

UNCLASSIFIED

AD NUMBER

AD367474

CLASSIFICATION CHANGES

TO: unclassified

FROM: confidential

LIMITATION CHANGES

TO:

Approved for public release, distribution unlimited

FROM:

Distribution: USGO: others to Director,
Defense Atomic Support Agency, Washington,
D. C. 20301.

AUTHORITY

DSWA ltr., 18 Apr 1997; DSWA ltr., 18 Apr 1997

THIS PAGE IS UNCLASSIFIED

XRD
118

①4 XRD-118

LIBRARY COPY NO. 3

BUREAU OF SHIPS GROUP TECHNICAL INSPECTION REPORT

CONFIDENTIAL

Classification (Cancelled) (Change 1 to)
By Authority of Joint Chiefs of Staff Action of 15 April 1949
By William P. Burdick Date 24 Apr 1951
1st Lt. AFSPA

367474

⑥ OPERATION CROSSROADS,
USS BANNER (APA60).

TEST BAKER [U].

U. S. GOVERNMENT AGENCIES MAY OBTAIN COPIES OF THIS REPORT DIRECTLY
FROM DDC. OTHER QUALIFIED DDC USERS SHALL REQUEST THROUGH

Director
Defense Atomic Support Agency
Washington, D. C. 20301

OPERATION CROSSROADS

DIRECTOR OF SHIP MATERIAL / DDC

JOINT TASK FORCE ONE

CONFIDENTIAL

TECHNICAL LIBRARY

of the

ARMED FORCES
SPECIAL WEAPONS PROJECT

DEC 2 1965

TISIA E

REG. NO. 3

8396

GROUP 3
Downgraded at 12 year intervals;
Not automatically declassified.

1 JAN 1966

BUREAU OF SHIPS GROUP
TECHNICAL INSPECTION REPORT

CONFIDENTIAL

Classified (Confidential) (Changed to _____)
By Authority of Joint Chiefs of Staff Action of 15 April 1949
By *James R. Bendick* date *24 Apr 1951*
1st Lt. AFWP

U. S. GOVERNMENT AGENCIES MAY OBTAIN COPIES OF THIS REPORT DIRECTLY
FROM DDC. OTHER QUALIFIED DDC USERS SHALL REQUEST THROUGH

Director
Defense Atomic Support Agency
Washington, D. C. 20301

APPROVED:
CONFIDENTIAL

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

USS BANNER (APA60)

Page 1 of 39 Pages

GROUP-3 1 JAN 1965
Downgraded at 12 year intervals;
Not automatically declassified.

TABLE OF CONTENTS

	PAGE NO.
Ship Characteristics Sheet, -----	3
Midship Section, -----	4
Overall Summary of Damage, -----	5
Hull Technical Inspection Report, (Section I) -----	12
Machinery Technical Inspection Report, (Section II) -----	18
Electrical Technical Inspection Report, (Section III) -----	23
Photographic Section, (Section IV) -----	29
Commanding Officers Report (Appendix) -----	38

SECRET

USS BANNER (APA60)

U.S.S. BANNER (APA 60)

SHIP CHARACTERISTICS

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

Commissioned: 16 September 1944.

HULL

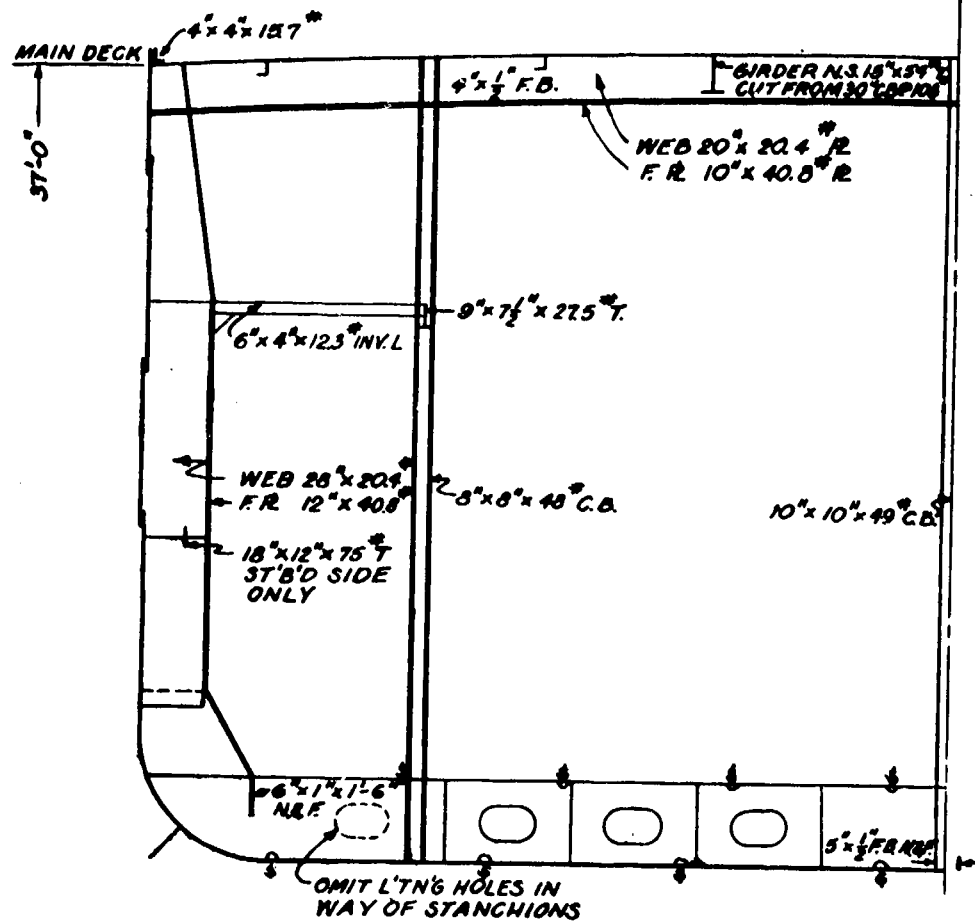
Length Overall: 426 feet 0 inches.
Length on Waterline: 400 feet 0 inches.
Beam (extreme): 58 feet 0 inches.
Depth (molded to upper deck): 37 feet 0 inches.
Drafts at time of test: Fwd. 8 feet 10 inches.
Aft. 18 feet 9 inches.
Limiting displacement: 7,080 tons.
Displacement at time of test: 6,005 tons.

MAIN PROPULSION PLANT

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

SECRET

USS BANNER (APA60)



FRAME 76 LOOKING AFT

MIDSHIP SECTION

TEST B

SECRET

U.S. BANNER (APA 60)

PAGE 4 OF 39

8396

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

(a) Draft's after test; list; general areas of flooding, sources.

There was some minor, harmless flooding from normal leakage and from decontamination wash water.

