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BUREAU OF SHIPS GROUND

TECHNICAL INSPECTION REPORT

366741

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By Authority of JOINT CHIEFS OF STAFF JCS 1795/36 DATED 15 APRIL 1949
By John H. Deyette Date 23 SEP 1953

U.S.S. APOGON (SS308)

TEST ABLE

U.S. GOVERNMENT PRINTING OFFICE: 1953
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Support Agency
Washington, D. C. 20301

OPERATION CROSSROADS

DIRECTOR OF SHIP MATERIAL

JOINT TASK FORCE ONE

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1 JAN 1965
3580

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⑨ BUREAU OF SHIPS GROUP
TECHNICAL INSPECTION REPORT

⑥ OPERATION CROSSROADS.
U. S. S. APOGON (SS308).
TEST ABLE [u] ⑧

U. S. GOVERNMENT PRINTING OFFICE: 1947
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Director
Defense Atomic Support Agency,
Washington, D. C. 20301

⑪ 1947, ⑫ 38p.

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⑭ XRD-51

SUBMITTED:

C. L. Gaasterland,
Commander, U.S.N.

APPROVED:

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

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USS APOGON (SS308)

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U.S.S. APOGON (SS308)

SHIP CHARACTERISTICS

Building Yard: Portsmouth Naval Shipyard.

Commissioned: 16 July 1943.

HULL

Heavy Hull Construction.

Length Overall: 311 feet 8 inches.

Length (between perpendiculars): 307 feet 0 inches.

Beam (extreme): 27 feet 3 inches.

Beam (molded): 27 feet 1 3/4 inches.

Height (lowest point of keel to top of periscope supports): 47 feet 2 inches.

Drafts (at time of test): Fwd. 14 feet 9 inches.
Aft. 15 feet 10 inches.

Standard Displacement: 1525 tons.

Displacement (at time of test): 1812 tons.

MAIN PROPULSION PLANT

Main Engines: Four Fairbanks-Morse, 9 cylinder,
Type 38D8.

Auxiliary Engine: Fairbanks-Morse, 7 cylinder,
Type 38D5.

Main Motors and Generators: Elliott.

Main Storage Battery: Exide.

