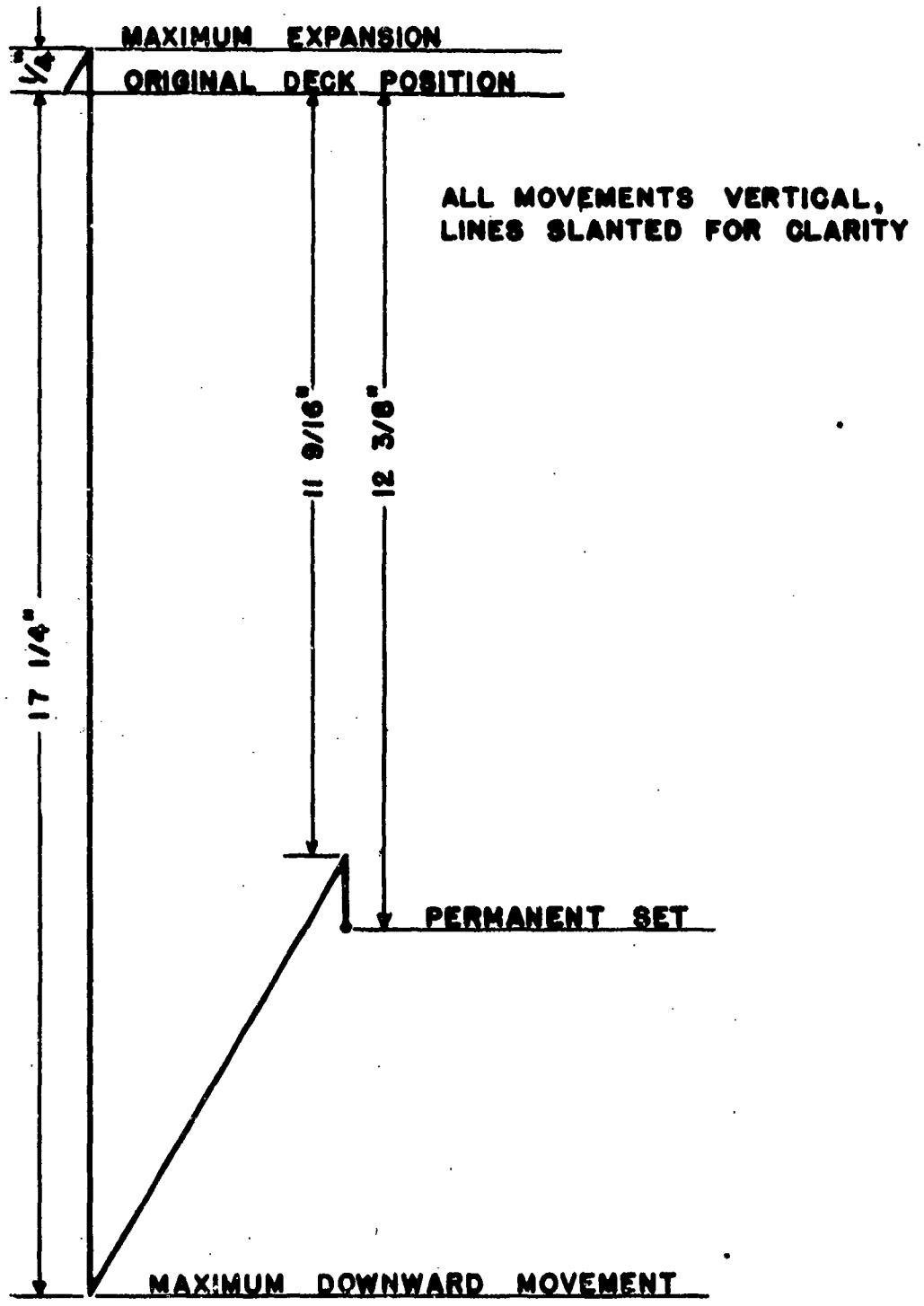
SHIP USS SALT LAKE CITY (CA-25) TEST A

LOCATION			MAXIMUM COMP.	MAXIMUM EXP.	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄			DISTANCE	EXP./COMP.	
17	2nd	Centerline	None	0-0-1/8	0-0-1/8	Exp.	Tublar gauge bent indicating sag in ship.
55	"	Stbd	0-0-1/8	0-0-3/16	0-0-1/8	Exp.	" " "
56	"	Port	0-0-1/2	0-0-1/4	0-0-0	Exp.	" " "
62 1/2	"	Centerline	1-5-1/4	0-0-1/4	1-0-3/8	Comp.	None
66	"	Port	0-7-7/16	0-0-1/4	0-4-1/4	Comp.	Set due to local conditions
66	"	Stbd.	0-6-24	0-0-8	0-3-11/16	Comp.	Set due to local conditions
69	"	Centerline	1'-0"	1/4"	7 5/8"	Comp.	None
97	"	Port	0-3-1/2	0-0-1/8	0-2-5/16	Comp.	Tublar bent indicating sag in ship
97	"	Stbd.	0-1-1/2	0-0-3/6	0-0-3/4	Comp.	" " "
97	"	Centorline	0-0-1/16	0-0-1/8	0-0-7/16	Comp.	" " "

DECK DEFLECTION GAGES

SHIP USS SALT LAKE CITY (CA-25) TEST A

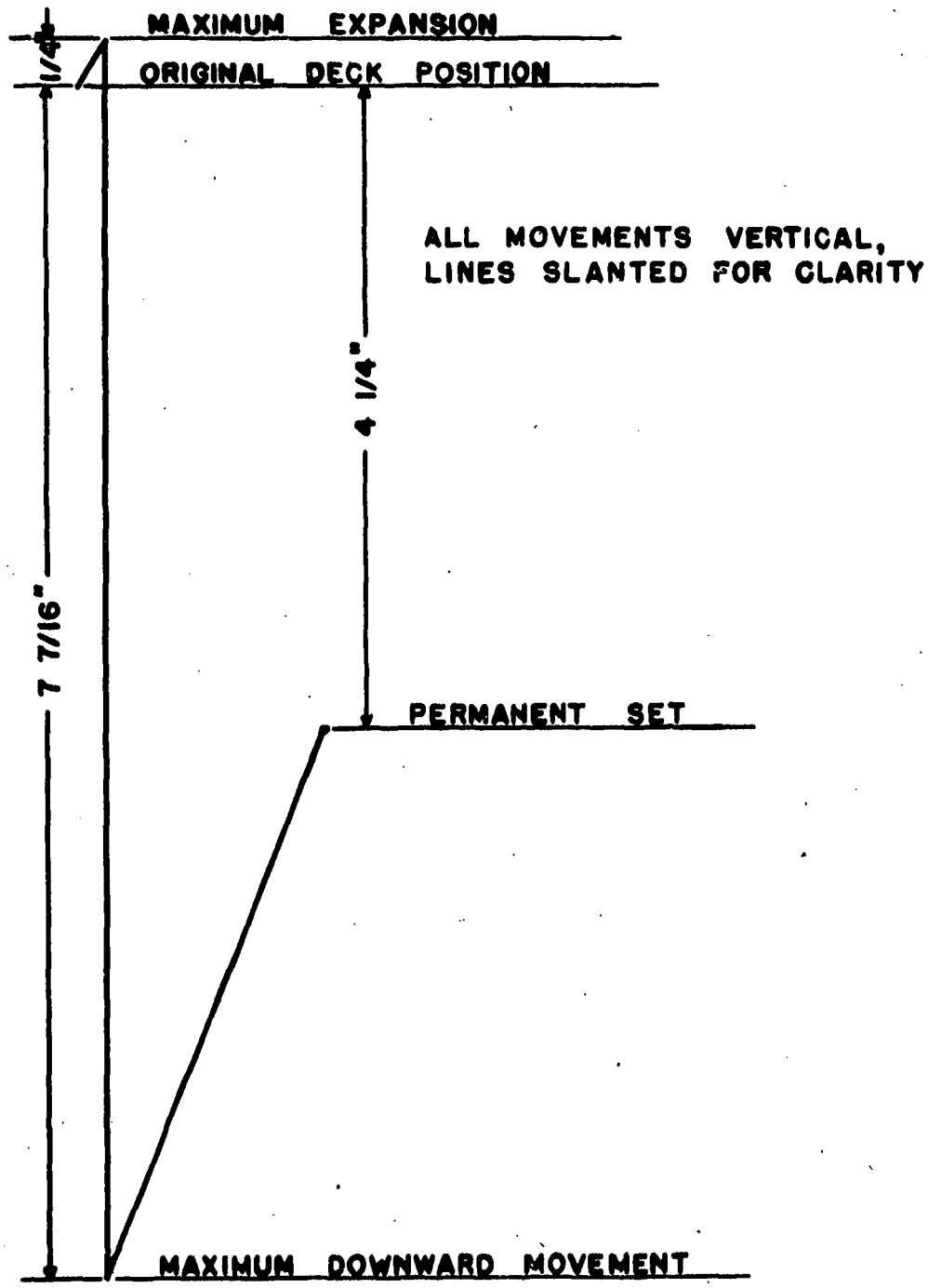
LOCATION			MAXIMUM COMP.	MAXIMUM EXP.	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄			DISTANCE	EXP. / COMP.	
124 1/2	2nd	Stbd	0-3-3/4	0-0-3/16	0-2-0	Comp.	Tubiar gauge bent indicating sag in ship.
124 1/2	"	Port	0-2-11/16	0-0-3/16	0-1-1/2	Comp.	" " "



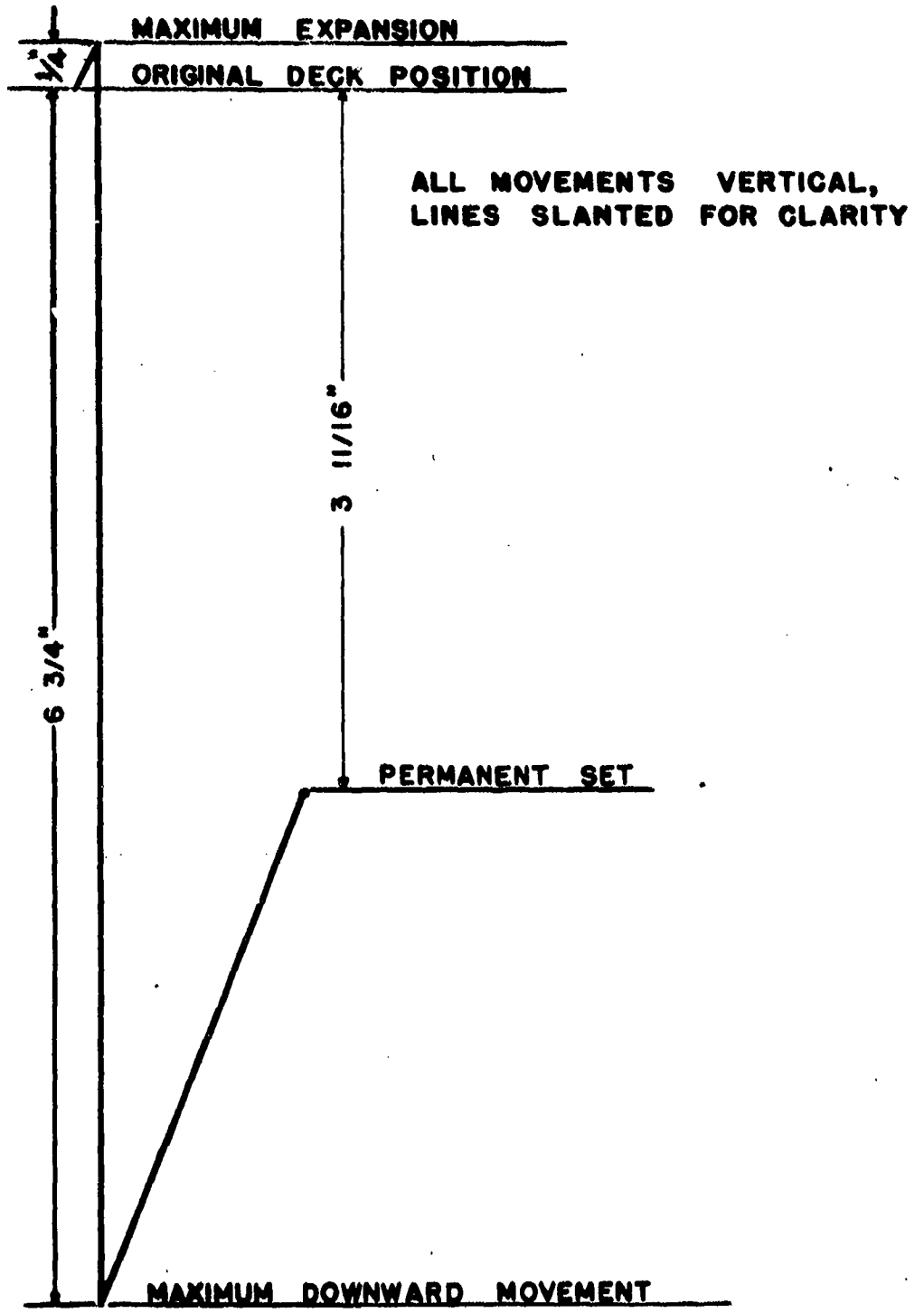
U.S.S. SALT LAKE CITY, TEST ABLE, PLOT OF MAIN DECK MOVEMENT. SCRATCH GAGE LOCATION, 2ND. DECK FRAME 62 1/2, CENTER LINE.

