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**UNDER CONSTRUCTION**

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# USS SCORPION SSN-589 - Court of Inquiry Findings

The following is my transcription of an information package I received from on 27 Dec 1996. Occasionally in the document there will be blanked out area that represent details regarding the search and do not impact the scope of the investigation.

There are a few typo's and errors. This is mainly due to the very poor quality of the findings we received. If anyone has a better copy and can help me correct some of the errors please let me know.

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PRESS RELEASE

26 Oct 1993

## NAVY RELEASE OF SCORPION/THRESHER DOCUMENTS & VIDEO

Changed world security situation allowed Navy to review the records on these two tragic accidents with an eye toward as much disclosure as possible...safeguarding only that operational or technical information about submarine operations and design still requiring protection.

NAVY intended general release BUT felt obliged to respond first to Freedom of Information Act requests which had been received while review of material was underway... that happened yesterday.

Navy News Desk at CHINO has copies of the materials if you're interested...photos have been put on PRESS LINK with caption data.

material does not contradict any previously released info, but does offer some additional details of the accidents themselves, and considerable data on the environmental monitoring the Navy has conducted at the two sites over the years.

Basic conclusion is that neither the presence of these two nuclear propulsion plants on the ocean floor nor the two nuclear weapons which were aboard USS Scorpion have posed any radiological threat to the surrounding environment. No sample from either site has ever shown any evidence of release fob radioactivity from the reactor fuel.

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On reconvening in November, after SCORPION was located, the court focused its attention on "what if as opposed to "what might have been" While mindful of earlier evidence, a conscious effort was made to prevent undue influence by old concepts and preconceived notions in a search for the most probably cause of the tragedy. Emphasis was placed on complete familiarity with all photographic evidence. Close coordination was maintained with the Naval Research Laboratory Evaluation Group in order to focus the scientific expertise of its members on areas of greatest productivity. The end result has been a greater depth of study than might otherwise have been possible in the time allotted. The Court reviewed it SE original report in the light of new evidence and has concluded that all findings of fact, opinions, and recommendations previously submitted

are still valid except that part of fact number 29 which relates to the identification of an uncharted sunken hull to be a small merchant ship, not a World War ID type submarine as previously identified.

The Court, after inquiring into all additional facts and circumstances connected with the loss of SCORPION, having considered the new evidence and having reconsidered the previous evidence, and finds additionally as follows and submits the following supplementary opinions and recommendations:

### FINDING THE FACTS

1. That the acoustic signals attributed to SCORPION were relocated at stations in Argentina, Newfoundland and the Canary Islands. Individual acoustic signals and stations recording them are outlined on the next page entitled "Table of Factual Data Acoustic Events."
2. That acoustic event number one has been determined by experts to be the result of high energy release, rich in low frequencies with no discernable harmonic structure.
3. That the Technical Director testified that the first SCORPION acoustic event looked different and sounded different from subsequent events, but he was unable to determine whether the initial event was an explosion or an implosion.
4. That, in the opinion of experts SCORPION acoustic events six and seven and eight appear to be from similar sources as indicated by their relative spectra and strong harmonic frequencies.
5. That the Director of Research Naval Research Laboratory after analyzing available acoustic data indicated that SCORPION acoustic events one, three, four, five, six, seven, eight, nine, and 13 were probably the events, and events ten, 10, 12 and 15 probably echoes of events one, eight, nine and 13 respectively reflected from Plato Sea Mount. He further stated he had not completed his analysis of event 11 and that event 14
6. That when an explosion occurred in a closed space and does not vent, a bubble is formed that pulsates. The size of the charge and the depth of the detonation can be correlated with the frequency of the bubble pulsation.
7. That a contact explosion of a charge of about \_\_\_\_\_ on the outside of a submerged submarine hull would instantly rupture the pressure hull and create a hole equivalent to several feet in diameter.
8. That recent experiments conducted by the Naval Ordnance laboratory and further testimony by experts in underwater explosive confirmed that it is possible to detonate an explosive device against a submerged air filled container or a submarine without observing a bubble pulse.
9. That the implosion of internal tankage due to pressure may or may not result in the detection of a bubble pulse.
10. That a series of calibration shots was conducted in the vicinity of \_\_\_\_\_ approximately one month after the loss of SCORPION and attempts were made to record these signals at acoustic stations that recorded the acoustic events attributed to SCORPION. The results are summarized as follows.
11. That the purpose of the calibration series was to verify predicted sound velocities in order to improve the accuracy of the search datum fix. In addition, the calibration series provided raw data