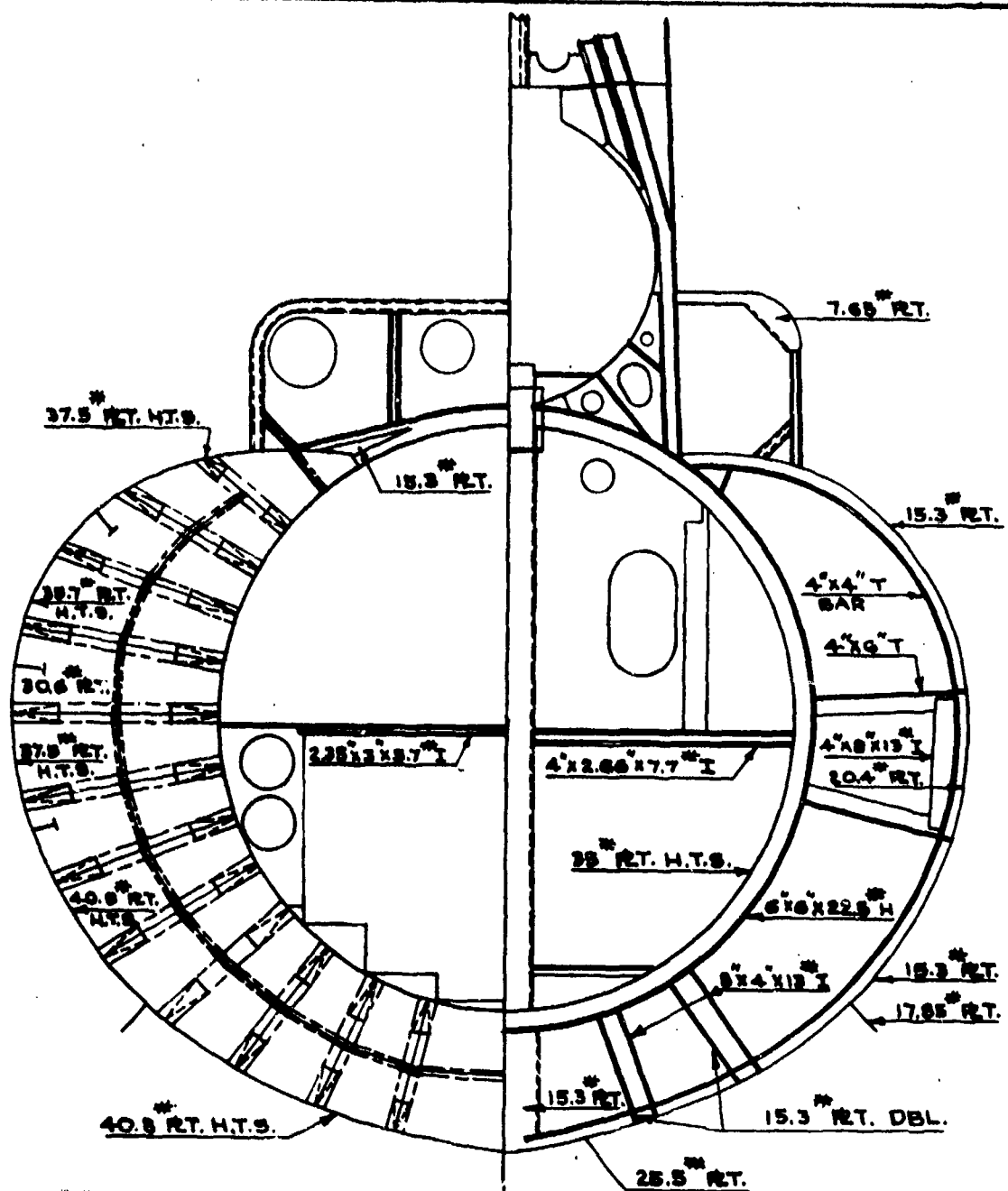
Main Controls: Westinghouse.

Reduction Gears: Westinghouse.

Diesel Electric Drive.

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TYPICAL SECT. AT FR. 69
LOOKING AFT

TYPICAL SECT. AT FR. 53
LOOKING FORD.

TEST A

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U.S.S. APOGON (SS 308)

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

Draft and list were normal after the test; no flooding occurred.

(b) Structural damage.

There was no structural damage of any consequence. Three perforated swash bulkheads (about 10 pound plates), that extend from the main deck to the pressure hull at frames 32, 44 and 60 respectively, are bulged forward. The maximum depth of bulging is about 2 inches. Apparently the blast pressure entered the semi-closed space between the main deck and the pressure hull and dished these bulkheads before it was dissipated through the numerous openings. It is interesting that the bulkhead at frame 44 was dished forward although it forms the after boundary of the space between frames 32 and 44. This would seem to indicate that the cause of these deformations was true blast rather than a uniform pressure within the space, acting in all directions.

(c) Other damage.

Machinery, electrical, ship control, fire control and electronic equipment was fully operable after the test.

II. Forces Evidenced and Effects Noted.

(a) Heat.

The top coat of paint on the exposed vertical surface of the port side of the superstructure and conning tower fairwater

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is moderately scorched and charred. The scorching is less than on the SKIPJACK and PARCHE which were further from the explosion, probably because the explosion bore about 200° relative. Topside cables in some few instances, where completely exposed, had a light covering of char or soot which could be rubbed off with the fingers, but in no case was the insulation damaged.

(b) Fires and explosions.

No fires or explosions occurred.

(c) Shock.

There is no evidence of shock.

(d) Pressure.

