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BUREAU OF SHIPS GROUP

TECHNICAL INSPECTION REPORT

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

OVERALL SUMMARIES OF TARGET VESSELS

TEST BAKER

VOLUME 1 OF 2

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~~ATOMIC ENERGY ACT 1946~~

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(6) OVERALL SUMMARIES OF TARGET VESSELS.

TEST BAKER.

VOLUME I [redacted] [U]. (8)

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APPROVED:

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

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INTRODUCTION

The report of damage on each target vessel contains an Overall Summary of damage for that vessel. In addition, for convenience and ready reference all Overall Summaries for Test Baker have been bound in two volumes.

This volume, Volume 1 of 2 contains the Summaries of the following vessels:

(a) Battleships

(b) Cruisers

(c) Aircraft Carriers

(d) Destroyers

(e) Submarines

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TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The ARKANSAS was sunk during test "B". The exact time and manner of her sinking is unknown. The ship was obscured by clouds one second after the burst, but she is known to have disappeared by 0844, 19 minutes after detonation.

The many holes and rivet seams which were opened throughout the entire length of the shell plating by the underwater explosion were the probable sources of flooding. A water wave which smashed over the ARKANSAS (see photograph on page 22) may have partially aided in swamping the ship.

No observation could be made of the ship's list. It is known from the divers reports that the ARKANSAS capsized for she is lying buried in the silt, bottom side up.

(b) Structural damage.

Approximately one second after the detonation, the ARKANSAS was obscured by the cloud formation. When clouds had cleared the ship was gone. The only structural damage observed in this one second interval prior to sinking was the toppling of the stack to port and a slight bending of the foremast. This damage was recorded on a high speed film, (approximately 1000 frames per second) Navy number 1428E. A few selected shots of this film are shown on pages 13 through 27.

The divers were able to examine only bottom and side shell plating because the ARKANSAS had overturned in sinking. The ship was found in one piece. The hull did not seem distorted, bent or twisted in its overall length. Most of the superstructure including stacks, boat cranes and masts is not visible and is presumed to have been driven into the coral silt on the lagoon bottom. The visible part of

the main deck near the deck coaming on the port side does not show extensive damage.

The only source of information regarding the damage to the ARKANSAS (other than the meager amount shown on the aforementioned high speed film) is the divers' reports. The following paragraphs are extracted from these reports.

Between the stem and frame 20 starboard and port, the breasthooks and bulkheads seem to have held fairly well. The plating has been indented (in some cases as much as six feet) and frequently has been torn and bent about the frames, breasthooks and bulkheads. There are numerous holes and deep dents in the shell plating in this area. A hole approximately five or six feet in diameter goes completely through both sides of the ship in the forepeak tank.

The most heavily damaged shell plate is in the area between frames 15 and 40. The transverse framing has failed, producing a deep washboarding effect. Butts and seams of the shell plating have parted in many places due to rivets shearing. Many holes in the shell plating are visible above the turn of the bilge. Below the turn of the bilge the holes diminished rapidly in number. The blister bounding angles were torn loose. The blister itself was heavily dented and bulged. Rivets had sheared at the blister seams and butts allowing the plates to spread as much as three feet in some places.

Just aft of number two turret at about frame 41, starboard, there is a large dent in the hull. Some indication of the size of the dent can be gathered from the fact it was so large as to cause the diver to erroneously report the ship broken in two pieces at this spot. It runs from where the ship is buried on the starboard side through the turn of the bilge. Its width varies from 15 to 20 feet. Its depth is unknown for it is filled with muck. Visible portions of this dent reveal no breaks or tears in the plating or failure of rivets.

Moving farther aft, beyond the heavy dent aft of number two turret, the pattern of the major damage changes again. Here the plates are bent in and out with the main type of failure being rivet failure at both longitudinal seams and butts. There have apparently

been no tears in the plating in this area even through the rivet holes. There are several long ruptures at longitudinal seams. The three longest of these are in the bottom, two to starboard and one to port. The longest of these is about fifty feet running forward from number three turret and its greatest width is about 10 feet. The bottom is dented about six feet or more. In general, throughout this area, few seams have held. The plates are pushed in and out with a maximum of separation between plates being about twelve or fifteen inches.

Aft of frame 20 port, the washboarding effect diminishes more rapidly than on the starboard side. The blister has been torn loose from the hull between frames 20 and 40. Number two casemate has been torn loose. Aft of frame 40 to the stern and at the turn of the bilge and across the bottom, rivets are sheared and plates have spread at the seams and butts. In comparison with the starboard side, damage on the port side is at least 50% less.

Little is left of the shafting and the rudder has not been found. Only the port forward shaft without the screw has been found, and it is seriously out of line. No struts have been sighted and two large holes aft indicate the after two shafts have been completely torn out stern tubes and all, leaving the surrounding area badly distorted and broken.

The keel in general appears to be intact. Some rivets have parted and dropped free of the keel. There are some buckles of about one to two feet in way of all six turrets.

Both anchor chains had dropped clear of the forecastle and are lying in the silt. The chains lead forward and down into the silt at the hawse pipes.

(c) Other damage.

The only indication of the amount of internal damage was the finding of a large manifold, presumably fuel oil, and a small electric motor on the bottom shell. They apparently came through one of the many holes in the hull. Although there is no way of determining whence these parts came, they indicate serious damage to both piping and electrical equipment.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Undamaged.

(b) Fires and explosions.

Unobserved.

(c) Shock.

The toppling of the stack to port and the bending of the foremast, observed prior to descent of water column (photographs on pages 14 through 23) are presumed to be due to air blast.

(d) Pressure.

Photographs taken approximately one (1) second after the explosion show a cavity in the rising column of water which is located at the spot where the ARKANSAS was moored, (see photograph on page 28). It may be inferred that the upsurge of water acted on the ARKANSAS from below and to starboard at a point approximately one third of her length from the bow. There is no further evidence of the continued presence of this vessel on this surface at any subsequent time. By the time the clouds of spray and steam had cleared away sufficiently to permit aerial observation, only a heavy oil slick remained where the ARKANSAS had been.

III. Results of Test on Target.

(a) Effect on propulsion and ship control.

Propellers and shafting were so seriously damaged that propulsion and control of ship was completely destroyed.

(b) Effect on gunnery and fire control.

Unobserved.

(c) Effect on watertight integrity and stability.

Completely destroyed.

(d) Effect on personnel and habitability.

Any personnel topside would probably have been killed by

the water column or washed overboard. All others would have gone down with the ship.

(e) Total effect on fighting efficiency.

Completely nullified.

IV. General Summary of Observers' Impressions and Conclusions.

Photographs of the burst taken from towers and planes, especially the high speed Navy film number 1428E, the reports of technical observer in PBM Charlie and the divers' reports are the total available sources of material for this report.

A pre "B" burst view of the ARKANSAS has been included in this report on page 12. This picture shows relationship of the ARKANSAS to the bomb carrying ship LSM 60.

The photographs on pages 13 through 27 were enlarged from the navy film 1428E. This definition is rather poor. Air blast damage was discovered and can best be seen by screening the film.

At the inception of the burst the foremast of the ARKANSAS can be seen upright. Photograph on page 13. However, in photograph on page 14, the first shot which shows the foremast silhouetted in front of the water shock wave and in subsequent photographs it is seen at an angle.

The stack can be seen being blown over by the air blast in photographs on pages 14 and 19.

V. Preliminary Recommendations.

None. It well be noted that the riveting resisted poorly the underwater shock.

VI. Pre-test Statistics.

(a) Instructions for loading the vessel specified the following.

ITEM	LOADING
Fuel oil	50%

Diesel oil	50%
Gasoline	50%
Ammunition	50%
Potable and reserve feed water	95%
Salt water ballast	95%

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

The ARKANSAS at the time of "B" burst floated at drafts of 29' 10" forward and 30' 10" aft. She had no list.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

HULL

	Forward	Aft	List
Drafts before test	28' 0"	30' 1"	0°
Drafts after test	25' 6"	33' 6"	1 1/2° port.

Flooding is confined to the after portion of the vessel. It originated in open seams in the after trimming tanks, and progressed through small leaks in bulkheads which are in poor condition due to the age of the ship. Flooding occurred in handling rooms and machinery spaces as the result of a poorly designed gravity drain system which connects spaces in the stern with compartments within the armor citadel.

The following spaces containing machinery were flooded: Starboard shaft alley, electric steering gear room; after diesel room. It is believed that all of this flooding could have been controlled if the crew had been aboard.

(b) Structural damage.

HULL

There is no structural damage in the superstructure. Damage below decks in interior compartments is negligible. Some barbette supports are stressed. The hull has several opened seams in the after trimming tanks, D-12 and D-13.

MACHINERY

No comment.

ELECTRICAL

Not observed.

(c) Other damage.

HULL

Flooding has caused some immersion damage aft. Main machinery is operable. Directors, turrets and radar suffered shock damage.

MACHINERY

The casings of boilers 3 and 4 received minor damage, and are parted at joints. The electric steering system, after emergency diesel generator, and after diesel fire pump were damaged by flooding. The after auxiliary condenser and both distilling units show evidence of considerable momentary displacement. They may have internal leaks, but no damage is apparent from visual inspection. There is a considerable amount of minor damage throughout the machinery spaces, such as minor leaks in piping, gages disarranged, water column gages (glass) broken, etc.

ELECTRICAL

Emergency generator and steering motors were disabled by flooding.

Both master gyro compasses were damaged by failure of sensitive element suspension springs and spilling of mercury.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

There is no evidence of heat.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of heat.

(b) Fires and explosions.

HULL

There were no fires or explosions.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of fire or explosions.

(c) Shock.

HULL

Underwater shock was sufficient to lift 14-inch shells out of stowage, fracture cast-iron foundations, damage holding-down clips and turret machinery and upset directors.

MACHINERY

The NEW YORK received an underwater shock of high magnitude. Shock and the resultant whipping motion of the ship caused most of the damage to the machinery installation. Leads left in two of the main bearings of the port main engine indicate momentary displacement of crankshaft of the order of .016 inch, which is additional evidence of heavy shock.

ELECTRICAL

The damage to both master gyro compasses and the broken casting on the dynamo room vent set indicates the presence of shock.

(d) Pressure.

HULL

There is no evidence of pressure. Bulkheads topside which were damaged in test A have somewhat increased damage, probably as the result of wave action.

MACHINERY

No evidence.

ELECTRICAL

No evidence of pressure was observed.

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

HULL

Radioactivity is the only peculiar effect.

MACHINERY

An underwater shock of such high magnitude at this distance from an explosion plus the violent displacement of the ship, is apparently peculiar to the atom bomb.

ELECTRICAL

The only effect peculiar to the atom bomb was the persistent high radioactivity of the exposed areas.

III. Effects of Damage.

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

HULL

Holding-down bolts on the steering pedestal in the steering gear room are sheared. Main machinery and generators are operable.

MACHINERY

Damage to boilers 3 and 4 made them inoperable, but repairs could have been made by the ship's force within 4 hours. The after auxiliary condenser and the main distilling plant may have been made temporarily inoperable by tube leaks. Some non-vital machinery is inoperable because of flooding, which could probably have been controlled if the crew had been aboard. As the steam steering engine is operable, flooding of the electric steering system would not have impaired operation of the ship.

ELECTRICAL

Electrical failures would have had no effect on propulsion or ship control.

(b) Effect on gunnery and fire control.

HULL

Shock damage has resulted in the inoperability of three 14-inch guns, but all turrets are operable despite damage to holding-down clips. The main battery control directorscope foundation is fractured and two directorscopes in the secondary battery control station are badly damaged.

MACHINERY

No comment.

ELECTRICAL

The failure of both master gyro compasses would have seriously affected fire control.

(c) Effect on watertight integrity and stability.

HULL

There are several seam leaks in the hull plating aft. Extensive flooding occurred through bulkheads and piping systems. The watertight integrity of the bulkheads is poor because of the age of the vessel and not as a result of the test. The vessel took a list of 1 1/2 degrees to port but stability was not seriously reduced.

MACHINERY

No comment.

ELECTRICAL

Watertight integrity and stability was not impaired by any electrical failures.

(d) Effect on personnel and habitability.

HULL

Shock would have caused numerous casualties. All compartments except those flooded are habitable.

MACHINERY

It is estimated that there would have been few, if any, casualties to personnel below decks. Habitability was not affected except for radioactivity.

ELECTRICAL

Electrical failures had no effect on personnel habitability of the vessel.

(e) Total effect on fighting efficiency.

HULL

Fighting efficiency is considerably impaired by shock damage to turrets and fire control and by flooding in the after spaces.

MACHINERY

Maximum speed would have been reduced to about 18 knots for a few hours while boilers 3 and 4 were being repaired. It is not believed that the test would have had any other effect on fighting efficiency as far as machinery is concerned.

ELECTRICAL

Damage to both master gyro compasses would have seriously affected fire control.

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

HULL

Shock damage seriously curtailed the fire power of this ship. Poor integrity of watertight bulkhead and leakage through drainage systems was largely responsible for progressive flooding. Strength and propulsion are relatively unimpaired.

MACHINERY

It is not believed that the boilers of a modern battleship would have been damaged by a shock such as the NEW YORK received. However, a main turbine in operation receiving a shock sufficient to cause movement of the rotor of like magnitude (.018 inch maximum) would probably be damaged. The NEW YORK has reciprocating engines.

ELECTRICAL

The Arma Mk VIII Mod. 3A gyro compass stands out as a critical weakness in the electrical equipment of modern ships.

V. Any Preliminary General or Specific Recommendations.

HULL

The type of turret holding-down clip installed on this vessel merits study. The conditions which permitted progressive flooding are fundamentally due to the age of the vessel and antiquated design. No recommendations, are made as modern vessels have already received corrective action.

MACHINERY

As the machinery of the NEW YORK is of obsolete design no specific recommendations based on her experience would be pertinent. However, the general recommendation is submitted that every effort be made to improve the resistance of naval machinery to shock.

ELECTRICAL

Gyro compasses requires modification and improvement to make them equal in damage resistance to other electrical equipment.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

	Draft Forward	Draft Aft	List
Before Test	28' 9"	22; 6"	1/2° Port
After Test	28' 6"	33' 0"	1 1/4° Port

The drainage tank, D-614-W, was completely filled, the H.P. compressor room, D-536-E, was completely flooded, and the steering gear compartment, D-437-E, and access trunk, D-426-T were slightly flooded from a leak in the rudder stock packing gland. The extent of this flooding is due to the absence of check valves in the gravity drain system.

The 14 inch handling room, D-407-B, contains three inches of water as a result of a split fitting in an overboard discharge line.

Inner bottom tanks, frames 82 to 98, and wing tanks, frames 54 to 110, are contaminated, apparently from seepage through seams in the shell plating.

Water taken in through ventilation systems has flooded several upper spaces, varying from a traceto two or three inches.

The after diesel generator room and the steering gear room were flooded. Flooding was progressive from the steering gear room (D-437-E) to the drainage tank D-614-W, overflowing the drainage tank to completely flood the H.P. air compressor and diesel generator room (D-536-E).

(b) Structural damage.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

	Draft Forward	Draft Aft	List
Before Test	28' 9"	22; 6"	1/2° Port
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Water taken in through ventilation systems has flooded several upper spaces, varying from a traceto two or three inches.

The after diesel generator room and the steering gear room were flooded. Flooding was progressive from the steering gear room (D-437-E) to the drainage tank D-614-W, overflowing the drainage tank to completely flood the H.P. air compressor and diesel generator room (D-536-E).

(b) Structural damage.

HULL

There is practically no increase in damage to the superstructure as a result of Test B. Some previous existing cracks were increased. The smoke pipe is collapsed further. There does not appear to be any increase in the dishing of superstructure decks, bulkheads, or deck houses. The upper and main decks in previously damaged areas may have deflected, as the buckling of some of the supporting stanchions between the main and second decks appears to have increased slightly. Two uptakes at frame 83, port and starboard, are bulged, probably by blast. There is evidence of increased damage on the third deck. Between frames 23 and 30 on the second platform level. The starboard bulkhead of compartment A-505-A is bulged in about two inches, and the frames are slightly bent. Several of the bulkheads which support barbettes 1 and 2 are buckled just below their connection to the second deck.

MACHINERY

No comment.

ELECTRICAL

Not observed.

(c) Other damage.

HULL

The only further damage appears to be the rupture and distortion of all the boiler casings that were repaired after being damaged during Test A.

MACHINERY

The intake shutters of 11 out of the 12 forced draft blowers were driven past their stop pins. The foundation of No. 3 spring bearing (starboard shaft alley) was loosened where it is bolted onto the ship's structure. The flange of the overboard connection to the port main condenser (which was open during the test) sprung a

small leak. The electric steering system, the after diesel generator and the after H.P. air compressor were damaged by flooding. Several gages scattered throughout the plant were disarranged. No other damage was found by visual inspection. Shock may have thrown some units out of alignment.

ELECTRICAL

All electrical equipment mounted in the steering engine room the after diesel generator room, the after gyro compass room, and the after high pressure air compressor compartment were rendered inoperative by flooding. The forward and after gyro showed some signs of shock damage.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

There is no evidence of heat.

MACHINERY

There was no evidence of heat.

ELECTRICAL

None observed.

(b) Fire and Explosions.

HULL

There were no fires or explosions.

MACHINERY

There was no evidence of fires or explosions.

ELECTRICAL

None observed.

(c) Shock.

HULL

Outside of the light topside damage attributable to air blast or falling water, the only effect of Test B upon the ship appears below the waterline. This damage is believed to be directly attributable to a shock wave transmitted into the structure by the underwater pressure wave. This damage has resulted in the loosening of some foundation bolts, the breaking of pipe hangers, the scattering of equipment, and the opening of seams in the underwater shell.

MACHINERY

The NEVADA received an underwater shock of considerable magnitude, as evidenced by loosening of holding down bolts, cracking of paint around machinery foundations, disarrangement of gages, etc. The effects of shock are particularly noticable on the starboard side of the vessel.

ELECTRICAL

The fact that this vessel experienced a fairly large amount of shock was evidenced in the damage to both gyro compasses, dislodging of finder relays in the automatic telephone switchboard, and the movement of the starboard anchor windlass motor. With the exception of the damage to the gyro compasses, the shock had no significant effect on the vessel's electrical equipment. The apparent direction of this shock could not be ascertained.