(b) Structural damage.

HULL

The ship suffered no apparent structural damage. The temporary upper deck covers, which were installed after Test A over both cargo holds, fell into the spaces below. The covers were made of two by four inch framing covered with canvas.

A steel fragment, apparently from the LSM 60, pierced the superstructure deck at frame 150, starboard.

MACHINERY

Superstructure, hull, interior of hull, above and below armored deck (if fitted).

No comment.

ELECTRICAL

Not observed.

SECRET

USS BANNER (APA60)

(c) Other damage.

HULL

Not observed.

MACHINERY

The machinery was not damaged, insofar as could be determined by visual inspection.

ELECTRICAL

No electrical equipment was damaged.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

No evidence.

MACHINERY

Not evidenced.

ELECTRICAL

No effects of heat were found on the vessel.

(b) Fires and explosions.

HULL

None.

MACHINERY

Not evidenced.

SECRET

USS BANNER (APA60)

ELECTRICAL

There were no fires and no explosions on the vessel.

(c) Shock.

HULL

There were mild indications of shock. In the forward engineroom, frame 69, asbestos insulation was broken loose from a four-inch boiler feed pipe. However, china dishes in the same space were not displaced from such places as flanges of horizontal I-beams.

MACHINERY

Not evidenced.

ELECTRICAL

No evidence of shock was found in any electrical equipment.

(d) Pressure.

HULL

None.

MACHINERY

Not evidenced.

ELECTRICAL

No effects of pressure were found in any electrical equipment.

SECRET

USS BANNER (APA60)

(e) Effects peculiar to the Atomic Bomb.

HULL

The only effects noted peculiar to the test are radioactivity and wave phenomena.

MACHINERY

None.

ELECTRICAL

No effects peculiar to the Atom bomb were found in any electrical equipment. The high radioactivity on the vessel was the only effect noted as being peculiar to the atom bomb.

III. Results of Test on Target.

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

HULL

None.

MACHINERY

None.

ELECTRICAL

None due to electrical damage.

(b) Effect on gunnery and fire control.

HULL

None.

SECRET

USS BANNER (APA60)

MACHINERY

No comment.

ELECTRICAL

None due to electrical damage.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No effect due to electrical damage.

(d) Effect on personnel and habitability.

HULL

Except for the effects of radioactivity, it is considered that personnel and habitability would not have been affected by the test.

MACHINERY

Test B had no effect on personnel or habitability except for the effect of radioactivity, which was high 15 days after Test B.

ELECTRICAL

No effect due to electrical damage.

SECRET

USS BANNER (APA60)

(e) Effect on fighting efficiency.

HULL

The longitudinal strength, buoyancy, stability, water-tight integrity, and the seaworthiness of the vessel and the operability of machinery and the hull were not affected by the test.

MACHINERY

Insofar as machinery is concerned, the test had no effect on fighting efficiency.

ELECTRICAL

No effect due to electrical damage.

IV. Summary of Observers' Impressions and Conclusions.

HULL

Except for the radiological phenomena experienced, this vessel was beyond the range of effectiveness of the bomb.

MACHINERY

The BANNER was beyond the effective range of the explosion except for the effect of radioactivity.

ELECTRICAL

No electrical damage was found on inspection and although operation was impossible, there is no reason to suspect any damage. No damage of any kind was noted during staff electrical inspection. The high radioactivity on the vessel is the only effect resulting from the BAKER atom bomb test. This vessel together with other vessels, emphasizes radioactivity as a major problem.

SECRET

USS BANNER (APA60)

V. Preliminary Recommendations.

HULL

No comment.

MACHINERY

None.

ELECTRICAL

As there was no electrical damage, no recommendations are made.

SECRET

USS BANNER (APA60)

TECHNICAL INSPECTION REPORT

SECTION I - HULL

GENERAL SUMMARY OF HULL DAMAGE

I. Target Condition After Test.

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

There was no flooding, hence no change in drafts or list.

(b) Structural Damage.

The ship suffered no apparent structural damage. The temporary upper deck covers, which were installed after Test A over both cargo holds, fell into the spaces below. The covers were made of two by four inch timber framing covered with canvas. A steel fragment, apparently from the LSM-60, pierced the superstructure deck at frame 150, starboard.

(c) Other damage.

Not observed.

II. Forces Evidenced and Effects Noted.

(a) Heat.

No evidence.

(b) Fires and Explosions.

None.

(c) Shock.

There were mild indications of shock. In the forward engineroom, frame 69, asbestos insulation was broken loose from a four-inch boiler feed pipe. However, china dishes in the same space were not displaced from such places as flanges of horizontal I-beams.

SECRET

USS BANNER (APA-60)

(d) Pressure.

None.

(e) Effects peculiar to the Atomic Bomb.

The only effects noted peculiar to the test are radioactivity and wave phenomena.

III. Results of Test on Target.

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

None.

(b) Effect on gunnery and fire control.

None.

(c) Effect on watertight integrity and stability.

None.

(d) Effect on personnel and habitability.

Except for the effects of radioactivity, it is considered that personnel and habitability would not have been affected by the test.

(e) Effect on fighting efficiency.

The longitudinal strength, buoyancy, stability, watertight integrity, and seaworthiness of the vessel and the operability of machinery and the hull were not affected by the test.

IV. Summary of Observer's Impressions and Conclusions.

Except for the radiological phenomena experienced, this vessel was beyond the range of effectiveness of the bomb.

SECRET

USS BANNER(APA-60)

V. Preliminary Recommendations.

No comment.

VI. 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	1280 tons.

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 Ship Material. This report is available for inspection in the Bureau of Ships Crossroads Files.

SECRET

USS BANNER(APA-60)

DETAILED DESCRIPTION OF HULL DAMAGE

A. General Description of Hull Damage.

There is no apparent structural damage. A fragment believed to be a part of a bearing cap from the LSM 60, penetrated the superstructure deck at frame 150, starboard. No machinery was operated but there appears to be no reason to expect even secondary damage. Small amounts of water were found in various parts of this vessel. This may have come from normal seepage, rain, or possible from the washing down of the ship during decontamination. General views of the vessel are shown on pages 30 to 37 inclusive.

B. Superstructure.

No damage occurred other than the fragment penetration of the superstructure deck.

C. Turrets, Guns and Directors.

No damage.

D. Torpedo Mounts, Depth Charge Gear.

Not applicable.

E. Weather Deck.

Temporary upper deck cargo hatch covers of both holds fell into the spaces below. The jury rig covers, installed after Test A were fabricated of two by four inch wood framing covered with canvas.

F. Exterior Hull.

No damage.

G. Interior Compartments (above waterline).

No damage.

SECRET

USS BANNER(APA-60)

H. Armor Decks and miscellaneous Armor.

Not applicable.