The dishing of the swash bulkheads described in I(b) above indicates that a relatively small dynamic pressure wave attacked the superstructure. The 'Coordinator's Report on Air Blast and Water Shock for Test Able and Baker' indicates that the peak air pressure was approximately 20 lbs. per square inch and the duration of the positive pressure phase was about 0.65 seconds. Elastic deformation of the single hull, measured at four stations, was less than 0.03 inches.

(e) Any effects peculiar to the atom bomb.

Slight radioactivity and heat as well as the pressure wave mentioned in II(d) above were the only effects noted peculiar to the atom bomb.

III. Effects of damage.

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

None.

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(b) Effect on gunnery and fire control.

None.

(c) Effect on watertight integrity and stability.

None.

(d) Effect on personnel and habitability.

It is believed there would have been no effect on personnel inside the sealed pressure hull but that exposed topside personnel would have suffered severe flash burns. Habitability is unimpaired.

(e) Total Effect on fighting efficiency.

There is no reduction in fighting efficiency from a material standpoint. Exposed personnel topside would have been at least temporarily out of action.

IV; General Summary of Observers' Impressions and Conclusions.

The APOGON had been moored on the surface at a distance of approximately 975 yards from the burst. From inspection the impression is formed that this ship was subjected to a directional flash of more or less instantaneous heat followed by a relatively high velocity wind. It is concluded that a submarine on the surface at this distance from an explosion of the type experienced in test A will not be affected from a material standpoint but would have casualties among exposed topside personnel. Had the submarine been submerged, there would have been casualties. For general views of the APOGON after Test A see photographic section on pages 27 to 34.

V. Preliminary Recommendations.

If it is expected that submarines will be subject to such an attack it appears desirable to protect topside personnel to the maximum practicable extent with clothing and structural enclosures. As there is no significant damage to this vessel no further recommendations are submitted herein.

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USS APOGON (SS308)

TECHNICAL INSPECTION REPORT

SECTION I - HULL

GENERAL SUMMARY OF HULL DAMAGE

I. Target Condition After Test.

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

There is no flooding and no change in draft or list.

(b) Structural damage.

There was no structural damage of any consequence. Three perforated swash bulkheads (about 10 pound plate), that extend from the main deck to the pressure hull at frames 32, 44 and 60 respectively, are bulged forward. The maximum depth of bulging is about 2 inches. Apparently the blast pressure entered the semi-closed space between the main deck and the pressure hull and dished these bulkheads before it was dissipated through the numerous openings. It is interesting that the bulkhead at frame 44 was dished forward although it forms the after boundary of the space between frames 32 and 44. This would seem to indicate that the cause of these deformations was true blast rather than a uniform pressure within the space, acting in all directions.

(c) Other damage.

Not observed.

II. Forces Evidenced and Effects Noted.

(a) Heat.

The top coat of paint on the exposed vertical surface of the port side of the superstructure and conning tower fairwater is moderately scorched and charred. The scorching is less than on the SKIPJACK and PARCHE which were further from the explosion, probably because the explosion bore about 200° relative.

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USS APOGON (SS308)

(b) Fires and explosions.

None.

(c) Shock.

No evidence.

(d) Pressure.

The dishing of the ~~swash~~ bulkheads described in I(b) above indicates that a relatively small dynamic pressure wave attacked the superstructure. The "Coordinator's Report on Air Blast and Water Shock for Tests Able and Baker" indicates that the peak air pressure was approximately 20 lbs. per square inch and the duration of the positive pressure phase was about 0.65 seconds. Elastic deformation of the single hull, measured at four stations, was less than 0.03 inches.

(e) Effects apparently peculiar to the Atom Bomb.

None other than previously noted.

III. Effects of Damage.

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

Not observed.

(b) Effect on gunnery and fire control.

Not observed.

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

None.

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USS APOGON (SS308)

(d) Effect on personnel and habitability.

Insofar as hull structure is concerned there is no effect on habitability. It is estimated that severe flash burns would have been received by all topside personnel, but that there would have been no other casualties.

(e) Effect on fighting efficiency.

None.