SECRET U.S.S. SALT LAKE CITY CA 25

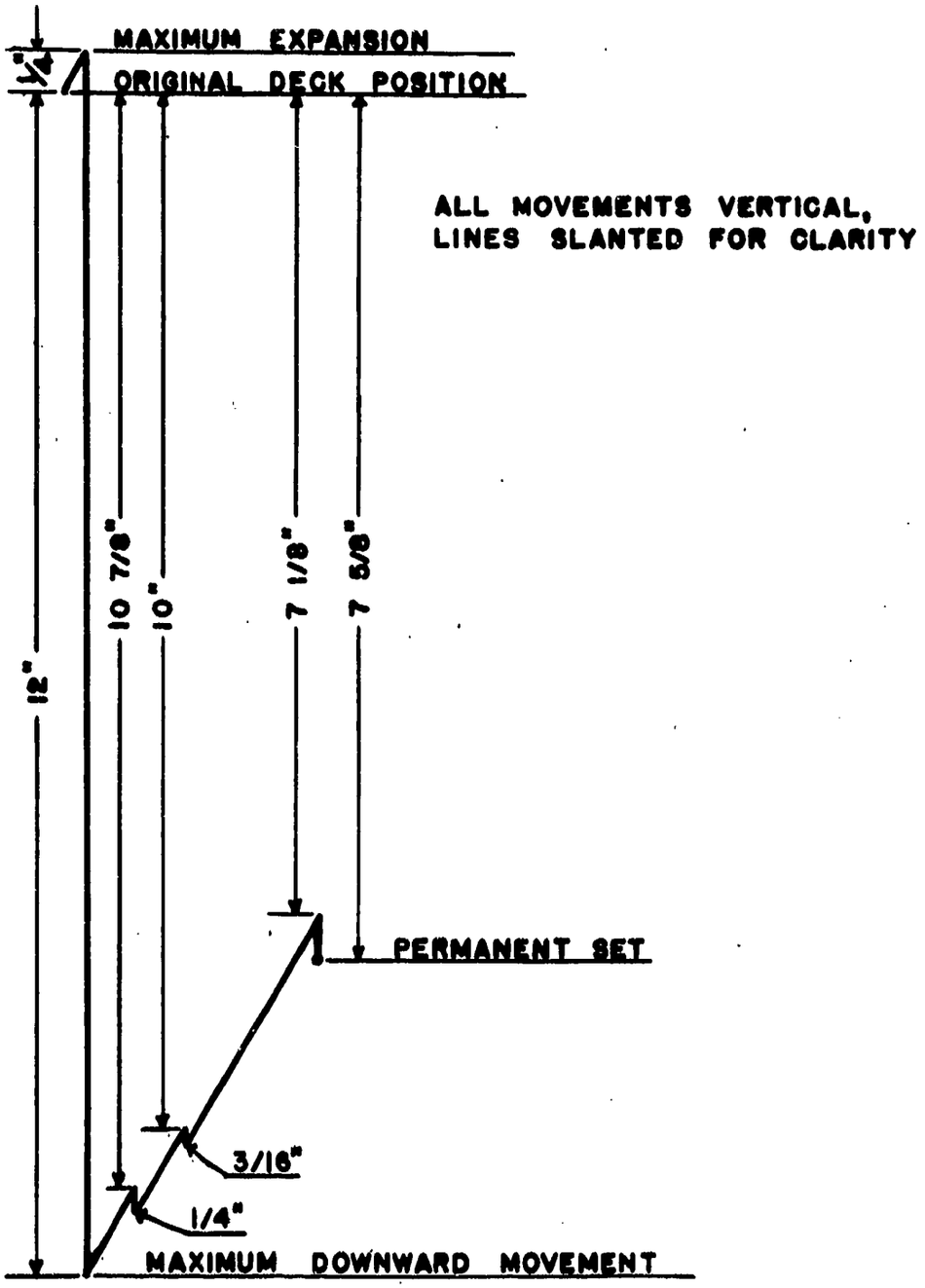
8738-B



U.S.S. SALT LAKE CITY, TEST ABLE, PLOT OF MAIN DECK MOVEMENT. SCRATCH GAGE LOCATION, 2ND. DECK FRAME 66 PORT, 16'-0" OFF CENTER LINE.



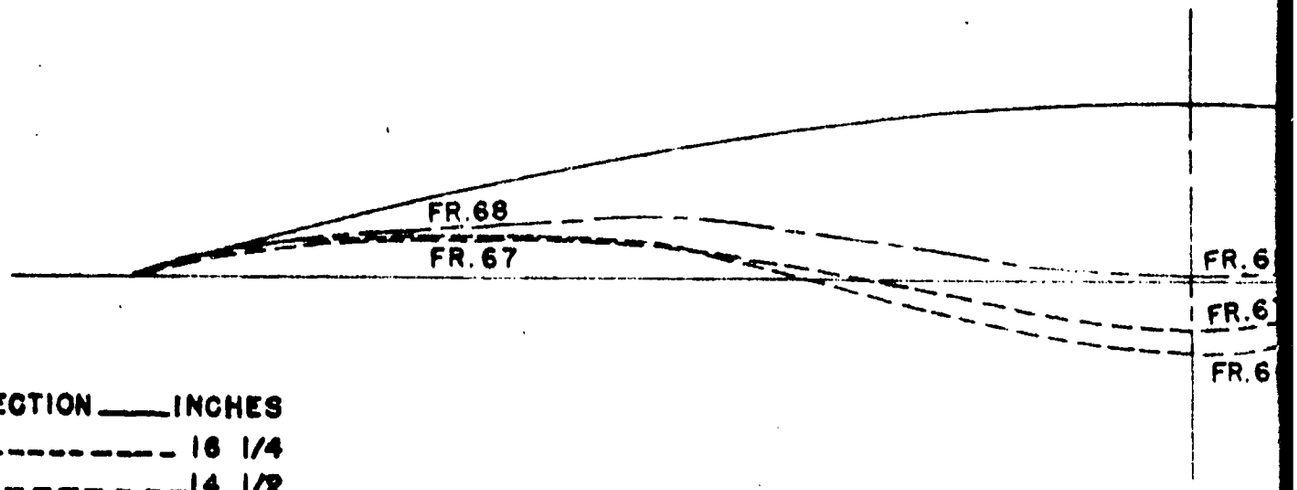
U.S.S. SALT LAKE CITY, TEST ABLE, PLOT OF MAIN DECK MOVEMENT. SCRATCH GAGE LOCATION, 2ND. DECK FRAME 66 STBD., 16'-0" OFF CENTER LINE.



U.S.S. SALT LAKE CITY, TEST ABLE, PLOT OF MAIN DECK MOVEMENT. SCRATCH GAGE LOCATION, 2ND. DECK FRAME 69 CENTER LINE.

SECRET U.S.S. SALT LAKE CITY CA 25

8738-B



MAX. DEFLECTION ____ INCHES

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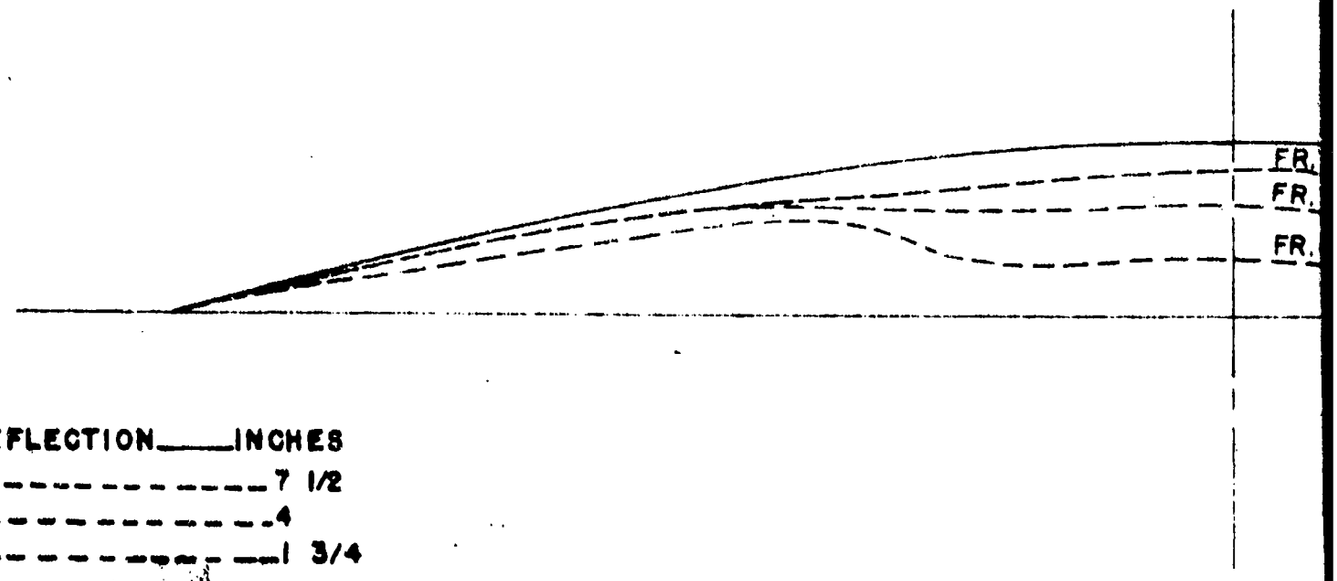
FR. 67 ---------- 14 1/2

FR. 68 ---------- 11



MAX. DEFLECTION ____ INCHES

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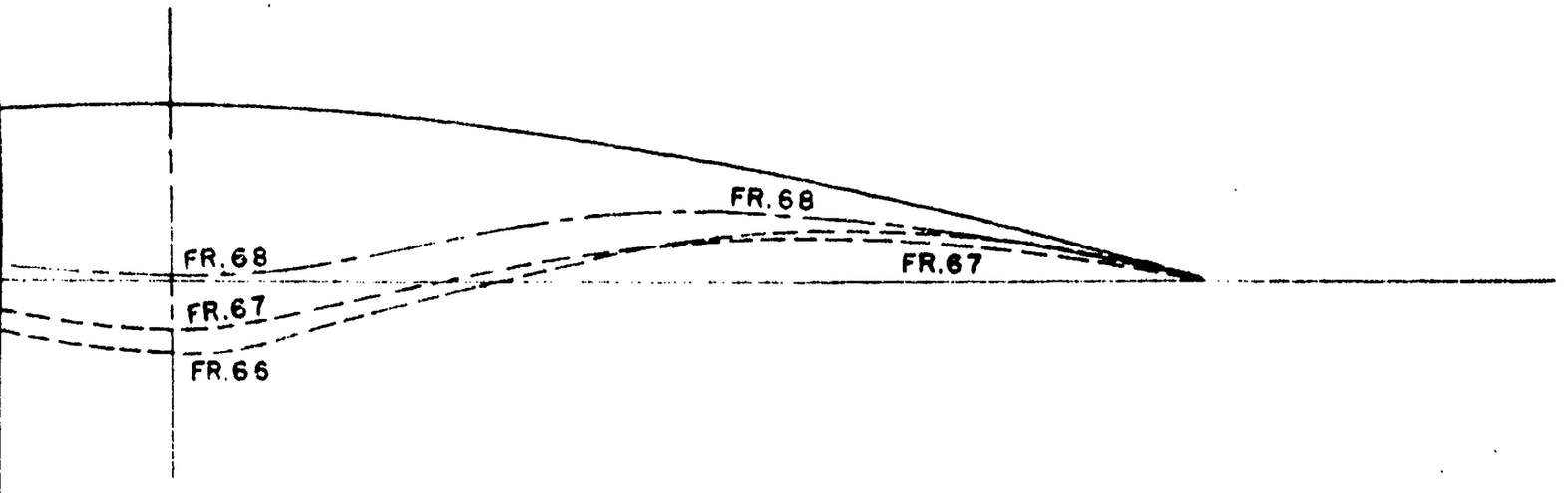
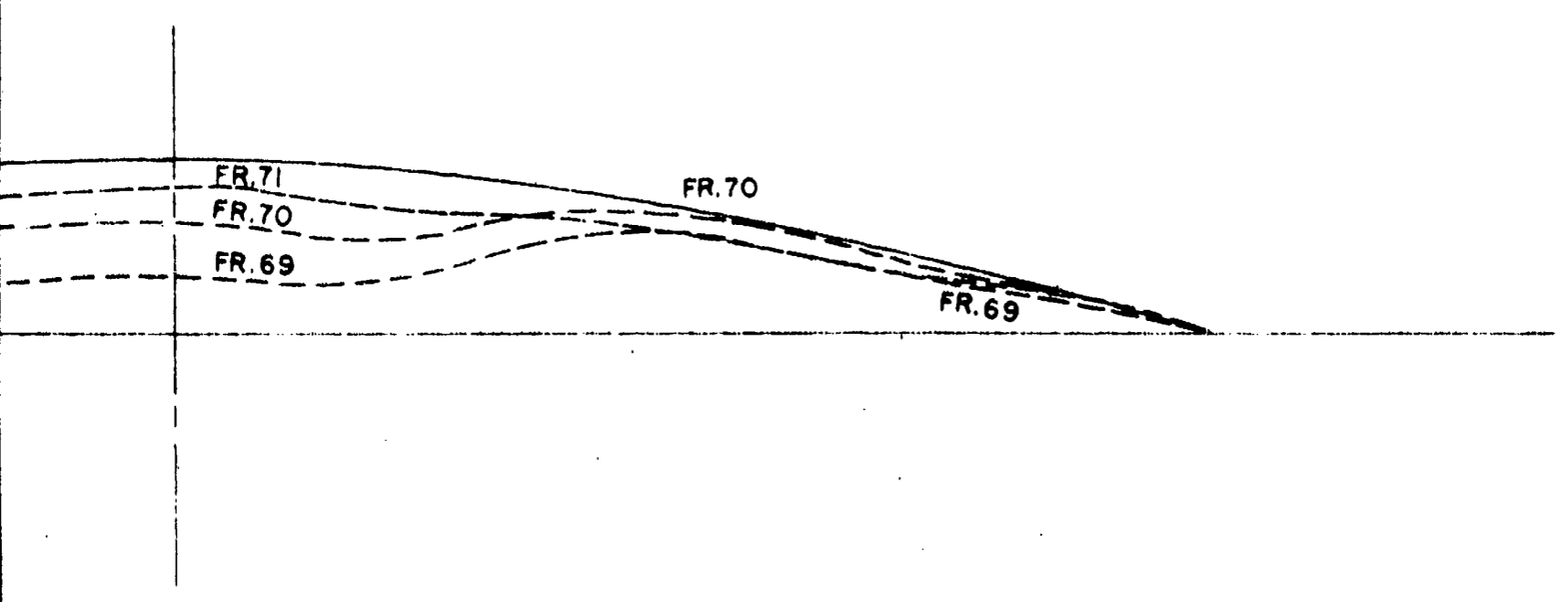
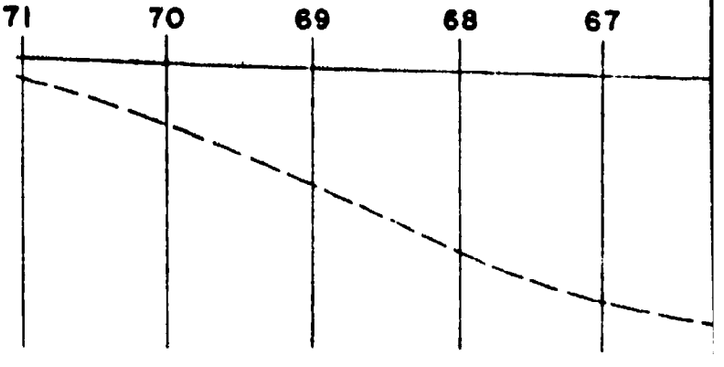
FR. 70 ---------- 4