I. Interior Compartments (below waterline).

There were indications of mild shock. In the forward engine room, frame 69, asbestos insulation was broken loose from a four-inch boiler feed pipe. However, china dishes in the same space were not displaced, from such places as ledges and flanges of horizontal I-beams.

J. Underwater Hull.

No damage is known or suspected.

K. Tanks.

No damage.

L. Flooding.

There is a slight amount of water in various parts of the vessel. The port after corner of the first platform level in the forward hold has approximately three inches of water. This water apparently came through the upper deck openings either from rain or from washing down of the ship during decontamination of the vessel. The auxiliary machinery space has about six inches of water in the bilges apparently from normal seepage, as the space was already rigged for pumping out. The forward machinery space has about four inches of water in the after bilges. The after machinery space has about one inch of water in the after bilges. The shaft alley bilges, port and starboard, are flooded nearly to the deck plating level as the result of stern tube leakage.

M. Ventilation.

No damage.

N. Ship Control.

No damage.

SECRET

USS BANNER (APA-60)

O. Fire Control.

No damage.

P. Ammunition Behavior.

No damage.

Q. Ammunition Handling.

No damage.

R. Strength.

No damage.

S. Miscellaneous.

No comment.

SECRET

USS BANNER(APA-60)

Page 17 of 39 Pages

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.

No comment.

(c) Other damage.

The machinery was not damaged, insofar as could be determined by visual inspection.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Not evidenced.

(b) Fires and explosions.

Not evidenced.

(c) Shock.

Not evidenced.

(d) Pressure.

Not evidenced.

SECRET

USS BANNER (APA60)

(e) Effects apparently peculiar to the atom bomb.

None.

III. Effects of Damage.

(a) Effect on machinery and ship control.

None.

(b) Effect on gunnery and fire control.

No comment.

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

No comment.

(d) Effect on personnel and habitability.

Test B had no effect on personnel or habitability except for the effect of radioactivity, which was high 15 days after Test B.

(e) Total effect on fighting efficiency.

Insofar as machinery is concerned, the test had no effects on fighting efficiency.

IV. General Summary.

The BANNER was beyond the effective range of the explosion except for the effect of radioactivity.

V. Preliminary Recommendations.

None.

SECRET

USS BANNER (APA60)

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall condition.

The overall condition since test B is unchanged insofar as can be determined by visual inspection.

(b) Areas of major damage.

There are no areas of major damage.

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

None.

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

Since no damage was sustained, there was no effect of the target test on the overall operation of the machinery plant.

NOTE: Because of radiological hazard no machinery on this vessel was operated after Test B.

B. Boilers.

No apparent damage.

C. Blowers.

No apparent damage.

D. Fuel Oil Equipment.

No apparent damage.

E. Boiler Feedwater Equipment.

No apparent damage.

SECRET

USS BANNER (APA60)

F. Main Propulsion Machinery.

No apparent damage.

G. Reduction Gears.

Not Applicable.

H. Shafting and Bearings.

No apparent damage.

I. Lubrication System.

No apparent damage.

J. Condensers and Air Ejectors.

No apparent damage.

K. Pumps.

No apparent damage.

L. Auxiliary Generators (Turbines and Gears).

No apparent damage.

M. Propellers.

The propellers could not be inspected from the surface of the water. However, in view of the general condition of the ship, they are believed to be undamaged.

N. Distilling Plant.

No apparent damage.

O. Refrigeration Plant.

No apparent damage.

SECRET

USS BANNER (APA60)

P. Winches, Windlasses, and Capstans.

No apparent damage.

Q. Steering Engine.

No apparent damage.

R. Elevators, Ammunition Hoists, Etc.

No apparent damage.

S. Ventilation (Machinery).

No apparent damage.

T. Compressed Air Plant.

No apparent damage.

U. Diesels (Generators and Boats).

No apparent damage.

V. Piping Systems.

No apparent damage.

W. Miscellaneous.

No apparent damage.

SECRET

USS BANNER (APA60)

Page 22 of 39 Pages

TECHNICAL INSPECTION REPORT

SECTION III - ELECTRICAL

GENERAL SUMMARY OF ELECTRICAL DAMAGE

I. Target Condition After Test.

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

The drafts and lists were not observed. There was some minor, harmless flooding from normal leakage and from decontamination wash water.

(b) Structural damage.

Not observed.

(c) Other damage.

No electrical equipment was damaged.

II. Forces Evidenced and Effects Noted.

(a) Heat.

No effects of heat were found on the vessel.

(b) Fires and explosions.

There were no fires and no explosions on the vessel.

(c) Shock.

No evidence of shock was found in any electrical equipment.

(d) Pressure.

No effects of pressure were found in any electrical equipment.

SECRET

USS BANNER (APA60)

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

No effects peculiar to the atom bomb were found in any electrical equipment. The high radio activity on the vessel was the only effect noted as being peculiar to the atom bomb.

III. Effects of Damage.

- (a) Effect on propulsion and ship control.

None due to electrical damage.

- (b) Effect on gunnery and fire control.

None due to electrical damage.

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

No effect due to electrical damage.

- (d) Effect on personnel and habitability.

No effect due to electrical damage.

- (e) Total effect on fighting efficiency.

No effect due to electrical damage.

IV. General Summary of Observers' Impressions and Conclusions.

No electrical damage was found on inspection and although operation was impossible, there is no reason to suspect any damage. No damage of any kind was noted during staff electrical inspection. The high radio activity on the vessel is the only effect resulting from the BAKER atom bomb test. This vessel together with other vessels, emphasizes radio activity as a major problem.

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

As there was no electrical damage, no recommendations are made.

SECRET

USS BANNER (APA60)

DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

A. General Description of Electrical Damage.

(a) Overall condition.

The ship's electrical equipment was unchanged by the blast.

(b) Areas of major damage.

There was no damage.

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

There was no damage.

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

1. Ship's service generator plant - no effects.
2. Engine and boiler auxiliaries - no effects.
3. Electrical propulsion - no effects.
4. Communications - no effects.
5. Fire control circuits - no effects.
6. Ventilation - no effects.
7. Lighting - no effects.

(e) Types of equipment most affected.

No electrical equipment was in any way affected by the test.

SECRET

USS BANNER (APA60)

B. Electric Propulsion Rotating Equipment.

No damage.

C. Electric Propulsion Control Equipment.

No damage.

D. Generators - Ships Service.

No damage.

E. Generators - Emergency.

No damage.

F. Switchboards, Distribution and Transfer Panels.

No damage.

G. Wiring, Wiring Equipment and Wireways.

No damage.

H. Transformers.

No damage.

I. Submarine Propelling Batteries.

This item does not apply to the vessel.

J. Portable Batteries.

No damage.

K. Motors, Motor Generator Sets and Motor Controllers.

No damage.

SECRET

USS BANNER (APA60)

L. Lighting Equipment.

No damage.