IV. General Summary of Observers' Impression and Conclusions.

From inspection, the impression formed is that this ship was subjected to a directional flash of more or less instantaneous heat followed by a relatively high velocity wind. It is concluded that a submarine on the surface at such distance from an explosion of the type experienced in Test A will not be affected as far as hull material condition is concerned.

V; Preliminary Recommendations.

If it is expected that submarines will be subjected to such an attack it appears desirable to protect topside personnel to the maximum practicable extent with clothing and structural enclosures. As there is no significant material damage to this vessel no further recommendations are submitted herein.

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DETAILED DESCRIPTION OF HULL DAMAGE

A. General Description of Hull Damage.

No damage except as covered in B and T.

B. Superstructure.

There is a very slight dishing of some 5 pound plating on the port side of the conning tower fairwater. A 20" x 24" access door in the same 5 pound plating was blown in and distorted. There is no other damage.

C. Turrets, Guns and Directors.

No damage.

D. Torpedo Mounts, Depth Charge Gear.

No damage.

E. Weather Deck.

No damage.

F. Exterior Hull.

No damage.

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

No damage.

H. Armor Decks and Miscellaneous Armor.

Not Applicable.

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

No damage.

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USS APOGON (SS308)

- J. Underwater Hull.
No damage.
- K. Tanks.
No damage.
- L. Flooding.
None.
- M. Ventilation.
No damage.
- N. Ship Control.
No damage.
- O. Fire control.
No damage.
- P. Ammunition Behavior.
No damage.
- Q. Ammunition Handling.
No damage.
- R. Strength.
No damage.
- S. Miscellaneous.
No comment.

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T. Covering.

The top coat of paint on the exposed vertical surface of the port side of the superstructure and conning tower fairwater is moderately scorched and charred.

U. Welding and Rivetting.

No damage.

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USS APOGON (SS308)

TECHNICAL INSPECTION REPORT

SECTION II - MACHINERY

GENERAL SUMMARY OF MACHINERY DAMAGE

I. Target Condition After Test Able.

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

Draft and list were normal: no flooding occurred.

(b) Structural damage.

No structural damage was noted.

(c) Other damage.

All machinery and equipment was undamaged and operable.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Momentary extreme heat from the direction of the bomb burst is evidenced by heavily scorched and blistered paint on vertical surfaces toward the burst.

(b) Fires and explosions.

No fires or explosions occurred aboard.

(c) Shock.

No indication of shock was evidenced.

(d) Pressure.

None evidenced.

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USS APOGON (SS308)

(e) Effects apparently peculiar to the Atom Bomb.

Slight radioactivity and momentary extreme heat were only noted effects peculiar to the Atom Bomb.

III. Effects of Damage.

(a) Effect on machinery and ship control.

None. No damage.

(b) Effect on gunnery and fire control.

None. No damage.

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

None. No damage.

(d) Effect on personnel and habitability.

It is believed there would have been no effect on personnel inside the sealed pressure hull. Habitability was unimpaired. Any personnel exposed topside would have suffered flash burns.

(e) Total effect on fighting efficiency.

None to material. Any personnel topside would have been at least temporarily out of action.

IV. General Summary.

It is apparent that a submarine sealed up as for diving and rigged for depth charge attack yet still on the surface would be undamaged by an air burst of an atomic bomb of similar strength and at similar range as the Test A bomb.

V. Preliminary Recommendations.

No comment.

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USS APOGON (SS308)

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall condition.

Undamaged. All machinery was operated under service conditions with vessel underway. Diving equipment was tested by stationary trim dive.

(b) Areas of major damage.

None.

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

None. No damage.

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

No effect. All machinery operable as before test.

B. Boilers.

Not Applicable.

C. Blowers.

Not Applicable.

D. Fuel Oil Equipment.

No damage.

E. Boiler Feedwater Equipment.

Not Applicable.

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USS APOGON (SS308)

F. Main Propulsion Machinery.

No damage.

G. Reduction Gears.

No damage.

