U.S.S. NORTHAMPTON (CA26)

Loss in Action

Battle of Lunga Point
30 November, 1942

Class.....Heavy Cruiser (CA26)	Length(W.L.)..... 569'
Launched.....5 Sept.,1929	Beam (W.L.).....66'-1"
Displacement.....9050 Tons (Standard)	Draft.....19'-7" (Before damage)

Reference:

(a) C.O. NORTHAMPTON ltr. CA26/A16-3/(03) of 8 December, 1942 (War Damage Report).

(b) C.O. NORTHAMPTON ltr. CA26/A16-3(06) of 5 December, 1942, (Action Report).

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SECTION I - SUMMARY

1. NORTHAMPTON was struck by two torpedoes in the closing stages of the Battle of Lunga Point on 30 November, 1942. Both hit the port side, one at about frame 98 in way of the after engine room and the other at about frame 108. The detonations occurred almost simultaneously and survivors felt but a single shock and saw only one geyser.

2. The after engine room and several compartments aft of bulkhead 102 were opened to the sea. A 10 degree list to port quickly developed. Both port shafts and the starboard inboard shaft stopped immediately. All communications with spaces aft of the damage were disrupted.

3. Both detonations were in way of fuel oil tanks and oil was thrown throughout several second deck spaces and over the mainmast structure. Within a few seconds fire broke out and spread quickly. It was fed by oil from the ruptured tanks bubbling up to the surface in the damaged area. The oil thrown over the topside was quickly ignited with the entire mainmast structure serving as a huge torch. This fire was never controlled.

4. Efforts to control the list were futile. Progressive flooding continued and the list increased slowly. About one hour and 40 minutes after the torpedoes struck, the vessel was abandoned except for the Commanding Officer and a salvage party. List continued to increase and when it reached 35 degrees the salvage party and Commanding Officer left the ship. Shortly after this, some three hours and 15 minutes after being hit, NORTHAMPTON rolled completely over and, with the keel showing, plunged by the stern.

5. The points of impact were separated by about 40 feet. As a result, overlapping of structural damage to a minor extent undoubtedly occurred although no indications of failure of longitudinal strength were reported. The fire was of serious proportions and unquestionably hampered damage control efforts. In spite of this it does not appear to have been a vital factor in the loss inasmuch as the major portion of NORTHAMPTON's pumping plant was intact and in an operable condition. Had other circumstances permitted, it appears probable that the fire could have been controlled as was the fire on PENSACOLA*.

6. The extent of immediate flooding reported was consistent with that caused by torpedo hits on other heavy cruisers, notably the PENSACOLA and CHICAGO**. As with the one hit on PENSACOLA and the first two hits on CHICAGO, immediate flooding was not sufficient to cause capsizing. Analysis indicates quite plainly that it was progressive flooding in spaces below the second deck which initially caused the list to increase to the point where water was free to enter on the second deck in large quantities. When this occurred, capsizing was inevitable.

7. The fact that more than three hours were required for NORTHAMPTON to capsize and sink is of particular importance.

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*Buships War Damage Report No. 35.
**Buships War Damage Report No. 37 (not yet published).

It is an excellent example of what may be termed a general rule for damage primarily involving flooding which has been derived from many cases of war experience, namely,

IF THE SHIP DOES NOT SINK WITHIN A VERY FEW MINUTES AFTER DAMAGE. SHE PROBABLY WILL SURVIVE FOR SEVERAL HOURS.

8. Loss of NORTHAMPTON by progressive flooding also parallels other war experience which has shown that,

CASES OF LOSS BY BODILY SINKAGE, PLUNGING OR CAPSIZING SEVERAL HOURS AFTER DAMAGE HAVE BEEN ENTIRELY ATTRIBUTABLE TO PROGRESSIVE FLOODING.

SECTION II - NARRATIVE
(Plate I)

9. The brief accounts contained in the two references constitute the basis for this report. The plate was prepared by the Bureau from a study of the references and from a sketch submitted with reference (b).