M. Searchlights.

No damage.

N. Degaussing Equipment.

No damage.

O. Gyro Compass Equipment.

No damage.

P. Sound Powered Telephones.

No damage.

Q. Ship's Service Telephones.

The vessel has only sound powered telephones.

R. Announcing Systems.

No damage.

S. Telegraphs.

No damage.

T. Indicating Systems.

No damage.

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

No damage.

SECRET

USS BANNER (APA60)

V. F.C. Switchboard.

There are no F.C. switchboards on the vessel.

W. Miscellaneous.

No comment.

SECRET

USS BANNER (APA60)

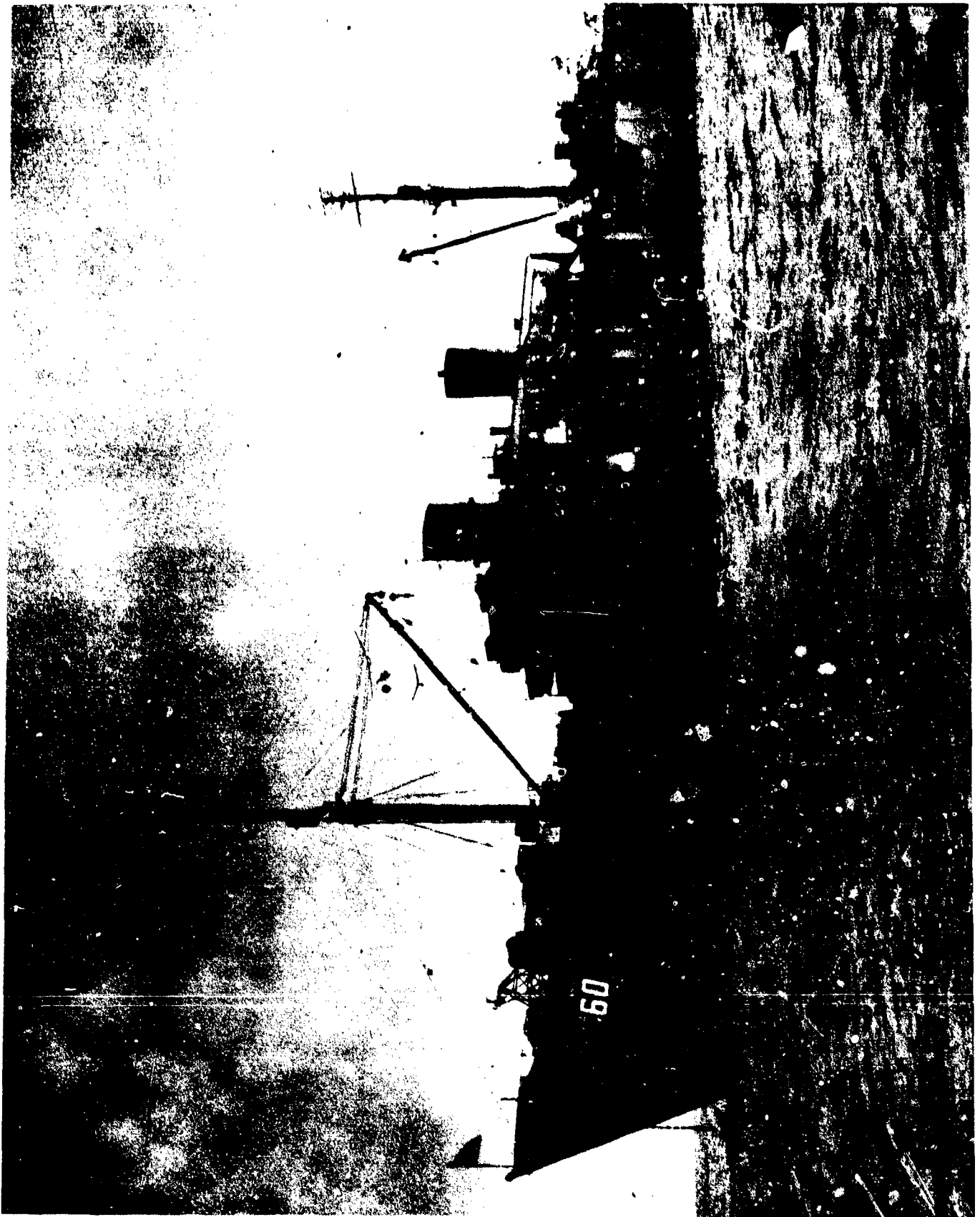
SECTION IV

PHOTOGRAPHS

TEST BAKER

SECRET

USS BANNER (APA60)



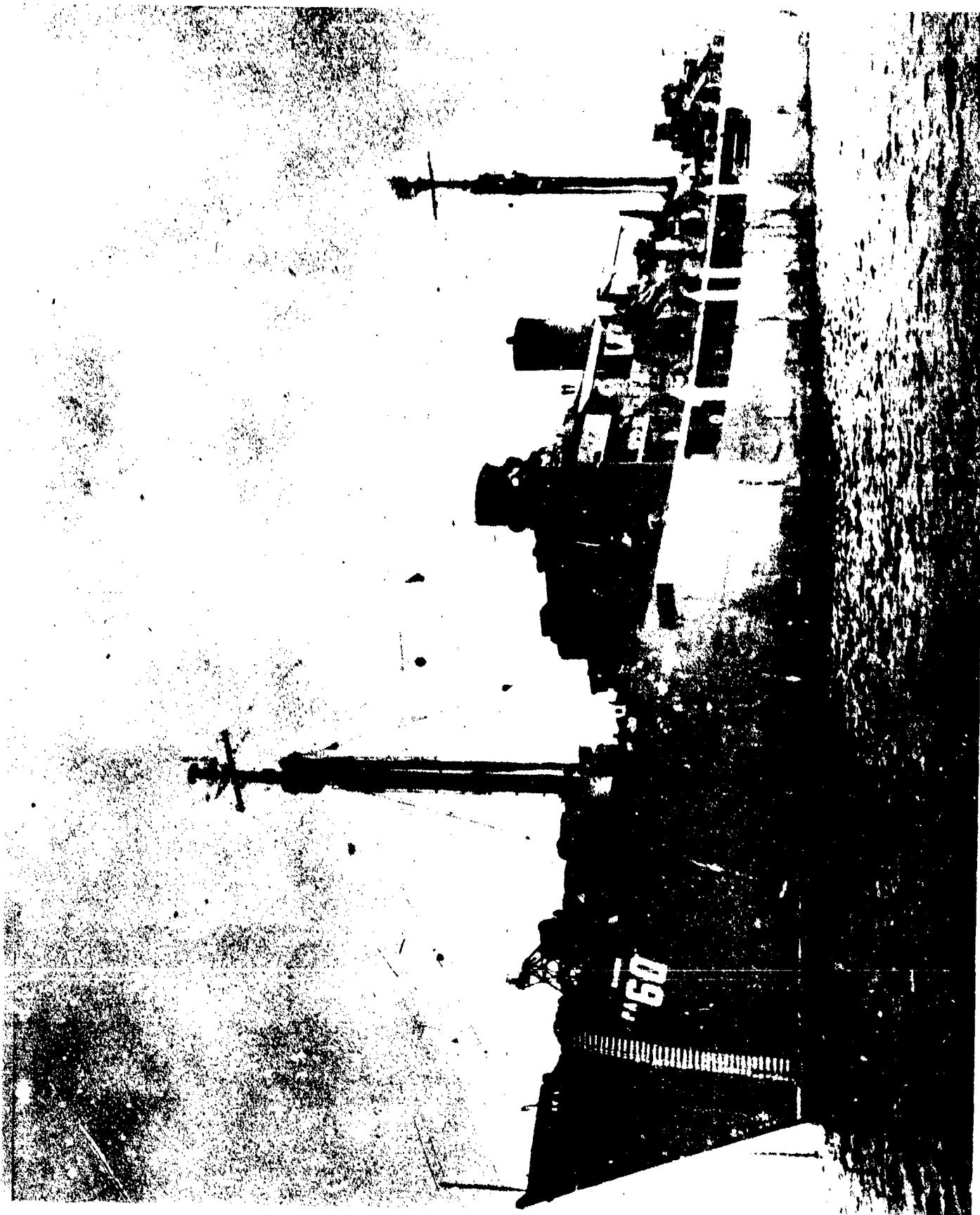
BB-CR-227-513-115. View from off port bow before Test B.