H. Shafting and Bearings.

No damage.

I. Lubrication System.

No damage.

J. Condensers and Air Ejectors.

Not Applicable.

K. Pumps.

No damage.

L. Auxiliary Generators (Turbines and Gears).

Discussed under Item F.

M. Propellers.

No damage.

N. Distilling Plant.

No damage.

O. Refrigeration Plant.

No damage.

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USS APOGON (SS308)

P. Winches, Windlasses, and Capstans.

No damage.

Q. Steering Engine.

No damage.

R. Elevators, Ammunition hoists, etc..

Not Applicable.

S. Ventilation (Machinery).

No damage.

T. Compressed Air Plant.

No damage.

U. Diesels (Generators and Boats).

Not Applicable (See Item F.)

V. Piping Systems.

No damage.

W. Hydraulic System.

No damage.

X. Navigational Instruments.

No damage.

Y. Periscopes.

No damage.

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Z. Radar and Sonar.

No damage.

AA. Miscellaneous.

None.

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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) Damage.

No electrical equipment was damaged or inoperable due to the test.

II. Forces Evidenced and Effects Noted.

(a) Heat.

There was no evidence of heat having affected any equipment inside the pressure hull. On the topside charring of paint on vertical surfaces of the superstructure had occurred along the port side. Topside cables in some few instances, when completely exposed, had a light covering of charr or soot which could be rubbed off with the fingers, but in no case was the insulation damaged at all.

(b) Fires and explosions.

None.

(c) Shock.

There was no evidence of shock damage.

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(d) Pressure.

There was no evidence of pressure damage.

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

Other than slight radioactivity the charring of the ship's superstructure on the side toward the blast is the only phenomenon noted that may be considered peculiar to the atom bomb.

III. Results of Test on Target.

(a) Effect on propulsion and ship control.

None.

(b) Effect on gunnery and fire control.

None.

(c) Effect on watertight integrity and stability.

Not observed.

(d) Effect on personnel and habitability.

None except for possible radiological effects and probable heat or blast effects on exposed personnel.

(e) Total effect on fighting efficiency.

None.

IV. General Summary of Observers' Impressions and Conclusions.

There was no effect from the atom bomb on electrical equipment in this ship. It is considered that even though on the surface, this submarine was outside the range of damage by the atom bomb.

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V. Preliminary Recommendations.

None.

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DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

10/11

A. General Description of Electrical Damage.

(a) Overall condition.

No damage to electrical equipment.

(b) Areas of major damage.

None.

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

None.

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

The operability of the electric plant was in no way impaired, either directly or indirectly, by the atom bomb.

(e) Types of equipment most affected.

None.

B. Electric Propulsion Rotating Equipment.

No damage.

C. Electric Propulsion Control Equipment.

No damage.

D. Generators - Ships' Service.

Not applicable.

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E. Generators - Emergency.

Not applicable.

F. Switchboards, Distribution and Transfer Panels.

No damage.

G. Wiring, Wiring Equipment and Wireways.

No damage. Topside cables in some few instances, where completely exposed, suffered slight scorching of paint, but in no case was the insulation damaged.

H. Transformers.

No damage.

I. Submarine Propelling Batteries.

No damage. Batteries were fully charged and on open circuit during the test. Analysis of electrolyte samples after the test by Pearl Harbor Naval Shipyard revealed no significant changes attributable to the atom bomb.

J. Portable Batteries.

Not applicable.

K. Motors, Motor Generator Sets and Motor Controllers.

No damage.

L. Lighting Equipment.

No damage.

M. Searchlights.

Signal searchlight removed from the ship during the test.

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USS APOGON (SS308)

N. Degaussing Equipment.

Not Applicable.

O. Gyro Compass Equipment.

No damage.

P. Sound Powered Telephones.

No damage.

Q. Ship's Service Telephones.

Not Applicable.

R. Announcing Systems.

No damage.

S. Telegraphs.

No damage.

T. Indicating Systems.

No damage.