FR. 71 ---------- 1 3/4

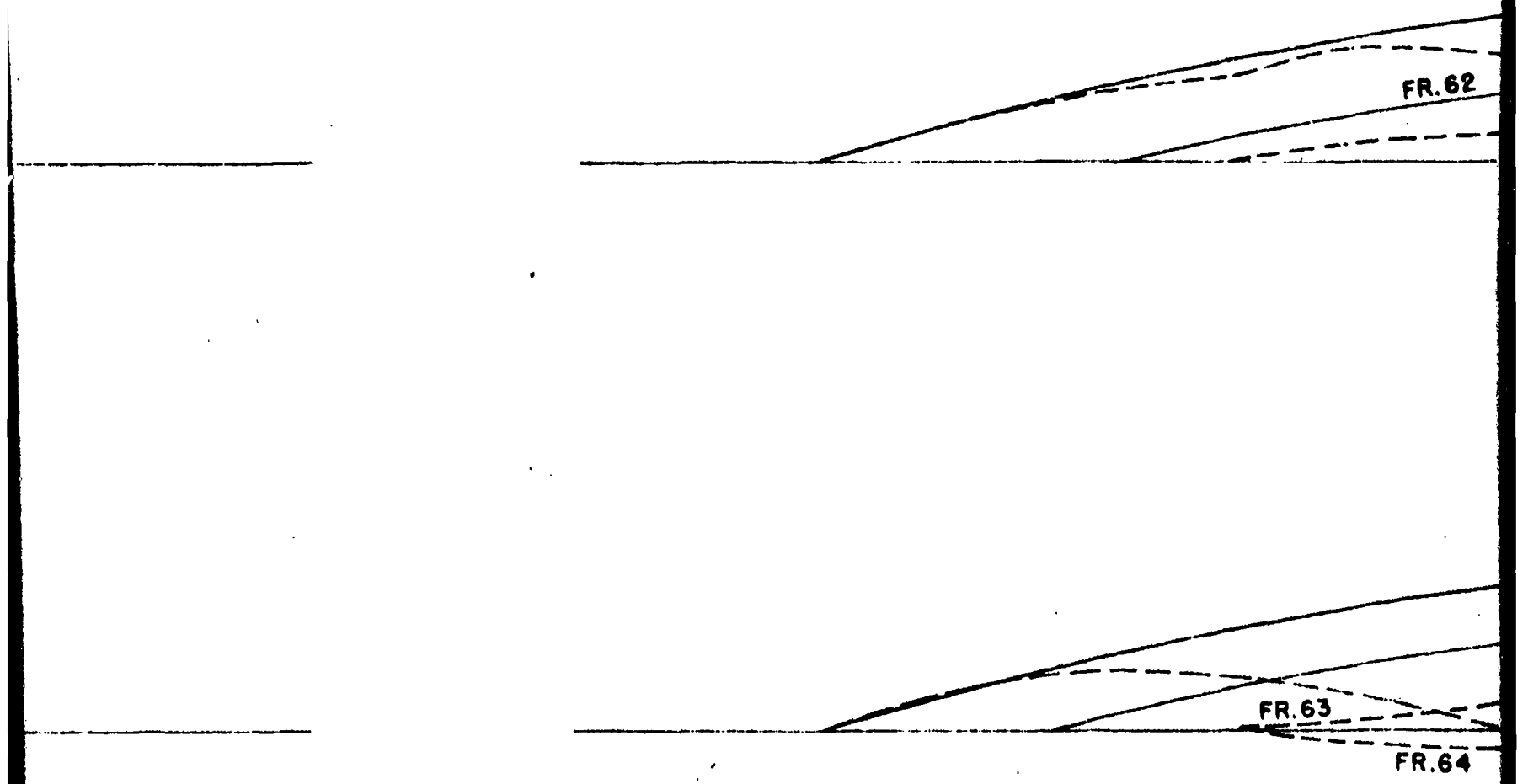


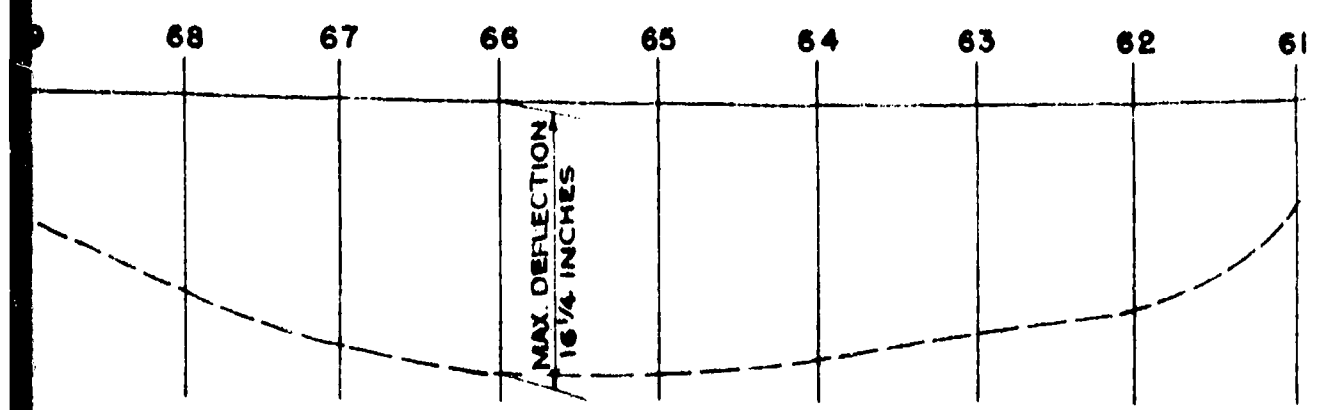




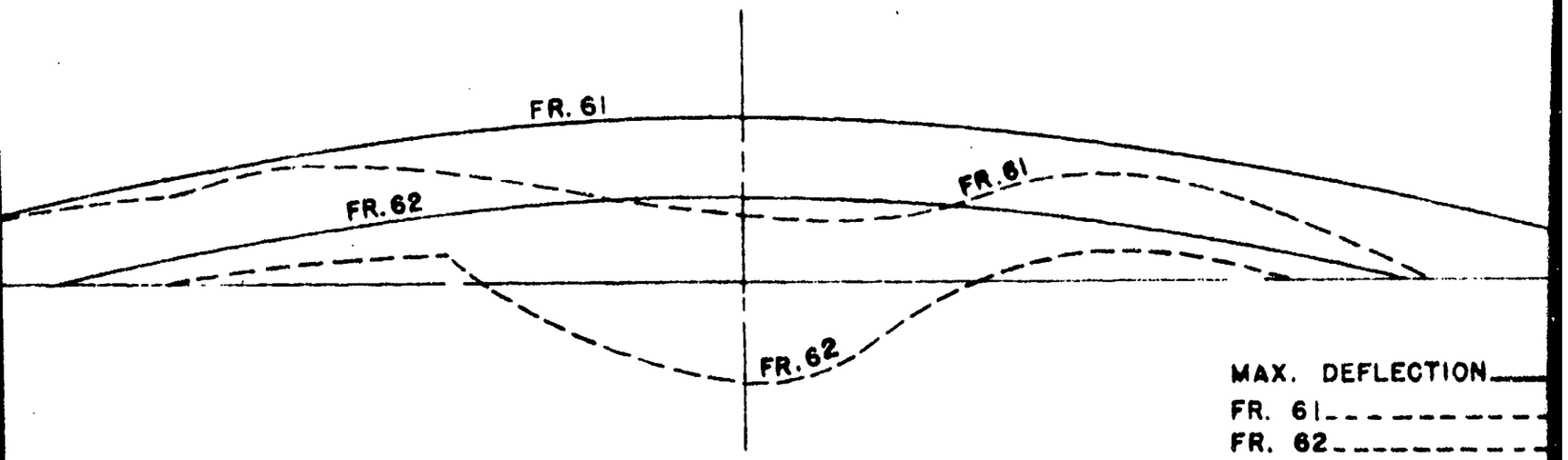
2

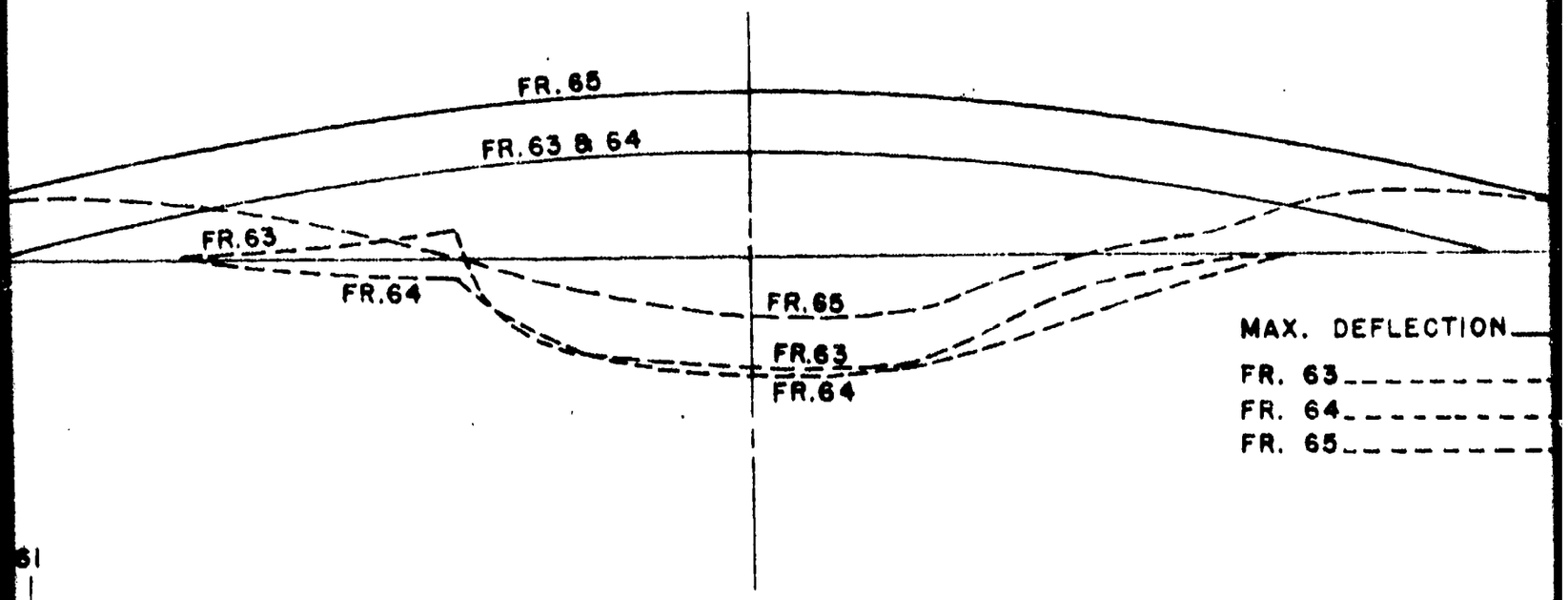
CENTER LINE





CENTER LINE PROFILE 5





BEFORE TEST

AFTER TEST

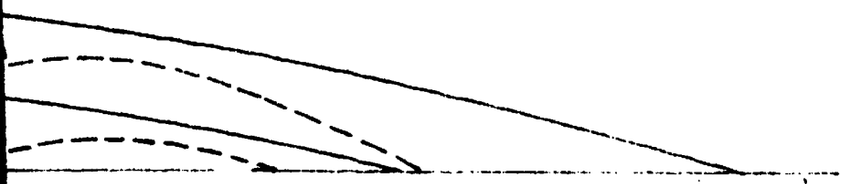
NOTE:

ALL SECTIONS SHOWN LOOKING FORWARD.

VERTICAL SCALE — 1" = 1'-0"

HORIZONTAL SCALE — 1" = 5'-0"

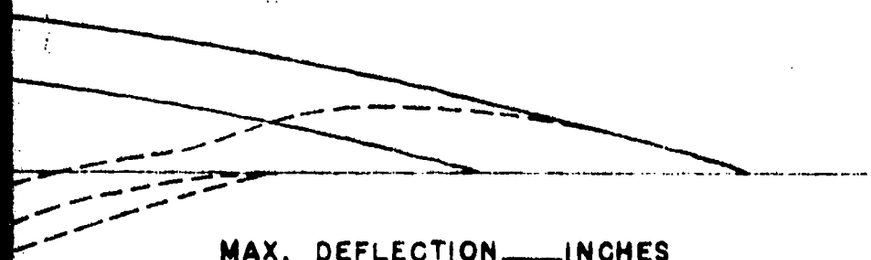
4



MAX. DEFLECTION ____ INCHES

FR. 61 _____ 6 7/8

FR. 62 _____ 12 1/2



MAX. DEFLECTION ____ INCHES

FR. 63 _____ 14 3/4

FR. 64 _____ 15 1/4

FR. 65 _____ 15 3/8

EST

EST

WN LOOKING FORWARD.