10. On 30 November, 1942 a U.S. task force engaged a Japanese force off the north coast of Guadalcanal. The U.S. force was composed of four heavy cruisers, one light cruiser and six destroyers. The cruisers were in column, spaced 1000 yards, with NORTHAMPTON the last ship in column. Four of the destroyers were in column some 4000 yards ahead of the cruisers and the two remaining destroyers were in column astern of NORTHAMPTON. The task force speed was 20 knots.

11. The night was intensely dark with no moon. The sky was completely covered by a heavy overcast of clouds with a ceiling of 3000 feet. Surface visibility was good. A light southeast breeze barely ruffled the surface of the water.

12. The best information indicates that the Japanese force consisted of eight destroyers, of which six were acting as transports. Large and midget submarines also are believed to have been in the area.

13. The U.S. formation was on course 300 degrees true when action was opened by the van destroyers with a torpedo attack at about 2318. At 2320 the cruisers commenced firing to port. At about 2324 NEW ORLEANS* and MINNEAPOLIS** were torpedoed. At about 2339 PENSACOLA*** was torpedoed. All of these vessels were hit on the port side. At about 2348, as NORTHAMPTON was coming to a westerly course after paralleling HONOLULU to avoid

*Buships War Damage Report No. 38.
**Buships War Damage Report No. 36.
***Buships War Damage Report No. 35.

the damaged cruisers, two torpedoes were seen close aboard on the port bow traveling very close together. One appeared to be running at a depth of about 10 feet and the other appeared to be at a somewhat shallower depth. Left rudder was ordered and the ship had started to swing to port when both torpedoes struck. Detonation of the two torpedoes was simultaneous and but one explosion was heard.

14. One torpedo struck at about frame 98 approximately 10 feet below the waterline, and the other one hit at about frame 108 near the surface. The single heavy detonation noted was followed by flexural vibrations of the hull which lasted for a few seconds. Neither flash nor smoke was observed to accompany the detonations. As the flexural vibrations ceased, fire broke out on the port side abreast the mainmast structure. It appeared to be centered at about frame 108 where a hole had been blown in the deck and shell.

15. Structural damage from the hit at frame 98 did not extend above the waterline. The after engine room, however, flooded immediately. The forward bulkhead of this space (bulkhead 90) was deflected forward until it was up against the back of the boilers in the after fireroom. Bulkhead 90 was reported to have opened slightly at the horizontal seams on the starboard side. The bounding angles joining the bulkhead to the second deck also were pulled loose. The stuffing boxes for the cables in the port wiring runs were noted to be leaking badly. The after fireroom thus began to flood but so slowly that personnel had time to escape. The second deck, of 1-inch STS, was raised slightly on the starboard side in the vicinity of bulkhead 102. Bulkhead 102, the after bulkhead of the after engine room, was reported to have been torn away from the shell at the port lower corner.

16. The detonation of the torpedo which struck at frame 108 (near the surface) blew a hole in the shell which extended vertically from below the waterline up to the main deck and longitudinally between frames 105 and 112. About 8 feet of shell plating projected out from the side at these frames (see plate I). The main and second decks were ruptured leaving a hole between frames 107 and 112 extending inboard from the side about 20 feet. Bulkhead 112 between the second and main decks was torn loose at the top and flattened down onto the second deck. The door in bulkhead 102 on the second deck starboard was blown forward into C-204-L. The door on the port side of bulkhead 112 was blown aft, bending the dogs.

17. Considerable quantities of fuel oil, and some diesel oil as well, were thrown up and over the mainmast structure and throughout the second deck spaces between bulkheads 90 and 130. Apparently, oil vapors in this area were ignited and the fire spread rapidly up until the mainmast structure was engulfed in flames. Eventually, the 5-inch ammunition in the ready service boxes for the two after port guns was ignited and began to go off singly with low-order detonations. Efforts to control the fire were not described beyond the statement that at times it was somewhat subdued, but was never entirely controlled.