(d) Pressure.

HULL

The existence of a mild blast wave is evidenced in the further damage of the boiler casings. The additional collapse of the

outer casing of the stack could also be a result of air blast, or the effect of falling water.

MACHINERY

Blast pressure jammed shut the intake flappers of 11 of the 12 forced draft blowers.

ELECTRICAL

None observed.

(e) Effects peculiar to the Atom Bomb.

HULL

Excluding radioactivity, the effect of the bomb upon this ship does not appear to be peculiar.

MACHINERY

Shock and blast pressure of such magnitude at the range of the NEVADA from an underwater explosion are apparently peculiar to the Atom Bomb.

ELECTRICAL

None observed.

III. Results of damage.

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

HULL

Except for the ruptured boiler casings, the effect upon machinery, electrical and ship control is practically negligible.

MACHINERY

The effect of the test on the machinery of the NEVADA is largely conjectural in the absence of opportunity fortesting out machinery, some of which may be out of alignment. Effects of known damage are as follows:

Boilers could have been steamed at only very low rates (natural draft) until the forced draft blower intake flappers were cleared, requiring about 4 hours. The after diesel generator and main steering system were made inoperable by flooding, but it is not believed that this would have occurred if the crew had been aboard. In any case, damage to them would not have handicapped operation appreciably. Ample power was available, and the emergency steering system was fully operable after Test B.

ELECTRICAL

The flooding of the steering engine room would not have greatly decreased the maneuverability of the vessel, since steam steering could be used as a stand-by. Other propulsion, and ship control electrical equipment was not affected by Test B.

(b) Effect on gunnery and fire control.

HULL

The turrets show evidence of being lifted by the underwater shock. The connecting bolts for the rear holding down clip of turret 2 are sheared off. The shell hoist motors of turrets 3 and 4 are out of alignment and the elevating screw in turret 2 binds. It is believed that the effect of the test upon fire control is very small.

MACHINERY

No comment.

ELECTRICAL

There was no visible indication that Test B had any effect on gunnery or fire control electrical equipment.

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

HULL

The effect on watertight integrity and stability is negligible.

MACHINERY

No comment.

ELECTRICAL

There was no visible indication that Test B had any effect on watertight integrity and stability of this vessel from an electrical standpoint.

(d) Effect on personnel and habitability.

HULL

Aside from the radioactivity, the effect would have been negligible.

MACHINERY

It is not believed that Test B would have had any appreciable effect on personnel or habitability except for radioactivity.

ELECTRICAL

The habitability of this vessel would not have been effected by electrical damage.

(e) Effect on fighting efficiency.

HULL

The only item that would have affected the fighting efficiency was the shearing of bolts in the rear holding down clip in turret 2.

MACHINERY

Boiler power was temporarily greatly reduced by the jamming of the forced draft blower intake shutters. It is estimated that maximum speed would have been reduced to about 8 knots for approximately 4 hours, after which speed could have gradually been raised to normal maximum.

ELECTRICAL

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

IV. General Summary of Observers' Impressions and Conclusions.

HULL

The extent of damage to the exterior hull below the waterline and the hull appendages cannot be ascertained unless the ship is dry docked. Apparently, the ship suffered only minor damage from Test B.

MACHINERY

Modern battleships do not have blowers that could be made inoperable by a casualty of the nature described above. It is not believed that the machinery of a modern battleship would have received any appreciable damage at the range at which the NEVADA was exposed.

ELECTRICAL

In general, the shock of the underwater atom bomb

burst had no serious effect on the electrical equipment of this vessel. Due to availability of stand-by equipment, the loss of the after emergency diesel generator sets, electric steering, and the gyro compasses would not have greatly affected the operability and fighting efficiency of the vessel.

V. Preliminary General or Specific Recommendations of Inspection Group.

HULL

No comment.

MACHINERY

As the blower arrangement on the NEVADA is obsolete, no recommendation is pertinent.

ELECTRICAL

It is recommended that the gyro compass element supporting mechanism be made more resistant to shock. In addition, some means should be provided to prevent spillage of mercury in the Arma type gyro compasses.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

	Forward	Aft	List
Before test drafts	30' 0"	32' 0"	0°
After Test drafts	27' 9"	36' 0"	1/2° Starboard

Seams in the previous torpedo damage area have been opened by the underwater shock wave. Leaks have also developed in the rudder stock gland and the stern tubes. Former slow leaks in bulkheads and decks immediately forward of the torpedo damage area have been reopened, apparently by the shock wave.

(b) Structural damage.

HULL

Hull damage occurs primarily on the starboard side aft in the area of previous torpedo damage and consists of opened seams.

MACHINERY

No comment.

ELECTRICAL

Minor damage to already damaged and weakened structure in vicinity of 1945 torpedo damage, had little or no effect on electrical equipment except for flooding.

(c) Other damage.

HULL

Not observed.

MACHINERY

The casings of all boilers except #5, and brickwork of boiler No. 1, are moderately damaged. The ice machine room is filled with freon gas, indicating breakage of piping and possibly other damage to the refrigeration equipment. A few heavy machinery components apparently movedslightly on their foundations, but not enough to cause any damage. There is a small amount of minor damage to gages, etc.

NOTE: Very little machinery on this vessel was operated after Test B.

ELECTRICAL

Damage to electrical machinery and electrical elements of ship control, fire control and gunnery as a direct result of the bomb was apparently negligible.

A small amount of mercury was spilled from the forward master gyro compass and several selectors, connectors and dust shields were dislodged on the automatic telephone exchange switchboard.

II. Forces evidenced and effects noted.

(a) Heat.

HULL

There is no evidence of heat.

MACHINERY

No evidence.

ELECTRICAL

None evidenced.

(b) Fires and Explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

None evidenced.

(c) Shock.

HULL

There is light shock damage to topside radar equipment and to foundations in the general workshop on the third deck. The foundation of the cruising turbine in the No. 1 engine-room has worked a slight amount.

MACHINERY

The PENNSYLVANIA received a fairly heavy underwater shock. Evidences include: cracks in brickwork in #1 boiler; disturbance of dust and paint around foundation of boilers 2 and 5 and main turbine foundations; breakage of freon lines in ice machine room; disarrangement of a few gages; breakage of one holding down bolt on the milling machine in the machine shop.

ELECTRICAL

There was some evidence of shock throughout the vessel. However, except for minor damage to master gyro compass, automatic telephone switchboard and a few marine globes

broken, electrical equipment was unaffected.

(d) Pressure.

HULL

The only indication of pressure is the damage to the boiler casings. All except No. 5 boiler casing are bulged. The maximum bulge is four inches.

MACHINERY

Blast pressure apparently caused the damage to the casings of boilers 1,2,3,4 and 6.

ELECTRICAL

This vessel was subjected to a pressure wave sufficient to cause further bulging of boiler casings and minor damage to a few radar antennas. However, there was no damage to any of the electrical equipment that could be detected from close visual examination.

(e) Effects peculiar to the Atomic Bomb.

HULL

The only effects peculiar to the Atomic Bomb are the long ranges of air blast and underwater shock waves and the presence of radioactivity.

MACHINERY

Blast pressure and shock sufficient to cause damage at this range from an explosion are apparently peculair to the Atom Bomb.

ELECTRICAL

Radioactivity and wave phenomena.

III. Results of Test on Target.

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

HULL

None.

MACHINERY

Boilers 1,2,3,4 and 6 could have continued steaming but their maximum steaming rates would have been reduced until repairs were made to their casings. It is estimated that this could have been done by the ship's force within a few hours without securing any boiler. Boiler #5 was not affected. The refrigeration equipment is inoperable. The extent of damage to it was not determined, but it is not believed to be heavy.

ELECTRICAL

The overall effect on the electrical installation was negligible. The main electrical plant, switchboards, distribution panels, boiler and engine room motor driven auxiliaries were undamaged and apparently operable.

Ship control was affected to the extent of the minor damage to master gyro compass and secondary damage to the electric steering gear due to flooding of compartment D-421- Port and D-421 starboard. This flooding was due to failure of temporary patch over torpedo damage which occurred in 1945, which time this equipment was rendered inoperable.

(b) Effect on gunnery and fire control.

HULL

The secondary battery MK 37 directors are unable to train, having been damaged by shock. Topside firecontrol radar has also been mildly damaged by shock.

MACHINERY

No comment.

ELECTRICAL

The electrical elements associated with gunnery and fire control were impaired to the extent of the minor damage to master gyro compass which had sufficient loss of mercury to introduce an error into the fire control input.

The power panels on electric deck in turret I and III, training motor in 40mm mount number 7 and elevating motor in 40mm mount number 2 received secondary damage from flooding, which was apparently due to decontamination efforts, while washing down with salt water.

(c) Effect on watertight integrity and stability.

HULL

Leaks have developed at the torpedo damage patch, the rudder stock gland, and the port inboard stern tube. Shock has apparently reopened former leaks in decks and bulkheads in the area just forward of the torpedo patch and this permitted progressive flooding.

Stability is negligibly affected.

MACHINERY

No comment.

ELECTRICAL

Electrical damage had no adverse effects on water-tight integrity and stability.

(d) Effect on personnel and habitability.

HULL

Personnel casualties would have been light.

Habitability is impaired only by the flooding in the after spaces and by radioactivity.

MACHINERY

There would probably have been some casualties among fireroom personnel if the ship had been steaming. It is not believed that there would have been any other personnel casualties below decks except for effects of radioactivity. Habitability was affected by inoperability of the refrigeration equipment and by radioactivity, which was high when the ship was inspected 25 days after Test B.

ELECTRICAL

Other than the effects of radioactivity it is estimated that casualties on topside would have been limited to minor bruises. Personnel below decks would be relatively secure except in firerooms where possible flareback and accumulation of combustion gases would render all operating personnel casualties, at least temporarily.

Habitability has not been impaired as a result of any electrical damage.

(e) Effect on fighting efficiency.

HULL

The fighting efficiency is impaired by the shock damage to the topside fire control radar equipment and the secondary battery MK 37 directors.

MACHINERY

The ship's maximum speed would have been reduced to about 15 knots but could have been gradually restored to normal as the ship's force effected repairs. The test had no other effect on fighting efficiency, as far as machinery is concerned.

ELECTRICAL

The fighting efficiency of this vessel has been somewhat reduced due to minor damage to master gyro compass which had sufficient loss of mercury to introduce an error to the inputs of radar and fire control equipment.

IV. General Summary of Observers' Impression and Conclusions.

HULL

The flooding aft is not of an important nature.

A ship of this class, if manned and in normal repair, would not suffer significant structural damage from an attack of this magnitude at her distance from the burst.

MACHINERY

The PENNSYLVANIA was outside the range of heavy mechanical damage from the explosion of Test B, but the effects of radioactivity on her would probably have been serious.

ELECTRICAL

This vessel was subjected to an underwater shock wave of sufficient intensity to cause minor damage to master gyro compass and automatic telephone exchange switchboard. There was no other electrical damage except for flooding of electric steering gear room (which could have been controlled had a crew been on board) and a broken dome door glass on the starboard 36 inch searchlight which was apparently struck by a fragment.

V. Preliminary General or Specific Recommendations of Inspection Group.

HULL

Adequate shock mounts should be provided for Mark 37 directors and topside radar equipment.

The problem of preventing or reducing air pressure damage to boiler casings is worthy of a thorough investigation.

MACHINERY

Boiler casings should be strengthened.

ELECTRICAL

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The NAGATO sank four and one half days after "B" burst.

The NAGATO is shown as she floated prior to "B" burst in the photographs on pages 10, 11, 12, and 13. After the bomb explosion the NAGATO remained afloat but had a slight list to starboard which increased to about five degrees 27 July. (See photographs on pages 14 and 15). On 28 July (see photographs on pages 16, 17 and 18) the draft readings had increased a little over three feet and the list was about eight degrees. By the morning of 29 July part of her main deck aft was awash as shown in photographs on pages 19, 20, 21 and 22. During the night of 29 and 30 July she sank, in all probability, by capsizing as a result of progressive flooding.

The watertight integrity of the NAGATO was found by test to be poor prior to the test. It was dependent solely upon a fairly tight shell plus pumping facilities to handle the water which leaked through the shell. The holes discovered in the shell plating by the divers after B test plus known leakage sources were the causes of flooding. The absence of internal watertight integrity permitted progressive flooding.

The probable area of main flooding was around frame 190 starboard.

(b) Structural damage.

The following information regarding damage to the NAGATO is taken from the diver's reports.

A number of dents in the underwater body were visible. These include dents between frames, as well as those where both longitudinal and transverse framing had given way. A hole about two feet in diameter about seven feet above the port bilge keel at frame 140 where plating had ruptured out, was emitting streams of air bubbles and fuel oil 29 days after the burst. There were seven other major leakage points but it was not determined whether they were caused by loose rivets or by holes in the shell.

(c) Other damage.

Unobserved.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Unobserved.

(b) Fires and explosions.

There were no fires or explosions observed.

(c) Shock.

The NAGATO was observed to have been displaced sideways, presumably by the air pressure and water wave, a distance of approximately 400 yards. See photographs on pages 23 and 24.

(d) Pressure.

Unobserved.

III. Results of Test on Target.

(a) Effect on propulsion and ship control.

Unobserved.

(b) Effect on gunnery and fire control.

Unobserved.

(c) Effect on watertight integrity and stability.

Completely destroyed.

(d) Effect on personnel and habitability.

Unobserved prior to sinking.

(e) Total effect on fighting efficiency.

The ship, though it remained afloat, was completely immobilized four days after the burst. Whether the ship could have been saved if a crew had been aboard is unknown.

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

Photographs of the burst taken from the towers and planes, after burst photos taken by PBM Charlie, the report of the technical observer in PBM Charlie, the MPG-1 radar scope pictures, the diver's reports, the initial boarding team reports and photographs are the total available sources of material for this report.

The NAGATO was visible for about two seconds immediately after the "B" explosion. She was then obscured by clouds for about 15 minutes. She was visible thereafter until she sank on the night of July 29 and 30.

The divers found the NAGATO lying on the bottom at an angle of 120°, with the starboard side down. She was apparently lying on top of the bottom mud and clear of any powdered coral covering. The radioactivity of the ship was relatively slight but the radioactivity on the bottom limited the diving time.

V. Preliminary Recommendations.

None.

VI. Pre-test Statistics.

Instructions for loading the vessel specified the following:

ITEM	LOADING
Fuel Oil	15%
Diesel Oil	15%
Gasoline	None
Ammunition	Minimum
Potable and Reserve Feed Water	95%
Salt Water Ballast	95%

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

The drafts of the NAGATO at the time of "B" burst were unknown as no draft marks were fitted in her. She had no list.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

Drafts before test B; Forward 20' - 1'' aft 21' - 1''

List 1° Port.

Drafts after test B; Forward 20' - 4'' aft 23' - 4''

List 3 1/2° Starboard.

The principal sources of flooding are a 2 inch cooling water line to the ice machinery room which broke in number 1 (starboard) shaft alley, and leakage through shaft stern tube glands.

No. 2 (starboard) shaft alley flooded through the stern tube and through opened rivets.

No. 3 (port) shaft alley partially flooded through the stern tube and weeps from adjacent fuel oil tanks.

No. 4 (port) shaft alley partially flooded through the stern tube.

The Ice Machine Room, D-301-E, partially flooded from No. 1 shaft alley through a leaky hatch.

The after engine room flooded with oil and water to a depth of 10 feet at the centerline (just below the upper gratings) from leakage through the four after bulkhead shaft glnads and from leakage of oil tanks seams.

The after fire room flooded with oil and water to a depth of 10 feet from the after engine room through bulkhead shaft glands and electrical stuffing tubes.

The forward engine room flooded with oil and water to a depth of 6 feet (about 2 feet above the lower level floor plates) from the after fire room through bulkhead shaft glands.

The forward fire room had 6 inches of oil and water in the bilges.

The fresh water pump room, A-508-E, partially flooded, presumably from fresh water tanks just forward or from the spare parts storeroom, A-506.

The aircraft small arms stowage, A-416-M, had 2 inches of water on the deck, presumably from the sprinkling system. A small amount of water accumulated in spaces below gun mounts during the decontamination washing of the ship.

It is believed that had personnel been on board, flooding could have been confined to shaft alleys.

General areas of flooding in way of electrical equipment were in forward engine room, after fire room and after gyro room.

(b) Structural damage.

HULL

Damage to the superstructure, except for directors and enclosed mounts is negligible. Some superstructure damage occurred to components already seriously distorted and weakened in test A.

Essentially no damage to hull plating above the waterline was observed. However, overall damage to this ship indicates that some leakage of the bottom shell may exist.

Above the second deck, damage is confined principally to structure previously seriously weakened during test A. In the well deck area, buckling of stanchions and failure of main deck girders was increased as a result of test B. Stanchions above the second deck,

severely buckled in test A, were completely fractured in test B. Uptake bulkheads, damaged in test A, were further damaged in test B.

Structural and joiner bulkhead between the second deck and first platform are severely buckled in way of number two 8 inch mount due to violent vertical movement of the mount. The only other damage observed on the first platform is buckling of stanchions at frame 113 (between 3 and 4).

In the engineering spaces there is evidence of severe shock vibration. Structure foundations under condensers are deformed and rivets sheared, turbine casings are cracked, boiler saddles are slightly damaged, considerable brickwork is knocked down, gratings are displaced and moveable gear is severely disarranged. In both the forward and after firerooms, the 16" x 3/8" centerline column failed in tension after having been first severely wrinkled in compression. Longitudinal and transverse girders supporting the armored deck in way of the engineering spaces are severely buckled in the webs, principally in way of lighening holes.

MACHINERY

No data taken by Machinery Group.

ELECTRICAL

Damage appreciably affecting the electrical plant was essentially as follows:

1. The foundation securing bolts at the lower starboard corner of the ship's service switchboard in the forward engine room sheared off allowing one end of the switchboard to drop about 2 1/2 inches. Apparatus on the board was not damaged.

2. Supporting framework for ship's service generators in after engine room was bent.

(c) Other damage.

HULL

No comment.