concerning signal strengths and characteristics of known charges detonated at various depths for comparison with acoustic signals attributed to SCORPION.

12. That the acoustical data which was considered to relate to the sinking of SCORPION was refined and a position determined at \_\_\_\_\_ which was designated as Point Oscar.

13. That the calibration shots fired at 1500 feet were recorded indicating similar energy levels at \_\_\_\_\_ Argentina. The first SCORPION event was recorded at Argentina

14. That an attempt was made to determine the depth of the initial SCORPION acoustic event by comparing the shape of the acoustic signal envelope with the envelopes signals from calibration charges exploded known depths Due to the many variables involved the results were inconclusive.

15. That the weight of expert testimony based on a comparison of data from analysis of the SCORPION acoustic events and the calibration series indicated that the first Scorpion event was either very small which is not compatible with the recording at the Canary Islands ) or it was at 500-700 feet or less

16. That the director of research Naval Research Laboratory stated that by measuring the time difference of two vertical multi paths of scorpion acoustic signal number one he estimated the signal depth to be 400 plus 0 minus 150 feet.

17. That witness concluded that one of the strongest factors indication that the initial SCORPION acoustic event was at a shallow depth is the requirement to reconcile hydrodynamics considerations with the 9 second delay between the first and second true acoustic events remaining from SCORPION. This consideration is independent of the analysis of acoustic events.

18. That during the months of August and September an artifact was discovered to the south and east of Point Oscar. Individual pieces numbered about 50 and were distributed in a medium pattern up to two miles from Point Oscar. None of the artifacts with certainty could be associated with a submarine.

19. That at about 0300Z on 30 October 1968 while viewing films on board USNS MIZAR Captain James T. Traylor USN Commander Submarine Squadron TEN and Commander Task Unit 4.2.1 Senior Officer Search Force) detected what he considered what was later identified as portions of SCORPION.

20. That after determining that the film showed portions of a lot marine hull, the Senior Officer impounded that film, and all subsequently exposed films and contained them in his custody until he delivered them to the appropriate naval authority.

21. That the depth of water at the position at which SCORPION was found was determined to be 11 100 feet and the minimum depth of water in the general vicinity was 9,600 feet.

22. That the bottom where SCORPION rests is level except where disturbed by the impact of the hull. The sediment is clayey silt and a core sample showed globigerina throughout the sample (Supp. Ex. 40. )

23. That during June and October in the vicinity of \_\_\_\_\_ the Senior Officer Search Force observed variable surface currents at a velocity of .3 to .7 knots. The currents at the bottom are classified as insignificant by the Naval Oceanographic Office.

24. That the major wreckage a submarine was found in a area at about 800 feet diameter centered at position \_\_\_\_\_ And that this wreckage has been identified as that of SCORPION by the Commander Submarine Force, U.S. Atlantic Fleet and there competent authorities.

25. That the distribution of debries is probabaly octatalaly defined but based on the plot repaired by the Senior Officer Search Force from photographs and navigational data, the debries field stands for about 3000 feet in a Norht West South East direction from the present location of the after hull section. The wigth of the field is about 1800 feet.