18. There seems to have been little damage from fragments from the torpedo detonations. The motor whaleboat on the boat deck

on the port side under the crane was reported to have been damaged by fragments. These apparently came from the 5-inch ready service ammunition.

19. The damage from shock was appreciable. No. 6 and No. 8 5-inch guns were lifted from the trunnions and elevated almost vertically. In D-502-E, the after gyro room, the motor generator set on the port side vibrated violently and carried away from its foundations. This was noted before the space was abandoned because of flooding through a rupture (estimated by survivors to have been about one foot in diameter) in the port bulkhead.

20. There was little or no damage observed in the engineering spaces forward of bulkhead 83 other than a pump which was knocked loose in No. 3 fireroom. Nos. 2 and 3 shafts stopped when the after engine room flooded. No. 4 shaft was probably broken in way of the torpedo detonations as it also was reported to have stopped immediately. No. 1 shaft and the forward engine room were undamaged. This shaft stopped, presumably by action of the engine room watch immediately after the torpedoes struck; but after a few moments No. 1 engine was placed back in operation and the ship went ahead.

21. The ship's service telephones were reported to have been put out of commission as a result of shock damage to the telephone switchboard. The general announcing system, however, remained in operation and the bridge retained control of the situation by this means although the lack of loud speakers in the forward engine room and the firerooms hampered the transmittal of orders to those spaces.

22. Immediately after damage a 10-degree port list occurred. Plate I shows the spaces which were reported to have been known to have flooded immediately. In general, these included port tanks between frames 83 and 120, second platform spaces between frames 90 and 112, first platform spaces between frames 90 and 112 and off-center compartments D-10-A and D-402-M on the second platform and D-304-E on the first platform. The Commanding Officer also considered that D-501-M in the hold, D-403-M on the second platform, D-303-A on the first platform and void D-906-V probably were flooded immediately although these spaces were not positively checked. This flooding caused a change of trim by the stern of about 10 feet putting the waterline some 3 or 4 feet above the first platform at the stern. This, combined with the list, put the second deck in way of the damage at about the water level.

23. Some 18,000 gallons of fuel oil were transferred during the first 1½ hours from the port wing tanks outboard of the forward engine room to the starboard wing tanks outboard of the two forward firerooms. About 13,000 gallons of ballast from the port wing tanks outboard of the forward firerooms were also pumped overboard. Despite these measures the list continued to increase and about an hour later had reached 16 degrees.

24. In the engineering spaces forward of bulkhead 83 the transfer and pumping of ballast and fuel oil were started immediately after damage was received, but, as noted in paragraph 20, No. 1 shaft was stopped. Some 20 minutes later, at about 0010, No. 1

engine was again started and the ship went ahead slowly. Reference (a) also reported that the forward generator was started at about this time. It presumably was not in operation at the start of the action inasmuch as no difficulties with it were reported. At 0040 No. 1 shaft was again stopped. It is not clear why the shaft was stopped inasmuch as reference (a) reported that this was done because it was hoped the list would stabilize with no way on, but also reported that at about this time the lubricating oil supply to No. 1 engine commenced to fail. The remaining oil in the lubricating oil storage tanks (approximately 700 gallons) was then run down to the sump of No. 1 reduction gear. Reference (a) reported that in spite of this measure complete failure of lubricating oil supply occurred at about 20 degrees port list which would place the time of this complete failure at about 0110. It is not clear whether the ship was completely dead in the water between 0040 and 0110 or whether No. 1 engine was turning over. In any event, at 0115 No. 1 engine room and the remaining firerooms were secured and abandoned. Apparently, some of the boilers were left in operation inasmuch as the fire pumps were reported to have been left running and, although not specifically mentioned, at least one main generator must have continued to operate as general lighting and auxiliary electrical power remained available to the forward portion of the vessel until about 0200.