MACHINERY

All boilers were severely damaged, including damage to casings, brickwork and stacks. The foundations appear to have moved upward. Holding down bolts were bent and stretched. One soot blower on #8 boiler was knocked off. The main engines were damaged beyond repair with numerous cracks in bearing and foundation pedestals and supports and one crack in #1 astern turbine casing. No. 2 reduction gear sagged about 1/4 inch at its after end when the foundation casting broke. Damage to spring bearings of #4 main shaft indicates misalignment of the shaft. The main condenser foundations twisted slightly, #1 and #4 condensers dropped slightly. The condensers probably leak. Nearly all pumps had some damage to their foundations, this being especially heavy in the forward fireroom. The anchor windlass bedplate was cracked all the way across. There was considerable damage to piping throughout the ship. Both machinery shop lathes were knocked over. There were many items of comparatively minor damage.

Damage to boilers would have been more severe if they had not already been damaged in test A, because blast pressure could vent out the ruptured casings of #1 - 4 boilers, and because the uptakes of boilers #6 and 8 were blanked off after test A, preventing blast pressure from entering them.

ELECTRICAL

Significant damage to electrical equipment was as follows:

1. Gyro compass suspension springs and supporting gimbels distorted. Compass was rendered inoperable.

2. Vacuum tubes for general announcing system control equipment damaged. Control is inoperable.

3. Ship's service telephone switchboard selector switches broken. Switchboard inoperable.

4. Several vent sets inoperable due to damaged casings.

5. A number of storage batteries damaged beyond repair.

f. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

There is no evidence of heat.

MACHINERY

There was no evidence of damage due to heat.

ELECTRICAL

There was no evidence of damage due to heat.

(b) Fires and explosions.

HULL

There are no evidences of fire or explosion, but personnel casualties in engineering spaces would have been high due to boiler flarebacks and shock.

MACHINERY

There was no evidence of fires or explosions.

ELECTRICAL

There was no evidence of damage due to fires or explosions.

(c) Shock.

HULL

The underwater pressure from test B struck this ship at an angle of approximately 357 degrees relative, or essentially from dead ahead. There is evidence of tremendous shock in main battery mounts, in engineering spaces, and to a lesser extent throughout the vessel.

The centerline stanchions in both the forward and after firerooms are fractured and second deck girders in the engineering spaces are buckled in the webs due to inertia of the armored (second) deck.

MACHINERY

Most of the damage was done by an underwater shock of very high magnitude. Effects of this shock were apparent throughout the ship, particularly in the machinery spaces.

Boilers are moved on their foundations, a large amount of brickwork is knocked down, numerous pedestals and other machinery supports are cracked. The casings of numbers 1 and 4 astern turbines are cracked and condenser supports are distorted. Moveable gear is thrown about, powder cans and batteries in magazines are dislodged and projectile stowages in mounts are disarranged.

ELECTRICAL

Damage was evidenced by sheared switchboard support bolts, damaged gyro compass, dislocated storage batteries and bent generator supports.

(d) Pressure.

HULL

Blast pressure in test B caused negligible damage to superstructure. Additional deflection of weather deck areas pre-

viously weakened by test A in due primarily to wave action and to upward acceleration of the ship. The ship was affected by underwater explosion pressure, followed by one or more very large sharp waves.

MACHINERY

A blast pressure of considerable magnitude is evidenced by the fact that damage to uptakes and boiler casings remaining from test A was increased. Temporary repair work to the casings of boilers #5 and #7 was blown out. It is possible that undamaged boilers would have suffered more from blast pressure than these did (see I (c) above).

ELECTRICAL

There was no evidence of damage due to pressure.

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

HULL

Effects noted peculiar to the atom bomb are wave phenomena and a high degree of contamination by radioactivity. It is estimated that personnel casualties above the second deck would have been extremely high due to radiological effects. Radioactivity was carried below decks by blowing out of boiler casings and to some degree by water coming down ventilation ducts from topside intakes.

MACHINERY

An underwater shock of this magnitude is believed to be peculiar to the atom bomb.

ELECTRICAL

There were no effects noted which were considered peculiar to the atom bomb.

III. Effects of Damage.

(a) Effect on propulsion and ship control.

HULL

The machinery plant was completely wrecked as an operating plant. Emergency repairs would have been ineffective even with control of flooding; repairs would require a lengthy shipyard overhaul. Machine shop equipment is wrecked. Ship control was lost through absence of power of any kind. Diesel power (from forward generator only)might have been restored within a short time if undamaged starting batteries had been available.

MACHINERY

The machinery plant as a whole is inoperable. Many units are damaged beyond repair. Diesel generators could not be operated as the starting batteries were knocked out of their racks and damaged, and the diesel engines themselves may be damaged. Propulsion and ship control were destroyed, and could not be restored by the ship's force.

ELECTRICAL

Ship propulsion was not affected by electrical damage.

Ship control was slightly affected by the loss of the gyro and the general announcing system.

(b) Effect on gunnery and fire control.

HULL

Gunnery and fire control was affected by loss of power and by inoperability of all protected mounts, directors, and rangefinders, and of electronic equipment in the bridge area, due to shock. Damage to powder cans, disarrangement of ammunition stowages, and leakage of powder fumes in magazines would have affected the rate of firing.

MACHINERY

No comment.

ELECTRICAL

Gunnery and fire control were somewhat affected by the loss of the gyro.

(c) Effect on watertight integrity and stability.

HULL

Watertight integrity was reduced slightly by loosening of shaft stuffing glands, due to shock. Flooding of the power plant could have been prevented had personnel been aboard. It is estimated that theship took on 920 tons of water and listed 3 1/2 degrees to starboard.

MACHINERY

No comment.

ELECTRICAL

Watertight integrity and stability were not affected by electrical damage.

(d) Effect on personnel and habitability.

HULL

It is believed that casualties to personnel would have been extremely high due to shock, topside blast, blast effects in firerooms, and radioactivity. Habitability of interior compartments was greatly reduced by complete loss of power and by temporary obstruction of living spaces and passages by disarranged equipment.

MACHINERY

It is estimated that there would have been high personnel casualties from shock and boiler flarebacks. The ship was made uninhabitable by reason of lack of power and high radioactivity.

ELECTRICAL

Habitability was slightly affected by the non-operability of a few vent sets.

(e) Total effect on fighting efficiency.

HULL

The fighting efficiency of this ship was completely lost due to absence of power, shock damage to 8 inch mounts, directors, and fire control electronic equipment and wrecking of the vessels power plant. Personnel casualties would have been high.

MACHINERY

Insofar as machinery is concerned, fighting efficiency was reduced to zero.

ELECTRICAL

The total effect of electrical damage on fighting efficiency was to reduce the accuracy and speed of gunfire due to loss of the gyro.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

It is considered that naval vessels of this type, and ship's personnel, are exceedingly vulnerable to shock, blast pressure, and radioactivity at the range of this ship from an explosion such as that of test B.

MACHINERY

It is not probable that no cruiser now afloat could withstand a shock of this magnitude without being damaged.

ELECTRICAL

Major electrical damage was sustained by the master gyro and a number of storage batteries. Minor damage was sustained by the ship's service switchboard supports, automatic telephone switches and vacuum tubes of the general announcing system.

Electrical damage did not materially affect the sea worthiness or cruising ability of the vessel but did have a moderate temporary effect on the fighting efficiency.

All electrical damage except to the gyro and telephone switchboard could have been repaired by the ship's force.

V. Any Preliminary or Specific Recommendation of the Inspecting Group.

HULL

No comment.

MACHINERY

A study should be made with a view to increasing the resistance of naval machinery to shock.

A study of stern tube glands should be made to reduce excessive leakage, both under shock and under normal operating conditions.

Studies of floor plates are recommended with a view to making them more secure and also to make them somewhat flexible. The floor plates on the PENSACOLA were almost without exception dislodged and many of them were thrown about with considerable force,

which would have caused numerous personnel casualties. If some flexibility could be provided, the catapulting effect of the shock on personnel would be reduced.

ELECTRICAL

Specific recommendations have been made under each item of Part C where applicable.

The Commanding Officer's recommendations are as follows:

1. The effectiveness and sufficiency of crew shelters are inadequate. Fire control stations on the topside should be reduced to an absolute minimum. Where possible the equipment and personnel should be below decks. Required topside fire control personnel should be in protected cylindrical or spherical shaped shields.

2. It is doubtful if mounts, directors, foundations, or shelters can be designed that will withstand an attack of this violence and nature. Stronger holding down clips and retaining rings are necessary. Spherical or cylindrical surfaces will provide better protection than flat surfaces.

3. A system of baffling should be installed in the uptakes of boilers to dissipate the air waves going down the stack before reaching the boilers.

4. Methods should be devised for protecting radio and radar antennae, such as protective housings or retractible antennae.

5. Some extra protection for the underwater hull and propelling machinery is necessary. It is possible that new methods of propulsion, such as the "jet" principle, or the use of atomic energy for propulsion will come in use. These, it is believed, may eliminate the vulnerable propeller shaft and simplify the main propulsion plant to an extent which would reduce the shock hazard.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

	HULL Forward	Aft	List
Before Test B Drafts	19' 3"	20' 6"	0°
After Test B Drafts	19' 7"	21' 6"	3° Stbd.

General areas of flooding are the three after machinery spaces, No. 4 shaft alley, D-5-F, C-919-F, B-924-F, the after gyro room (D-501-A), B-913-W, B-914-W, B-915-W, B-919-W, B-920-W, B-921-W, and C-924-F. After gyro room flooded to a depth of three feet. The after engine room and after fireroom were flooded to a depth of about 8 feet by water.

Sources of flooding are broken salt water service line, a ruptured ballasting line, a fractured firemain riser, a corroded plug in a salt water cooling water discharge line to the ship's service generator, and opened shell seams in D-5-F. Progressive flooding has been permitted by main propulsion shaft bulkhead stuffing glands, open drain lines and sounding tubes.

ELECTRICAL

After engine room and after fire room flooded to a depth of eight feet. After gyro room flooded to a depth of three feet.

(b) Structural damage.

HULL

There appears to be no significant structural damage. There is some additional distortion of the main and second decks in the areas damaged during Test A. Stanchions below the well deck are more severely buckled than before and some which had previously been badly damaged are fractured.

MACHINERY

No comment.

ELECTRICAL

This item was not observed.

(c) Other damage.

HULL

There is no visible damage to machinery or electrical equipment except that caused by flooding. This would not have occurred if the ship had been manned. The forward AA Director is damaged and inoperable. The after AA Director is normal except for a slight binding caused apparently by corrosion. The AA switchboard which controls the AA Directors and the after 20mm battery has been flooded by a ruptured firemain. Flooding would not have occurred if the ship had been manned. The only damage to gunnery is a broken sight bracked in one of the after group of 20mm guns. Electronics equipment has been seriously affected by shock.

MACHINERY

Boilers # 5, 6, 7 and 8, #2 evaporating plant, and machinery in the after engine room were damaged by flooding. There was considerable damage to the casings and brickwork of all boilers. The main engines are apparently undamaged. However, the leads left in the bearings of # 4 main unit during the test indicate motion of the rotors sufficient to cause probable damage to the turbine blading and to the reduction gears if these units had been in operation during the test.

ELECTRICAL

All electrical equipment located in the lower level of the after engine room was disabled by flooding. Electrical circuits and equipment on the lower level of after fire room were disabled from flooding. All equipment located in the after gyro room was grounded from submersion.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

There is no evidence of heat.

MACHINERY

There was no evidence of heat.

ELECTRICAL

No evidence of heat was observed.

(b) Fires and explosions.

HULL

There have been no fires or explosions.

MACHINERY

There was no evidence of fires or explosions.

ELECTRICAL

There was no evidence of fires or explosions.

(c) Shock.

HULL

There is some evidence of shock and rapid movement of the ship. There are leaks in the overboard discharge valves in the after engine room. Floor plates are generally displaced in the machinery spaces. The forward AA Director and electronic equipment have also been damaged by shock.

MACHINERY

There was evidence, of rather heavy shock; viz., cracking and spalling of boiler brickwork; a few gages disarranged; floor plates loosened; breaking out of a plug in a salt water cooling line in the after engine room; motion up to .003 inch of main turbine rotors indicated by bearing leads. The shock apparently came from below and set up a whipping action causing some motion of the ship in both vertical and horizontal planes.

ELECTRICAL

A few small beads of mercury were observed within the binnacle of the forward gyro compass. It was not determined if this spillage was the result of shock or due to the heavy rolling of the vessel after the blast. The gyro was not affected by the loss of mercury. This condition was the only possible evidence of shock to any electrical equipment.

(d) Pressure.

HULL

There is very little damage that can definitely be attributed to pressure. The access trunk at frame 47 above the main deck has been crushed by air pressure. Pressure also possibly aggravated the damage to the well deck.

MACHINERY

There was considerable blast pressure, as evidenced by the fact that the boiler casings; which had been sprung apart by Test A, were sprung farther by Test B. Blast pressure also bent the flaps of the after forced draft blowers.

ELECTRICAL

There was no evidence of pressure.

(e) Effects apparently peculiar to the atom bomb.

HULL

With the exception of radioactivity, there are no effects peculiar to the atom bomb.

MACHINERY

The amount of shock and blast pressure experienced by a vessel at the range of the SALT LAKE CITY from an underwater explosion to be peculiar to the atom bomb.

ELECTRICAL

The high radioactivity was the only effect noted that was peculiar to the atom bomb.

III. Effects of Damage.

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

HULL

There has been no additional damage to machinery and damage to ship control equipment is negligible. Boilers have been slightly damaged by shock. There is no visible damage to electrical equipment.

MACHINERY

The after fireroom and after engine room were made inoperable by flooding. It is not believed that this would have occurred if the crew had been aboard, as the flooding could have been controlled. Damage to the boilers would have left them operable (assuming that no flooding occurred) but would have reduced their steaming capacity by about 50%. This would have reduced the ship's maximum speed by

approximately 4 knots. The damage could have been temporarily repaired by the ship's force, one boiler at a time, while steaming, probably being completed within 2 days. If the main turbines had been in operation, they and the main reduction gears would probably have sustained some damage. The effect of this is conjectural but it might possibly have caused loss of all motive power.

From a machinery point of view, ship control was not appreciably affected by Test B.

ELECTRICAL

Failure of electrical equipment did not affect ship control or propulsion.

(b) Effect on gunnery and fire control.

HULL

The effect of the test on gunnery is negligible. The only serious damage to fire control equipment is the shock damage to the forward AA Director which has been rendered inoperable.

MACHINERY

No comment.

ELECTRICAL

There would have been no immediate effect on gunnery and fire control. However, the later flooding of the after gyro room would have disabled the after fire control switchboard.

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

HULL

If personnel had been available to take corrective action, flooding could have been limited to tanks D-5-F, C-919-F, and C-924-F. The affect of this on stability would be negligible.

MACHINERY

No comment.

ELECTRICAL

None due to electrical failures.

(d) Effect on personnel and habitability.

HULL

There is no structural damage that affects personnel or habitability.

MACHINERY

There might have been a few casualties in fire-rooms if the ship had been in operation. Otherwise, the test would have had little, if any, effect on personnel in machinery spaces. Habitability was not affected except for radioactivity.

ELECTRICAL

There was no effect on personnel or habitability due to electrical failures.

(e) Total effect on fighting efficiency.

HULL

The fighting efficiency of the ship has been reduced approximately ten percent. This is due to the loss of the forward AA Director and to the damage to the boilers.

MACHINERY

Actually, the effect on fighting efficiency was to make the after engine room and after fireroom inoperable and to reduce

the steaming capacity of the forward boilers. Maximum speed under these conditions is estimated at 18-20 knots.

If the ship had been in operation during the test, maximum speed would have been temporarily reduced by at least 4 knots (by damage to boilers) and possibly to zero, depending on damage to main turbines and gears.

ELECTRICAL

Electrical failures other than flooding would not have affected the fighting efficiency of the vessel.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

The ship has sustained only minor hull damage.

MACHINERY

In view of lack of opportunity to operate most of the machinery after Test B, or to open it for interior inspections, this report is based largely on visual exterior inspections. However, performance of such machinery as has been operated, and general conditions and appearance of the ship, are believed to warrant the conclusions contained herein.

ELECTRICAL

It is believed that had the ship been manned flooding would have been quickly controlled and no electrical damage would have occurred.

V. Preliminary General or Specific Recommendations of Inspection Group.

HULL

Shorter spacing should be provided between ventilation duct hanging brackets. Attention should be given to joints between sections of ventilation ducts.

The necessity for adequate shock mounting of electronic equipment has been emphasized by this test.

MACHINERY

As most of the machinery of this vessel is of obsolete design, recommendations based on it would not be pertinent to present designs. It should be noted that modern turbines have smaller bearing clearances than those of the SALT LAKE CITY and their rotors could not move as much relative to the stators as the SALT LAKE CITY's did. Modern boilers would have withstood the blast.

ELECTRICAL

The slight mercury splash in the Arma MK VIII Mod 3A gyro compass together with similar damage on other target vessels indicates a need for modification of the compass.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

	Draft Forward	Draft Aft	List
Before Test	17' 6"	24' 6"	0°
After Test	17' 6"	24' 6"	1 1/2° starboard.

Tank number 9, just forward of the boiler room, has flooded through a sea valve that has apparently been jarred open. There is some water in the steering Engine Room, and Generator Rooms 1 and 3. This water is due to normal seepage around the rudder post through sea valves.

Generator room #1 and the after engine room were flooded to a depth of about 3 1/2 feet, generator room #3 was flooded to a depth of about 2 1/2 feet. Twenty-two electric motors were grounded out by this flooding, which is not considered to have been caused by Test B. Tne ship had a list of about 1 1/2° to starboard after Test B.

(b) Structural damage.

HULL

No known or detectable damage to structure has resulted from this test.

MACHINERY

No comment.

ELECTRICAL

None observed.

(c) Other damage.

HULL

Twenty seven electric motors have been grounded in the After Engine Room and Generator Room 1 and 3 as a result of seepage at what is considered to be a normal rate for this ship.

MACHINERY

There was no damage to machinery of this vessel during Test B. A number of auxiliaries were operated after the test.

ELECTRICAL

Twenty seven electric motors were grounded as a result of the flooding. There was no other electrical damage reported.

II. Forces Evidenced and Effects Noted.

(a) Heat

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of fires or explosions.

(b) Fires and Explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of fires or explosions.

(c) Shock.

HULL

The sea valve in tank number 9 has apparently bee jarred open. This is the only evidence of shock aboard the ship.