26. Info based on the photographs edivence pressented to the court and the evaluation and reports of technical experts on this same photographics edivence, the conditions of the major sections of SCORPION'S hull are summarized as follows:

#### I. After Hull Section

- a. The forward portion of the Engine Room is imploded , collapsed and/or telescoped into or around the Auxiliary Machinery Space.
- b. There is a clean siplunterential break of the Engine Room at or near the amine cylinder juncture frame 57.
- c. The tail section with upper ruddre and port surfaces attatches is visible from about frame 86 to the end of structure about frame 101 and appears structucutaly undistorted.
- d. The propellor with shaft attached, is separated from and located well of jull sections.
- e. The light tank plating and framing around the Auxiliary Machinery Space appears to be relatively undamaged.
- f. The visible portion of the forward end of the after hull section terminates at about frame 88 in an apparent clean cross lateral fracture.

#### II. Forward Hull Section

- a. The forward hull portion extends from the extreme bow or forward perpendicular to about frame 28 or 30 on the starboard side. the after edge break appears irregular rather shactruacumratential. It appears to progress around the heavy periscope and mast insert area on the top centerline at about frame 21 tp 32 amd then to angle starboord about frame 31 to the port side.
- b. From about frame 26 forward the axis of the bow structure is straight but the remaining structure after frame 26 is bent to port about 15 degrees.
- c. The forward escape trunk upper access hatch is detached.
- d. The Bridge Fairwater (Sail) is separated from the hull section
- e. The outer hull plating between frames 22 and 27 is distorted primarily on the port side with one distored area on the starborad side about frame 25.

#### III. Missing Hull Section

A large segment of pressure hull from about frame 38 to frame 34 port and from about frame 29-

30 starboard has not been identified in the photographic evidence available.

#### IV. Bridge Fairwater ( Sail )

- a. It is lying on its port side separated from the hull sections.
- b. The leading edge, top and after edge above the level of the fairwater planes, exhibit no structural damage.
- c. The starboard fairwater plane appears to be undamaged and in normal position.
- d. The sail plane access door appears normal but the deck access door is detached.
- e. The leading edge of the fairwater below the top of the deck access door is displaced aft and / or to port.
- f. The Bridge clamshell appears to be rigged for dive.
- g. The fairing for No. two periscope is exerted and the upper section (deplumer ) is missing
- h. The VLF loop antenna ( football ) appears undamaged and extended in normal position.
- i. The AN/BRA-9 helical antenna is extended, discredited and the fairing missing.

27. That photographic evidence depicts disturbed bottom areas with large unidentifiable items that appear to be portions of hull structure separated from the major hull sections Supp. Ex.32-35.

28. That Gamma radiation readings taken at the ocean floor and of the bottom core sample taken at SCORPION's location give little or no background readings. Water samples taken in close proximity to the Reactor Compartment of SCORPION gave only normal background readings.

29. That the court studied photographic evidence of THRESHER remains and evaluations of implosion testing of U.S. and British submarine.

30. That the estimated collapse depths to SCORPION'S principal pressure hull compartments, tanks, trunks, and bulkheads are as follows:

31. That the photographic evidence does not portray, in the evaluation of the structural expert, any of the failure conditions expected or previously experienced in the hydrostatic collapse (implosion) of submarine hull structures.

32. That the testimony of experts indicates that the telescoping of the Engine Room forward would be a high energy event, would occur in a fraction of a second and bubble pulse may or may not be detected.

33. That evidence presented did not establish that there was or that there necessarily should be visible evidence of burning or scorching.