25. For the after spaces, very little information is contained in the references concerning either the extent of damage or measures taken, if any, to control flooding. There are, however, some isolated significant events described. In D-406-M oil and water were reported entering through a vertical seam at the forward outboard corner. The crack was about four feet in length. Oil also was reported leaking into this space through electric cable stuffing tubes at the top of the outboard longitudinal bulkhead. The men in this space, together with those in D-408-M (8-inch handling room) and D-410-M remained at their stations long enough to bring powder back down the hoists by manual operation and restow it. They then abandoned the three spaces through D-410-M. Here, the record of their successful escape ends but they must have passed into handling room D-411-M and up to the first platform through the hatch at frame 126 to starboard of the centerline in D-307-L. In the after gyro room (D-502-E) men on watch reported a hole in the port bulkhead with water and oil flooding through it. They escaped through D-307-L, apparently via the trunk in D-503-E and the centerline hatch at frame 117. It thus seems definite that D-502-E, D-406-M and D-408-M flooded quite slowly, that D-410-M was undamaged and finally, that D-307-L was undamaged and dry for a considerable period of time after damage was received. Concerning D-307-L one remaining item of information is significant. A scuttle in one of the hatches leading to the storerooms on the second platform below D-307-L was opened some time after personnel from D-502-E escaped through D-307-L. When the scuttle was lifted both references report that considerable pressure was released and smoke and fumes issued from the scuttle. The hatch in question thus must have been on the port side and probably was the one opening into D-10-A, frames 116 to 121, on the second platform, although there is some possibility that it could have been to D-12-A, frames 121 to 127. Neither reference gave the times of these events nor reported that the scuttle was closed again.

26. At 0130 all personnel except the Commanding Officer and a salvage crew were ordered to abandon ship. Two U.S. destroyers arrived at about 0155 and commenced picking up survivors in the water. During the period between 0115 and 0200 the salvage crew apparently continued efforts to fight the fire, although the references do not report any measures to control list and flooding beyond those taken by the engineering force to move ballast and fuel oil. By 0200 the fire was spreading rapidly forward on the boat deck and the pressure at the fire plugs was very low. Measures taken in the next 40 minutes were not reported inasmuch as reference (a) states only that at 0240 the list was 35 degrees and the salvage party abandoned the vessel.

27. At 0304 the ship lurched to port, the bottom came into view and she rolled completely over and plunged by the stern with the bow making an angle of about 60 degrees with the surface as she slipped under.

SECTION III - DISCUSSION

A. Type of Torpedo

28. The source of the enemy torpedoes has never been established. It was the opinion of the Task Force Commander that NEW ORLEANS and MINNEAPOLIS probably were torpedoed by destroyers. The hits on NORTHAMPTON, however, occurred about 21 minutes later than those on NEW ORLEANS and MINNEAPOLIS, and at 20 knots NORTHAMPTON would have moved some seven or eight miles from the spot where the other two cruisers were torpedoed. All of these vessels, however, were hit on the port side. The absence of detailed information concerning the structural damage to NORTHAMPTON precludes reliable estimates of the type and size of torpedoes. About all that can be said is that the extent of flooding and the size of the hole in the shell resulting from the aftermost hit, as reported in the references, are consistent with what would be expected from a 21-inch torpedo with a 660-pound charge of Hexa.

B. Structural Damage

29. If the locations of the points of impact reported in the references are reasonably accurate, it seems probable that they were close enough together so that structural damage probably overlapped to a minor extent. The references, however, contain no information which would indicate that longitudinal strength was seriously impaired or that breaking up in even a minor degree was a factor in the loss. It follows, thus, that the points of impact were probably separated by a minimum of 30 feet and may have been as far apart as 50 feet. It is improbable that separation was more than 50 feet because initial flooding would have been more extensive. It thus appears that the locations of the points of impact were probably frames 98 and 108, as estimated in the references.