MACHINERY

No evidence in machinery spaces.

ELECTRICAL

There was no evidence of shock.

(d) Pressure.

HULL

There is no evidence of pressure.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of pressure on electrical equipment.

(e) Effects peculiar to the Atom Bomb.

HULL

The only effects peculiar to the atom bomb is the presence of radioactivity.

MACHINERY

None.

ELECTRICAL

There were no effects noted that are considered peculiar to the Atomic Bomb except radioactivity.

III. Effects of damage.

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

HULL

No comment.

MACHINERY

None.

ELECTRICAL

There was no effect on electrical equipment or ship control except as a result of the flooding due to normal leakage.

(b) Effect on gunnery and fire control.

HULL

No comment.

MACHINERY

No comment.

ELECTRICAL

None.

(c) Effect on watertight integrity and stability

HULL

The ship has assumed a list of 1 1/2 degrees to starboard, primarily due to flooding of tank number 9.

The watertight integrity is unimpaired.

MACHINERY

No comment.

ELECTRICAL

None.

(d) Effect on personnel and habitability.

HULL

The immediate effect on personnel would have been slight except for the psychological factors pertaining to an atomic bomb attack. Some casualties might have appeared later.

Habitability of spaces is not impaired at present, but transmission of radioactive material from the weather deck to other spaces is a hazard.

MACHINERY

None below decks except for radioactivity.

ELECTRICAL

There was no effect on personnel or habitability as a result of this test except for radioactivity. It is considered, however, that personnel would have been seriously affected by the radioactivity. This is evidenced by the fact that the vessel was declared unsafe for personnel more than three weeks after the bomb explosion had occurred.

(e) Total effect on fighting efficiency.

HULL

The total effect on fighting efficiency is slight except for the presence of radioactivity.

MACHINERY

None, except for possible effects of radioactivity.

ELECTRICAL

Providing there were no personnel casualties due to radiological effects, it is considered that there would have been no effect on the fighting efficiency of the vessel.

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

HULL

An atomic bomb attack of this type at this range is not capable of inflicting structural damage. The ship, however, is within the range of dangerous radioactivity.

MACHINERY

The PRINZ EUGEN was outside the effective range of the explosion during Test B, except for possible effects of radioactivity.

ELECTRICAL

The distance of this vessel from the center of the blast is considered to be too great for electrical damage to result.

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

HULL

Topside personnel should be entirely enclosed wherever possible.

MACHINERY

None.

ELECTRICAL

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The SARATOGA sank approximately seven hours and thirty-five minutes after the underwater explosion.

Thirty-three minutes elapsed after the burst before the SARATOGA became clearly visible to the Technical Observer in PBM Charlie. At this time, 0908 on "B" day, the Technical Observer reported the ship low in the water and listing to starboard. The SARATOGA settled, without apparent change in attitude, until at 1029 the top of the starboard blister was reported as being within two or three feet of the water. The ship then had a slight starboard list and was trimmed slightly by the stern. At 1058, the water began to lap over the blister and at 1109 the blister was reported completely underwater. Light smoke or steam was sighted at 1139 on the port quarter of the ship about half the distance from amidships to the stern. This smoke thickened for a few minutes and then disappeared about 1145. This may have been caused by salt water reaching the diesel generator which operated during the test. The next report by the Technical Observer concerning the SARATOGA's flooding was at 1410 when she was reported as having settled deeper. At 1505 it was reported that the after starboard edge of the flight deck was within 10 feet of the water and that the ship was listing 3 degrees. At 1545 the flight deck was reported three feet above the water. (See photographs, pages 15, 16, 17, 19 and 20 for selected PBM Charlie photographs of the listing SARATOGA). At 1555 the Technical Observer reported the SARATOGA sinking. Her flight deck was awash from a point approximately 100 feet abaft the island structure to the centerline at the stern. (Photographs on pages 21, 22, 23, 24, and 25). The list had increased to approximately 6 degrees. At this time, water was pouring in through the stack openings in the flight deck and down the elevator. By 1600 the stern had apparently struck bottom, The ship righted and hung momentarily with the mast, the top of the pilothouse and approximately 150 feet of the bow out

of water. Air escaping all along the port side bubbled violently to the surface throwing spray into the air. At approximately 1606 the bow of the ship went under and at 1610 the top of the mast disappeared (photograph on page 26).

The only shell damage reported by the divers was a tear in the hull in way of the forward starboard strut. This tear, probable bottom damage, possible failure of sea chests and sea valves, and the swamping effect of water descending from the column were apparently the flooding sources. The oil slicks on the water surrounding the SARATOGA indicate that the bottom plating is damaged.

(b) Structural damage.

The divers, during the time allocated for SARATOGA underwater inspection, were able to examine only the ship's flight deck and starboard shell plating. Structural damage reported in these areas was slight and not sufficiently extensive to explain the early increase in draft. Bottom shell plating, where more extensive damage is suspected to exist, and port shell plating were not inspected.

The only break in the shell plating reported by the divers was located in the stern. The shell plating and doubler plate in way of the forward starboard strut were damaged. The strut was broken just outside the hull and had buckled and torn out the doubler plate and fractured the shell plating.

The after strut was broken midway between the barrel and the shell of the ship. The lower portion of the after strut and the rest of the stern, is buried in the mud up to the shafts. The rudders, pintles, gudgeons and bearings are apparently in good condition though half buried. The propellers scooped out holes in the lagoon bottom when the ship settled. They are almost wholly visible and appear in good condition. The shafting seems to be in line and there is no apparent damage to the stern tubes.

Except for the one break, the starboard side of the hull was in good condition aft of frame 144. Forward of frame 144, no great damage to the starboard shell plating was reported by the divers. They reported a three to six inch dishing of the plating above the bilge between frames 68 and 137. The bilge plating was apparently undamaged in this area.

The greatest damage to the flight deck reported by the divers was at the stern of the ship. The flight deck is d shed from approximately 15 feet forward of the after edge to about frame 130. This indentation which can be seen in photographs on pages 15 and 19 slopes forward and downward to a depth of about 12 feet at frame 130. Transversely it extends between the port and starboard outermost longitudinal bulkheads. The deepest indentation is midway between the two bulkheads. This indentation is gradual with no abrupt breaks or bends. There is no indication that the steel deck has been ruptured but the wood decking has been splintered and broken as shown in photographs on pages 32, 33 and 34.

The divers reported that the platform which covered the original number two elevator is missing. This platform later was reported to have been found on the starboard quarter of the ship. A drip pan, formerly installed under the completely fueled airplane at frame 198, was blown out of its location. (See photograph on page 15). This may be the reported elevator platform. Furthermore the flight deck appears intact where the number two elevator was formerly located. See photographs on pages 18, 19 and 20.

Forward of frame 130, the only damage reported by the divers and visible in photographs on page 16, 19 and 20 was the collapse of the forward elevator platform. The platform was dished downward diagonally from the forward port to after starboard corner. The port side of the platform appears in the photographs to be below the level of the flight deck whereas the starboard side appears to be above this level.

The stack was split into two sections. Three quarters of the stack can be seen on the deck in photographs 15, 18, 19 and 20. The remaining portion of the stack stands erect but is twisted about 20 degrees counter clockwise. (See photographs on pages 16 and 19).

The top foremast was broken off above the SK radar platform. (See photographs on pages 17 and 18). The stub mast as shown in photograph on page 20 has been bent to port.

(c) Other damage.

Machinery and electrical damage were unobserved.

The SK, YE, and MK 12-22 antennae are missing. The whip antennae installed forward, at the starboard side of the flight deck, were missing after the blast. The radar equipment located on the forward portion of the stack was damaged.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Unobserved.

(b) Fires and explosions.

Unobserved.

(c) Shock.

Unobserved.

(d) Pressure.

Part of the stack was toppled over onto the flight deck. Most of the Army equipment, the airplanes, one of the drip pans installed for an airplane and some instrumentation were missing from their installed positions on the flight deck. They may have been blown off the ship or washed over the side by the descending water column.

The SARATOGA which was approximately 300 yards from the burst was moved sidewise. The photographs on pages 27 and 28 show how the ship was displaced outwardly to about 800 yards, the maximum displacement occurring about three minutes, thirty-two seconds after the burst. She began to move inward again until at forty-four minutes after burst she was approximately 600 yards out. See photograph on page 29. The true bearing of the SARATOGA changed from 180 degrees to 170 degrees during this movement.

The wave caused by the underwater explosion lifted the SARATOGA vertically. Her stern rose at lease 43 feet and her bow at least 29 feet. Compare photographs on pages 13 and 14. It is possible that some damage to the SARATOGA may have been caused by the ship's falling into the trough (after passage of initial wave) and being hit by the second wave crest.

III. Results of Test on Target.

(a) Effect on propulsion and ship control.

The starboard shaft struts were broken, destroying propulsion power on two of four shafts. The rudder and its attachments were apparently in good shape. Other equipment vital to propulsion and ship control were unobserved after the test.

(b) Effect on gunnery and fire control.

The fire control equipment was completely immobilized. The guns, left on the ship for test purposes, as viewed from air and by the divers were apparently in good shape. Gun galleries bounding the flight deck were not damaged. The MK 12-22 fire control antennae cannot be seen in photographs on pages 18 and 19.

(c) Effect on watertight integrity and stability.

The explosion completely destroyed the watertight integrity of the ship. The ship remained upright throughout her sinking.

(d) Effect on personnel and habitability.

Personnel in exposed areas would probably have been killed by the descending water column or washed overboard.

(e) Total effect on fighting efficiency.

The ship sank as a result of test B.

IV. General Summary of Observers' Impressions and Conclusions.

Photographs of the burst taken from towers and planes, after burst photographs taken of the array from PBM Charlie, the reports of the technical observer in PBM Charlie, the divers' reports, radar pictures, initial boarding team reports and the Bureau of Ships interim report for test B are the total available sources of material for this report.

The SARATOGA, after quickly disappearing in the descending water column, was not clearly seen until a little over 33 minutes had passed. Observations were continued from the air and at 1130 the Technical Observer, noticing that the SARATOGA was sinking, recommended that she be beached. Dangerous radiological

conditions of both ship and water precluded this undertaking. The SARATOGA sank without any person getting aboard or even alongside.

The divers report finding the ship about 625 yards from the center of the array bearing 174 degrees true in about 180 feet of water. She was lying on her port bilge at about a 10 to 15 degree angle. Her bow tilted upward about five degrees. She was buried beyond the keel with the starboard bilge about seven to eight feet above the bottom.

Approximately fifty underwater pictures were taken. Only a few of these are included in the photographic section of this report because of their poor definition. See pages 30 through 41.

V. Preliminary Recommendations.

None.

VI. Pre-test Statistics.

(a) Instructions for loading the vessel specified the following:

ITEM	LOADING
Fuel oil	10%
Diesel oil	15 tons or less
Gasoline	None
Ammunition	66 2/3%
Potable and reserve feed water	95%
Salt water ballast	95%

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

The SARATOGA at time of "B" burst floated at drafts of 23'8" forward and 31'6" aft. She had no list.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

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. Considerable quantities of water from the base surge entered the hangar deck and was bound in the elevator wells.

(b) Structural damage.

HULL

Structural damage to this ship as a result of Test B is negligible. It is considered that slight accentuation of damage occurred in various areas already seriously weakened as a result of Test A. Any increase in damage is of little real significance because of the previous weakening of the structure involved. It is probable that had the structure been normal prior to Test B, no significant damage would have been noted.

MACHINERY

The temporary stack installed after Test A, was moderately dished.

ELECTRICAL

There was no damage to electrical equipment due to the increase in hull damage resulting from Test B.

(c) Other damage.

HULL

Not observed.

MACHINERY

There was no apparent damage to the machinery installation except to the temporary stack referred to under (b) above.

ELECTRICAL

There was no further damage to the electric plant, ship control, fire control or gunnery equipment as a result of Test B.

II. Forces evidenced and effects noted.

(a) Heat.

HULL

No heat effects were noted.

MACHINERY

There was no evidence of heat.

ELECTRICAL

None evidenced.

(b) Fires and explosions.

HULL

There were no fires or explosions.

MACHINERY

There was no evidence of fires or explosions.

ELECTRICAL

None evidenced.

(c) Shock.

HULL

No damage is known to have occurred from the underwater shock wave. Tools and loose furniture did not move. Bombs and ammunition in the magazines showed no signs of movement.

MACHINERY

There was no evidence of shock.

ELECTRICAL

Shock of a minor nature was evidenced throughout the vessel by loose gear and small objects not properly secured being adrift. However, there was no apparent damage to any electrical equipment that could be determined by visual inspection. Close examination of gyro compass equipment, automatic telephone exchange and fluorescent lighting fixtures which are especially susceptible to damaging effect of shock as compared to other electrical equipment, revealed no damage whatsoever as a result of this test. The automatic telephone system was energized and put in operation. It required no repair or adjustment to give satisfactory service.

(d) Pressure.

HULL

Blast pressure struck this ship at an angle of approximately 265 degrees relative. A slight accentuation of Test A damage apparently occurred as a result of blast pressure. A temporary uptake installed on the hangar deck, frames 65-68, starboard, was severely dished.

MACHINERY

The crumpling of the temporary stack was caused by pressure. This may have been air blast pressure or pressure exerted

by the heavy mass of water falling on the vessel immediately after the explosion, or by a combination of both.

ELECTRICAL

There was no apparent damage to any electrical equipment from the effects of pressure.

(e(Effects peculiar to the Atomic Bomb.

HULL

None, except that of radioactivity.

MACHINERY

Damage to stacks on a vessel so far away from an explosion is believed to be peculiar to the Atom Bomb.

ELECTRICAL

Radioactivity and wave phenomena were the only effects noted peculiar to the atom bomb.

III. Results of Test on Target.

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

HULL

None.

MACHINERY

Damage to the temporary stack would have had little effect but might have slightly reduced boiler capacity. Otherwise, the test had no effect on machinery or ship control. If the stacks had been in their original condition before Test B, they would probably have been damaged. The amount of damage they would have received is conjectural.

but it is not believed that it would have been as great as they received in Test A. However, some reduction in maximum possible steaming rate and hence some reduction in maximum speed would undoubtedly have resulted.

ELECTRICAL

None.

(b) Effect on gunnery and fire control.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

None.

(c) Effect on watertight integrity and stability.

HULL

None. There was no evidence of change in watertight integrity or stability

MACHINERY

No comment.

ELECTRICAL

Not observed.

(d) Effect on personnel and habitability.

HULL

There was practically no effect on habitability. Aside from the effects of radioactivity there would have been little effect on personnel.

MACHINERY

Test B would have had no effect on personnel or habitability below decks, except for possible effect of radioactivity.

ELECTRICAL

Except for the effects of radioactivity, it is believed that personnel and habitability would not have been appreciably affected.

(e) Effect on fighting efficiency.

HULL

Fighting efficiency would have been unaffected except for the effects on personnel of air blast and radioactivity, and the effect of blast pressure on airplanes in exposed locations.

MACHINERY

If the ship had been undamaged before Test B, the total effect on fighting efficiency, insofar as machinery is concerned, would have been some reduction in maximum speed because of damage to stacks.

ELECTRICAL

Due to there being no further increase in damage to electrical equipment, it is considered the fighting efficiency would have been unchanged.

IV. Summary of Observers' Impressions and Conclusions.

HULL

The ship does not appear to have suffered any damage of significance as a result of Test B. The total effect of the forces released during the test was to accentuate previous damage except for some hazard to airplanes on the flight deck.

MAC NERY

Damage to this vessel from Test B is difficult to assess because of her condition after Test A. However, it is not believed that any more damage would have been done by Test B if the ship had been in her original condition except that to stacks, discussed above.

ELECTRICAL

Except for the radiological phenomena experienced, this vessel does not appear to have suffered any new damage as the result of Test B. The total effect of the forces released during the test was to accentuate previous damage. It is considered that this vessel was outside the effective range of the bomb.

V. Preliminary Recommendations.

HULL

None.

MACHINERY

None.

ELECTRICAL

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

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.

HULL

No structural damage occurred in this ship as a result of Test B, Some damage was sustained from contact with tugs.

MACHINERY

No comment.

ELECTRICAL

None observed.

(c) Other damage.

HULL

No damage to propulsion or auxiliary machinery was discovered.

MACHINERY

No machinery on this vessel was damaged by Test B.

ELECTRICAL

None.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

No evidence of any heat effects was found.

MACHINERY

No evidence.

ELECTRICAL

None.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

None.

(c) Shock.

HULL

There is a small crack in the brick work of No. 3 boiler, but this did not prevent steaming of the boiler. No other shock effects were noted.

MACHINERY

No evidence.

ELECTRICAL

None.

(d) Pressure.

HULL

No effects noted.

MACHINERY

No evidence.

ELECTRICAL

None.

(e) Effects apparently peculiar to the atom bomb.

HULL

None, except radioactivity.

MACHINERY

None.

ELECTRICAL

The high, persistant radioactivity remaining on the vessel after the explosion was the only effect noted.

III. Effects of Damage.

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

HULL

None.

MACHINERY

None.

ELECTRICAL

None.

(b) Effect on gunnery and fire control.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

None.

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

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No effect due to electrical failure.

(d) Effect on personnel and habitability.

HULL

Habitability is unaffected. There probably would be no effect on personnel other than that of radioactivity.

MACHINERY

None.

ELECTRICAL

Electrical failures or derangements had no effect on the habitability of the vessel.

(e) Effect on fighting efficiency.

HULL

Fighting efficiency is not affected, if effects of radioactivity are neglected.

MACHINERY

None.

ELECTRICAL

None.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

This vessel was outside of the danger range except for probable radiological hazards.

MACHINERY

The CONYNGHAM was outside the effective range of the explosion in Test B.

ELECTRICAL

The vessel position in the target array was too far from the point of the explosion to receive sufficient shock for a good test of the ruggedness of the ship and its equipment.

V. Preliminary General or Specific Recommendations of Inspection Group.

HULL

None.

MACHINERY

None.

ELECTRICAL

No recommendations are made in view of the fact that no damage was sustained.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

HULL

There was no flooding as a direct result of Test B. The engine room flooded to about 3-1/2 feet above the lower level floor plates, - the port and starboard shaft alleys flooded to above the shaft level. The flooding resulted from excessive leakage through the stern tube glands, a condition known to have existed prior to Test B. The diesel generator room was partially flooded by water backing up through the exhaust line, which terminates at a point a short distance above the waterline. The radio room was flooded to a few inches of depth by wash water entering during decontamination. All of the flooding could have been controlled if the crew had been aboard.