SECRET

Page 30 of 39 Pages

USS BANNER (APA 60)

8396



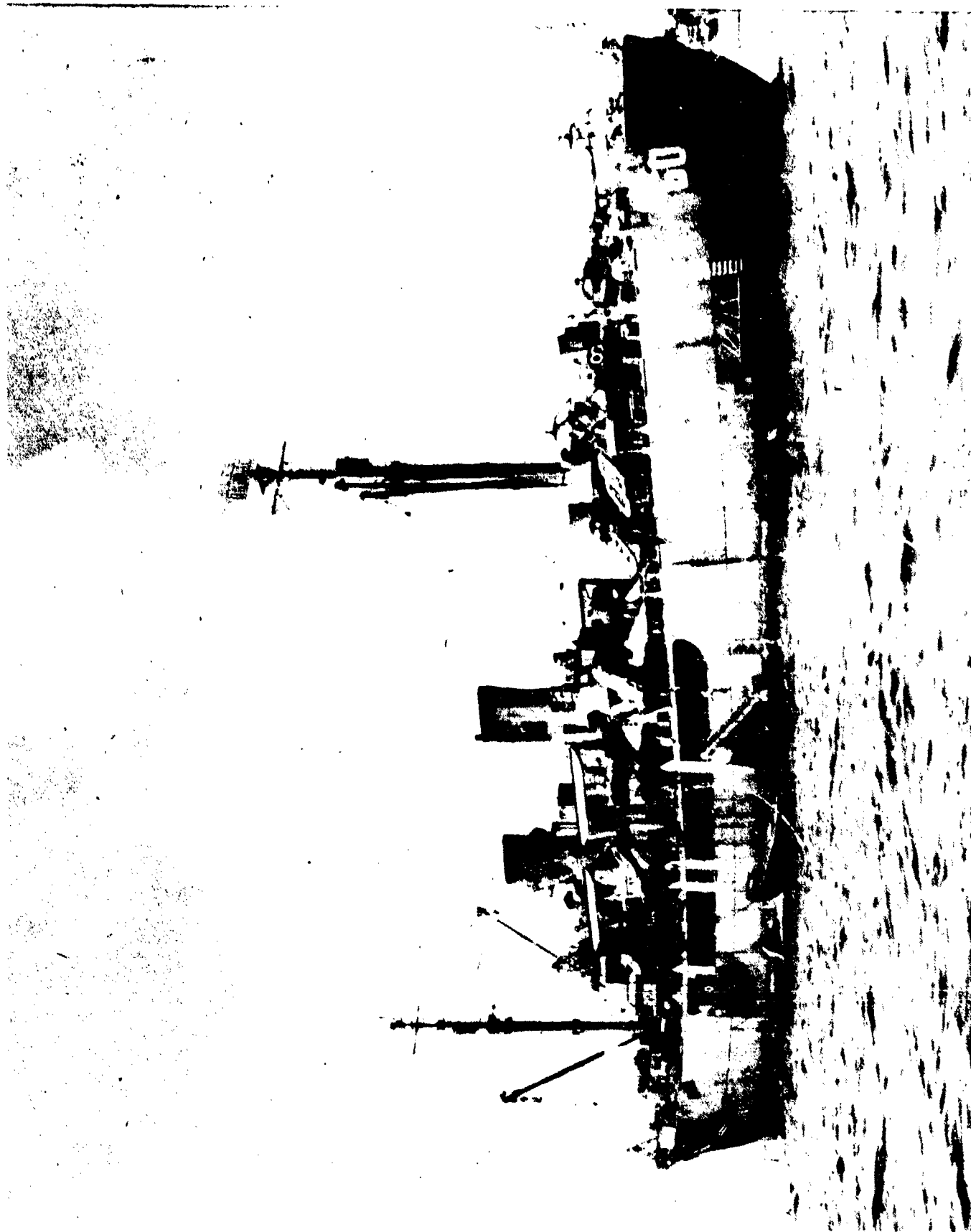
AB-CR-227-243-4. View from off port bow after Test B.

SECRET

Page 31 of 39 Pages

USS BANNER (APA60)