—— 1" = 1'-0"

—— 1" = 5'-0"

5

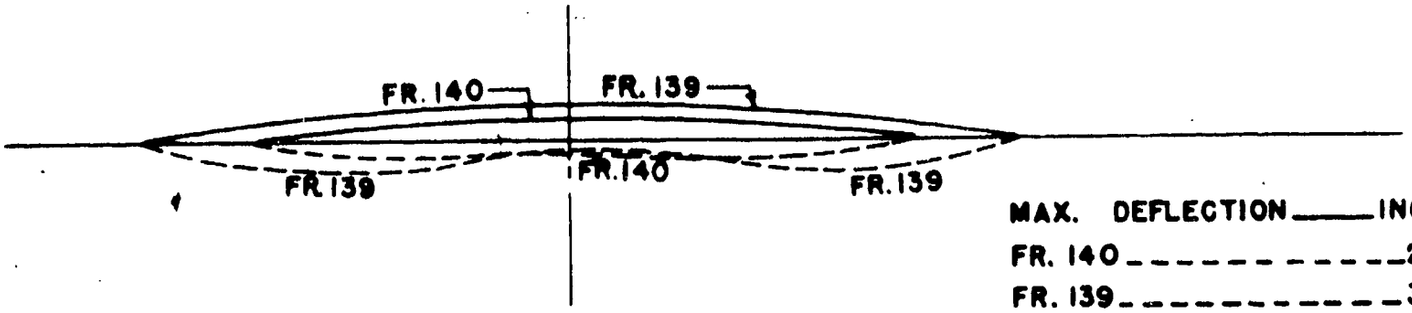
SECRET

U.S.S. SALT LAKE CITY CA 25

DEFLECTION OF MAIN DECK, FRAMES 61—7

TEST ABLE

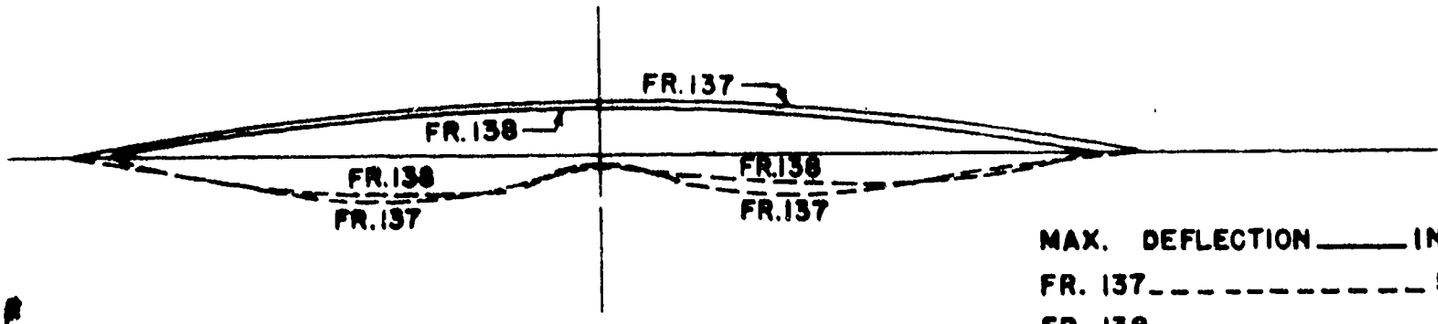
NAVY DEPT. BUREAU OF SHIPS



MAX. DEFLECTION ____ INCH

FR. 140 _____ 2

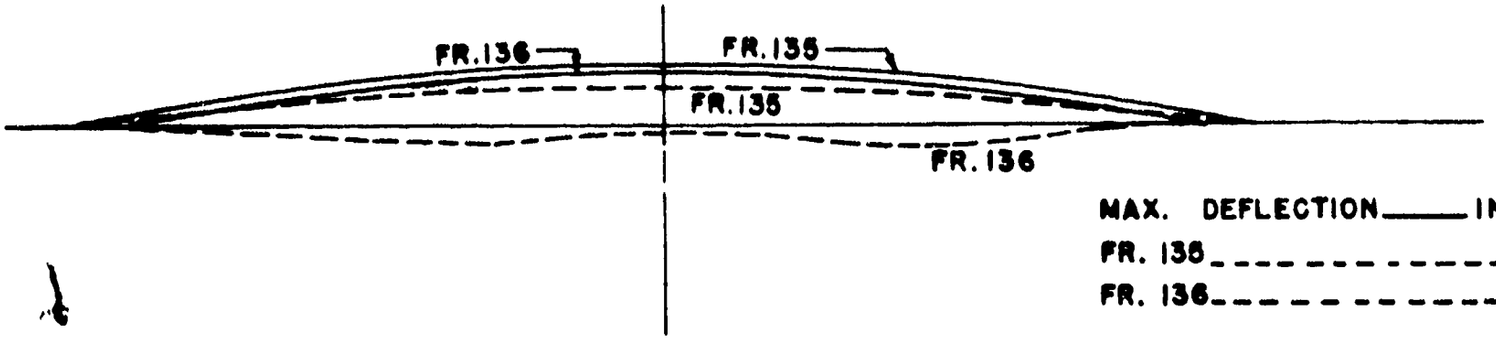
FR. 139 _____ 3



MAX. DEFLECTION ____ INC

FR. 137 _____ 5

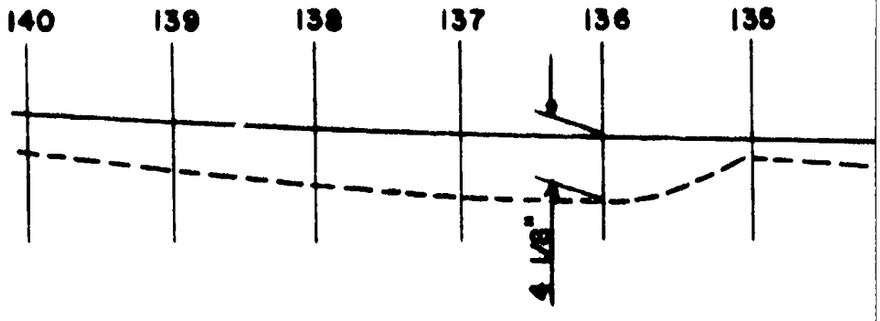
FR. 138 _____ 5

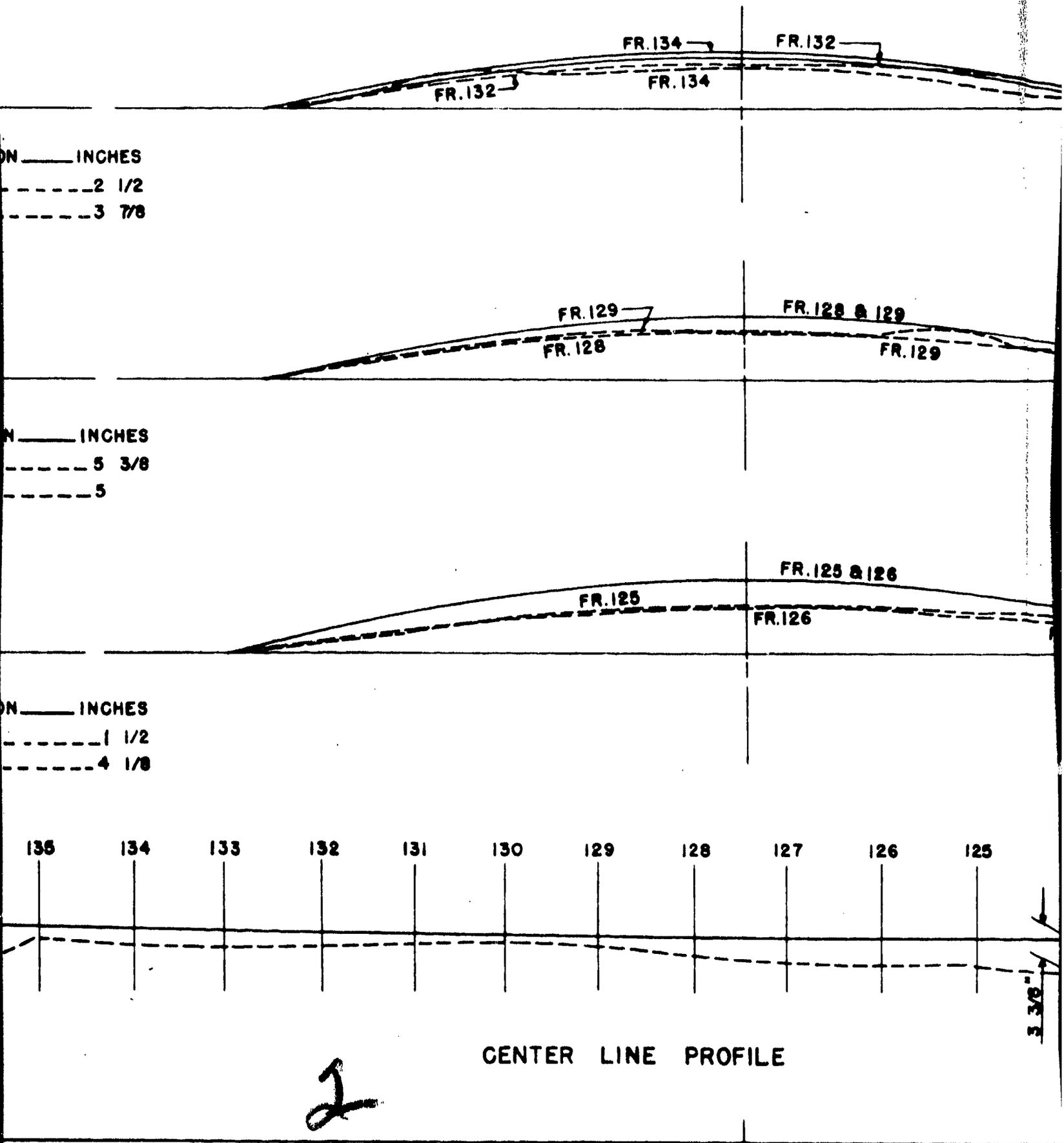


MAX. DEFLECTION ____ INCH

FR. 135 _____ 1

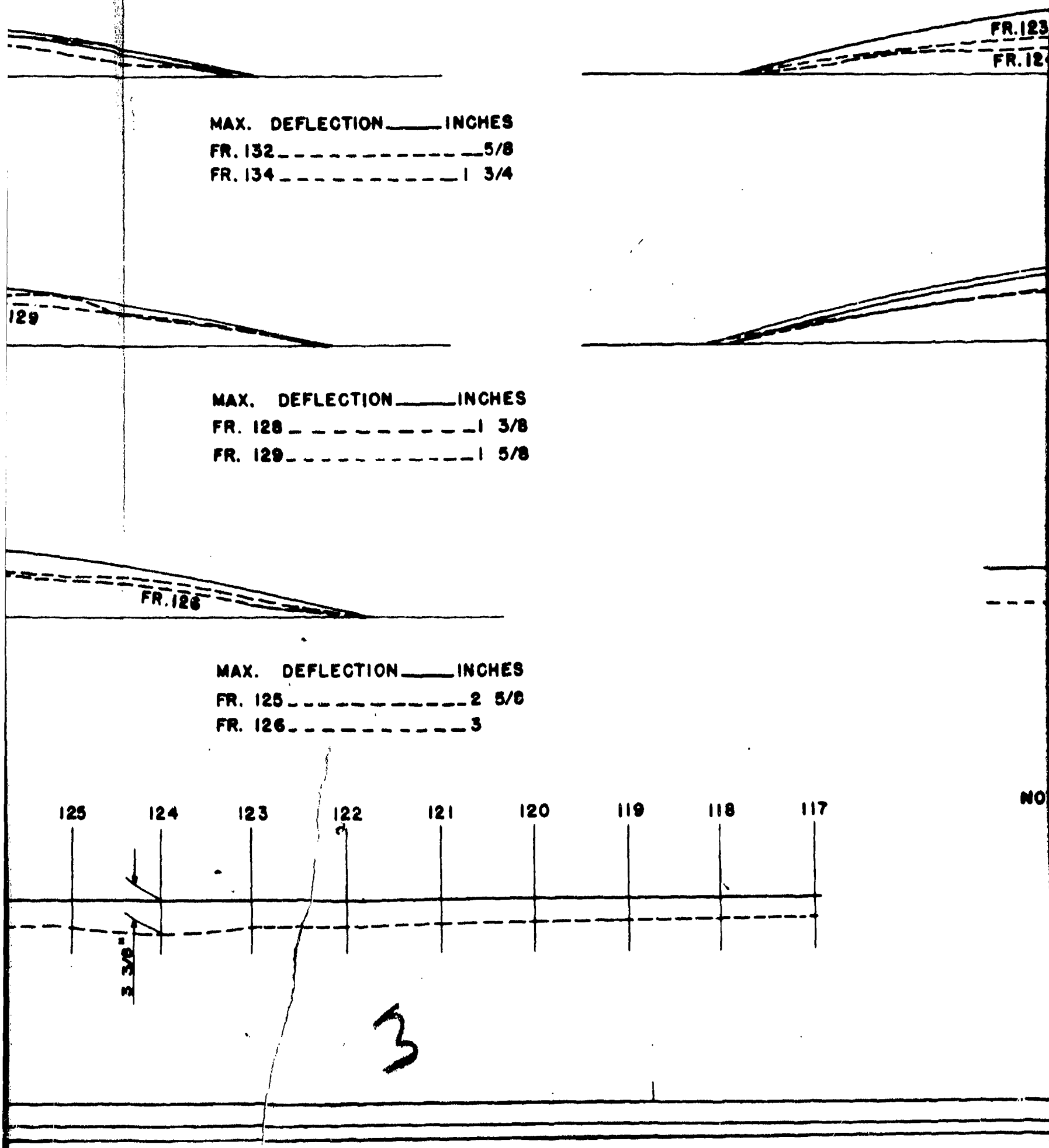
FR. 136 _____ 4

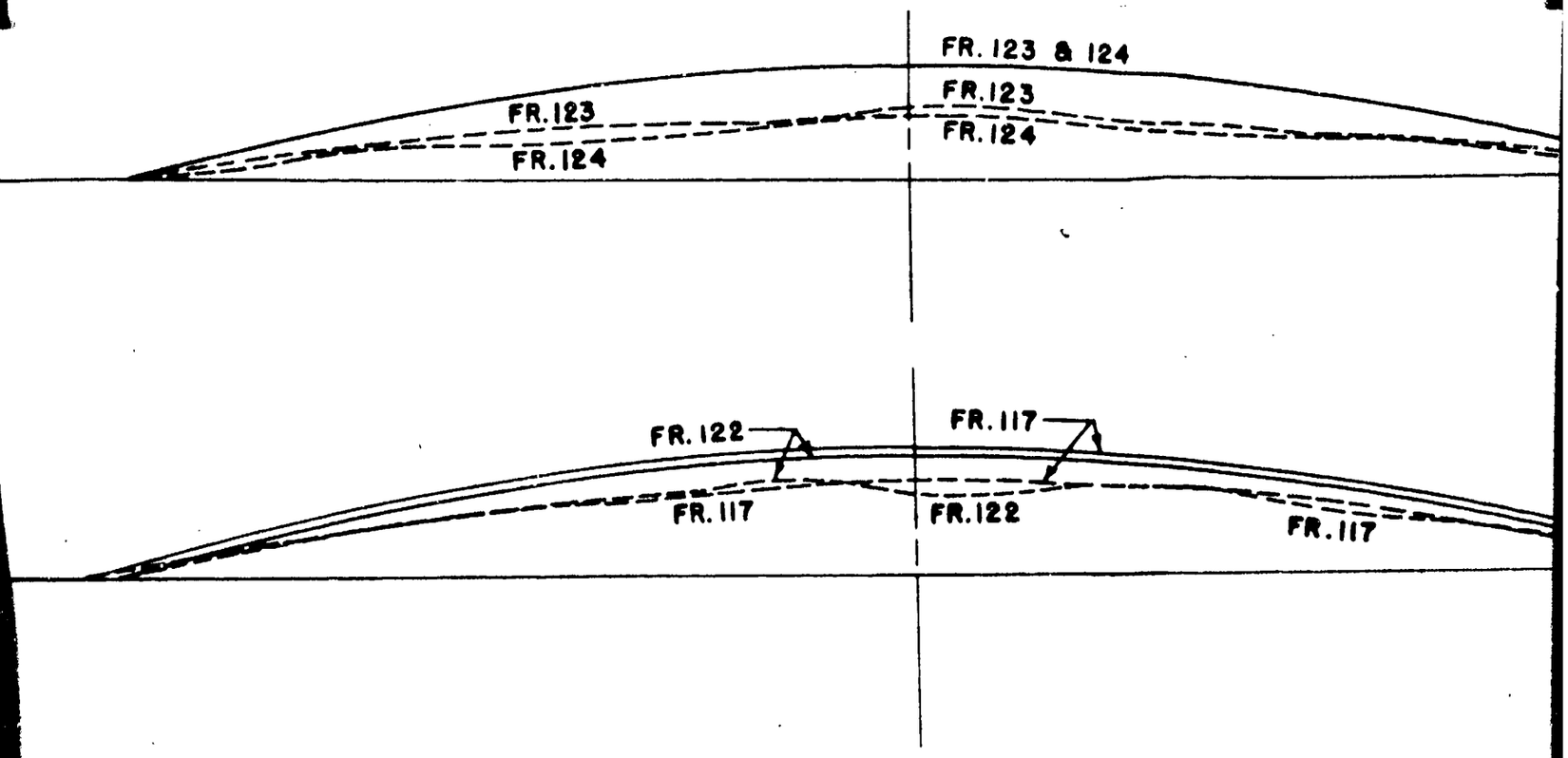




CENTER LINE PROFILE

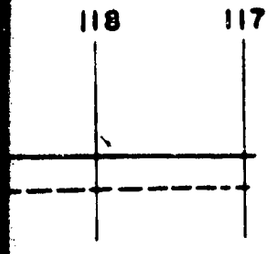
2


FR. 123
FR. 12
MAX. DEFLECTION ____ INCHES
FR. 132 _____ 5/8
FR. 134 _____ 1 3/4
129
MAX. DEFLECTION ____ INCHES
FR. 128 _____ 1 3/8
FR. 129 _____ 1 5/8
FR. 126
MAX. DEFLECTION ____ INCHES
FR. 125 _____ 2 5/8
FR. 126 _____ 3
125
124
123
122
121
120
119
118
117
3 3/8"
3



BEFORE TEST

AFTER TEST



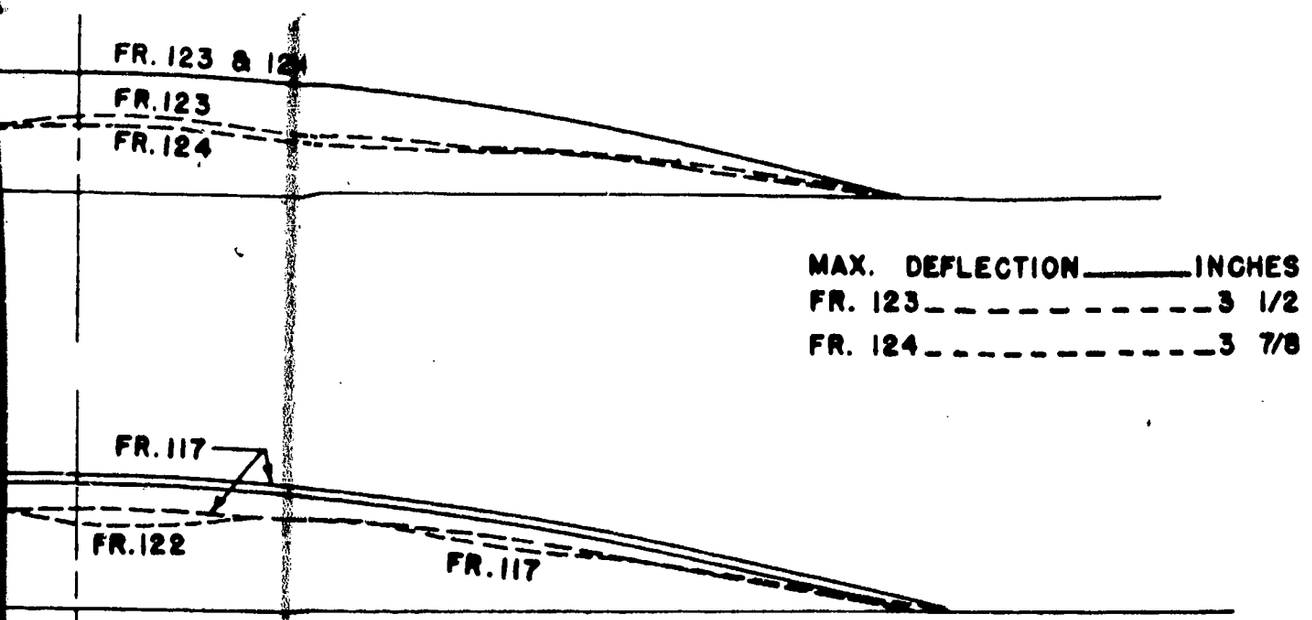
NOTE:

ALL SECTIONS SHOWN LOOKING AFT.

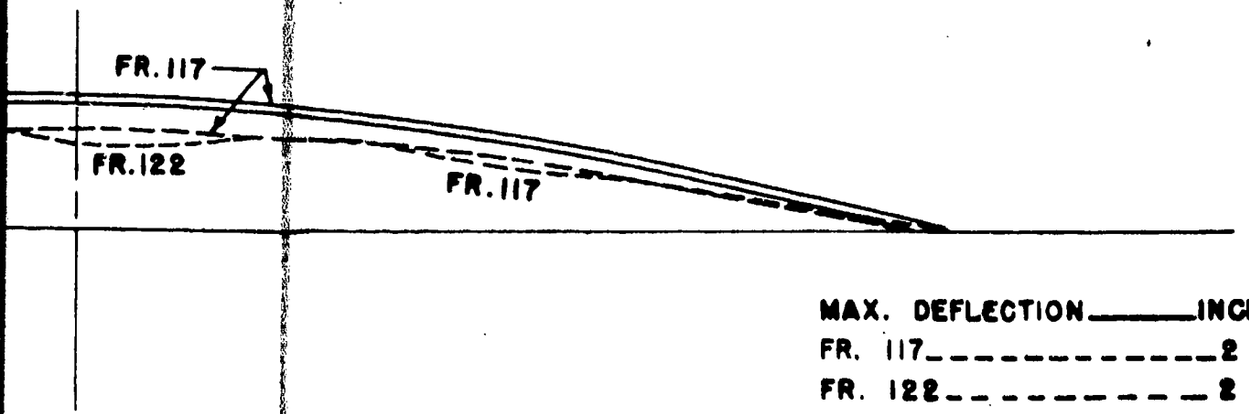
VERTICAL SCALE 1" = 1'-0"

HORIZONTAL SCALE 1" = 5'-0"

4



MAX. DEFLECTION ——— INCHES
FR. 123 - - - - - - - - - - - 3 1/2
FR. 124 - - - - - - - - - - - 3 7/8



MAX. DEFLECTION ——— INCHES
FR. 117 - - - - - - - - - - - 2 1/2
FR. 122 - - - - - - - - - - 2 5/8

——— BEFORE TEST
- - - AFTER TEST

SHOWN LOOKING AFT.
ALE ——— 1" = 1'-0"
ALE ——— 1" = 5'-0"

SECRET

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U.S.S. SALT LAKE CITY CA 25

DEFLECTION OF MAIN DECK, FRAMES 117-140

TEST ABLE

NAVY DEPT. BUREAU OF SHIPS

APPENDIX

COMMANDING OFFICERS REPORT

TEST ABLE

REPORT #11

COMMANDING OFFICERS REPORT

PART A - GENERAL SUMMARY

I. Target condition after test.

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

Draft after the test, forward 19'-6", aft 20'-6", a list of 1/2 degree to port which was the same as before the test. There was no flooding in any of the compartments except the rudder void which flooded to 46 inches. The rudder glands and packing were in a poor condition initially. The flooding is little if any above normal.

(b) Structural damage; superstructure, hull, interior of hull above and below armored deck (if fitted).

All light superstructure was damaged. Both stacks were demolished with forward stack blown overboard and after stack laying on after superstructure and extending over the side. The mainmast was bent about 35° away from 230° relative (direction of blast). The main deck was dished downward about 24 inches between frames 61 and 72 (well deck). The main deck aft was deflected downward about 5 inches between frames 136 to 140 and about 2 inches between frames 122 and 127. The second deck underneath the well deck was dished downward about 1 inch. The side plating of the hull showed no evidence of being dished in. The starboard leg of the tripod of the airplane crane was bent by the after stack falling against it.

(c) Operability: machinery, electrical, ship control, fire control, gunnery and electronics.