MACHINERY

The engine room was flooded to a depth of about 4 feet above the lower level floor plates. Water entered through stern tube glands, which leaked badly before the test.

ELECTRICAL

Drafts and list were not observed.

The engine room was flooded to about four feet above the lower floorplates.

(b) Structural damage.

HULL

No structural damage occurred in this ship.

MACHINERY

No comment.

ELECTRICAL

Not observed.

(c) Other damage.

HULL

Not observed.

MACHINERY

None except that incident to flooding.

ELECTRICAL

Moderate damage due to flooding is the only damage found in electrical equipment.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

No effects noted.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of heat on the ship.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

There were no fires and no explosions.

(c) Shock.

HULL

No effects noted.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of shock found in any electrical equipment.

(d) Pressure.

HULL

None.

MACHINERY

No evidence, except for pressure incident to wave action. The wave action partially flooded the diesel generator room, and increased the leakage of the stern tube glands.

ELECTRICAL

There was no evidence of pressure found in any electrical equipment.

(e) Effects peculiar to the atom bomb.

HULL

None, other than radioactivity.

MACHINERY

None.

ELECTRICAL

There were no effects peculiar to the atom bomb except high radioactivity, which did not affect electrical equipment.

III. Results of Test on Target.

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

HULL

Not observed.

MACHINERY

None except that incident to flooding, which could have been controlled if the crew had been aboard.

ELECTRICAL

There would be no effect on propulsion and ship control caused by failure of electric equipment, although flooding would have taken out some electrical engine room auxiliaries.

(b) Effect on gunnery and fire control.

HULL

Not observed.

MACHINERY

No comment.

ELECTRICAL

Damage to electrical equipment would have had no effect on gunnery and fire control.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

Electrical damage had no effect on watertight integrity and stability.

(d) Effect on personnel and habitability.

HULL

None, other than that of radioactivity.

MACHINERY

None except radioactivity, which was high 15 days after Test B.

ELECTRICAL

Electrical failures would have had no direct effect on personnel.

The flooding of the galley transformer bank would have affected habitability through loss of food preparation capacity.

(e) Effect on fighting efficiency.

HULL

None.

MACHINERY

None except possible effects of radioactivity.

ELECTRICAL

Damage to electrical equipment would have had no effect on fighting efficiency.

IV. Summary of Observers' Impressions and Conclusions.

HULL

The test had no effect on structural strength, watertight integrity, or fighting efficiency of the ship. Flooding could have easily been controlled if the crew had been aboard during the Test.

MACHINERY

The MUGFORD was outside the range of mechanical damage during Test B, but was within the range of action of the water wave and radioactivity.

ELECTRICAL

The only electrical damage was caused by flooding. This would not have occurred if the crew had been aboard.

V. Preliminary Recommendations.

HULL

None.

MACHINERY

The exhaust from the diesel generator should be as high above the waterline as practicable.

ELECTRICAL

As the only damage would not have occurred under service conditions, no recommendations are made.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Conditions after Test.

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

There was no flooding, hence no change in drafts or list. When the ship was inspected two weeks after the test, normal leakage was observed in the engine room and sound room.

(b) Structural damage.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

Not observed.

(c) Other damage.

HULL

Not observed.

MACHINERY

None, as far as can be determined by visual inspection.

ELECTRICAL

There was no damage to electrical equipment from Test B.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

No effects noted.

MACHINERY

No evidence.

ELECTRICAL

No evidence of heat observed.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No fires or explosions.

(c) Shock.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of shock observed.

(d) Pressure.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of pressure observed.

(e) Effects peculiar to the Atomic Bomb.

HULL

None.

MACHINERY

None, except radioactivity.

ELECTRICAL

No effects peculiar to the atom bomb were noted.

III. Results of Test on Target.

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

HULL

Not observed.

MACHINERY

None, except for possible effects of radioactivity, insofar as could be determined by visual inspection. No machinery on this vessel was operated or opened for interior inspection after Test B because of radioactivity, which was high when the ship was inspected 15 days after the test.

ELECTRICAL

No effect.

(b) Effect on gunnery and fire control.

HULL

Not observed.

MACHINERY

No comment.

ELECTRICAL

No effect.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No effect from any electrical damage.

(d) Effects on personnel and habitability.

HULL

None.

MACHINERY

None, except radioactivity.

ELECTRICAL

No effect on habitability from electrical damage.

(e) Effect on fighting efficiency.

HULL

Except for the effects of radioactivity, the fighting efficiency of the ship is not affected.

MACHINERY

None, except for radioactivity.

ELECTRICAL

No effect.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

None.

MACHINERY

The RALPH TALBOT was outside the effective range of the explosion in Test B, as far as physical damage to machinery is concerned.

ELECTRICAL

As there was no damage from Test B, no conclusions were formed by the observers.

V. Preliminary Recommendations.

HULL

None.

MACHINERY

None.

ELECTRICAL

No recommendations.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

Before test drafts: Forward 12′ 6″; Aft 12′ 6″; 1/2° list starboard. After test drafts: Forward 12′ 6″; aft 13′ 0″; 3° list starboard.

The after engineroom flooded to the outside water line, about one foot above the upper grating level through a broken nipple (previously sealed with a wooden plug, which blew out in test B) in a 3/4 inch cooling waterline to the stern tube, through opened petcocks from four fresh water tanks, through the stern tubes, and through valve packing glands. The forward engineroom flooded to the outside waterline at the upper grating level through a broken salt water line to a lubricating oil cooler and as the result of progressive flooding from the after engineroom through the shaft bulkhead gland. The increase in list was caused by the draining of the fresh water tanks, the shifting of liquid in the forward fuel oil tanks, and the displacement of projectiles in the magazines to starboard.

(b) Structural damage.

HULL

The principal damage was sustained by bulkheads, stanchions, and miscellaneous fittings and equipment in the superstructure. All weather doors and door frames are dished from two to four inches. Some damage was sustained by the shell plating on the starboard side amidships. From the comparatively local nature of this damage it appears that it was sustained as the result of contact with tugs during the process of radiological decontamination.

MACHINERY

The breechings between the stack and uptakes (above the main deck) are considerably dished on both sides. Welds at the lap joints failed and the sheets are parted in places.

ELECTRICAL

Structural damage generally was confined to the superstructure side plating, dishing of doors and starboard shell. The duct to the No. 3 port use forced draft blower in after fire room was ruptured at the section immediately below the fan outlet, however, there was no adverse effects to the motor or impeller and from visual inspection appears to be operable.

(c) Other damage.

HULL

The operability of hull equipment is apparently unaffected.

The main machinery in the engineroom lower levels is flooded.

Operability of the electrical equipment is impaired primarily because of the flooding of the engine rooms and the damaging of the master gyro compass.

MACHINERY

All machinery below the upper level of both engine rooms is damaged by flooding. There is considerable minor damage throughout the machinery spaces to piping, gages, pumps, #3 port use blower etc. Other damage may exist which could not be found by visual inspection.

ELECTRICAL

1. The main electric plant, distribution switchboards,

panels, and main engine and boiler motor driven auxiliaries were undamaged as a direct result of this test, except for the shearing of the mounting bolts on the No. 2 flushing pump located in the after engine room which may have left this unit out of line. The flooding of the forward and after engine rooms as noted under I (a) (3) rendered operational tests on this equipment impossible, as all motors, controllers and wiring for same located below the upper grating level were grounded.

2. Vital ship control systems except for the master gyro compass, which was damaged and temporarily inoperable, were still intact and from visual inspection appeared to be operable.

3. The fire control signalling and communication systems were still intact and from visual inspection appeared to be operable.

4. All the gun mounts could be operated manually. Operation of the mounts electrically was not accomplished as there was no power available. From close visual inspection the power wiring and equipment was undamaged.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

No evidence.

MACHINERY

No evidence.

ELECTRICAL

None.

(b) Fires and explosions.

HULL

None evidenced.

MACHINERY

No evidence.

ELECTRICAL

None.

(c) Shock.

HULL

Considerable evidence of shock is seen in the disarranging of equipment, the movement of projectiles and depth charges and damage to piping joints and ventilation ducts and closures.

MACHINERY

The MAYRANT received a heavy underwater shock. Evidences include broken piping, broken pipe hangers, deranged gages, two sheared foundation bolts on #2 flushing pump, rupture of the duct of #2 port use forced draft blower, disarrangement of engine room floor plates and grating, etc.

ELECTRICAL

Underwater shock was evidenced throughout the ship. Lockers and their contents were displaced, pipe lines and hangers were fractured and floor gratings were dislodged. The effect of shock on electrical equipment was evidenced by damage to the master gryo compass, dislodgement of a 12'' searchlight from its mounting, breaking of several rough service lamps, failure of mounting bolts for No. 2 flushing pump and dislodgement of emergency diesel generator starting batteries.

(d) Pressure.

HULL

The damage to bulkheads and weather doors in the superstructure resulted from the impingement of water of the inundating wave which followed the blast and/or from air pressure.

MACHINERY

The pressure of the heavy mass of water falling on the vessel is believed to have caused the damage to the uptake breechings.

ELECTRICAL

There was some evidence of a pressure wave in the air, although not sufficient to cause damage to exposed electrical equipment.

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

HULL

Effects peculiar to the atomic bomb are the radioactive water, the water wave, shock wave, and the falling water.

MACHINERY

Shock of this magnitude and the heavy mass of water at this distance from an underwater explosion are apparently peculiar to the atom bomb.

ELECTRICAL

Radioactivity and wave phenomena.

III. Effects of damage.

(a) Effects on machinery and electrical and ship control.

HULL

Machinery and electrical equipment are inoperable. Ship control is inoperable due to the loss of power.

MACHINERY

The main propulsion plant is inoperable because of flooding. It is believed that if the crew had been aboard, the flooding could have been controlled. All machinery appears to be otherwise operable except #3 port use blower, which is not used for underway operation. Some reduction in maximum steaming rate of the boilers would be required by damage to the uptake breechings, reducing maximum speed by about 3 knots. It is estimated that this damage could be repaired by the ship's force within 2 days. Some damage not found by visual inspection may exist.

ELECTRICAL

There was no material damage to the electric plant and its associated auxiliaries. The elements of propulsion and turbo generator plant are presently impaired because of post test flooding of both engine rooms.

Ship control would have been impaired to the extent of the temporary loss of the master gyro compass.

(b) Effects on gunnery and fire control.

HULL

Operation of topside station would have been impaired by personnel casualties, by the damage to the master gyro compass, and by loss of electrical power.

MACHINERY

No comment.

ELECTRICAL

The electrical elements associated with gunnery and fire control were impaired to the extent of the temporary loss of the master gyro compass and minor damage to a fire control communication selector switch, system 49jy.

(c) Effect on watertight integrity and stability.

HULL

When the small piping leaks were stopped there was no further flooding. The watertight integrity and stability were affected negligibly by the test.

MACHINERY

No comment.

ELECTRICAL

The only effects on watertight integrity and stability due to electrical equipment was the transfer of a small amount of water from the after engine room to the forward room through cable stuffing tubes. This was not a direct result of electrical damage, but negligence in failure to blank off these tubes when cables were removed.

(d) Effect on personnel and habitability.

Aside from the effects of radioactivity, personnel would have been injured by shock and by contact with loose equipment. Habitability is reduced by numerous piping leaks and by disarrangement of equipment. These items could be corrected by the ship's force.

MACHINERY

It is not believed that there would have been any personnel casualties below deck. Casualties among exposed personnel would have been high. Habitability was not appreciably affected except for radioactivity, which was very high when the ship was inspected 21 days after test B.

ELECTRICAL

There was little if any electrical damage affecting the habitability of this vessel. All flushing and fresh water pumps, galley equipment, lighting, fans, etc., in crew's berthing and messing spaces were undamaged. Other than the effects of radioactivity which are not known to the observers, some personnel on topside may have been temporarily incapacitated by falling water and metal fragments. Others below decks may have suffered bruises resulting from equipment being dislodged and strewn about by underwater shock.

(e) Effect on fighting efficiency.

HULL

None.

MACHINERY

It the crew had been aboard to control flooding, the effect on fighting efficiency would have been to reduce maximum speed by about 3 knots until damage to the uptake breechings was repaired. It is possible that other damage, not found by visual inspection, would affect military efficiency.

ELECTRICAL

The fighting efficiency of this vessel has been somewhat reduced by loss of gyro input to fire control and radar equipment due to damage sustained by master gyro compass. This loss would have been temporary, however, and is within the capacity of

ship's force to replace in service. Further reduction in fighting efficiency would probably result from the momentary confusion among personnel and possible loss of power and lighting due to tripping of circuit breakers. However, this would be only temporary and in a relatively short time the fighting efficiency would return to normal insofar as vital electrical equipment is concerned.

IV. General Summary.

HULL

This vessel was affected principally by the impingement of the water mass of the inundating wave and by the resulting violent motion of the ship. An underwater shock wave caused minor structural, machinery, and electrical damage. It is believed all flooding could have been controlled by the ship's force.

MACHINERY

The MAYRANT was apparently near the limiting range for serious mechanical damage to vessels of her type during test B.

ELECTRICAL

This vessel was subjected to an underwater shock wave sufficient intensity to cause minor structural and machinery damage. The only damage to vital electrical equipment attributed to the blast was that suffered by the master gyro compass. There is evidence of huge masses of water accompanied by metal fragments falling on decks of this vessel, although no electrical damage resulted from this effect, it is the opinion of the observer that some personnel in topside locations would have been injured.

V. Preliminary Recommendations.

HULL

None.

MACHINERY

None.

ELECTRICAL

The future design of gyro compass equipment especially the master gyro compass should be to obtain a more shock resistant unit. At present they are more vulnerable to shock than any other standard electrical equipment, including automatic telephones and electronic gear.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

No flooding, or change of list or trim resulted from test B. Parallel sinkage occurred to a slight degree due to normal leakage. This leakage amounted to 12 inches in the forward fireroom, 24 inches in the after fireroom, 8 inches in the forward engine room, and 16 inches in the after engine room. A small amount of water was found in the ice machine room, two inches of water in the wardroom washroom, A-105-2L, and in the crews washroom. Water in washrooms probably resulted from washing down operations. Leakage into the ice machine room probably was through loose valves, flanges, and other fittings.

(b) Structural damage.

HULL

No structural damage, attributable to the test, occurred. No topside damage resulted except the parting of a foremast stay.

MACHINERY

No comment.

ELECTRICAL

There was no apparent structural damage due to test B.

(c) Other damage.

HULL

Not observed.

MACHINERY

A large patch of plastic fell out of the front wall of #1 boiler. This wall was in poor condition before test B. It is not believed that the boiler would have been damaged at all if it had been in good condition. There is no other damage to machinery of this vessel, as far as can be determined by visual inspection.

ELECTRICAL

No damage occurred to electrical equipment due to test B.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

There was no evidence of heat.

MACHINERY

No evidence.

ELECTRICAL

No evidence of heat.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of fires or explosions.

(c) Shock.

HULL

There is evidence of a slight shock. A large patch of plaster fell from the forward wall of No. 1 boiler. This wall was in poor condition prior to test B. The only other evidence of shock is in the breakage of several light bulbs.

MACHINERY

The vessel received a moderate shock which knocked a large patch of plastic out of #1 boiler. There is no other evidence of shock on machinery.

ELECTRICAL

No evidence of shock.

(d) Pressure.

HULL

The explosion bore approximately 345 degrees relative. Slight damage occurred to the stack breeching and to the door to the general workshop, (B-104-E).

MACHINERY

No evidence.

ELECTRICAL

No evidence of pressure.

(e) Effects peculiar to the atomic bomb.

HULL

None, except radioactivity.

MACHINERY

None.

ELECTRICAL

Other than radioactivity, no effects peculiar to the atom bomb were noted.

III. Results of Test on Target.

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

HULL

None, except loosened plaster on No. 1 boiler which rendered this boiler temporarily inoperable.

MACHINERY

Boiler #1 was made temporarily inoperable. Repairs could be made by the ship's force within a few hours.

Note: Because of radioactivity, which was high when the ship was inspected 16 days after test B, no machinery except the emergency diesel generator was operated after test B.

ELECTRICAL

No damage apparent.

(b) Effect on gunnery and fire control.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No damage apparent.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No electrical damage affected watertight integrity or stability.

(d) Effect on personnel and habitability.

HULL

No effect except that of radioactivity.

MACHINERY

None below decks, except radioactivity.

ELECTRICAL

No electrical damage affected personnel or habitability.

(e) Effect on fighting efficiency.

HULL

It is estimated that inoperability of No. 1 boiler, resulting from dislodged plaster, would have temporarily reduced the ship's speed by three knots.

Figl ting efficiency is otherwise unaffected, except inscfar as personnel would be affected by radioactivity.

MACHINERY

Damage to #1 boiler reduced the ship's maximum speed by about 3 knots temporarily. Repiars could be made by the ship's force within a few hours. It is not believed that this boiler would have been damaged if it had been in good condition. In this case the test would have had no effect on fighting efficiency from a machinery viewpoint, except for possible effects of radioactivity.

ELECTRICAL

No electrical damage affected the fighting efficiency of the vessel.

IV. General Summary of Observers Impressions and Conclusions.

HULL

No comment.

MACHINERY

The TRIPPE was outside the effective range of physical damage to machinery during test B.

ELECTRICAL

No damage was evident on any electrical equipment on this vessel. It appears that the presently available electrical equipment has sufficient shock resistance qualities to withstand any stresses imposed on it under conditions existing during test B.

V. Miscellaneous.

HULL

No comment.

MACHINERY

None.

ELECTRICAL

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

There was no flooding, hence no change in drafts or list. There was normal leakage of six inches of water into both engine rooms during a two week period.

(b) Structural damage.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No structural damage occurred.

(c) Other damage.

HULL

No comment.

MACHINERY

There was no damage to the machinery of this vessel during Test B insofar as can be determined by visual inspection. It was not practicable to operate any machinery on this vessel after Test B because of radioactivity, which was high when the ship was inspected 16 days after the test.