34. That there is no evidence that the loss of SCORPION was the result of an unfriendly act.

35. That is probable that the high order detonation of a torpedo in the Torpedo Room would cause sympathetic detonation of other torpedo warheads stowed in the near vicinity.
36. That, during an oxygen fire in the stern room of USS SARGO (SSN-583) on 14 June 1960, two MK 37 torpedo warheads detonated low order. The pressure hull of SARGO was not ruptured.
37. That, in the opinion of expert witnesses, the high order detonation of one or more torpedoes in the Torpedo Room could destroy or severely damage the Torpedo Room bulkhead, frame 26, and could damage the surrounding hull structure.
38. That, in the opinion of the structural experts, the hydrostatic collapse of the Operations Compartment would damage or destroy structure in the vicinity of the forward conical transition section, frames 26 to 28.
39. That an explosive shock loading in the vicinity of the Operations Compartment would be expected to cause longitudinal whipping of the hull which could induce high bending moment stress in the vicinity of the cone cylinder juncture, frame 67.
40. That the configuration of the cone cylinder juncture at frame 67 makes this a high stress point due to normal hydrostatic loading and that this area is constrained by the applied stresses to collapse less than sections forward or aft of the juncture point.
41. That the hydrostatic collapse of the Engine Room bulkhead due to flooding forward of frame 64 would probably occur at about an \_\_\_\_\_ pressure head; that such a failure in to the Engine Room would, through the bulkhead stiffing and main girder reinforcements, induce additional large bending stresses in the ----- juncture, frame 67; and that the stress loading would tend to bend the cone cylinder juncture outward relative to the platform ----- frame 67.
42. That the Chief Scientist for the Navy & Strategic Systems Project and Deep Submergence System Project testified that it was his opinion, \_\_\_\_\_ that an intact submarine which passes through collapse depth will produce one very large complicated multiple bubble pulse type signal and that there would not be a large number of other mahor events associated with that collapse. He further testified that the large number of accustic signals associated with SCORPION is characteristic of the signals foram a submarine going through deep depths after experiencing substantial flooding. He therefore concluded that the first SCORPION event was not the type of signal associated with an intact submarine passing through collapse depth.
43. That the Commander Submarine Force, U.S. Atlantic Fleet has postulated that SCORPION was lost as a result of a flooding type casualty which originated at a depth of \_\_\_\_\_ feet or less; that for undetermined reasons the flooding caused the ship to sink near or beyond the hull designed collapse depth, that the Engine Room telescoped into or around the Ausiliary Machinery Space at a depth of about \_\_\_\_\_ feet, and, that this was the initial acoustic event.
- 44 That the Technical Director, NRL, estimated the average sinking rate between acoustic event one and acoustic event six to be in excess of 16 feet per second.
45. That NSRDE Report, S-301-H-01 of October 1968, predicted for SCORPION, fully flooded and intact, an impact trajectory Velocity of about 35 knots (58+ feet per second) at a depth of 11,000 feet based on the initial conditions \_\_\_\_\_ foot depth trajectory velocity \_\_\_\_\_ knots, full rise on the fairwater and stern planes a three degree down pitch angle, and a rate of change of depth of 22 feet per second.

46. That the Chief Scientist of the Navy's Strategic Systems Project and Deep Submergence Systems Project testified that in his opinion SCORPION probably did not break apart prior to impact with the bottom.
47. That the Court attempted to utilize the ship motion simulator facilities at the Naval Ships Research and Development Center (NSRDC) to provide the Court with evaluation and guidance indices of possible actions and events associated with SCORPION's loss but was unable to obtain such studies.
48. That, following the finding of SCORPION, an evaluation group was established by the Chief of Naval Operations at the Naval Research Laboratory (NRL). The membership of this group was drawn from naval activities which had the diverse scientific and technical competence considered essential to the effective analysis of the available data (Supp. Ex. 25).
49. That the NRL Evaluation Group did not as a group attempt to make a conjecture regarding the cause for the loss of SCORPION.
50. That an officer who had served in a sister ship of SCORPION and who had been Ship Superintendent for SCORPION during two shipyard availabilities (1965 and 1967) assisted the NRL Evaluation Group in the identification of debris. In testimony before the Court he reduced his level of confidence about identification of some of the parts. Specifically, he expressed doubt about his identification of a torpedo handling track from the Torpedo Room, which is Annotation number one on Supplementary Exhibit 28, and stated that items from other than the Operations Compartment did not seem to be present.
51. That the identified debris from inside the ship is associated with the operations compartment.
52. There are no objects identified in the debris field which can be definitely associated with the Torpedo Room.
53. That neither the Senior Officer, Search Force, nor any of the numerous experts who viewed the photographic evidence could identify in Supplementary Exhibit 26 as number two periscope. This item appears to have a flange on the end which does not exist on a periscope but is present on the mast of the AN/BPS-9 radar.
54. That the twisted pipe-like object bent forward and to starboard from the aftmost portion of the bow sections is identified in Supplementary Exhibit 26 as number two periscope. This item appears to have a flange on the end which does not exist on a periscope but is present on the mast of the AN/BPS- radar.
55. That the arrangement of the principal parts of SCORPION as shown by the photographic mosaic (Supp. Ex. 26) is in general agreement with the plot made by the Senior Officer, Search Force based on the navigational track of the towed sled. (Supp. Ex. 22)
56. That the Cartographer who prepared the photographic mosaic expressed doubt about the aspect of the bow section. He stated that the scale of the mosaic was arrived at arbitrarily, is not the same for all parts, and consequently introduces visual distortions.