All machinery, steam and electrical, has been tested and with few exceptions, are in satisfactory operating condition. All boilers require extensive repairs before they can be steamed (boiler #6 has been repaired and is now steaming). #1 set of evaporators had a leak in vacuum side but can be repaired. The efficiency of the airplane crane was decreased by damage as described in above paragraph but is operable for handling of light weights. Minor repairs could be

accomplished in a few hours to make the crane capable of handling a plane in an emergency.

Steering control was undamaged. Both gyros had mercury splashed into sensitive element; otherwise, they are undamaged. One gyro repeater bracket and both bridge alidade stands were broken although all gyro repeaters remained operative.

All gun batteries were operable, no material damage occurred which would prevent substained fighting action of this vessel other than loss of main power. The condition of ammunition was excellent and the ammunition train was in full operating condition. Resulting damage to fire control equipment would have caused all batteries except 40mm and 20mm to go to local control. These two batteries could have maintained primary means of control.

The overall condition of electronic equipment is poor due principally to heavy damage to antenna or antenna supports. The forward SG radar received the least damage and after replacing small resistances knocked out of place, the radar would have been 80% effective although its antenna was canted about 20% from bending of the support structure. Radio equipment was slightly damaged from light shock but was made operative after minor repairs, the fact that most of the transmitting and receiving antennas were knocked down, would have left the associated equipment inoperative until emergency antennas were rigged.

(d) Heat: fires; estimated personnel casualties.

The heat from the blast was apparently intense. All the paint directly exposed to the blast was burned and blistered through several coats. Although the paint was very thick on most weather decks surfaces, there was no evidence of sustained paint fires. The burning was apparently instantaneous with probable smouldering fires for a short time. There was evidence of only two small smouldering fires, namely: chaffing mat at stern and mattresses used for chaffing gear on fantail. With a full complement of about 1100 men on board and all general quarter stations manned it is

estimated that about 250 men of about 325 exposed men would have been casualties from the heat and blast. An estimated 75 casualties would probably have resulted from flying fragments or by personnel being thrown against structure. The radiological effects on personnel is unknown.

II. Forces evidenced and effects noted.

(a) Heat.

The blast heat was apparently from 230° relative. Its extent longitudinally was the full length of the ship and the full width transversely except where protected by any structure in the direction of the point of detonation. There was apparently little penetration by the heat. The effect of heat on structure and equipment was negligible.

(b) Fires and explosions.

There were no explosions nor any apparent effect on any of the ammunition. About 10 percent of all allowance was placed in all normal stowages, including ready boxes, in exposed locations.

(c) Shock.