8396



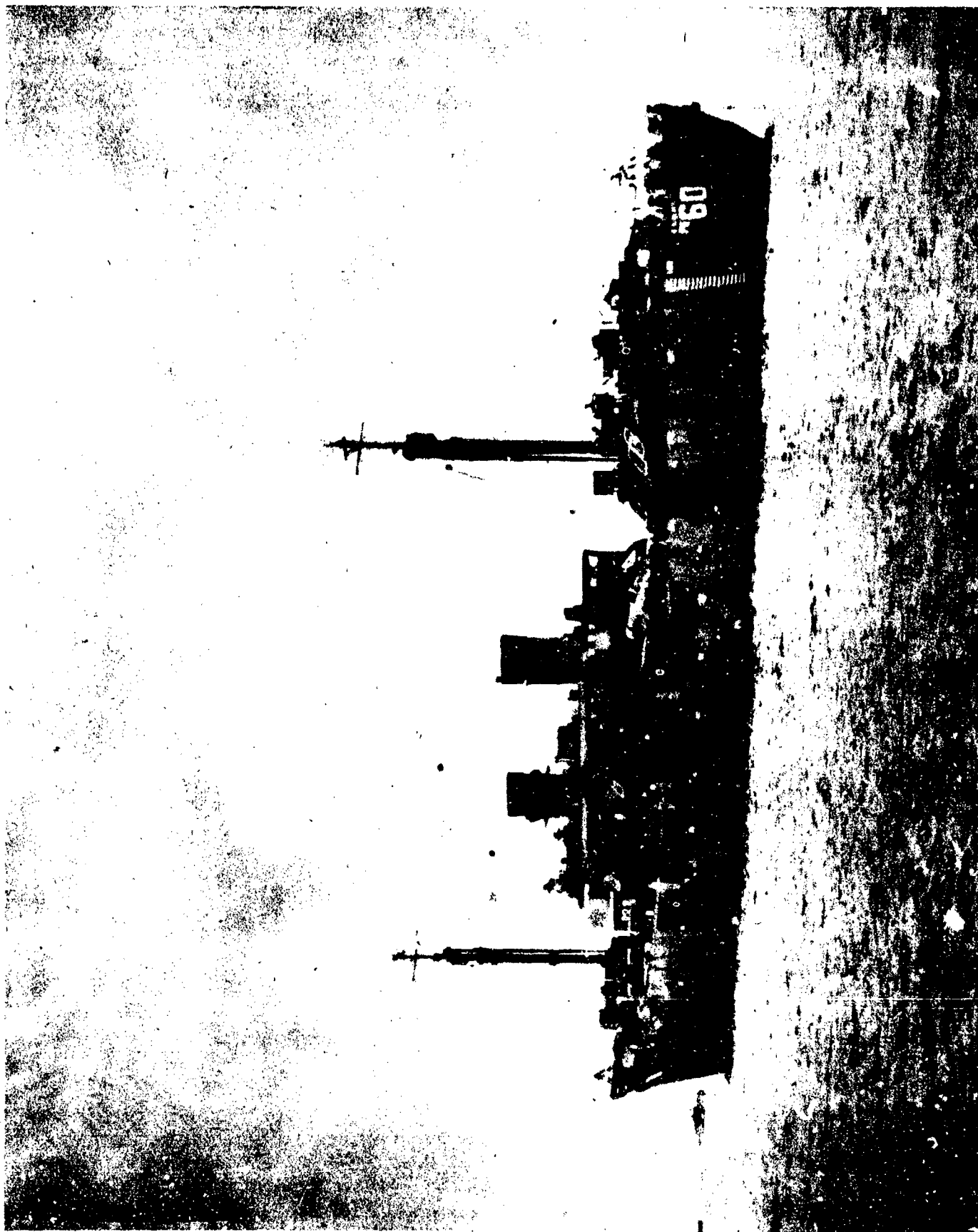
BB-CR-227-513-117. View from off port quarter before Test B.

SECRET

Page 32 of 39 Pag

USS BANNER (APA60)

8396



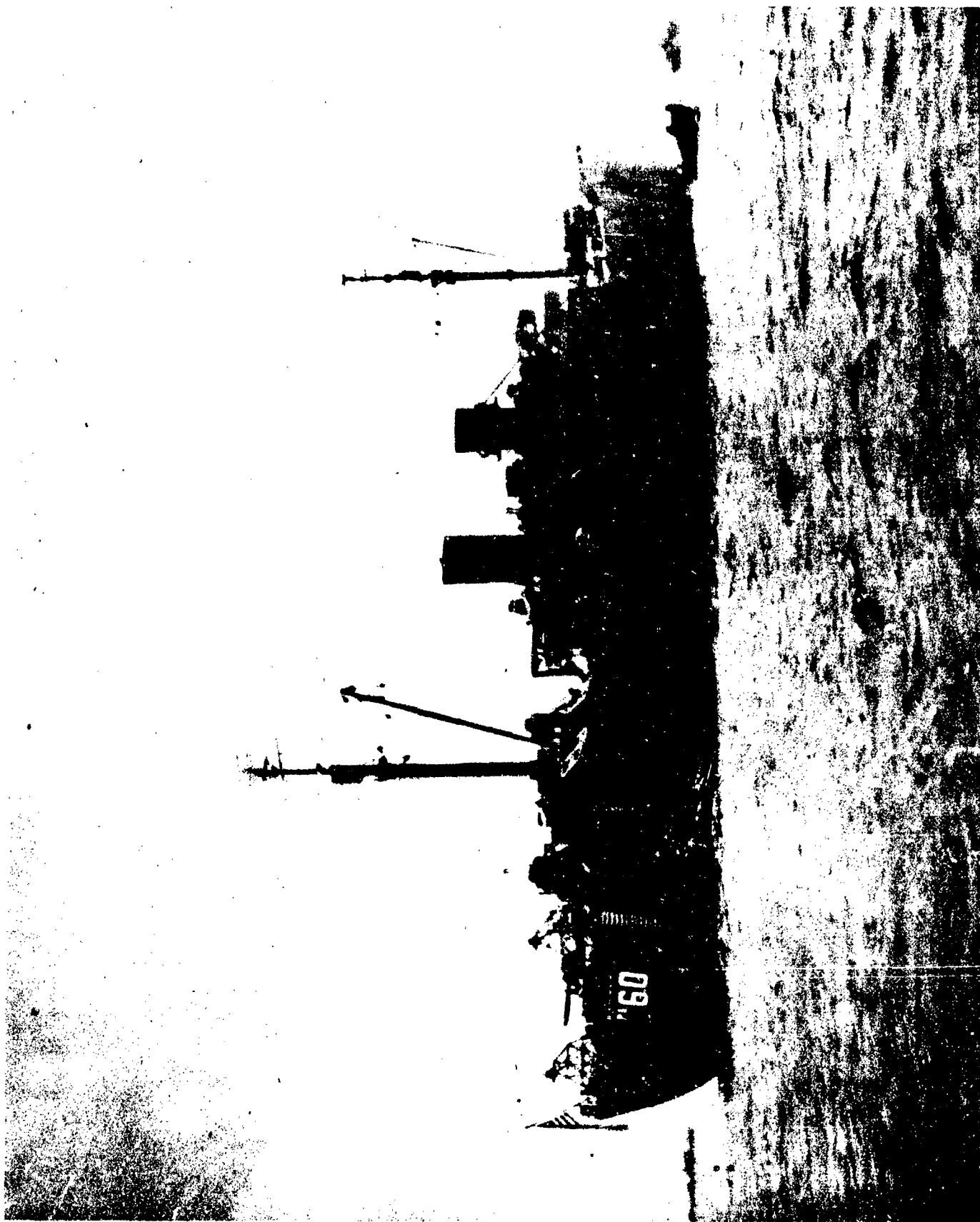
AB-CR-227-243-6. View from off port quarter after Test B.