ELECTRICAL

No damage to electrical equipment occurred due to Test B.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of heat was observed.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of fires or explosions.

(c) Shock.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

There was no evidence of shock.

(d) Pressure.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of pressure was observed.

(e) Effects peculiar to the Atom Bomb.

HULL

None.

MACHINERY

None.

ELECTRICAL

There were no effects apparently peculiar to the Atom Bomb other than radioactivity.

III. Effects of Damage.

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

HULL

No comment.

MACHINERY

None, except for possible effects of radioactivity.

ELECTRICAL

No damage occurred.

(b) Effect on gunnery and fire control.

HULL

No comment.

MACHINERY

No comment.

ELECTRICAL

No damage occurred.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No effect was noted.

(d) Effect on personnel and habitability.

HULL

None.

MACHINERY

None, except radioactivity.

ELECTRICAL

No electrical effect occurred.

(e) Effect on fighting efficiency.

HULL

No effects other than those of radioactivity.

MACHINERY

None, except for possible effects of radioactivity.

ELECTRICAL

No damage occurred.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

None.

MACHINERY

The RHIND was outside the effective range of mechanical damage from the explosion of Test B.

ELECTRICAL

The distance of this ship was too great to result in any damage to electrical equipment directly or indirectly attributable to the subsurface blast.

The only damage was done by water through vent ducts. This water came from washing down in decontamination and rain.

V. Preliminary Recommendations.

HULL

None.

MACHINERY

None.

ELECTRICAL

Ends of vent ducts should not be located so as to allow water to drip over electrical equipment.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

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.

HULL

No apparent damage.

MACHINERY

No comment.

ELECTRICAL

No damage occurred affecting electrical equipment.

(c) Other damage.

HULL

No comment.

MACHINERY

None, as far as could be determined by visual inspection.

ELECTRICAL

No damage to machinery, fire control, gunnery or electronics.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No damage due to heat occurred.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No fires or explosions occurred.

(c) Shock.

HULL

None.

MACHINERY

No evidence.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

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.

HULL

No apparent damage.

MACHINERY

No comment.

ELECTRICAL

No damage occurred affecting electrical equipment.

(c) Other damage.

HULL

No comment.

MACHINERY

None, as far as could be determined by visual inspection.

ELECTRICAL

No damage to machinery, fire control, gunnery or electronics.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No damage due to heat occurred.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No fires or explosions occurred.

(c) Shock.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No damage by shock occurred.

(d) Pressure.

HULL

No pressure effects were reported.

MACHINERY

No evidence.

ELECTRICAL

No damage by pressure occurred.

(e) Effects peculiar to the atomic bomb.

HULL

None, except radiological contamination.

MACHINERY

None.

ELECTRICAL

No effects apparent.

III. Results of Test on Target.

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

HULL

None.

MACHINERY

None, as far as could be determined from visual inspection. It was not practicable to operate any machinery or open it for interior inspection because of radioactivity, which was high when the ship was inspected 16 days after test B.

ELECTRICAL

No effect occurred electrically.

(b) Effect on gunnery and fire control.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No effects occurred electrically.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No effects occurred electrically.

(d) Effect on personnel and habitability.

HULL

None.

MACHINERY

None except radioactivity.

ELECTRICAL

No effects occurred electrically.

(e) Effect on fighting efficiency.

HULL

None, except for radiological contamination.

MACHINERY

None, except for possible effects of radioactivity.

ELECTRICAL

No effects occurred electrically.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

No comment.

MACHINERY

The STACK was outside the range of physical effects of the explosion during test B.

ELECTRICAL

The distance of this ship from center of blast was too great for electrical failures.

V. Preliminary Recommendations.

HULL

No comment.

MACHINERY

None.

ELECTRICAL

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

There was essentially no change in draft or trim. A 3/4 degree port list existed before and after the test.

Bilges of the forward fireroom and after engine room contained 18 inches of water. Twelve inches of a mixture of oil and water accumulated in the after fireroom, and twelve inches of water in the bilges of the forward engine room. All of this is attributable to normal leakage of valves, fittings and glands. Small amounts of water accumulated in compartments opening to the weather deck. This water was forced into the compartments when the ship was washed down with fire hoses. There was no other flooding.

(b) Structural damage.

HULL

None. Moderate dishing of the shell plating which exists throughout the ship is believed to have occurred before the test.

MACHINERY

No comment.

ELECTRICAL

There was no apparent structural damage due to test.

(c) Other damage.

HULL

Not observed.

MACHINERY

None, as far as can be determined by visual inspection.

ELECTRICAL

No damage occurred to electrical equipment due to test.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of heat.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of fires or explosions.

(c) Shock.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of shock.

(d) Pressure.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

No evidence of pressure.

(e) Effects apparently peculiar to the atom bomb.

HULL

None, other than radiological contamination.

MACHINERY

None, except radioactivity.

ELECTRICAL

Other than radioactivity, no effects peculiar to the atom bomb were noted.

III. Results of Test on Target.

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

HULL

Not observed.

MACHINERY

None, as far as can be determined by visual inspection, except for possible effects of radioactivity. No machinery except the emergency diesel generator and the steering equipment was operated after test B because of radiological hazard. Radioactivity was high when the ship was inspected, 18 days after test B.

ELECTRICAL

No damage apparent.

(b) Effect on gunnery and fire control.

HULL

Not observed.

MACHINERY

No comment.

ELECTRICAL

No damage apparent.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No electrical damage affected watertight integrity or stability.

(d) Effect on personnel and habitability.

HULL

Personnel and habitability would have been affected only by radiological conditions.

MACHINERY

None, except radioactivity.

ELECTRICAL

No electrical damage affected personnel or habitability.

(e) Effect on fighting efficiency.

HULL

There is no immediate effect on fighting efficiency.

MACHINERY

None, except radioactivity.

ELECTRICAL

No electrical damage affected the fighting efficiency of the vessel.

IV. General Summary.

HULL

None.

MACHINERY

The WILSON was outside the range of physical damage during test B.

ELECTRICAL

No damage was evident on any electrical equipment on this vessel. It appears that presently available electrical equipment has sufficient shock resistance to withstand any stresses imposed on it under the conditions existing during test Baker.

V. Preliminary Recommendations.

HULL

None.

MACHINERY

None.

ELECTRICAL

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

	Forward	Aft	List
Before Test B	12' 4"	12' 6"	0°
After Test *B	17' 6"	20' 0"	2° port

*Estimated drafts before vessel was beached.

All four man engineering spaces and compartments A-206; A-404M to A-407M; C-201L, C-204L, C-206A; C-301M, C-302M, C-306M, C-307M, C-309A and C-311A flooded completely, or to the waterline. The sources of flooding were:

1. In the forward engine room through a large crack in awelded joint in the cooling water discharge line from the lubricating oil cooler to the main overboard line, a broken flange in a seachest blow out line, and leaks in the fire and bilge pump overboard discharge valve.

2. In the after fireroom, through several unplugged electrical stuffing tubes which allowed progressive flooding from the forward engine room.

3. In the forward fireroom through progressive flooding from the after fireroom.

4. In the after engine room through five failures in 1/2 inch or 3/4 inch piping connections to the main condenser which was open during the test and through the stern tubes.

5. Spaces aft of engine rooms. - The shell was torn in way of local damage at frame 196 permitting flooding of C-311 and C-206. So far as can be determined, all after spaces flooded progressively from this source by leaks in doors, hatches, and transverse bulkheads. This local damage was not due to the burst.

6. Compartment A-206, the diesel generator room, flooded from the forward fireroom through an open two inch drain line.

7. Compartments A-404M to A-406M flooded through doors progressively from A-407M which was flooded by small leaks in the shell in way of grounding damage.

(b) Structural damage.

HULL

Superstructure - A majority of the top side doors and hatches were damaged during Test A. The stack and uptakes have been damaged. The port bulwark of the navigation bridge is carried away and a few division bulkheads are further distorted. Interior equipment has been damaged by shock and rapid displacement. This is most noticeable in the disarrangement of electronic equipment in the bridge area.

The weather deck is intact, the life lines amidships, port side, are damaged and the starboard section, frames 115 to 120 is carried away. The loading machine is missing. There is additional deflection of the deck aft between frames 175-183 and the deck girders show stress lines in the paint in this area. Apparently, the use of the weather deck has not been reduced by Test B.

Interior compartments - There is significant structural damage to the interior of the crews quarters, between bulkheads 175 and 183. There is a noticeable increase in the damage to the main deck longitudinals and brackets in this area. Bunks are down, ammunition is dislodged, lockers and equipment are thrown about throughout

the ship. Web frames in way of the engine rooms show distortion in way of upper lightening holes. Transverse bulkhead 101 is wrinkled at the port shell. Stanchions supporting platforms are buckled and machinery foundations are crumpled. Many pipe hangars have parted and ventilation duct work is separated at joints.

Underwater hull - There is general panel dishing between frames and longitudinals. This dishing is worst on the light plating near the ends of the ship. It is least noticeable above the turn of the bilge amidships where the shell plating is heavier than it is near the ends of the ship. There is a small amount of leakage through loosened butt seams and weeping rivets in way of panels damaged by grounding. There is a small hole in the shell at about the 12' 6" W.L. at the starboard connection to the transom, which allowed considerable progressive flooding after the ship was beached. This hole is believed to be the result of contact with a submarine grounded just astern of the HUGHES, and is then not attributable to the burst.

MACHINERY

No comment.

ELECTRICAL

The stanchions under the ship's service turbo generator bases were badly distorted. Although there was no visible indication that this had caused damage to the turbo generators, it is quite possible that some misalignment of the units accompanied this distortion.

(c) Damage.

HULL

No comment.

MACHINERY

The machinery plant as a whole is probably damaged beyond repair. The boiler rear casings (inner and outer) were bulged

outward, brickwork (especially floors) were severely damaged. Stack and uptakes were considerably damaged. Main engine throttle manifold hanger plates sheared, allowing manifolds to drop and crush governor control piping. All upper plate flexing bolts of forward supports on both low pressure turbines sheared, allowing turbines and condensers to fall into bilges. Both turbo-generators fell when the supporting stanchions bent. Piping was severely damaged. All machinery was damaged by flooding. There are innumerable cases of lesser damage, and undoubtedly a great deal of major damage that could not be discovered because of the limited nature of the inspection.

ELECTRICAL

All electrical equipment mounted in the machinery spaces and emergency diesel generator room was damaged from flooding. The following electrical equipment received damage from effects other than flooding:

1. Low pressure air compressor motor.
2. Several pump and vent set motor controllers.
3. Electric lights were broken throughout the vessel.
4. Gyro compass and repeaters.
5. Rudder angle indicator and telegraph in pilot house.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

None.

MACHINERY

There was no evidence of heat.

ELECTRICAL

None observed.

(b) Fires and explosions.

HULL

None.

MACHINERY

There was no evidence of fires or explosions.

ELECTRICAL

None observed.

(c) Shock.

HULL

There is evidence of rather high accelerations upward and of rapid displacements forward and to port in the after part of the ship and to starboard in the forward part of the ship. Fittings, furniture equipment, projectiles and powder cans are dislodged from stowages and thrown about, apparently with considerable force. The after torpedo mount is bent slightly aft and the loading machine is missing.

MACHINERY

The HUGHES received an underwater shock of very great severity which caused most of the damage described under I (c) above.

ELECTRICAL

There were numerous indications from electrical damage that this vessel experienced a heavy shock. This was indicated by:

1. Internal damage to various pump motor controllers mounted in the engine room.

2. Extreme distortion to the stanchions under the ship service turbo generators.

3. Breakage of electric light bulbs throughout the vessel.

4. Distortion of wire ways in the engine room.

5. Extreme damage to the gyro compass and some of its repeaters.

6. Dislodgment of storage batteries from their racks.

Most of the shock on this vessel appears to have come from the bottom of the vessel.

(d) Pressure.

HULL

The general panel dishing of the underwater hull, rudder and skeg indicates that the ship was subjected to underwater pressure.

MACHINERY

The stack, uptakes, and boiler casings of the HUGHES had been damaged by blast pressure during Test A. Additional damage was done to them by blast pressure during Test B.

ELECTRICAL

The only pressure effects noted were those that were in the immediate vicinity of hull damage caused by pressure. An example of this is the damage sustained by the port pelorus, when the port windshield on the bridge was carried away.

(e) Effects peculiar to the atomic bomb.

HULL

The only effects noted were the creation of a water wave of tidal proportions at short range and the contamination of all exposed surfaces caused by the presence of radioactive materials.

MACHINERY

An underwater shock of this magnitude, and blast pressure high enough to cause damage at such a distance from an underwater explosion, are apparently peculiar to the Atom Bomb.

ELECTRICAL

None observed.

III. Results of damage.

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

HULL

The ship's main machinery is inoperable, and there is no power available for ship control or electrical power and lighting except that supplied by the emergency generator.

MACHINERY

All power was lost and none could be regained without major repairs requiring extended repair at a shipyard. The machinery

installation as a whole is damaged beyond economical repair. The ship could not be controlled except by such make shifts, not requiring power, as could be devised.

ELECTRICAL

It is considered that the damage sustained by the forward engine room would have resulted in the loss of power and lighting on this vessel. Since the emergency diesel generator room was only subjected to very slow flooding, the essential electrical equipment probably still could have been supplied with power by utilizing the emergency generator. Since the main propulsion auxiliaries on this vessel were all steam driven, the loss of electrical power would not have affected the ship propulsion. Although damage to the gyro compasses, rudder angle indicator and telegraph would have affected the ease of ship control, their functions could be accomplished by means of the standard magnetic compasses and sound powered telephones.

(b) Effect on gunnery and fire control.

HULL

The guns and fire control equipment are apparently intact except for possible water damage to the I.C. and F.C. switchboard. However, the limited amount of electrical power available would allow only a small portion of the ship's guns to be operated.

MACHINERY

No comment.

ELECTRICAL

Outside of possible water damage to the I.C. and F.C. switchboards, the electrical damage to this vessel would not have affected gunnery and fire control equipment. However, due to the limited amount of electrical power that would have been available, only a small portion of the guns on this vessel could have been operated.

(c) Effect on watertight integrity and stability.

HULL

It is believed that the damage sustained by the hull has only slightly reduced its longitudinal strength and that the flooding is a minor significance. Watertight integrity was reduced, however, due to the loosening of dogs on watertight doors and hatches by shock. The stability of the ship was not affected.

MACHINERY

No comment.

ELECTRICAL

From an electrical standpoint, there was only a slight effect on the watertight integrity and stability of the vessel. It appears that the flooding in the after fire room resulted from water from the forward engine room going through some unblanked stuffing tubes. This was due to some carelessness on the part of the repair activity which pulled the cables and did not blank off the open stuffing tubes.

(d) Effect on personnel and habitability.

HULL

Personnel efficiency would have been seriously reduced by radioactivity and by the effect of shock. The habitability of spaces was reduced immediately by the derangement of furniture, fittings and equipment.

MACHINERY

It is estimated that a large percentage of the crew, both above and below decks, would have been killed or severely injured. The ship was made uninhabitable by loss of power, structural damage, generally disarranged condition of interior spaces, and high radio-activity.

ELECTRICAL

It is considered that the loss of electric power would have affected the habitability of the vessel. Undoubtedly cooking, lighting, and ventilation would have to be greatly reduced, since only the diesel generator sets are available to carry the load.

(e) Total effect on fighting efficiency.

HULL

The longitudinal strength is not impaired. Ship control has not been reduced by damage sustained by the hull and appendages. Buoyancy and watertight integrity are reduced as a result of failures in piping and sea chest connections, however, the crew could have controlled this damage provided they could have remained aboard.

MACHINERY

Fighting efficiency was completely destroyed insofar as machinery is concerned.

ELECTRICAL

The fighting efficiency of the vessel would have been greatly reduced because of the loss of ship service power, Since the emergency diesel generator set would have to supply steering, some pumps, lighting, and ventilation, only a small amount of power would have been available for the gun loads.

IV. General Summary.

HULL

Damage to the hull is confined to structure below the waterline. Light equipment is generally displaced and heavy machinery and equipment are misalignment due to failures in foundations and holding down bolts.

MACHINERY

It is believed that the HUGHES would have been lost if she had been in the open sea at the time of the test. It is not believed that any destroyer afloat could have survived a shock of this magnitude without having her machinery plant immobilized.

ELECTRICAL

The greatest source of electrical damage to this vessel resulted from the flooding in the machinery spaces. In general, most of the electrical damage sustained from the primary effects of the underwater blast was low in the ship. The electrical equipment on the lower level of the engine room suffered much more damage than that on the upper level. However, from the degree of shock damage sustained by the various items of electrical equipment, it is believed that comparable high shock modern Navy equipment probably would have withstood the shock experienced by this vessel. Undoubtedly the modern destroyer split electrical plant, would have withstood the damage better.

V. Preliminary Recommendations.

HULL

Adequate strength in the foundations and improvement in holding down methods of machinery units are essential.

It is believed that the severe damage sustained by electronic gear in the bridge area could have been reduced by supplying adequate means for securing the equipment against the violent displacement and roll of the ship experienced immediately following the shock wave.

Careful attention should be given to the design of supporting hangers for ventilation duct work and piping.

MACHINERY

Specific recommendations based on the experience of the HUGHES are too numerous to list here. A general recommendations is submitted that a study of the foundations and supports of all heavy machinery, particularly turbines, generators, and condensers should be made to determine how they can be made more resistant to shock. Similar studies should be made with respect to piping, particularly pipe hangers.

ELECTRICAL

Considering the flooding experienced in the machinery spaces by this vessel, and the likelihood that damage control personnel would not be immediately available, it is recommended that all electrical equipment which must be installed in the lower levels of the machinery spaces be of the submersible type. Such equipment which is vital to the damage control and fighting efficiency of the vessel should be arranged for operation from the upper levels.

It is recommended that gyro compass element supporting mechanism be made more resistant to shock, and the use of cast aluminum for gyro compass repeaters be discontinued.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

	Forward	Aft	List
Drafts before Test	11' 6''	12' 0''	0°
Drafts after Test (Two weeks)	13' 0''	12' 6''	0°

The forward fireroom flooded to a depth of 8'6'' through a leak in a steam line to a sea chest. The line was already badly corroded. The forward engine room flooded to a depth of 7' 0'' as the result of progressive flooding from the forward fireroom. The exact source of this leakage was not determined. The cause of flooding of the forward engine room was not completely determined. The following probably contributed to it:

(a) Failure of an already badly corroded blowing-out connection to a sea chest. The stop valve for this line leaked before Test B. Failure of the line allowed some water to enter the engine room, but not enough to account for all the flooding.