The direction of shock could not be determined from the nature of shock damage. Evidence of shock appeared in fire control instruments which in some cases were made inoperable by bearing supports springing out. The mercury was spilled out of the sensitive element of both gyro compasses. The leads installed in bearings indicate that shafts were forced up against the upper half of main turbine bearings.

(d) Pressure.

The general direction of pressure was from 230° relative. Some damage to topside structure showed an increased effect where the surrounding structure tended to "funnel" the blast. The general nature of pressure damage was the dishing in of bulk

heads and decks. Cast aluminum ports exposed to the blast were blown in.

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

None.

III. Results of Test on Target.

(a) Effect on propulsion and ship control.

The ship would have been left dead in the water as a result of boiler damage although all main drive machinery, auxiliaries and ship control machinery (excluding gyro) were operative.

(b) Effect on gunnery and fire control.

Damage resulted in the "knocking out" of AA and main battery directors due to blast; other secondary weapons could continue in action. All fire control radar antennas were disabled, and the majority of optical equipment. There was no apparent effect upon the operation of the guns and mounts.

(c) Effect on watertight integrity and stability.

There was no effect on stability. Damage to watertight integrity was slight. Several doors and hatches on the main and second deck were dished or warped but the contour of the closure still fits the coaming and remains watertight. The main deck was torn loose around engine room vent at frame 62(S). Access trunk at frame 47 was badly battered and dished, destroying watertight integrity to compartment A-203-L.

(d) Effect on personnel and habitability.

The effect on personnel is described in Paragraph I(d) above.

The actual habitability of the ship was not greatly

affected, except through the loss of steam by damage to boilers. Services which could be restored by emergency diesel generators were very slightly damaged. Sufficient lighting, fresh water, fire main and flushing water services could be furnished to easily sustain living and safety of personnel for about ten days, based on fresh water available. The damage to the galley could have been repaired in 24 hours to full operation with the exception of steam. Although some inconveniences to the crew would have resulted, they could have been easily accepted under battle conditions. With the exception of the supply of fresh water, the habitation of the ship could have continued indefinitely.

(e) Total effect on fighting efficiency.

It is estimated that the fighting efficiency would probably be reduced to about 5 percent. Most of the loss in efficiency would result directly from almost complete loss of power. Casualties to topside personnel and damage to radar antennas and fire control circuits would leave only the turrets in possible operation by local control, or power operated to a greatly reduced degree using emergency diesel generators.

PART C - INSPECTION REPORT

SECTION A - HULL

A. General Description of Hull Damage.

(a) Overall condition of vessel.

The paint was scorched in areas of the ship's structure toward the blast. Light topside structure in direct path of the blast were carried away. Any shielding whatsoever afforded protection. Open deck spaces were dished and some light bulkheads, where the blast was trapped, were buckled. Watertight integrity was impaired by dishing and tearing of main deck in well deck area, severe damage to access trunk frame 46 CL and flooding of C-909-F.

(b) General areas of hull damage.

Both stacks were carried away. The well deck, fantail and main deck, port side #4 turret, were dished in. Light structure on bridge and fire control stations were badly damaged.

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

All hull damage was caused by blast effect. Blast effect followed passageways and restricted areas where surrounding structure tended to "funnel" the blast. Bulkheads and watertight doors dished in in such areas.

(d) Principal areas of flooding with sources.

Flooding occurred only to a minor extent and this was limited to C-909-F which was probably caused by rupture of a seam or failure of a rivet.

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

The dishing in of the well deck has resulted in a re-

duction of strength in that locality. The reserve buoyancy of C-201-L is impaired since the overhead is not watertight. The reduction of strength and the non-watertightness at frame 62(S), reduces the operability of the ship, as heavy weather will work the ship's structure which could cause a hull failure at or near frame 62(S). Shipping of water into C-201-L will reduce stability by free surface effect. The same effects to a lesser degree resulted from the tearing of the access trunk at frame 47 to compartment A-203-L.

B. Superstructure (exclusive of gun mounts).

(a) Description of damage, giving important dimensions.

Bridge area: SK radar is missing and SG radar mast is bent about 20°. The splinter shield on forward FC platform is dished in and all windows are blown out. Brass bulkheads in sea cabins are dished in and torn from mounting angles. Signal shack is dished in on all four sides. All plexiglass in windshields are shattered and also in instruments. Armored doors to 20mm clipping rooms were only minorly damaged while all others were badly dished in. Flag bags were demolished and torn loose. The port door of the pilot house was dished in and torn loose from its fittings. The after bulkhead of Flag Plot was dished in to a maximum of 5" with a few cracks around strength members. The ladder to the communications deck on the starboard side was missing. The door and forward bulkhead to 20mm clipping room on communications deck was dished in. A lightly constructed locker on top was crushed in. The temporary steel plate over the centerline hatch at frame 46 (communications deck) was dished in. The superdeck officer's country suffered one air port blown in and damage to port bulkhead between frames 46 and 49. The deck at frame 47 tore rivets loose from transverse frame. Two wardroom ports were blown in. There was minor dishing of bulkheads on the port side between frames 42 and 46, while the after wardroom bulkhead at frame 46 (port) was dished, including frames and door structure. The ladder at frame 47 was moderately damaged and was torn loose from the main deck fittings.

Midship deckhouse and stacks: The forward stack was completely missing having been torn loose at the breeching. The after

stack was torn loose about 6 to 8 feet above the superdeck and laying across the after superstructure deck extending over the starboard side.

After deckhouse and tower: The starboard support of the airplane crane was bent by falling stack. The after port corner of battle II tower at superdeck level was torn loose from the deck and raised up 3". The forward starboard corner dished in the superstructure deck and buckled the tower structure. The after starboard corner also buckled and the forward port corner shows signs of twisting but did not tear loose from the deck. The structure as a whole has leaned to starboard about 4". The searchlight platform had a wrinkled deck, dished in splinter shields and demolished flag bags. The mainmast was bent about 35° from 240° relative. On the after fire control tower the armored door to main battery fire control director was dished in and lightly constructed ladders were torn loose and severely damaged. All compartments adjacent to the port and starboard maindeck passageways of amidship superstructure had dished in bulkheads and doors. Ventilation ducts in the galley were slightly damaged and some fresh water pipes were ruptured. The galley stack was torn off about 15' above the superdeck.

(b) Causes of damage in each area.

All damage was caused by the effects of blast on large flat areas and in spaces where blast was confined.

(c) Evidence of fire in superstructure.

None.

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

Various plating thicknesses: Heat had no effect on structure regardless of thickness. Any plating to 1/2" will suffer distortion depending upon the position relative to the blast and how the structure confines the blast.

Various shaped surfaces: Curved and rounded surfaces tend to deflect effects of blast under all circumstances. Flat areas suffer considerably.

STS compared to MS: STS is far superior to MS.

Aluminum structures (where fitted): Cast aluminum structure such as ports and port hole rims failed completely when exposed to the blast.

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

The superstructure needs to be streamlined and must prevent trapping of blast forces.

C. Turrets, Guns and Directors.

(a) Protected Mounts.

General condition, including operability, if known.

All turrets are operable. Turret #1 was slightly damaged by the bending of the left trunnion bearing; however, the damage does not effect operation of the turret.

Effectiveness of installed turrets or shields.

The protection afforded by turrets is excellent.

(b) Unprotected Mounts.

General condition, including operability, if known.

All unprotected mounts are operable. Some of the mounts received slight damage such as; bent pointer telescope, open sights missing, burned wiring, and scorched paint.

Effectiveness and sufficiency of crew shelters.

Burned paint and wiring indicated that all personnel should be protected by enclosed mounts. A high percentage of topside personnel on the guns would have been casualties with no more protection than is provided on this ship.

(c) Directors and Range Finders.

General condition, including operability, if known.

All directors were temporary inoperative. The after main and AA directors could have been repaired to normal operation within 24 hours. The forward main and AA directors were moderately damaged and would have required Navy Yard repairs.

The range finders in both AA directors were inoperative due to jamming of shafting and gears, however, the range finder optics were apparently undamaged.

The main battery range finders were slightly damaged by displacement of the I. A. scale which prevents accurate internal adjustment.

Condition of instruments therein.

5'' Directors - Sky Forward.

Rangekeeper. R2 and F limit stop switches were damaged by the blast as was the Parallax mechanism. Power leads to the rangekeeper were damaged at an external point.

Stable Element. 1 C5B tube was broken by the shock of the blast; the level preamplifier unit was put functioning properly after the blast. Inner level gimbal was found to have jumped out of its bearings. Wires on resistors in the anti-hunt unit were broken and the level gear to the Range Finder now binds in operation.

Hydraulic Unit. The relay in the controller and starter box was damaged by the blast.

Optics. The trainers scope was out of alignment 57' depression.

5" Directors - Sky Aft.

Rangekeeper. Operation is rather sticky; "A" tests show good majority readings but poor averages.

Stable Element. 2 C5B tubes were broken by the shock of the blast and approximately one half of the mercury of the equipment was spilled by the blast.

Hydraulic Unit. The controller relays were damaged.

Optics. The alignment of these instruments was found to be off of the brench mark readings, 9' in elevation and 18' in train.

Main Battery Directors.

Director I. General. The trainers prism was loose from its shafting and the cross level indicator knob was broken as was also the indicator bracket by the blast. Co knob was bent by falling radar gear. Rangekeeper clock runs slow and eratic. Bench marks for this director were destroyed by the blast.

Director II. General. The rangekeeper clock is slow and eratic in operation as a result of the blast. Sight depression drum will not synchronize with the rangekeeper.

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

The construction of mounts and directors should provide curved surfaces in all directions to minimize the effects of blast. The directors should be spherical with as few openings as possible. All foundations withstood the blast effects satisfactorily.

D. Torpedo Mounts, Depth Charge Gear.

Not applicable.

E. Weather Deck.

(a) General condition of deck and causes of damage.

The weather deck is torn at frame 47 CL and 61(S). The well deck is dished in to a depth of about 24" and the fantail about 1 1/2". All damage was caused by blast effect and pressure.

(b) Usability of deck in damaged condition.

The entire main deck is usable in its damaged condition.

(c) Condition of equipment and fittings.

The lifelines facing the blast were damaged and stanchions were bent but all are readily repairable. Light sheet-metal lockers were crushed and distorted in varying degrees according to their position relative to the blast.

Mooring and towing fittings: The after 1 3/4" mooring wire parted. The 3" mooring shackle at the forward buoy was bent and cracked. The starboard riding shackle was slightly bent.

Boats and boat-handling; liferafts: All boat handling equipment was intact. #2 MWB was demolished. #1 MWB suffered a cracked port gunwhale and a 6" hole in the bilge. About 20% of the liferafts were missing or demolished. All others were usable.

Airplane handling gear; airplane crane: All airplane handling gear except the crane was removed prior to target test. The airplane crane suffered a bent starboard support caused by falling after stack resulting in slight misalignment of kingpost. It is operable and can be used with a reduction in lift of about 50%.

F. Exterior Hull (above waterline).

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

No damage.

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

No damage.

(c) Details of any impairment of sheet strakes.

No damage.

(d) Condition of side armor belt, if fitted externally.

No damage.

G. Interior Compartments (above waterline or armor deck, if fitted).

(a) Damage to structure and causes.

Dishing of frames and wrinkling of stanchions occurred under the well deck and fantail. The failure of the well deck caused rupturing of miscellaneous saltwater, fresh water, steam heat piping and ventilation ducts. There was minor damage such as split seams in ventilation ducts in other compartments on second deck. Doors on second deck were dished slightly.

(b) Damage to joiner bulkheads and causes.

No damage.

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

All closures and fittings remain operable although there is slight dishing to some doors on second deck.

(d) Condition of equipment within compartments.

No damage.

(e) Evidence of fires.

None.

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

Vent ducts and steam heat piping under well deck were ruptured. Blower ducts in #4 blower room were ruptured. Lighting cables broke in wardroom passageway due to failure of structure to which attached. In general there was practically no damage to this type equipment except where the supporting structure was severely damaged.

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

Tearing of the main deck at frame 62(S) made C-201-L non-watertight. Dishing of the well deck reduced the habitability and utility about 25%. Tearing of access trunk outside wardroom at frame 47 made A-203-L non-watertight. The habitability and utility of A-203-L is unimpaired.

H. Armor Deck (if fitted).

(a) Damage to armor deck and causes of damage.

No damage.

(b) Protection afforded spaces below.

Unimpaired.

(c) Condition around openings.

Hatches: No damage.

F. Exterior Hull (above waterline).

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

No damage.

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

No damage.

(c) Details of any impairment of sheet strakes.

No damage.

(d) Condition of side armor belt, if fitted externally.

No damage.

G. Interior Compartments (above waterline or armor deck, if fitted).

(a) Damage to structure and causes.

Dishing of frames and wrinkling of stanchions occurred under the well deck and fantail. The failure of the well deck caused rupturing of miscellaneous saltwater, fresh water, steam heat piping and ventilation ducts. There was minor damage such as split seams in ventilation ducts in other compartments on second deck. Doors on second deck were dished slightly.

(b) Damage to joiner bulkheads and causes.

No damage.

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

All closures and fittings remain operable although there is slight dishing to some doors on second deck.

(d) Condition of equipment within compartments.

No damage.

(e) Evidence of fires.

None.

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

Vent ducts and steam heat piping under well deck were ruptured. Blower ducts in #4 blower room were ruptured. Lighting cables broke in wardroom passageway due to failure of structure to which attached. In general there was practically no damage to this type equipment except where the supporting structure was severely damaged.

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

Tearing of the main deck at frame 62(S) made C-201-L non-watertight. Dishing of the well deck reduced the habitability and utility about 25%. Tearing of access trunk outside wardroom at frame 47 made A-203-L non-watertight. The habitability and utility of A-203-L is unimpaired.

H. Armor Deck (if fitted).

(a) Damage to armor deck and causes of damage.

No damage.

(b) Protection afforded spaces below.

Unimpaired.

(c) Condition around openings.

Hatches: No damage.