30. The lack of serious damage to the second deck in the vicinity of frame 98 indicates that this torpedo struck at least 10 and possibly 15 feet below the waterline. The holes in the second

and main decks are evidence that the aftermost of the torpedoes struck not far below the waterline at a point possibly as shallow as 4 or 5 feet beneath the surface.

31. It is probable that the forward torpedo ruptured the shell and inner bottom from the "A" or "B" strake up to the bottom of the armor belt. The presence of an internal longitudinal armored bulkhead (3-3/4-inches STS) outboard of the evaporator room and after magazines between the first and second platforms may have had some effect in reducing the transverse extent of damage caused by the after hit. It is noted that personnel escaped from D-502-E (centerline, frames 110 to 117 in the hold) and from magazines D-406-M and D-410-M (second platform, frames 118 to 125, port).

C. Machinery Damage

32. Very little is known concerning direct machinery damage other than that shafts Nos. 2, 3 and 4 stopped immediately. No. 4 shaft, which was directly in way of the damage, was undoubtedly broken as was the case of No. 4 shaft on PENSACOLA*. The port inboard propulsion unit in the after engine room probably was extensively damaged inasmuch as it was almost directly in way of the forward hit. No. 1 shaft apparently was undamaged. Reference (a) reported that the lubricating oil supply to No. 1 engine in the forward engine room commenced to fail when the list reached 15 degrees and that complete failure occurred at about 20 degrees. It was also reported that the remaining lubricating oil in the storage tanks (about 700 gallons) was run down, presumably to the sump. Reference (a) recommended that the lubricating oil suction in the sump be so located that loss of suction because of list will not occur.

33. A study of the arrangement of the lubricating oil system on NORTHAMPTON reveals that the suction in the sump could not have been uncovered when the vessel was listed to angles of only 15 or 20 degrees even with a comparatively small amount of oil in the system. The fact that about 700 gallons of lubricating oil, more than the capacity of the entire system, was subsequently introduced into the system indicates the existence of an undetected leak, possibly caused by shock, in either the suction or discharge piping.

D. Fire

34. A considerable quantity of oil was carried up through the openings in the decks and thrown well over topside structures. Vapors from this oil apparently ignited almost immediately as it was reported that within about two seconds following the initial shock, flames shot skyward, much higher than the mainmast. A similar phenomenon occurred with the torpedoing of PENSACOLA.

35. This phenomenon has been somewhat general in the case of torpedoed tankers in which the deck over the tanks has been ruptured. In most cases, at the instant of detonation, a geyser of water and oil has been blown upward to a height of a hundred

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* Buships War Damage Report No. 35.

or more feet. The geyser normally has two cores; one at the side composed chiefly of sea water and rising to the greatest height, and one up through the ruptured deck composed primarily of oil and reaching a less height than the outer core. Around both cores there is a cloud of steam and gases which gives the effect of a single geyser.

36. If the force of the detonation does not rupture the decks, there usually is an insufficient supply of oxygen for combustion and ignition of vapors is less likely to occur. This was evident on MINNEAPOLIS* and CHESTER* where torpedo detonations in way of side fuel oil tanks did not rupture the second deck and no fires occurred.

37. Under favorable conditions the detonation of a torpedo will cause ignition of oil vapor which may be present in combustible concentrations, either by the generation of heat or by hot fragments. In such cases no other source of ignition is required to cause an oil fire.

38. In cases of an oil fire following a torpedo detonation one of the most important measures is to bring promptly into play as many hose lines equipped with fog nozzles as is possible. Time is the very essence of effective action in combatting a fire of this type inasmuch as it will accelerate swiftly and can quickly advance beyond control of any facilities which are practicable to install on a warship.