(b) Water backing up from the forward fireroom through interconnected piping, in which some leaks existed before Test B.

All of the flooding could have been easily controlled without impairing operation of the machinery if the crew had been aboard. The after engine room filled to a depth of 3' 0'' as the result of leakage through the shaft gland in bulkhead 118.

(b) Structural damage.

HULL

None.

MACHINERY

The outer castings of the breeching between uptakes and stacks (above the main deck) are moderately dished. Seams failed in several places. A number of staybolts have pushed through the sheet. The stack is slightly dished near its base, but its strength is not impaired. All of the above damage occurred on the starboard side.

ELECTRICAL

Not observed.

(c) Other damage.

HULL

Not observed.

MACHINERY

Machinery in the forward fireroom and forward engine room is damaged from flooding. Two small sections of piping, already badly corroded, ruptured. One is a blowing-out connection to a sea chest in the forward fire room, the other is a blowing-out connection to a sea chest in the after engine room. No other damage to machinery was found by a careful visual inspection.

ELECTRICAL

No electrical damage other than from flooding.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

None.

(b) Fires and explosions.

HULL

None.

MACHINERY

No evidence.

ELECTRICAL

There were no fires or explosions.

(c) Shock.

HULL

None.

MACHINERY

The ship received a moderate underwater shock, which ruptured the piping mentioned in I (c) above.

ELECTRICAL

None observed.

(d) Pressure.

HULL

As the result of blast or of water pressure, the outer casing of the boiler uptakes is damaged, a weathertight door on the main deck is dished, and screens on exterior ventilation duct openings are damaged.

MACHINERY

Blast pressure and/or the heavy mass of water thrown upon the vessel caused the structural damage mentioned in I (b) above. Canvas covers had been fitted over air intakes to prevent entry of radioactive particles. Those on the starboard side were damaged, which is additional evidence of blast pressure. The blast came from starboard.

ELECTRICAL

None observed.

(e) Effects peculiar to the atom bomb.

HULL

None.

MACHINERY

The magnitude of underwater shock, blast pressure, and wave action, sufficient to cause noticeable effects at this distance from an explosion, are apparently peculiar to the atom bomb.

ELECTRICAL

Persistent radioactivity was the only peculiar effect noted.

III. Results of Test on Target.

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

HULL

The only effect on these items is that of slow flooding of the machinery spaces.

MACHINERY

Flooding of the forward fire room and forward engine-room left machinery in these spaces inoperable. This leaves the ship with only one operable boiler and one operable engine, a situation making steering more difficult as well as greatly reducing speed. No electric power is available except that furnished by the emergency diesel generator (the latter was inoperable before Test B but was not affected by it and would have been operable after the test if it had been so before). All of the flooding could have been controlled if the crew had been aboard, in which case it is not believed that the test would have had any appreciable effect on operation of machinery, except for possible effects of radioactivity. Damage to uptake breeching and piping is minor and would not affect operation.

NOTE: No machinery on this vessel was operated after Test B. Radioactivity was high when the ship was inspected, 15 days after the test.

ELECTRICAL

The only effect was from salt water flooding.

(b) Effect on gunnery and fire control

HULL

Not observed.

MACHINERY

No comment.

ELECTRICAL

None.

(c) Effect on watertight integrity and stability.

HULL

The watertight integrity and stability of the ship are not appreciably affected.

MACHINERY

No comment.

ELECTRICAL

None.

(d) Effect on personnel and habitability.

HULL

The only effect on personnel and habitability would have been the result of radioactivity.

MACHINERY

Except for effects of flooding, which could have been prevented if the crew had been aboard, and for radioactivity, the test would have had no effect on personnel or habitability below decks.

ELECTRICAL

None electrically.

(e) Effect on fighting efficiency.

HULL

None.

MACHINERY

Fighting efficiency is greatly reduced by loss of steam and electric power, and reduction of maneuverability caused by having only one usable engine. If the crew had been aboard to control flooding, it is not believed that fighting efficiency would have been affected at all, as far as machinery is concerned, except for possible effects of radioactivity.

ELECTRICAL

None electrically.

IV. Summary of Observers' Impressions and Conclusions.

HULL

No comment.

MACHINERY

The MUSTIN was apparently near the limiting range of serious mechanical damage to vessels of her type during Test B.

ELECTRICAL

Had the ship been manned flooding would have been quickly controlled, thereby eliminating all damage found on inspection.

V. Preliminary Recommendations.

HULL

No comment.

MACHINERY

Uptake breechings, as installed on this vessel, are an obvious point of weakness against this form of attack. Design changes are indicated.

ELECTRICAL

No recommendations are made.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition after test.

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

HULL

	Draft Forward	Draft Aft	List
Before test	12' - 6''	12' - 8''	2° Stbd.
After test	12' - 6''	12' - 9''	3° Stbd.

The after engine room was flooded to an average depth of about 6 feet above the lower level floor plates. The water entered through the stern tubes, which leaked excessively before Test B.

(b) Structural damage.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

There was no structural damage in way of electrical equipment.

(c) Other damage.

HULL

No comment.

MACHINERY

None except that incident to flooding.

ELECTRICAL

No damage occurred to electrical equipment due to test.

II. Forces evidenced and effects noted.

(a) Heat.

HULL

No effects.

MACHINERY

No evidence.

ELECTRICAL

No evidence of heat.

(b) Fires and Explosions.

HULL

No evidence.

MACHINERY

No evidence.

ELECTRICAL

No evidence of fires or explosions.

(c) Shock.

HULL

No effects.

MACHINERY

No evidence.

ELECTRICAL

No evidence of shock.

(d) Pressure.

HULL

No effects.

MACHINERY

No evidence.

ELECTRICAL

No evidence of pressure.

(e) Effects peculiar to the Atomic Bomb.

HULL

None.

MACHINERY

None.

ELECTRICAL

Other than radio activity, no effects peculiar to the Atom Bomb were noted.

III. Results of test on target.

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

HULL

Not observed.

MACHINERY

A number of electrically driven auxiliaries were made inoperable by the partial flooding of the after engine room. This could have been controlled if the crew had been aboard. The test had no other effect on machinery. A considerable amount of the machinery on this vessel was operated after Test B, and functioned normally.

ELECTRICAL

No damage apparent.

, Effect on gunnery and fire control.

HULL

Not observed.

MACHINERY

No comment.

ELECTRICAL

No damage apparent.

(c) Effect on watertight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

No electrical damage affected watertight integrity and stability.

(d) Effect on personnel and habitability.

HULL

Personnel and habitability would have been affected by radioactivity.

MACHINERY

None below decks, except radioactivity.

ELECTRICAL

No electrical damage affected personnel or habitability.

(e) Effect on fighting efficiency.

HULL

Except for the effects of radioactivity, fighting efficiency is not affected.

MACHINERY

None, except for possible effect of radioactivity.

ELECTRICAL

No electrical damage affected the fighting efficiency of the vessel.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

No comment.

MACHINERY

The WAINWRIGHT was outside the range of ship damage from the explosion in Test B.

ELECTRICAL

No damage was evident on any electrical equipment on this vessel. It appears that presently available electrical equipment has sufficient shock resistance to withstand stresses imposed at the distance under conditions existing during test.

V. Preliminary Recommendations.

HULL

None.

MACHINERY

None.

ELECTRICAL

None.

VI. Instructions for loading the vessel specified the following:

HULL

ITEM	LOADING
Fuel oil	50%
Diesel oil	50%
Ammunition	50%
Portable and reserve feed water	As full as practicable
Salt water ballast	160 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 Ships Material. This report is available for inspection in the Bureau of Ships Crossroads Files.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The SKIPJACK was submerged for test B in 30 fathoms of water to a keel depth of approximately 85 feet. The relative bearing to the bomb was about 270°, and the range about 800 yards. After test B the ship was found on the bottom with all compartments flooded. The major sources of flooding were a 20" x 1" rupture of the shell plating at frame 30 and the torpedo tubes. Compartments other than the torpedo rooms flooded slowly via damaged or partially opened fittings and by progressive flooding through leaks in the main bulkheads.

(b) Structural damage.

The circular hull plating is generally dimpled (up to a maximum depth of 2 1/2 inches), but predominantly on the port side. Distortion of the circular hull frames had just started. The major damage was confined to the single hull sections at either end of the ship where severe frame distortions (up to 8 1/2 inches) and one rupture of the shell plating were found. Dimpling of the single hull plating between frames is severe on the port side and moderate on the starboard side. The performance of structural welding was exceptionally good. Only three minor failures were found.

(c) Other damage.

Nearly all equipment within the ship was incapacitated by flooding, shock or hull distortion. The superstructure and main deck were moderately damaged. The torpedo tubes were all put out of action by distortions of the barrels and failure of the fittings. Gaskets were blown out of nearly all of the main ballast tank emergency vent valves and bulkhead ventilation flappers, and the vent risers and flood valves were severely damaged.

All machinery and equipment was inoperable except for hand power steering when the ship was surfaced, due mainly to salt water damage and misalignment of foundations incident to structural deformations. Main and auxiliary machinery received small direct primary damage as a result of the bomb, this damage being limited to isolated cases of broken or cracked castings.

Practically all electrical equipment was rendered inoperable due to flooding of all compartments. Considerable corrosion due to electrolysis occurred, particularly on exposed copper parts. Even if flooding could have been controlled, the electrical damage due to shock was severe enough to render the propulsion system inoperable, and seriously impair ship control and fire control. However, sufficient temporary repairs probably could have been effected by the ships crew to permit emergency operation of major electric equipment except where hull and machinery damage would have prevented operation.

All electronic equipment was flooded. The QC-JK, QB and NM sound heads had ruptured diaphragms.

II. Forces Evidenced and Effects Noted.

(a) Heat.

There was no evidence of heat.

(b) Fires and explosions.

Secondary electrical fires resulted from flooding of the vessel with salt water. These were confined to the shore connection junction boxes in the pump room. There is no evidence of an explosion.

(c) Shock.

There is plentiful evidence that the vessel was subjected to severe shock. Several castings cracked in areas where the hull distortion was negligible. Numerous items of electrical and other equipment were thrown out of their housings, and foundation bolts were generally loose, stretched, bent or broken.

(d) Pressure.

The distortions of the pressure hull are convincing evidence of extreme pressures. The "Coordinator's Report on Air Blast and Water Shock, tests A and B" of 27 September 1946 indicates the pressures wave attained a value of approximately 1150 p.s.i.

(e) Effects apparently peculiar to the atom bomb.

In confined spaces, such as the vent risers from the ballast tanks, there is evidence that (1) the pressure within the space was built up to a higher value than the ambient pressure or (2) the ambient pressure wave passed on, leaving a relatively high pressure within the space for a short time longer. For example, the vent risers, which were open at one end, split along their seams, apparently as a result of excessive internal pressure. This phenomenon was common during the air burst of test A, and appears to have a counterpart under water.

Radioactivity was more pronounced in this vessel than in the other submerged submarines. This phenomena is under study in the San Francisco area.

III. Results of Test on Target.

(a) Effect on propulsion and ship control.

Nearly all such items were placed out of commission by flooding, shock and hull distortion. Had the ship been manned, ships force may have been able to effect temporary repairs to permit limited emergency operation.

(b) Effect on gunnery and fire control.

Gunnery and fire control equipment was generally damaged by flooding, shock and hull distortion. Major damage was caused by flooding.

(c) Effect on watertight integrity and stability.

The watertight integrity was completely destroyed al-

though there was only one major breach in the hull. Small leaks accounted for the flooding of all compartments except the forward torpedo room.

With all compartments flooded the center of gravity moves up approximately 0.7 feet which reduces the initial stability approximately 70% from the normal submerged condition.

(d) Effect on personnel and habitability.

Habitability completely destroyed. The effect on personnel is difficult to evaluate since no personnel were aboard; however, it is estimated that all personnel in the forward torpedo room would have been lost from flooding since that was the only compartment in which the pressure hull was ruptured. It is further estimated that had personnel in other compartments survived the effects of shock and the immediate possible effects of radioactivity, they could have prevented the complete flooding of the ship and possibly brought her to the surface.

(e) Total effect on fighting efficiency.

Assuming the ship had not sunk, due to the efforts of an alert crew, the fighting efficiency would nevertheless be negligible. She could not submerge, it is doubtful if the screws would turn over, and no torpedo tubes were operative.

IV. General Summary of Observers' Impressions and Conclusions.

It is apparent that the SKIPJACK was subjected to a pressure wave of great severity. It is believed that reflections caused local peaks of even higher pressure. The circular hull is more resistant to such an attack than the non-circular hull. The non-circular parts of the ships were damaged to such an extent that a complete collapse must have been imminent. Despite these severe distortions, the structural welding was almost 100% intact and only the forward torpedo room would have flooded had there been no failure of fittings.

From damage to the SKIPJACK and also to the APOGON, it is concluded that the lethal range of an underwater explosion of an atom bomb of the type used in test B is in the order of 950 yards.

V. Preliminary Recommendations.

It is considered that the SKIPJACK should be retained for further detailed study at such times as new designs of features found in this ship are being prepared. Ideally, the ship should be placed on dry land in the vicinity of the leading submarine design agency.

While detailed recommendations are contained in the following sections of this report, the following general suggestions are considered to be of major importance.

(1) The single hull type of construction should be eliminated or greatly strengthened. Instead of the strongest, it is the weakest part of the structure against such an attack. Investigations of the measure of protection provided by the outer shell, of the effect of the proximity of rigid and relatively flexible structure and a review of the physical properties of the various steels and welds available for hull construction should be undertaken in the light of what has been learned regarding atomic bomb underwater explosions.

(2) The distribution of the damage to the pressure hull of the SKIPJACK lends support to the suggestion, made in the Bureau of Ships Technical Inspection Report on the USS SKATE for test A, namely to extend the side tanks up over the top of the hull. It now appears that such a structure would not only improve the resistance to damage from an atomic air explosion and protect personnel from neutron radiation, but would also even out the peaks in the underwater pressure wave.

(3) The standard of fittings affecting watertight integrity must be improved, particularly access hatches and valves, and particularly with regard to gaskets.

(4) The method of mounting equipment to bulkheads and on foundations should be improved so as to minimize shock failures of securing bolts, welded joints and supports.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The SEARAVEN was submerged to eighty feet keel depth for Test B at a range of approximately 1400 yards from the center of the burst. Upon being resurfaced no significant flooding was found. A gasket leak under the main induction valve allowed flooding into the main induction system, some of which seeped into the crews washroom and forward engine room. The ship had previous trouble with this valve when set up by hand from outside and does not attribute the leakage to the bomb. There was no readable change in drafts and list.

(b) Structural damage.

There is no structural damage.

(c) Other damage.

All propulsion machinery was tested and is operable as before the test.

The master gyro compass follow up system was inoperable due to an open circuit in a relay-coil of the alarm circuit, probably caused by moisture grounds.

Enough mercury spilled from the auxiliary gyro compass to prevent proper flotation.

Supply leads to the internal fitting in a lighting distribution box at Frame 59 in the control room were found loose from connections.

The resistor cutout switch in the solenoid circuit of the bow plane tilting motor at frame 31 in the forward torpedo room was found out of adjustment.

An open armature coil was found in the motor of No. 1 Fuel Oil Purifier at Frame 113 in the forward engine room.

II. Forces Evidenced and Effects Noted.

(a) Heat.

None.

(b) Fires and explosions.

None.

(c) Shock.

Shock was of a minor nature. Spilled mercury in the auxiliary gyro compass, a loose supply lead to one lighting distribution box and mal-adjustment of the cut-out switch in the bow plane tilting motor circuit are attributed to shock.

(d) Pressure.

The 'Coordinators Report on Air Blast and Water Shock for test A and B' of 27 September 1946 indicates that the peak water pressure was some thing less than 800 lbs. per square inch. Elastic distortion of the torpedo room hull, measured at four stations, was not greater than 0.07 inches.

III. Effects of Damage.

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

None, other than temporary loss of power operation of bow plane tilting.

(b) Effect on gunnery and fire control.

The gyro follow up system failure would necessitate feeding Own Ship's Course to the Torpedo Data Computer by hand.

(c) Effect on watertight integrity and stability.

None.

(d) Effect on personnel and habitability.

None.

(e) Total effect on fighting efficiency.

Fighting efficiency would have been affected slightly and temporarily by the necessity of feeding Own Ship's Course to the Torpedo Data Computer by hand while repairing gyro follow-up system.

IV. General Summary of Observers' Impressions and Conclusions.

It is concluded that a submarine submerged at this distance from the type of atomic bomb used in Test B would not suffer material damage. For general views of the SEARAVEN after Test B, see photographs on pages 32 to 39.

V. Preliminary Recommendations.

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The TUNA was submerged to eighty feet keel depth for test B at a range of approximately 1600 yards from the center of the burst. When resurfaced she had normal drafts and no list. Number three main engine had flooded due to leaking inboard and outboard exhaust valves which is attributed to age of material rather than to direct effects of the bomb.

(b) Structural damage.

None.

(c) Other damage.

All hull equipment was fully operable.

All machinery was fully operable after draining water out of number three main engine.

All electrical equipment was operable except that mercury had been spilled from master and auxiliary gyro compasses, the master gyro follow up system would not function due to an open circuit in the alarm bell relay coil and there was a full voltage ground in No. 3 main motor caused by salt water leaking from a defective sea valve and cooler.

II. Forces Evidenced and Effects Noted.

(a) Heat.

None evidenced.

(b) Fires and explosions.

None evidenced.

(c) Shock.

There was no evidence of shock other than a broken glass in the gyro repeater in the forward torpedo room and the spillage of mercury from the master and auxiliary gyro compasses.

(d) Pressure.

The 'Coordinators Report on Air Blast and Water Shock for tests A and B' of 27 September 1946 indicates that the peak water pressures were considerably less than 800 lbs. per square inch. The elastic deformation of the single hull, measured at four stations was not greater than 0.13 inches.

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

Retention of radioactivity by the ship outside the pressure hull were the only noted effects peculiar to the atom bomb.