Gratings: No damage.

Uptake bulkheads: No damage.

Barbettes: No damage.

(d) Condition of connections to vertical armor.

No damage.

I. Interior Compartments (below waterline).

(a) Damage to structure and causes.

C-909-F has a leak from sea - probably caused by failure of a rivet or seam.

(b) Damage to joiner bulkheads and causes.

No damage.

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

No damage.

(d) Condition of equipment within compartments.

All boilers have had casings blown out; some bricks loosened and about 60% of the plastic has failed. No other equipment in interior compartments was damaged.

(e) Flooding.

C-909-F and D-421-V were flooded. The leak in D-421-V is around the rudder post and is considered little if any above normal.

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

There has been only minor damage to ventilation, piping and cables and no damage to shafts. Auxiliary equipment is undamaged.

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

Except for leak in C-909-F there is no reduction in watertight subdivision. Habitability and utility of spaces has been unimpaired.

J. Underwater Hull.

(a) Interior inspection of underwater hull.

A leak in C-909-F has appeared.

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

No effects have been noted.

(c) Any known or suspected damage to:

Shafts and propellers: None.

Struts: No damage.

Rudders: No damage.

External keels: No damage.

(d) Details of impairment of keel structure.

No damage.

K. Tanks.

(a) Condition of tanks in areas of damage.

There has been no major damage to tank structure. C-909-F is the only tank which has suffered any damage - this is external as the tank has flooded with water.

(b) Contamination of liquids.

Extent and cause, if known: No damage.

Effect on ship operability: No damage.

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

No damage.

L. Flooding.

(a) Description of major flooding areas.

No major flooding.

(b) Sources of flooding.

Opened boundaries: C-909-F probably has a loose rivet or open seam.

Damaged or poorly designed system or fittings; as, access closures, piping, wiring, ventilation ducts, etc.: No damage.

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

None.

M. Ventilation (exclusive of blowers).

(a) Damage to ventilation system and causes.

Ducts: In engine rooms, ducts have had minor ruptures

in seams. These ducts were in fair to poor condition previously. Vent ducts in the spaces under the well deck were ruptured as a result of the well deck being dished. There were a few minor ruptures in seams in compartments on the second deck but the effect on ventilation was very slight.

Closures: None.

Effect on habitability: There was no effect on habitability.

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

There is slight discoloration of paint on engine room ducts indicating that heat was conducted thru the ducts. Also there is evidence of blast through natural exhaust trunks; this is shown by warped and ruptured aprons under ladders on these trunks. There is no such evidence in any other spaces.

(c) Evidence that ventilation system allowed progressive flooding.

None.

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

Engine room exhaust vents should be fitted with protected blowers rather than to rely on vulnerable straight escape trunks. Vent ducts in spaces under the exposed areas of the main deck should be supported from the second deck rather than from the main deck overhead.

N. Ship Control.

(a) Damage to ship control stations and causes.

Bridge area: One gyro repeater bracket and both alidade

stands were broken and all glass and plexiglass covers on all instruments were shattered, by the blast. In spite of this damage all instruments remained operative.

C.I.C.: No damage.

Gyro-compass equipment: As noted above repeaters remained operative. Master gyros had mercury splashed into sensitive element, however, after being cleaned, gyros were operative.

Steering gear: No damage.

Interior communications: No damage.

(b) Constructive criticism of ship control system.

Layout and arrangement. The arrangement of the open bridge is such that there are many blind spots caused by mast structure and 40mm mounts which interferes with conning the ship.

A compact and streamlined structure which will allow maximum visibility through ports would be necessary to provide protection to ship control personnel and instruments.

Location with respect to protection. Almost no protection is provided for ship control personnel on the bridge. See remarks in paragraph above.

O. Fire Control.

(a) Damage to fire control stations and causes.

Directors and elevated control positions. The damage in the directors was caused by the blast and resultant shock. No damage was caused by heat or fire. Damage to directors is described in subparagraph C(c).

Plot rooms and protected spaces. Not applicable.

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

5"/25 battery (8 guns)
40mm battery (6 quad mounts)
20mm battery (16 single mounts)
AA directors (two)

Each mount directly exposed to the blast (without other intervening ship structure) would have been almost a complete loss due to personnel casualties. There would also have been casualties at other mounts from flying debris.

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

Location of the stations appears to be satisfactory but the lightness in the construction and also the design (of shielding, etc.) give inadequate protection. Housing of optics and fire control radar antennas should be improved to provide protection against blast.

P. Ammunition Behavior.

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

Main battery. There was no apparent affect on any ammunition.

Secondary battery. There was no effect on ammunition. The sun shield on ready service boxes were damaged by the blast.

40mm, 20mm and other. Same as secondary battery.

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

Main battery powder and projectiles. Satisfactory in

all respects.

Secondary battery. Satisfactory in all respects.

40mm, 20mm and other. Satisfactory in all respects.

Bomb, mine, depth charge and torpedo stowage. Applicable to bomb only - satisfactory in all respects.

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

No stowage protection resulted in the damage or explosion of ammunition. Ready service boxes of AA battery in exposed positions appear to be insufficiently protected from blast.

(d) Behavior of gasoline stowage facilities.

No damage.

Q. Ammunition Handling.

(a) Condition and operability of ammunition handling devices.

Main battery hoists. No damage.

Secondary battery. No damage.

Passing scuttles. No damage.

Bomb and torpedo elevators. Not applicable.

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

None.

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

Exposed ammunition positions, due to insufficient protection, are considered to be hazardous and undoubtedly would result in casualties.

R. Strength.

(a) Permanent hog or sag.

Hull evidence. No visual evidence.

Superstructure expansion joints, etc. None installed.

Local evidence of longitudinal stresses. None.

(b) Shear strains in hull plating.

None.

(c) Evidence of transverse or racking strains.

None.

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

The main deck tore away from the engine room vent trunk at frame 62(S); this was caused by dishing of well deck. See Part C, section 1, paragraph B(a) for details of battle II.

(e) Evidence of panel deflection under blast.

Evidence is shown by dishing of decks and bulkheads and loss of stacks.

(f) Turret, machinery and gun foundations.

None.

S. Miscellaneous

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

None.

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

None.

PART C - INSPECTION REPORT

SECTION B - MACHINERY

A. General Description of Machinery Damage.

(a) Overall condition.

All boilers suffered casing failures and apparent movement of steam drums. Brick work fell to a very minor extent and plastic about 60% failure. Boiler #8 suffered structural failure in tubing such as to cause loss of water, however, all other boilers are tight. All boilers can be repaired and placed in operating condition with replacement of stacks and repairs to upper breeching and casings and replacement of miscellaneous ruptured drain and atmospheric exhaust lines. No other major damage to machinery has been experienced.

(b) Areas of major damage.

Major damage occurred to stacks and to breeching and casings of all boilers.

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

All damage to above was caused by blast effect.

(d) Effect of Target Test on overall operation of machinery plant.

Target test had little effect on the operation of machinery except as noted above in connection with the boilers. By repairing boiler casings on boiler #6 and rigging a temporary stack, the ship was able to light fires and get up steam to test all machinery. Only a few steam heating lines were ruptured by carrying away of structure to which they were attached.

B. Boilers.

(a) Air casings.

All air casings and breeching were blown out to extent that repairs are required before boilers may have fires lighted. This failure was caused by blast effect of target test. Boiler #4 appears to have had a general settling of about 6 inches.

(b) External fittings (stop and check valves, safety valves, etc.)

No damage.

(c) Fuel oil burner assemblies.

Registers were undamaged. Burner barrels were blown out with sufficient force that 50% were found on floor plates. No damage was found to burner barrels, plates or tips.

(d) Brick work and furnaces.

There was minor damage to brickwork and will require a small amount of patching. All floors are in satisfactory condition. About 60% of plastic will require replacement. Shaking and possible movement of steam drum is primary cause of plastic failure.

(e) Steam and water drums and headers.

Steam drums appear to have moved slightly, however, only boiler #8 lost any water and this by rupturing a poor tube. All steam and water drums and headers appear to be in good condition.

(f) Tubes (generating, superheater, downcomer, economizer).

Boiler #8 suffered one tube failure and this probably was abetted by the tube being in only fair condition prior to test.

C. Blowers.

(a) Turbines or motors.

All blower turbines were undamaged.

(b) Blower.

Blower impellers were undamaged.

(c) Foundations.

Foundations were undamaged.

(d) External fittings (gages, piping, oil coolers, etc.)

No damage, however, nearly all gages require resetting of pointer as they were found behind zero stop peg.

(e) Shutters (air intake, automatic, etc.)

All shutters were warped but require only minor repairs.

(f) Blower rooms (air lockers if enclosed fireroom).

#4 blower room bulkhead was ruptured and after door sprung.

D. Fuel Oil Equipment.

(a) Heaters.

No damage.

(b) Strainers.

No damage.

(c) Manifolds.

No damage; except reach rods to transfer manifold in #1 boiler room were bent by movement of floor gratings which were attached to boiler casings.

(d) Fittings (thermometers, gages).

No damage.

E. Boiler Feedwater Equipment.

(a) Heaters.

No damage.

(b) Deaerating Tanks.

None installed.

(c) Feedwater tanks (hotwell, filter, etc.)

No damage.

(d) Miscellaneous.

No other damage.

F. Main Turbines.

(a) Casings.

No damage.

(b) Bearings.

No damage.

(c) Rotors.

No damage.

(d) Blading and shrouding.

No damage.

(e) Packing and glands.

No damage.

(f) Valves.

No damage.

(g) Foundations.

No damage.

(h) Fittings (oilsights, thermometers, clearance indicators, etc.)

No damage.

G. Reduction Gears.

(a) Foundations and casings.

No damage, except breather cap broken by ladder apron falling on it.

(b) Gears and shafting.

No damage.

(c) Bearings.

No damage.

(d) Couplings (flexible and solid).

No damage.

(e) Fittings (oilsight, thermometers, etc.)

No damage.

(f) Turning gears.

No damage.

H. Shafting and Bearings.

(a) Shafting.

No damage.

(b) Bearings and bearing foundations.

No damage.

(c) Alignment.

No damage.

(d) Stern tubes, bulkheads packing glands, etc.)

No damage.

I. Lubrication System.

(a) Coolers.

No damage.

(b) Filters and strainers.

No damage.

(c) Purifiers.

No damage.

(d) Tanks (sump, settling, etc.)

No damage.

(e) Fittings (gauges, etc.)

No damage.

J. Condensers and Air Ejectors.

(a) Water boxes.

No damage.

(b) Shell and shell connections.

No damage.

(c) Expansion joints.

No damage.

(d) Air ejectors.

No damage.

(e) Inter and after condensers.

None installed.

(f) Miscellaneous valves, gages, fittings, and attached piping.

Resetting of gages required, otherwise no damage.

K. Pumps.

(a) Feed pumps.

No damage.

(b) Circulating pumps.

No damage.

(c) Condensate pumps.

No damage.

(d) Fire pumps.

No damage.

(e) Lube oil pumps.

No damage.

(f) Fuel oil pumps.

No damage.

(g) Flushing pumps.

No damage.

L. Auxiliary Generators (Turbine and Gears).

(a) Foundations and misalignment.

No damage.

(b) Turbines.

No damage.

(c) Gears.

No damage.

(d) Coolers.

No damage.

(e) Governors.

No damage.

(f) Valves, fittings, etc.

No damage.

M. Propellers.

(a) Blades.

Unknown; no damage suspected.

(b) Caps, nuts, etc.

Unknown; no damage suspected.

N. Distilling Plant.

(a) Evaporators.

First effect of #1 set suffered a ruptured tube.

(b) Distilling condensers.

No damage.

(c) Evaporators feed heaters.

No damage.

(d) Miscellaneous valves, fittings, gages, attached piping, etc.

Two sight glasses broken on #2 set.

O. Refrigerating Plant.

(a) Compressors.

No damage.

(b) Motors.

No damage.

(c) Condensers.

No damage.

(d) Foundations.

No damage.

(e) Refrigerant piping and cooling coils.

No damage.

(f) Insulation and lagging.

No damage.

(g) Miscellaneous valves, switches, controls, fittings, etc.

No damage.

P. Winches, Windlasses and Capstans.

(a) Foundations and bedplates.

No damage.

(b) Motors.

No damage.

(c) Brakes and brake lining.

No damage.

(d) Gearing.

No damage.

(e) Hydraulic system.

No damage.

(f) Drums, bearings, shafting.

No damage.

(g) Fittings, wildcats, valves, etc.

No damage.

Q. Steering Engine.

(a) Foundations.

No damage.

(b) Ram, quadrant, chains, screws, etc.

No damage.

(c) Hydraulic system, including pumps, piping, etc.

No damage.

(d) Follow up system.

No damage.

(e) Motors or engines.

No damage.

(f) Miscellaneous (steering stands, gages, etc.)

No damage.

R. Elevators, Ammunition Hoists, etc.

(a) Machinery foundations.

No damage.

(b) Motors and gearing.

No damage.

(c) Hydraulic systems.

No damage.

(d) Guide rails, dredger chains, etc.

No damage.

(e) Elevator platforms.

None installed.

(f) Brakes and brake lining.

None installed.

(g) Control systems and follow up gear.

No damage.

S. Ventilation (Machinery).

(a) Fans and motors.

No damage.

(b) Foundations and mountings.

No damage.

(c) Heaters.

Unknown as ducts and steam heat lines have not been repaired; those intact suffered no damage.

(d) Miscellaneous.

None.

T. Air Compressors.

(a) Foundations.

No damage.

(b) Compressors and motors.

No damage.

(c) Coolers.

No damage.

(d) Tanks.

No damage.

(e) Miscellaneous gages, attached piping, etc.

No damage.

U. Diesels (Generators and Boats).

(a) Foundations.

No damage. NOTE: #2 Motor Whale Boat was shattered and engine damaged beyond repair. Whether damage resulted from blast or from being thrown out of boat on deck, is unknown.

(b) Casings and cylinders.

No damage.