E. Flooding and Stability

(Plate I)

39. Reference (b) reported flooding in three categories; immediate flooding verified by inspection immediately after damage, progressive flooding known, presumably by visual observation, to have occurred prior to abandoning the vessel and, finally, immediate flooding which probably occurred. The flooding shown on Plate I is an accurate representation of the compartments listed in reference (b) under the three categories mentioned. These compartments were also shown on a sketch submitted with reference (b).

40. With respect to those compartments which probably flooded immediately, the Commanding Officer's estimate appeared to be reasonable and in the analysis which follows compartments in this category have been considered as having flooded immediately.

41. Liquid loading before damage was not reported but the drafts before damage were given as 19 feet 6 inches forward and 19 feet 7 inches aft. This information permitted a fairly reliable estimate to be made of the GM before damage based on data from the latest inclining experiment performed in April, 1941.

42. The data concerning progressive flooding, given in both references, consisted chiefly of a list of compartments and the statement that they were known to have flooded progressively. The remainder of information of significance on this point was scattered through the references and concerned the escape of survivors from a few spaces below the second deck aft of bulkhead 112 and is condensed in paragraph 25.

43. A brief log of events, contained in reference (a), is the basis of all times used in this report. Inasmuch as the times listed in the log were not qualified in any way they were considered to be approximately correct. An error of a few minutes in any single time given would make little difference in any event.

44. For convenience, a brief chronological recapitulation of the events pertaining to NORTHAMPTON's stability is presented here:

2348 - NORTHAMPTON was torpedoed. The immediate flooding shown on Plate I occurred. The vessel listed 10 degrees to port and increased trim by the stern about 10 feet. The waterline approached, or just passed, the second deck on the port side in way of the damage.

2350 - Commenced transferring fuel oil from port to starboard wing tanks and pumping salt water ballast from port wing tanks overboard. This continued for an unreported time but not longer than 1-1/2 hours. 18,000 gallons of fuel oil was transferred and 13,000 gallons of salt water ballast was pumped overboard.

0040 - Angle of heel was 16 degrees and list was slowly increasing. No. 4 fireroom was probably flooded to the waterline and D-502-E and D-406-M were probably completely flooded. Presumably survivors from lower spaces had made good their escape as described in paragraph 25. The waterline was about four feet above the second deck on the port side in way of damage.

0115 - Angle of heel was 23 degrees and still increasing slowly. The waterline was about to the main deck on the port side. Water on the second deck in way of damage extended to the centerline.

0240 - Angle of heel was 35 degrees and increasing rapidly. Main deck at port side was well under water.

0304 - NORTHAMPTON rolled over to port and, with the bottom showing, plunged by the stern.

45. In the intact condition and at a mean draft of 19 feet 7 inches the initial GM, as indicated by the inclining experiment data, was about 3.4 feet corrected for a normal amount of free surface in tanks. The corresponding displacement was about 11,500 tons.

46. The quantity of water taken aboard in those compartments which flooded immediately totaled about 3200 tons assuming that wing tanks in way of the damage were either full or ballasted with salt water to the waterline prior to damage. Compartments B-4 (No. 4 fireroom), D-502-E and D-406-M were known to have begun flooding progressively almost at once. Compartments C-2 (the after engine room), D-1-E, D-301-L, D-303-A and D-304-E were open to the sea. In this condition, calculations indicate that GM would have been small but positive, probably 3 or 4 inches, if the vessel were upright.

47. However, when compartments D-502-E and D-406-M were completely full and B-4 was flooded to the waterline, calculations indicate that GM would have been more than one foot at a list of 10 degrees. Had there been no further progressive flooding, in all likelihood, the list would have stabilized at this figure until the transfer and pumping overboard of liquids began to return NORTHAMPTON to the upright. At this point, some time between 2400 and 0030, NORTHAMPTON would not have been in jeopardy if flooding had not continued to spread.

48. But D-410-M and, particularly D-307-L were flooding. When water in D-307-L extended from side to side the effect was disastrous. Free surface in this compartment alone would have reduced GM by at least one foot.