SECRET

Page 33 of 39 Pages

USS BANNER (APA60)

8396



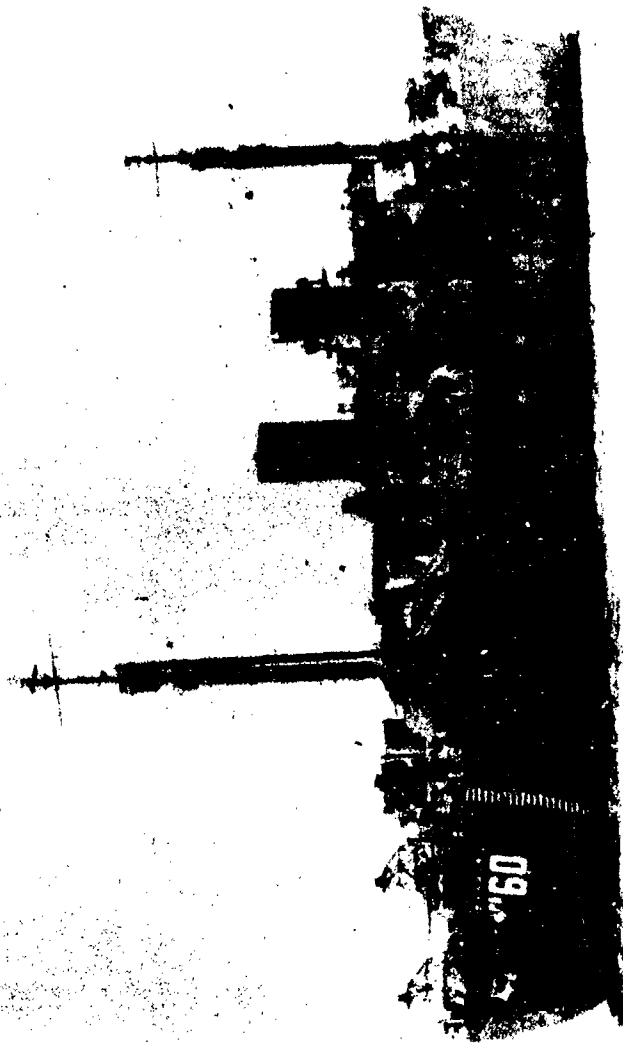
BB-CR-227-513-111. View from off starboard quarter before Test B.

SECRET

Page 34 of 39 Pages

USS BANNER (APA30)

8396



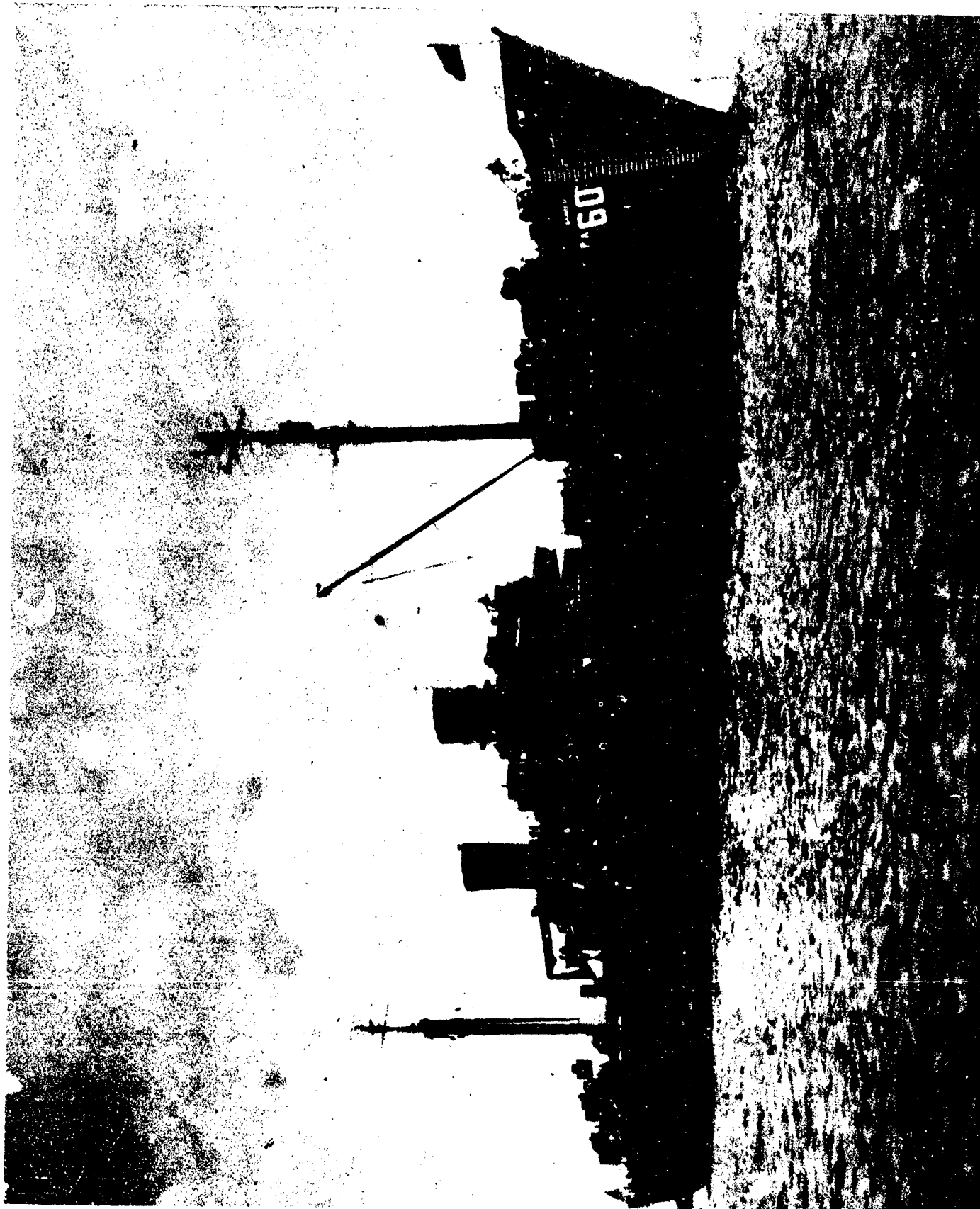
AB-CR-227-243-8. View from off starboard quarter after Test B.