### OPINIONS

The finding of SCORPION's hull does not lessen the tragedy of her loss nor does it lessen the

obligation to identify and correct any practice, condition, or deficiency subject to correction.

The photographic evidence made available, on finding SCORPION, reduced the areas of speculation regarding the cause of her loss and provided impetus to refocused scientific analysis of all available data pertaining to this tragedy. After careful weighing of all resulting evidence the Court finds that there is still no incontrovertible proof of the exact cause or causes for SCORPION's loss.

1. That the submarine located on the bottom at is SCORPION.

2. That, having weighed all new evidence and having reexamined all previous evidence in the light thereof, the following key facts and technical opinions are considered cardinal in estimating the most probable scenario for the loss of SCORPION. These are:

a. The first acoustic event

(1) Originated at a depth of feet or less;

(2)

(3) Had no bubble pulse frequency recorded.

b. The casualty, which initiated the first acoustic event

(1) Represented an incident that was cataclysmic in nature;

(2) Occurred forward of frame 44; and

(3) Resulted in uncontrollable flooding.

c. There is a 91 second time interval between the first acoustic event and the next true acoustic event (Event No. 3).

d. The remaining true acoustic events, 4 through 13, were recorded over a time span of 74 seconds.

e. The Engine Room at about frame 67, telescoped into or around the Auxiliary Machinery Space.

f. The pressure hull structure between about frames 29 to 38 has been destroyed.

g. The visible hull plating of the remaining hull sections show an absence of massive damage thereto.

3. That the following is a logical general scenario related to the acoustic events;

a. Ship is at a depth of 250 feet or less. Position of watertight doors open if normal cruising, shut if in an emergency situation. Casualty occurs which results in flooding from sea (Acoustic Event 1). If not incapacitated, personnel initiate recovery action, but in any event, ship begins to lose depth control due to inability to control or counteract flooding.

b. The flooding most probably occurred as a result of a casualty in the area of the Operations Compartment or Torpedo Room.



(1) If the initial casualty was in the area of the Operations Compartment, on reaching a depth of feet the Reactor Compartment bulkheads rupture. If the tunnel doors were shut, the forward and after bulkhead collapse in quick succession. If open, the Reactor Compartment below the tunnel ruptures. The Torpedo Room may or may not flood during this period depending on the nature of the initial casualty and whether the Torpedo Room watertight door was open or shut.

(2) If the initial casualty was in the area of the Torpedo Room, extent of flooding would depend on whether the Torpedo Room bulkhead was damaged and whether the watertight door was open or shut.

c. The Engine Room door would probably now be shut whether or not it was shut before the flooding casualty occurred.

d. On reaching a depth of feet:

(1) If the initial casualty was in the area of the Operations Compartment and if the Torpedo Room door had been shut, the Torpedo Room bulkhead collapses into the Torpedo Room and the forward escape hatches blow out.

(2) If the initial casualty was in the Torpedo Room, and the bulkhead had not previously been ruptured and the door had been shut, the Torpedo Room bulkhead now collapses into the Operations Compartment and the forward escape trunk hatches blow out.

(3) If the bulkhead had been previously ruptured or weakened, it could have collapsed at a lesser depth.