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

No damage.

V. F.C. Switchboard.

No damage.

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USS APOGON (SS308)

SECTION IV -

PHOTOGRAPHS

TEST ABLE

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USS APOGON (SS303)



AACR-227-92-69. General view from ahead.

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AACR 327-92-70. General view from starboard bow.

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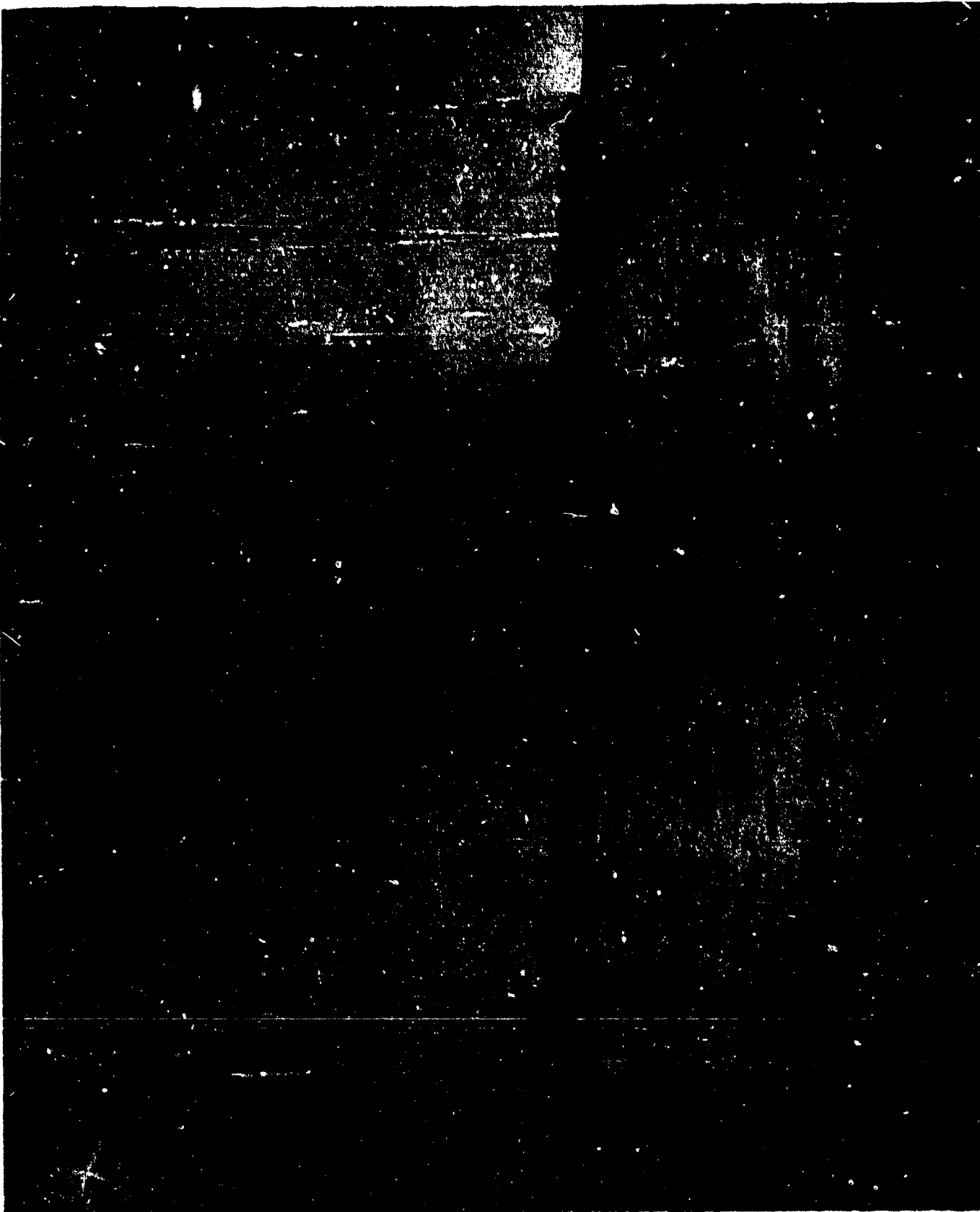
AACR-227-92-71. General view from starboard beam.