SECRET

Page 35 of 39 Pages

USS BANNER (APA60)

8396



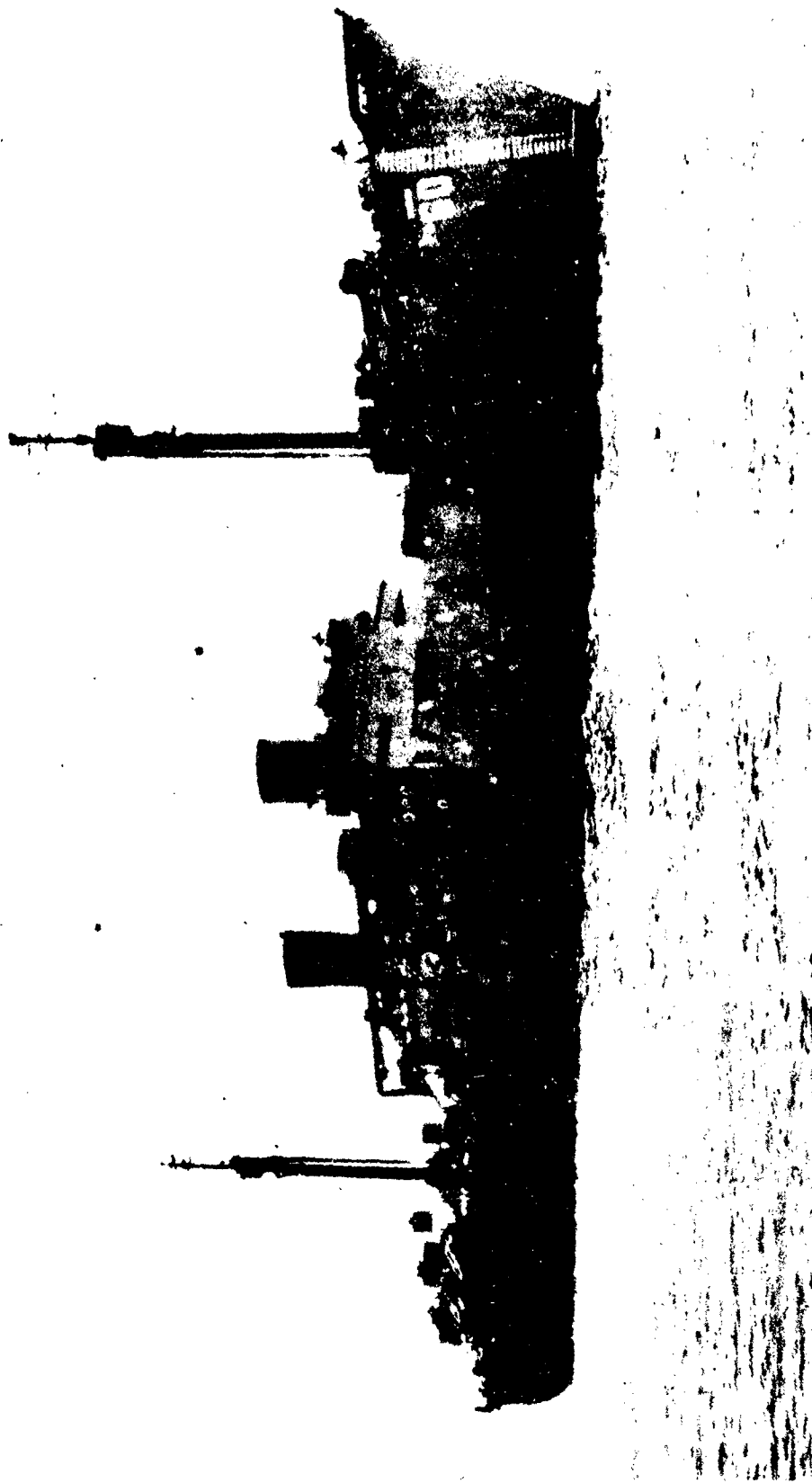
BB-CR-227-513-113. View from off starboard bow before Test B.

SECRET

Page 36 of 39 Pages

USS BANNER (APA 60)

8396



AB-CR-227-243-2. View from off starboard bow after Test B.

SECRET

Page 37 of 39 Pages

USS BANNER (APA60)

8396

APPENDIX

COMMANDING OFFICERS REPORT

TEST BAKER

SECRET

USS BANNER (APA60)

COMMANDING OFFICERS REPORT

REPORT # 5

SECTION - 1

There was no major damage warranting a special inspection by the Technical Staff of the Director of Ship Material.

There was no sign of flooding in any compartments inspected which included the forward and after parts of the ship and the engineering spaces. The hatch covers on both holds were knocked in but they only consisted of a temporary cover made of two by four wood framing and canvas.

SECRET

USS BANNER (APA-60)



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

TRC

18 April 1997

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

SUBJECT: Declassification of Reports

The Defense Special Weapons Agency has declassified the following reports:

✓AD-366588 4	XRD-203-Section 12✓
AD-366589✓	XRD-200-Section 9
AD-366590✓	XRD-204-Section 13
AD-366591✓	XRD-183
✓AD-366586 X	XRD-201-Section 10✓
✓AD-367487 4	XRD-131-Volume 2✓
✓AD-367516 4	XRD- 1 143✓
✓AD-367493 4	XRD-142✓
AD-801410L✓	XRD-138
AD-376831L✓	XRD-83
AD-366759✓	XRD-80
✓AD-376830L 4	XRD-79✓
✓AD-376828L 4	XRD-76✓
✓AD-367464 X	XRD-106✓
AD-801404L✓	XRD-105-Volume 1
✓AD-367459 X	XRD-100✓

TRC

18 April 1997

Subject: Declassification of Reports

✓AD-367491 ✕	XRD-134-Volume 2 ✓
✓AD-367479 ✕	XRD-123 ✓
✓AD-367478 ✕	XRD-122 ✓
✓AD-367481 ✕	XRD-125 ✓
AD-367500 ✓	XRD-159-Volume 2 <i>reinst</i>
✓AD-367499 ✕	XRD-160-Volume 3 ✓
✓AD-367498 ✕	XRD-161-Volume 4 ✓
AD-367512 ✓	XRD-147
AD-367511 ✓	XRD-148
✓AD-367465 ✕	XRD-107 ✓
AD-366733 ✓	XRD-43
✓AD-367477 ✕	XRD-121 ✓
✓AD-367476 ✕	XRD-120 ✓
✓AD-367467 ✕	XRD-109-Volume 1 ✓
✓AD-367475 ✕	XRD-119 ✓
AD-367474 ✕	XRD-118 ✓
AD-367473 ✕	XRD-117 ✓
AD-367472 ✕	XRD-116 ✓
AD-367471 ✕	XRD-115 ✓
AD-367466 ✕	XRD-108 ✓
AD-801405L ✓	XRD-113
AD-367470 ✕	XRD-112 ✓
AD-367469 ✕	XRD-111 ✓

TRC

18 April 1997

Subject: Declassification of Reports

AD-801406L ✓ XRD-114.

In addition, all of the cited reports are now **approved for public release; distribution statement "A" now applies.**

Arldith Jarrett

ARDITH JARRETT
Chief, Technical Resource Center