(4) In any event, a bubble pulse results from this bulkhead collapse or escape trunk blow out (Acoustic Event # 3.)

e. Shortly after the above event, due to a combined sea and air pressure in the Auxiliary Machinery Space now equal to about feet of water, the Engine Room bulkhead collapses into the Engine Room. This results in telescoping of the Engine Room into the Auxiliary Machinery Space (Acoustic Event #4). This piston effect, driving forward against what is now a considerable volume of water in the ship forward of the Engine Room bulkhead, could have resulted in further severe damage rupture to the Operations Compartment hull plating. The main shaft's probably extruded at this time but remains attached to the ship.

f. Ship is now completely flooded except for various hard tanks and air pockets and continues to sink rapidly in excess of 15 feet per second. On passing approximately feet, an internal tank implodes (Acoustic Event #5).

g. On passing feet, torpedo tubes or other tankage implode in fairly rapid succession (Acoustic Events #6,#7 and #8)

h. As SCORPION continues to sink below feet, remaining true acoustic events can logically be accounted for as follows:

i. Ship, still in one piece although severely damaged amidships, continues to sink, reaching a trajectory velocity of approximately 25-35 knots. Ship hits the bottom with a relatively small trim angle.

j. On impact, the ship breaks apart. The sail is probably separated from the ship at this time. The main sections of the hull probably bounce and skip before coming to their final resting place. A

considerable amount of debris is spilled out during this process. The main shaft, either on initial impact or shortly thereafter, is thrown clear with screw still attached. The bow section plows deeply into the bottom in an upright position. The stern section slews around and finally comes to rest on its starboard side. During this movement, or perhaps on initial impact with the bottom, the starboard stabilizer and stern plane snap off, separate and are thrown clear.

k. The pressure/depth ranges stated above reflect considerations to account for flooding rates, damage conditions, and dynamics of ship motion.

4. That in addition to the cardinal points considered in construction of the above scenario, the following facts and opinions are pertinent in support of a most likely cause of the loss of SCORPION;

a. The initial casualty, which resulted in flooding, was most probably due to causes other than characteristic implosion of a major compartment.

b. The visible structural damage in the Operations Compartment does not clearly indicate the failure mode but is more probably associated with an explosion rather than an implosion.

c. If an external explosion in contact with the pressure hull and initiated the casualty, the resulting gas bubble could vent and the submarine and no bubble pulse would be detected.

d. The initial casualty resulted in flooding forward of the center of gravity generating a down angle on the ship. By the time of telescoping of the Engine Room, it is postulated that this down angle could approximate 60%. Subsequent to telescoping and complete flooding of the ship, the trim angle would tend to decrease.

e. (The two signals, 1.8 minutes apart, detected by SOSUS emanated from SCORPION and correspond to acoustic events number one and six or to event number one and a combination of events five, six and seven.

f. The Engine Room was not flooded by (the first event) and was the last compartment to flood.

g. Except for the Engine Room, SCORPION was fully flooded before passing hull collapse depth.

h. The location of the initial casualty and the resultant flooding caused the Engine Room bulkhead to collapse into the Engine Room initiating failure of the cone cylinder juncture about frame 67.

i. (Telescoping of the Engine Room into the Auxiliary Machinery Space produced a high energy, low frequency acoustic event and may or may not have produced a detectable bubble pulse.)

j. (Telescoping of the Engine Room corresponds most probably to acoustic event number four; however, if the Torpedo Room bulkhead was destroyed or severely damaged by event number one, the telescoping could correspond to event number three.)

k. (Although the nature and magnitude of acoustic events six, seven and eight suggest the Engine Room telescoping analysis of the depth of SCORPION at the times of these events mitigate against this conclusion.)

l. The effective pressure applied to internal structures could lag the static pressure head due to flooding rates damage conditions, and dynamics of ship motion.