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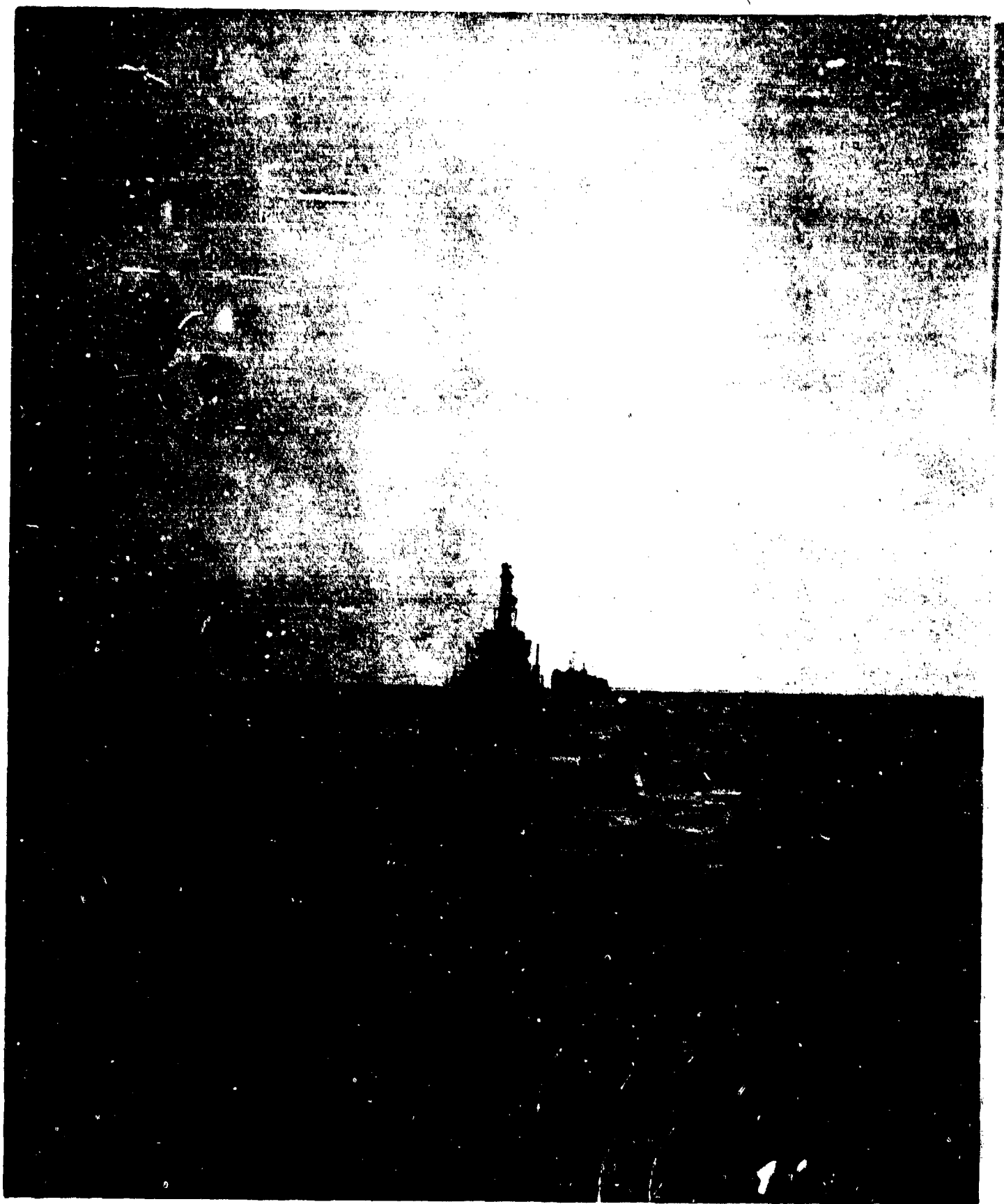
AACR-227-92-72. General view from starboard quarter.