(c) Bearings, crankshafts, pistons, etc.

No damage.

(d) Fuel injection system.

No damage.

(e) Superchargers.

None installed.

(f) Governors.

No damage.

(g) Miscellaneous.

No damage.

V. Piping.

(a) Main steam.

No damage. NOTE: There is evidence of movement of piping as some hangers have bends in them and some lagging has broken and fallen off.

(b) Auxiliary steam.

No damage.

(c) Auxiliary exhaust.

No damage except for loss of atmospheric exhaust pipes attached to the stacks.

(d) & (f)

No damage.

(g) Firemain, sprinkling, and water curtain.

Minor damage to risers from second deck to main deck. Damage caused by movement of structure to which attached. No damage to sprinkling system.

(h) & (k)

No damage.

(l) Gasoline.

Unknown as the system was inoperative before the test.

(m) Other systems.

No damage.

W. Miscellaneous.

Machine shop tools were not damaged.

PART C - INSPECTION REPORT

SECTION C - ELECTRICAL

A. General Description of Electrical Damage.

(a) Overall condition.

Electrical equipment in general withstood the blast satisfactorily. All equipment below decks and in protected areas was undamaged. Exposed equipment suffered broken stands and glass. Some exposed cable was ruptured by carrying away of structure to which attached.

(b) Areas of major damage.

Units exposed to blast in open areas of bridge and fire control stations suffered the most damage.

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

All damage resulted from blast effects.

(d) Operability of electric plant.

Ship's service generator plant. No damage.

Engine and boiler auxiliaries. Undamaged.

Electrical propulsion. Not applicable.

Communications. One 17 MC reproducer blown out of case on open bridge, otherwise no damage.

Fire control circuits. Undamaged.

Ventilation. Undamaged.

Lighting. Not damaged except where structure to which attached has carried away.

(e) Types of equipment most affected.

Switchboards and switch gear. No damage.

Rotating machinery. No damage.

Motor controllers. No damage.

Cables and supports. Damage occurred only where structure to which attached carri.. away, primarily on bridge and fire control stations.

B. Electric Propulsion Rotating Equipment.

Not applicable.

C. Electric Propulsion Control Equipment.

Not applicable.

D. Generators - Ship's Service.

Not damaged.

E. Generators - Emergency.

(a) Frame and mounting.

Undamaged.

(b) Commutators or Slip rings.

Not damaged.

(c) Brushes and brush rigging.

Not damaged.

(d) Bearings.

Not damaged.

(e) Fans.

Not damaged.

(f) Balance coils.

Not damaged.

F. Switchboards, Distribution and Transfer Panels.

(a) Framework and mountings.

No damage suffered except to battery charging rheostat structure which was twisted by movement of rheostat unit attached to switchboard on a cantilever support.

(b) Electrical connections and wiring.

No damage.

(c) Busbars.

No damage.

(d) Circuit breakers, contactors, switches and relays.

No damage.

(e) Rheostats and resistors.

No damage.

(f) Mechanical operating mechanisms and interlocks.

No damage.

(g) Insulating materials.

No damage.

(h) Instruments.

No damage.

(i) Rectifiers.

No damage.

(j) Fuses.

No damage and none thrown out of clips.

(k) Voltage regulators.

No damage.

G. Wiring, Wiring Equipment, and Wireways.

(a) Cable (power, lighting, I.C., F.C., propulsion and degaussing.)

No damage except for lighting and anemometer cable which were ruptured by failure of supporting structure.

(b) Wireway supports.

No damage suffered except as in (a) above.

(c) Connection, junction boxes, receptacles, and plugs.

No damage suffered except as noted in (a).

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

(a) Framework and mountings.

No damage.

(b) Electrical connections.

No damage.

I. Submarine Propelling Batteries.

Not applicable.

J. Portable Batteries.

(a) Mounting.

#6 gunfiring battery box (5'' battery) was torn loose by a missile.

(b) Jars.

No damage except as noted in (a) and #2 Motor Whale Boat which was shattered.

(c) Cell and cable connections.

Same as (b) above.

(d) Acid spillage.

Same as (b) above.

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

(a) Rotating equipment.

Framework and mounting. No damage.

Commutator or slip rings. No damage.

Brushes and brush rigging. No damage.

Bearings. No damage.

Speed regulators. No damage.

(b) Control equipment.

Framework and mounting. No damage.

Electrical connections and wiring. No damage.

Contactors, switches and relays. No damage.

Rheostats and resistors. No damage.

Insulating materials. No damage.

Pilot circuit devices. No damage.

Brakes. No damage.

L. Lighting Equipment.

(a) Lamps.

No damage suffered even in exposed areas.

(b) Reflectors.

No damage.

(c) Fixture Mounts.

No damage suffered except for those attached to structures which carried away.

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

No damage suffered except for failure of supporting structure.

(e) Pendant lamp holders.

No damage.

(f) Lamp globes.

No damage.

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

(a) Framework and mountings.

36": Bases were twisted which prevented the light being able to elevate or train. Light broken from base.

24": Starboard: Light broke away from base and fell to the open bridge and was demolished.

24": Port: Framework was twisted and broken, shattering the drum and dome.

12": No damage.

8": None installed.

(b) Front glass.

36": Starboard is broken while the port is intact.

24": Both are broken.

12": No damage.

(c) Shutter and operating mechanism.

36": Both units have iris disengaged from operating mechanism and retaining lip was insufficient to hold the iris assembly in place allowing the iris to fall into lamp.

24": Both are demolished.
12": No damage.

(d) Locks and brakes.

36": Both are inoperative as the foundation is twisted.
24": Both are off their base and broken.
12": Undamaged.

(e) Arc lamp feed rods.

36": Starboard and port appear undamaged.
24": Both appear undamaged.

(f) Incandescent lamps.

12": Undamaged.

(g) Rheostats.

Undamaged.

N. Degaussing Equipment.

(a) Compass compensating coils and control boxes.

No damage.

(b) Connection boxes.

No damage.

(c) Heading switches and relays.

No damage.

O. Gyro Compass Equipment.

(a) Master.

Mercury splashed into sensitive element but upon cleaning and replacing mercury, no damage was found.

(b) Repeaters.

No damage.

(c) DRT and DRA.

No damage.

P. Sound Powered Telephones.

(a) Headsets.

No damage.

(b) Handsets.

No damage.

(c) Jack and switch boxes.

No damage suffered except to those attached to structures which failure such as bulkheads and shields in fire control and bridge areas.

(d) Stowage.

No damage suffered except unprotected boxes in open control stations.

Q. Ship's Service Telephones.

(a) Exchange.

No damage.

(b) Line equipment.

R. Announcing Systems.

(a) Portable (PAM and PAB).

No portable units were installed. Stationary units were undamaged.

(b) Amplifier Racks.

No damage.

(c) Control Racks.

No damage.

(d) Transmitting stations.

No damage.

(e) Reproducers.

No damage suffered except to one 17 MC unit on open bridge.

(f) Inter-communicating units.

No damage.

S. Telegraphs.

No damage suffered except to glass in exposed units on bridge.

T. Indicating System.

No damage suffered except to glass in exposed units on bridge.

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

No damage.

V. F.C. Switchboards.

No damage.

SECTION III

PART C - INSPECTION REPORT

SECTION D - ELECTRONICS

A. General Description of Electrical Damage.

(a) Overall condition.

Overall condition is poor due to the exposed portions of electronic equipment such as antennas, wave guides and cabling, suffering severe damage. Units located inside compartments received minor damage, principally from shock. Shock fractured large tube envelopes and caused resistors to fly out of fuse type clips.

(b) Areas of major damage.

The following radar antennas were blown overboard by blast and high wind: SK, after SG, forward Mark III and after Mark III. The Mark IV antenna was severely damaged. The Mark 28 antenna was blown off the director and completely demolished.

(c) Primary cause of damage in each area.

The causes of damage to all antennas was the initial blast and high wind velocities. Minor damage to equipment inside compartments was caused by shock.

(d) Operability of electronic equipment.

1. Radar.

All radar units except the forward SG radar were made inoperative by damage or destruction of antennas. The forward SG radar antenna support was bent about 15 or 20 degrees but the antenna was operative and the equipment was estimated to have about 80% of original efficiency.

2. Radio.

All radios were made inoperable by the damage or destruction of antennas. Some of the antennas could have been replaced in a few hours and the unit made operative. Blast damage to mast structure and high winds were apparently the cause of antenna damage.

3. Sonar.

The fathometer (only sonar gear on board) was Undamaged.

4. Loran.

The loran antenna was blown down. There was no internal damage to the equipment. The antenna could have been replaced in a few hours to make the unit operative.

5. Other.

All test equipment that was not secured was knocked around by blast and shock causing minor damage.

(e) Types of equipment most affected.

The Mark III and Mark IV fire control radar equipment was most affected, possibly due to their age and early design. Antenna damage accounted for 95% of the total damage suffered by electronic equipment. The SG radar equipment withstood the effects of the blast and shock better than other types of radars.

B. Fire Control Radar.

All fire control antennas were severely damaged or completely destroyed. Minor damage occurred in the main frame and indicators. The following elements suffered damage: Mark III (fwd); V2 (70KA keyer tube) envelope broken by shock, globar resistor type A (50K ohms) bent by shock, wave guide bent by motion of main frame, 2X2 H.V. rectifiers developed open filaments; Mark IV; 2X2 and 3B54 H. V. rectifiers developed open filaments, Micolex support for H. V.

line cracked and bent; Mark III (aft); H. V. corona discharge at porcelain insulator and at entrance to transmitter.

C. Surface Search Radar.

(1) After SG: The antenna parabola was blown overboard. The cabling must have shorted or grounded in the antenna pedestal or on the mainmast for the amplidyne overheated. No damage occurred in the main frame or indicator.

(2) Forward SG: The antenna was intact and capable of normal operation. Minor damage was suffered in the main frame. R104, R105 and R106 were blown out of their clips. K104 was broken open. T106 suffered a shorted secondary. No damage occurred in the control and indicator unit.

D. Air Search Radar.

The antenna was blown over the side, the pedestal remaining unharmed. Minor damage occurred in the transmitter. Three of the ring oscillator tubes (327A's) suffered broken envelopes. The metal hanging strap on the filament voltage variac fractured. No damage occurred in the control and indicator units.

E. Radar Repeaters.

Six repeaters suffered no damage whatsoever. The VD-2 on Sky Control was seriously damaged. Its frame was badly bent, two 807 tubes have broken envelopes, and the range selector switch was demolished. The VC in auxiliary CIC developed arcing in two places, through the terminal board at R3313 and from a cable to ground below the intensity potentiometer.

F. Radar Counter Measures Equipment.

All transmitters and receivers are located in CIC, and were undamaged. All RCM transmitter antennas were damaged or destroyed. The two receiving antennas forward of Sky Control were bent on their mount to starboard but were funtionally intact. The only operable transmitting antenna was the one forward of and below Sky Control.

G. Radar and Radio Beacons.

None installed.

H. IFF Equipment.

All IFF equipment was operable following the test. No change was noticed in any unit, even though the two ABK-7's in Flag Plot were knocked off their mounts to the deck.

I. Communication Transmitters.

All radio transmitting antennas were destroyed or damaged. Internal damage to equipment was negligible, and mainly due to tubes being knocked from sockets. Only one bowl insulator was damaged.

J. Communication Receivers.

All antennas destroyed or damaged. Internal damage was negligible; only a few tubes were knocked from sockets.

K. Communication Antennas (Radio).

All antennas were blown down.

L. Radio Transceivers (Combined Transmitters and Receivers).

None installed.

M. Sonar Echo Ranging and Listening Equipment.

None installed.

N. Sonar Echo Sounding Equipment.

No damage to fathometer.

O. Loran Navigation Equipment.

Loran antenna was blown down. No damage to equipment.

P. Power Supplies (Motor generators and filters).

All radar motor generators were in full operating condition.

All radio power supplies were in full operating condition.

Q. Television and Teletype Equipment.

None installed.

R. Test Equipment (Including frequency meters).

The equipment was knocked around badly where not firmly secured, causing minor damage.

S. Instrumentation.

Apparently none of the instruments placed on board suffered any damage. The success of the instruments in obtaining the desired data is not known.

T. Telephone Equipment.

No damage.

U. Direction Finders (Radio).

None installed.

V. Spare Parts.

A high percentage of spare parts were damaged where stowed in boxes or cabinets which were not securely fastened to the bulkhead or deck. One cabinet was knocked over, breaking a large number of tubes. Where the stowage was secure very little damage occurred.

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

TRC

10 April 1997

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

SUBJECT: Declassification of Reports

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

AD-366718	XRD-32-Volume 3	
AD-366726	XRD-12-Volume 2	
AD-366703	XRD-16-Volume 1	
AD-366702	XRD-14-Volume 2	
AD-376819L	XRD-17-Volume 2	
AD-366704	XRD-18	
AD-367451	XRD-19-Volume 1	
AD-366705	XRD-20-Volume 2	AD-366705
AD-376028L	XRD-4	
AD-366694	XRD-1	
AD-473912	XRD-193	
AD-473891	XRD-171	
AD-473899	XRD-163	
AD-473887	XRD-166	ST-A 28 JAN 80
AD-473888	XRD-167	made target
AD-473889	XRD-168	

TRC 10 April 1997

SUBJECT: Declassification of Reports

AD-B197749	XRD-174
AD-473905	XRD-182
AD-366719	XRD-33 Volume 4
AD-366700	XRD-10
AD-366712	XRD-25 Volume 1
AD-376827L	XRD-75
AD-366756	XRD-73
AD-366757	XRD-74
AD-366755	XRD-72
AD-366754	XRD-71
AD-366710	XRD-23 Volume 1
AD-366711	XRD-24 Volume 2
AD-366753	XRD-70
AD-366749	XRD-66
AD-366701	XRD-11
AD-366745	XRD-62.

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

Ardith Jarrett
ARDITH JARRETT
Chief, Technical Resource Center

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Completed

B.W