49. D-307-L is a large compartment, extending completely across the vessel and more than 40 feet in length. The progressive spread of water across the deck of this compartment caused a simultaneous decrease in the righting moment*. In addition, the moment causing heel (off-center compartments D-10-A, D-304-E and D-406-N with a total capacity of about 190 tons of water, were full) was still increasing slowly as D-410-M, with a capacity of about 35 tons of water, was flooding. Against these factors causing the list to increase there were also two factors tending to keep the vessel upright. The first, and most important, was the vessel's residual stability. The second, and less important, was the movement of liquid, started by the engineering force, which somewhat decreased the moment causing heel. However, the rate of application of this moment was so slow (less than 115 tons of liquid was moved in something less than one and a half hours) that it had but a minor effect in slowing the rate of listing. Of all these factors the free water in D-307-L had the greatest effect, and the angle of heel consequently continued to increase slowly and by 0040 had reached 16 degrees.

50. It will be recalled that at a 10 degree angle the second deck at the low side was at or slightly below the waterline. A small increase in angle of heel beyond 10 degrees would not produce a large area of water on the second deck. A small amount of water on the second deck would not have had an appreciable effect on stability because the spaces immediately below also contained free surface. As list increased, however, water on the second deck, rising through the hole, spread fore and aft and covered areas with no longitudinal bulkheads and larger than those below the second deck. By 0040, with a list of 16 degrees and the waterline 4 feet above the second deck at the low side, the effect of water on the second deck was appreciable and increasing. It will be noted from plate I that the second deck was open from bulkheads 90 to 130, a distance of 160 feet. Thus, as list increased, free surface on the second deck covered an enormous area.

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*Free surface has the effect of causing the transverse metacentric, usually referred to as "M", to move down, if displacement remains substantially unchanged. This in turn reduces the righting arm, usually referred to as "GZ". GZ multiplied by the displacement gives the "righting moment" and hence, righting moment is a linear function of GZ if the displacement be constant.

51. By 0115 the angle of heel was 23 degrees and the main deck in way of damage was awash. D-410-M unquestionably was full and D-307-L must have been nearly full. At this point free surface on the second deck extended beyond the centerline and the effect of this free surface was precisely similar to that for free surface in D-307-L, as explained in paragraph 49. The movement of liquids by the engineering force had ceased and only the inherent resistance to capsizing, as the underwater form changed, was opposing the effect of free surface. As the main deck became submerged more deeply the effect of the change in form of the underwater body became progressively less and the angle of heel increased more rapidly. By 0240 the angle of heel was 35 degrees and increasing rapidly. At this point the salvage party and the Commanding Officer left the vessel.

52. At about 0304 NORTHAMPTON rolled deeply to port and, with the bottom showing, plunged by the stern.

53. Summarizing, progressive flooding destroyed NORTHAMPTON's stability. Thus, calculations with the vessel in the upright condition show that if progressive flooding in D-307-L and D-410-M had not occurred, GM would have been about 1.0 feet. When free surface in D-307-L extended from side to side GM was zero. When D-307-L was full and free surface on the second deck between bulkheads 90 and 130 extended from side to side, GM was a negative 2.5 feet. In this latter condition the curve of statical stability, if plotted, would be completely negative.

F. Conclusions

54. The loss of NORTHAMPTON is entirely attributable to progressive flooding, primarily in D-307-L and to a lesser extent in D-410-M. Had water been denied access to these compartments it seems certain that the second deck would not have been flooded to any great extent under the favorable sea conditions which prevailed. It is probable that NORTHAMPTON could have been righted eventually by the measures to reduce list so promptly started by the engineering force. Although time consuming, the transfer of liquids is effective under such circumstances as was borne out by the cases of PENSACOLA* and CHICAGO** which incurred very similar damage and flooding.