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AACR-227-92-65. General view from astern.

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AACR-227-92-66. General view from port quarter.

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AACR-227-92-67. .General view from port beam.

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AACR-227-92-68. General view from port bow.

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APPENDIX

COMMANDING OFFICER'S REPORT

TEST ABLE

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U.S.S. APOGON (SS-308)

Crossroads Report No. 11 - Commanding Officer's Report

Section I.

Ship:	U.S.S. APOGON
Type:	Submarine
No. and Class:	SS-308 (SS 312 Class)
Location:	Berth 199, Chart Bikini Lagoon, H.O. 11846 (May Edition).

The ship was in good material condition at the time of Test "Able" capable of withstanding any type of attack which she was built to survive. This general condition was left unchanged by Atomic Bomb Test "Able".

Section II.

The only damage sustained by this ship was the scorching of superstructure paint on the port side, and the slight bulging of three superstructure bulkheads.

Section III - Part A. - General Summary.

I. Target condition after test.

(a) No change in draft during test; zero list; no evidence of flooding.

(b) No structural damage; slight bulge noted in three sections of superstructure bulkhead; no damage to pressure hull, ballast tanks, or compartments.

(c) Operability: Ship is completely operable in all respects.

(d) Heat evidenced in that paint on superstructure, port side only, was blistered; no fires were started; estimated personnel casualties: inside pressure hull - none, exposed topside four.

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USS APOGON (SS308)

II. Forces evidenced and effects noted.

(a) Heat: apparent direction: 210° relative; paint blistering extended throughout the superstructure length and beam width, but no effect of penetration could be detected, and even the most inflammable materials (cloth, paperboard, rubber tubing) showed no ill effects other than slight scorching.

(b) Fires and explosions: None.

(c) Shock: No evidence of shock damage.

(d) Effects peculiar to the Atomic Bomb: None, except as described above.

III. Results of test on target.

(a) Effect on ship propulsion and control - none.

(b) Effect on gunnery and fire control - none.

(c) Effect on watertight integrity and stability - none.

(d) Effect on personnel and habitability - none except possibility of topside casualties previously noted.

(e) Total effect on fighting efficiency - none, except as in III (d).

IV. From the complete inspection which has been made of this ship, it is obvious that no damage of any consequence was sustained by this ship in Test "A". Even the possibility of personnel casualties topside noted above is by no means considered a definite one.

V. Recommendations:

In view of the lack of damage sustained by this ship, no recommendations are submitted.

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USS APOGON (SS308)

Section III - Part B.

(N.B. The only items on the ship that was damaged are the three listed below).

Item	Subject	Material Group
B (Hull)	Superstructure	S11-5
E (Hull)	Weather deck	S19-2
T (Hull)	Coverings	S12-2

Section III - Part C.

Item

B.-S11-5 (1) Superstructure bulkhead at Frame 32.

Slightly bulged and broken loose from frame at the bottom (cracked before test).

(2) Superstructure bulkhead at Frame 43.

Slightly bulged and pulled loose on the port side only.

(3) Superstructure bulkhead at Frame 60.

Bent upward; was previously unsecured at bottom.

E.-S19-2 (1) Superstructure paintwork.

Blistered on port side only.

T.-S12-2 (1) Coverings, marlin (On lifelines).

Singed; scorched; blackened.

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USS APOGON (SS308)



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

TRC

9 April 1997

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

SUBJECT: Declassification of Reports

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

+ ST-A

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

TRC

9 April 1997

SUBJECT: Declassification of Reports

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

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

Arndith Jarrett
ARDITH JARRETT
Chief, Technical Resource Center

Completed
1 Mar 2000
B.W.