- m.. can affect the signal reception capability as evidenced by the calibration shots heard at Arentia when detonated at a depth of 1500 feet. or greater, it could have occurred at about
- n. Separation of th hull in the Operations Compartment area occurred upon impact withthe bottom, however, severe damage to this area resulted from the initial casulty and was aggravated by the telescoping of the LLEngine Room and the action of hydrodynamic forces while sinking.
- o. The detachment of the propellor and shaft was not an initiation casualty.
5. That the finding of SCORPION so close to the point computed from the acoustic events leaves no doubt that these events did in fact emunited from the SCORPION.
6. That currents in the area would have a limited effect on the distrubution of debris, but light objects, dropped from near the surface, would probably be carried in a southerly direction.
7. That all photographs avaiable at this time, which pertain to the loss of SCORPION, have been examined to dicover and analyze any clues which might lead to an explanation for the loss of SCORPION.
8. That no definitely identifiable human remains appeared in any photograph reviewed by the court.
9. An examination of the photographs of SCORPION's hull and associated debris does not lead to the certain conclusion that the first ascoustic event was caused by either and explosion or and impllosion.
10. That the fact that SCORPION was limited to an operating depth of feet, though designed for a test depth of feet, supports the conclusion that she was above feet when the initial casualty occurred.
11. That the positions of the various mast, relative to the top of the Bridge Fairwater, do not permit a certain conclusion as to mode of operations or depth of the ship at the time of the initial casualty.
12. That acoustic event number one was most probalby an explosion of the large charge weight externalto the pressure hull.
13. That the initial acoustic evnet produced a degree of damage and race of flooding from which no submarine could be expected to survive.
14. That, as established in the original report (fact 271 ), the only item on board, forward of frame 44, with sufficient explosive energy to cause the initial evnet, were the torpedo warheads.
15. That in view of the lack of identifable debris from the Torpedo Room, it is concluded that the Torpedo Room was not the location of a major explosive event.
16. That, while the sequence of events postulated by the Commander Submarine Force, U.S. Atlantic Fleet is considered possible, the weight of evidence leads to the conslusion that such a sequence of evnets was not probable.
17. That in the absence of evidence to the contrary it is assumed that objects in the "artifact field" are associated with SCORPION.
18. That some debris spilled out of the Operations Compartment of SCORPION on h

19. That the absence of air or oxygen flasks in the debris field indicates that there was no severe damage to the ballast tanks in which they are located and supports the opinion that the Engine Room telescoped into rather than around the Auxiliary Machinery Space.
20. That the identifiable debris does not lead to a determination of the cause for the loss of SCORPION.
21. That the damage to the stern planes and rudders was not a primary cause of loss of SCORPION.
22. That there is no conclusive photographic evidence that relates the condition or position of the visible ship control surfaces to the cause for the loss of SCORPION.
23. That the lower trunk access hatches could fail catastrophically from pressure inside the submarine and the resultant water jet could detach or destroy the upper hatches.
24. That, since the Bridge Fairwater appears essentially undamaged in the vicinity of the bridge access trunk, implosion or collapse of the bridge access trunk is improbable.
25. That the Bridge Fairwater was probably loosened by the initial event and separated from the ship on impact with the bottom.
26. That the outer hull distortion about frames 22 to 27 port most probably resulted from the hydrodynamic forces attendant to sinking and from impact on the bottom.
27. That the outer hull damage about frame 25 starboard is most probably a wrinkle due to distortion from sinking motions or bottom impact.
28. That the visible structural failures shown in the photographs are not indicative of deficient or defective materials or workmanship as a primary cause of SCORPION's loss.
29. That the information sought from the NSRDC ship motion simulator studies has been adduced by other means and the lack of these studies does not adversely affect the finding of the Court.
30. That the additional evidence supports the finding that no radiological hazard resulted from the loss of SCORPION.
31. That the additional evidence does not establish that the loss of SCORPION and deaths of those embarked were caused by the intent, fault, negligence, or inefficiency of any person or persons in the naval service or connected therewith.

### **RECOMMENDATIONS**

1. That, as part of the continuing efforts to obtain additional clues as to the cause for this tragedy and to prevent others, a further examination of the main hull sections of SCORPION and the associated debris field be conducted as and when practicable using the latest techniques available.
2. That consideration be given to the research and study of large weight contact explosions to determine the damage mechanism, to evaluate secondary effects thereof and to provide currently unavailable data for future design improvements for damage resistance to high performance submarines.

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