55. The very important lesson to be drawn from the loss of NORTHAMPTON is that flooding boundaries must be determined quickly and maintained effectively. CHICAGO, with an 11 degree initial list and much more extensive flooding than NORTHAMPTON, managed to control and finally to stop completely the infiltration of water into compartments not open to the sea. It required more than four hours for CHICAGO to accomplish this. In addition to drainage facilities, CHICAGO employed portable submersible pumps and even bucket brigades. When the flooding boundaries were established firmly and beyond doubt, the pumps in the two unflooded firerooms were utilized to remove the 11 degree list.

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*Buships War Damage Report No. 35.
**Buships War Damage Report No. 37. (Not yet Published).

56. The cause of flooding of D-307-L was not reported. Yet, as noted in the summary, several events were reported which could have permitted this space to flood. The first and most obvious of these was the escape of survivors through this compartment and who might have left the hatches to lower spaces open. Training of the crew in watertight integrity discipline must emphasize the danger of leaving watertight hatches and doors open and must insure that such must be closed immediately if opened. Another obvious possibility lies in the report that a scuttle to a storeroom below D-307-L was opened for inspection. If the scuttle was in the hatch leading to D-10-A and had been left open, flooding of D-307-L would have occurred inevitably inasmuch as D-10-A was reported to have flooded immediately, probably because of structural damage at the forward end. If the scuttle were in the hatch to D-12-A it is possible that D-307-L could have flooded from this space inasmuch as there is a possibility that the lower forward peripheries of D-12-A were damaged sufficiently to permit slow flooding of this storeroom. The obvious lesson here is the danger of opening scuttles for visual observation of damage to spaces below. Sounding tubes or air escapes should be utilized for this purpose, where installed. Air test fittings can always be used if sounding tubes or air escapes are not installed. Under no circumstances should any hatch be opened where there is even a slight possibility of the space below being flooded.

57. Both references contain statements concerning the spread of water via cable stuffing tubes, notably in the after fireroom and in D-406-M. Such cable stuffing tubes are a recognized source of danger and will permit the spread of water. However, all experience points to the fact that such leakage can be controlled and eventually stopped if flooding boundaries are promptly determined inasmuch as such a step will inevitably disclose such leaks. To date such leakage has always been controlled when prompt measures have been taken.

58. It is noted that NORTHAMPTON was abandoned, except for a salvage crew, at about 0130. At this time the main deck at the low side was continuously submerged, a condition with an alarming appearance. Yet, the salvage crew remained aboard until 0240, at which time the list was 35 degrees. Even at this angle sufficient time was available for the salvage party to make a successful and orderly escape. This procedure was in conformity with instructions issued by the forces afloat following earlier war experience, particularly the loss of YORKTOWN*. These instructions require that no vessel be completely abandoned as long as a vestige of hope remains.

59. More than three hours were required for NORTHAMPTON to capsize and sink. This is of the greatest significance because it is another vivid example among many cases of war experience, primarily involving flooding, which have proved that IF THE SHIP DOES NOT SINK WITHIN A VERY FEW MINUTES AFTER DAMAGE, SHE PROBABLY WILL SURVIVE FOR SEVERAL HOURS. It is this period which presents the opportunity for undertaking effective damage control measures.

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*Buships War Damage Report No. 25.

60. As noted in paragraph 54, the loss of NORTHAMPTON has been attributed to progressive flooding. This is again of the greatest significance because this parallels other war experience which has shown that CASES OF LOSS BY BODILY SINKAGE, PLUNGING OR CAPSIZING SEVERAL HOURS AFTER DAMAGE HAVE BEEN ENTIRELY ATTRIBUTABLE TO PROGRESSIVE FLOODING.

61. The fact that effective damage control measures were not achieved is attributable to the difficult situation created by a combination of extensive flooding and structural damage, a fairly large list, and a severe oil fire. The circumstances are discussed in some detail in this report for the purpose of offering guidance to ships which may unfortunately be confronted with similar situations in the future. Damage control training should be based on coping with the most adverse combinations of conditions.