III. Effect of Damage.

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

None except temporary loss of use of gyro compasses.

(b) Effect on Gunnery and Fire Control.

Automatic feed of own ship's course to the Torpedo Data Computer was inoperable due to failure of master gyro follow up system.

(c) Effect on watertight integrity and stability.

None.

(d) Effect on personnel and habitability.

None except for the effects of radioactivity.

(e) Total effect on fighting efficiency.

A slight temporary reduction in fighting efficiency would have resulted from the loss of the gyro compass follow up system.

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

Except for the radiological phenomena expierenced, this vessel was beyond the range of effectiveness of the bomb used in test B. For general views of TUNA after test B see photographic section on pages 26 to 33.

V. Preliminary Recommendations.

No comment.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The SKATE was on the surface for test B at a range of approximately 900 yards from the center of the burst. Draft and list after test were normal. There was no flooding except into safety tank through a leaking salvage air valve.

(b) Structural damage.

None.

(c) Other damage.

All main propulsion machinery has been tested and is operable as before test B.

The master gyro compass and its follow-up system were inoperable after the test.

Because of shattering of battery cell ventilation ducts, use of one battery was lost except for emergency.

The auxiliary gyro compass was found out of balance because of mercury spillage from the flotation bowl. The pickup pin which supplies power to rotors was bent.

II. Forces Evidenced and Effects Noted.

(a) Heat.

No evidence.

(b) Fires and explosions.

No evidence.

(c) Shock.

There is evidence of some shock from below. The after battery sustained one cracked jar. Three cracked jar tops were found in each battery. About 50% of battery ventilation hard rubber ducts were broken in each battery tank. The appearance and location of the fractures as well as other evidence (loose and displaced battery wedges) indicates that the ducts were broken by an upward motion of the battery cells.

Shock caused the spillage of mercury from the auxiliary gyro compass and the bending of the pickup pin. The centering pin and the outer contact ring of the master gyro were bent. This was apparently caused by movement due to shock.

(d) Pressure.

The 'Coordinators Report on Air Blast and Water Shock, tests A and B' of 27 September 1946 indicates that the peak water pressure was approximately 1000 pounds per square inch, and the peak air pressure was approximately 6.6 pounds per square inch. Long base displacement gages located in the forward and after torpedo rooms showed that the hull was deflected toward the center axis as follows. None of these deflections exceed those which are normal at deep submergence:

	Horizontal Deflection	Vertical Deflection
Forward Torpedo Room	0.085	0.110
After Torpedo Room	0.100	0.120

(e) Any effect peculiar to the atom bomb.

The only effect noted peculiar to the atom bomb was radioactivity. The SKATE with the other submarine on the

surface for test B was more radioactive than the submerged submarines and the inside of the pressure was above the radiological tolerance of 0.1R/24 hours.

III. Effects of Damage.

(a) Effect on propulsion and ship control.

While the failure of the individual battery cell ventilation would not prevent the SKATE from discharging her batteries, it would make charging extremely hazardous as the hydrogen generated can not be effectively carried away without this ducting. Sufficient sections of ducting remain intact to equip one battery. Thus, by grouping all the intact sections in one tank, 50% of the ships submerged power can be utilized. Surfaced propulsion and ship control is not affected.

(b) Effect on gunnery and fire control.

The gyro follow-up system failure would necessitate feeding Own Ship's Course to the Torpedo Data Computer by hand.

(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 fighting efficiency is reduced by loss of battery power for submerged operations. Temporary loss of Automatic Ship's Course feed to the Torpedo Data Computer would further reduce efficiency in a slight degree.

IV. General Summary of Observers' Impressions and Conclusions.

Except for the radiological phenomena experienced and except for the damage to the battery installation, this vessel was beyond the range of effectiveness of the bomb used in test B. The fact that no shock or other damage outside of the battery wells has been observed, leads to the conclusion that the battery cells may have been loosened by test A. However, such an effect was not noticed during the inspection after test A. For general views after test B see photographic section on pages 38 to 45.

V. Preliminary Recommendations.

The serious reduction in battery power resulting from shock damage to the ducting indicates the necessity for the following corrective measures:

(a) Redesign wedging and securing devices to prevent movement of battery cells.

(b) Fabricate ventilation ducts from a material more resistant to shock than the hard rubber ducts currently in use.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

All information has been obtained from salvage operations, which were abandoned before the ship was brought to the surface. The APOGON was submerged for Test B in 28 fathoms of water to a keel depth of approximately 100 feet at a range of approximate 850 yards from the center of the burst. After the test she was found on the bottom. All compartments were flooded or partially flooded with the possible exception of the conning tower. The forward torpedo room flooded through a hole in the pressure hull plating. The sources of flooding of the outer compartments is not definitely known. All compartments which can be blown contain some oil.

(b) Structural damage.

All bulkheads except that at frame 88 are known to have openings which permit the passage of air. All bulkheads were air tested and found tight immediately prior to Test B. The after torpedo room upper hatch cover and either the lower hatch cover or the hatch trunk failed. The tank top in the vicinity of Main Ballast Tank 6-B is reported to be ruptured. There is a 30" x 15" hole in the pressure hull plating between frame 30 and 31. Considerable other damage is suspected.

(c) Other damage.

Due to flooding and possible other damage it is extremely unlikely that any equipment could be operated. No inspection could be made of the interior of the ship.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Unknown.

(b) Fires and explosions.

Unknown.

(c) Shock.

Insufficient data for comment.

(d) Pressure.

An ordnance torpedo, designed to operate at 600 feet, was lashed to the deck of the APOGON for Test B. When this equipment was recovered it was found to be completely crushed and collapsed. The damage to the gasket of the after torpedo room hatch (described herein under Item G), appears to have been caused by a very high and relatively sustained pressure wave.

The "Coordinator's Report on Air Blast and Water Shock in Test A and B" of 27 September 1946, indicates that the peak pressure was around 1200 lbs. per square inch. Data from a Hilliar gage submerged to 20 feet at a range of 1090 feet shows the positive phase had a duration of 1.6 milli-seconds.

(e) Effects peculiar to the atom bomb.

None except as covered elsewhere.

III. Effect of Damage.

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

Although no inspection has or could be made it is assumed that all machinery and equipment is completely inoperable as a result of flooding and possible other damage.

(b) Effect on gunnery and fire control.

Probably completely inoperable.

(c) Effect on watertight integrity and stability.

Eight out of nine compartments are flooded or partially flooded. The other, the conning tower, is suspected of being in a similar condition.

(d) Effect on personnel and habitability.

It is estimated that the ship would have been lost with all hands. No habitability remains.

(e) Total effect on fighting efficiency.

Completely destroyed.

IV. General Summary of Observers' Impressions and Conclusions.

It is considered that the damage suffered would have sunk a fully manned ship despite any preventive efforts available to the crew.

V. Preliminary Recommendations.

The damage sustained is of such nature as to be extremely valuable for future design. It would be desirable that the APOGON be salvaged and repaired to such an extent that the ship can return to a shipyard for extensive and detailed examination. The time required to complete the salvage is estimated at three weeks.

The damage to the double lip "T" gasket installed on the after torpedo room hatch cover and discussed under Item G raises a question as to the suitability of this gasket design. None of the "dove tail" or solid "T" type hatch gaskets on the USS SKIPJACK (which was submerged at approximately the same range) are

significantly damaged. Nothing is known regarding the remaining hatch covers on USS APOGON except that the hand wheels had backed off a turn or two in nearly all cases.

The reason for the severe damage of the after torpedo room hatch cover of the APOGON is not known. Depth charge tests with 300 lb. TNT charges were conducted at the time the double lip gasket was developed, and at this time the gasket and hatch cover successfully withstood peak water pressures several times those estimated to have prevailed at the range of the APOGON in Test B.

Several theories might be advanced in explanation of the severe damage to this gasket. Although the characteristics of the underwater pressure phenomena during Test B have not yet been definitely determined, the consensus indicates that the duration of high pressure for an atomic blast is several times greater than for a TNT blast. This may explain why the development tests did not produce failure under higher peak pressures.

The APOGON was submerged about 30 feet deeper than the SKIPJACK. The vertical stations of ball crusher gages show the pressures to have been somewhat more severe with increased depth. Also local peaks in the pressure distribution were caused by reflections from the bottom or other surfaces. Some phenomena similar to this may explain why damage to the APOGON in general, and to the subject hatch cover in particular, was more severe than to the SKIPJACK.

Another possible explanation of the damaged gasket is that some force acted on this particular hatch to produce rubbing or chattering which resulted in mechanically cutting the rubber between the hatch cover and the seat. Such a force could have been caused by elastic flattening of the spherical cover plate followed by vibrational deflections which caused the gasket to be rubbed back and forth rapidly between the two metal surfaces. On the other hand, the air, blown into the torpedo room during salvage operations, might have caused chattering while blowing out past the gasket. (A maximum of 40 lbs. per square inch over bottom pressure was used.

The evidence available is not sufficient to indicate that the double lip gasket is weaker than earlier types. However, it does appear to be sufficient to justify further investigation. Therefore, inasmuch as an alteration to install double lipped "T" gaskets in all active submarines has been authorized, it is recommended that further investigation be undertaken to uncover the possible weakness or confirm the suitability of this gasket design.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The DENTUDA was submerged for Test B on Baker minus two day in 28 fathoms of water to a keel depth of approximately 80 feet at a range of approximately 1500 yards from the center of the burst. Her drafts, immediately before submerging were 18' - 0" forward and aft and her list one half degree to starboard. On Baker plus two day the ship, which was found on the bottom, was surfaced using normal procedure. The stern surfaced first and the ship had a momentary down angle of about thirty degrees. The drafts upon surfacing were 20' - 6" forward and 18' - 6" aft.

The pump room was flooded to the level of the control room floor plates by way of the ten pound blow lines from No. 6D Main Ballast Tank. The conning tower bilges and No. 2 periscope well were flooded, apparently via the No. 2 periscope stuffing box. The two engine induction lines, but not the hull induction line, were partially flooded, apparently as a result of slow leakage through the outboard induction valve.

(b) Structural damage.

There is no structural damage. The hull was carefully examined in drydock during November 1946 and no damage was found which could be attributed to Test B. Bore sighting of the forward torpedo tubes showed that there is no significant distortion of the bow.

(c) Other damage.

All main propulsion machinery was operable when tested. Flooding of the pump room rendered the following auxiliaries inoperative:

(1) Trim pump motor.
(2) Drain pimp motor.
(3) 10 lb. blower motor.
(4) Hydraulic plant motor (2).
(5) Gyro motor-generator sets (2).
(6) Ice machine motor.
(7) Air conditioning plant motors (2).
(8) High pressure air compressor motors (2).
(9) I. C. Motor-generator sets (2).
(10) I. C. Motor-generator panels (4).

The steep down angle of the vessel on surfacing caused water to run forward flooding the lower half of the I. C. Switchboard in the control room, covered the auxiliary gyro compass, and at least heavily splashed, or perhaps momentarily flooded, the extreme lower portion of the master gyro compass panel just aft of the I. C. Switchboard.

An inboard fuel oil vent valve beneath the galley sink in the line leading from the fuel oil filling and transfer line on the port side to Fuel Ballast Tank 3A on the starboard side was found partially open on re-entry. Oil had leaked out and run across to the starboard side and aft in the waterway. Some oil leaked into the battery well and into four cells in the forward end of the after battery. The lower two rows of jars were immersed to a depth of 36 inches, the middle two rows on either side to a depth of 28 inches, and the upper two rows on either side to a depth of 12 inches. Oil leaking through openings in the waterway and behind the lining of the meat and cold rooms soaked the insulation in these spaces. See photograph on Page 41 for view of effect of fuel oil on the rubber battery tank lining.

II. Forces Evidenced and Effects Noted.

(a) Heat.

There is no evidence of heat.

(b) Fires and explosions.

There is no evidence of fires or explosions.

(c) Shock.

Shock probably jarred open hull flapper valve in 10 lb. blow line to No. 6B - 6D main ballast tank and possible jarred open a test cock in fuel oil filling and transfer line in after battery compartment. The tail stops of loaded torpedo tubes were found backed off a partial turn. No evidence of damage to machinery from shock was noted and loose gear was not disarranged.

(d) Pressure.

The "Coordinator's Report on Air Blast and Water Shock, Tests A and B" of 17 September 1946 indicates the peak pressures were much less than 800 lbs. per square inch. More accurate data is not now available.

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

None other than radioactivity. Outside the pressure hull, the structure was moderately radioactive. Inside the pressure hull, radioactivity was below tolerance.

III. Effects of Damage.

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

There was no effect on propulsion equipment. Those circuits affecting ship control which run through the I. C. switchboard were out of commission due to the flooding damage to that switchboard. Flooding of the main hydraulic power plant motors prevented hoisting periscopes or operating vent valves, torpedo tube outer doors, etc. by hydraulic power.

(b) Effect on gunnery and fire control.

Own Ship's Course feed to the Torpedo Data Computer was out of commission due to inoperability of the master gyro compass. 120 volt A. C. circuits coming through the I. C. switchboard to instruments indirectly affecting fire control were out of commission.

(c) Effect on watertight integrity and stability.

The watertight integrity of the control room was destroyed as a result of valve failures. No structural material is involved. The water in the No. 2 periscope well and conning tower bilges is estimated at two tons, which is believed to have entered through the stuffing box of No. 2 periscope. No worthwhile estimate of the amount of water in the induction lines is available but it is believed to have been relatively minor. Neglecting this induction leakage, the effect of the remaining flooding is calculated to have reduced the transverse metacentric height by approximately 0.25 feet (17.5%) and the reserve buoyancy by 18%. Had the ship been manned, all flooding could have been stopped immediately.

(d) Effect on personnel and habitability.

It is considered that there would have been no effect on personnel as a result of hull damage. Had the ship been manned, flooding would have been prevented and there would be no effect on habitability. This excludes radiological effects.

(e) Total effect on fighting efficiency.

With personnel on board, the fighting efficiency of the ship would have remained at 100%.

IV. General Summary of Observers' Impressions and Conclusions.

The DENTUDA received no major damage as a direct result of the Test B atom bomb. Had the ship been manned, the secondary damage resulting from flooding would not have occurred. For general views of the DENTUDA after the test, see photographs on pages 42 to 48.

V. Preliminary recommendations.

Install a more positive "locked-closed" device in the hull flapper valves in the ten pound blow lines.

Where practicable, controllers and associated control equipment for rotating electrical equipment should be located in the same watertight compartment with the rotating equipment. Duplicate equipment should be located in separate compartments.

Starter panels, feeder and junctior boxes should be held to a minimum in the pump room.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

The PARCHE was on the surface for test B at a range approximately 1600 yards from the center of the burst. Her drafts before and after the test were the same, 16' - 3" forward and 16' - 4" aft. There was no flooding.

(b) Structural damage.

There is no structural damage.

(c) Other damage.

All machinery and equipment tested and operable as before test.

II. Forces Evidenced and Effects Noted.

(a) Heat.

There is no evidence of heat.

(b) Fires and explosions.

There is no evidence of fire or explosions.

(c) Shock.

No evidence of shock of any magnitude was noted. Loose gear inside the ship was not disarranged.

(d) Pressure.

The 'Coordinators Report on Air Blast and Water Shock for tests A and B' dated 27 September 1946 indicates the peak air pressure was approximately 2.5 lbs. per square inch. Elastic hull distortion in the torpedo rooms, measured at four stations, was not greater than 0.015 inches.

(e) Any effects peculiar to the atom bomb.

The only effect noted peculiar to the atom bomb is radioactivity. The PARCHE, along with the other submarine on the surface, showed more radioactivity than those submerged, and was above the radiological tolerance of 0.1R/24 hours inside the pressure hull.

III. Effects of Damage.

(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.

Aside from radioactivity, no peculiar effect was noted.

(e) Total effect on fighting efficiency.

Test B had no effect on fighting efficiency from a material standpoint.

IV. General Summary of Observers' Impressions and Conclusions.

Except for the effects of radioactivity, a modern submarine would be unaffected by an atom bomb under conditions similar to those of the PARCHE in test B. For general views of the PARCHE after the test, see photographs on pages

V. Preliminary Recommendations.

None.

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

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

Ship is resting on bottom with an indeterminate amount of flooding. The hull is covered to about three quarters height with silt and coral.

(b) Structural damage.

In way of the after torpedo room the plating between frames is dished to a depth of about six inches. The superstructure and tank tops are dished in several locations and the superstructure plating has numerous tears and holes. See photograph on page 9. Complete examination is not possible. Superstructure has shifted to starboard about six inches amidships and one inch at the stern. This shift makes salvage connections inaccessible unless part of the deck is cut away.

(c) Other damage.

Unknown.

II. Forces Evidenced and Effects Noted.

(a) Heat.

No evidence.

(b) Fires and explosions.

No evidence.

(c) Shock.

Unknown.

(d) Pressure.

The "Coordinator's Report on Air Blast and Water Shock for tests Able and Baker" of 27 September indicates that the peak water pressures were over 7000 pounds per square inch.

III. Results of Tests on Target.

(a) Effect on propulsion and ship control.

Unknown.

(b) Effect on gunnery and fire control.

Unknown.

(c) Effect on watertight integrity and stability.

Unknown.

(d) Effect on personnel and habitability.

Unknown.

(e) Total effect on fighting efficiency.

Unknown.

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

The PILOTFISH was submerged for test Baker in 28 fathoms of water to a keel depth of approximately 56 feet, at a range of approximately 300 yards from the center of the burst. After test Baker she was found on the bottom with a starboard list of approximately 30 - 40 degrees. The deck is covered with silt to a depth of 3 - 18 inches. A few pieces of loose coral are resting on the deck. All information has been obtained from exploratory divers' reports. No further information is available. Based on damage observed by divers on SKIPJACK and APOGON, which were farther from the blast, it is considered likely

that all or nearly all compartments are flooded and that the tops of the ballast tanks are no longer tight. It is believed that a comparatively lengthy operation would be required to salvage this ship. See the photographic Section pages 9 to 16 for views of portions of the deck and superstructure taken by underwater photography.

V. Preliminary Recommendations.

None.

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Security Information

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[redacted]

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

TRC

4 April 1997

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

SUBJECT: Declassification of Documents

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

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

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

Ardith Jarrett

ARDITH JARRETT
Chief, Technical Resource Center