Introduction

This document provides:

- Summary (pages 2-3)

- Letter dated 14 March 2009 (pages 4-28)

- Letter dated 3 April 2009 (pages 29-38)

- Letter dated 30 June 2009 (page 39)

- Letter dated 28 October 2009 (pages 40-44)

These letters provide the results of the first reanalysis in 40-years of acoustic data associated with the loss of the US nuclear submarine SCORPION (SSN 589) on 22 May 1968 in the East Central Atlantic.. Subjects of special interest are discussed on the following pages.

Pages 8-16: Analysis that confirmed two explosions contained within the pressure-hull were the initiating events that resulted in the loss of SCORPION.

Pages 22-28: Analysis that establshed SCORPION did not reverse course to deactivate a Mk-37 torpedo as conjectured in 1968.

Pages 30-31 and 33-35: Data that refutes the 1968 contention that a bubble-pulse signal could be "swallowed" within a collapsing submarine pressure-hull and not be acoustically detected. These pages also provide the basis for rejecting the 1968 conclusion that all post-pressure-hull collapse acoustic events were produced by the impacts of large masses of machinery torn loose from their foundations by the collapse event and adrift within the telescoped SCORPION after hull sections. These signals were produced by small, more-pressure-resistant structures within the wreckage that failed at depths greater than hull collapse at 1530-feet.

Page 39: Information that confirms the SCORPION wreck-site is located on the intended course of 290 from her 220001Z May 1968 position as reported by COMSUBLANT message date-time-group 271946Z May 1968.

Pages 40-41: Identfication of six-post pressure-hull collapse acoustic events as the probable collapse of SCORPION torpedo-tubes at depths between 3370- and 4570-feet.

Summary

When the US nuclear submarine SCORPION was lost in the East Central Allantic on 22 May 1968, the event produced a series of acoustic signals detected by sea-floor sensors on both sides of the Atlantic.

The first reanalyses of these acoustic signals in 40-years has resolved many of the questions associated with the loss of SCORPION by providing the following new information.

- The initiating events responsible for the loss of SCORPION were two explosions that occurred one-half second apart at 18:20:44Z on 22 May 1968 and were contained within the submarine's pressure-hull. The source of these explosions, which are estimated to have been equal to the explosion of no more than about 20 lbs of TNT each, cannot be determined from analysis of the acoustic data.

- These explosive events prevented the crew from maintaining depth-control. SCORPION sank to 1530-feet at which depth the pressure-hull and all internal bulkheads collapsed at 18:42:34Z on 22 May 1968 in one-tenth of a second with a force equal to the explosion of 13,200 lbs of TNT at 1530-feet. This energy was produced by the almost instantaneous conversion of potential energy in the form of 680 psi sea-pressure on the entire SCORPION pressure-hull to kinetic energy, the motion of the intruding water-ram which entered the pressure-hull at supersonic velocity: circa

The collapse depth of 1530-feet was determined from the empirical relationship among three values: (1) the volume of the collapsing structure, (2) the frequency of the bubble-pulse signal produced by the collapse event, and (3) the depth at which collapse occurred. If the depth and the bubble-pulse frequency are known, the size of the energy release - in lbs of TNT - can be derived.

- During the 111.6-second period when it was conjectured in 1968 that SCORPION had reversed course to deactivate a Mk-37 torpedo that had become active in its launch tube, the already-fragmented hulk was sinking at about 12-knots with a displacement of no more than 100-feet from the vertical.

- During the 200-second period following pressure-hull collapse, 17 additional acoustic events were detected. These events were produced by more pressure-resistant small structures that survived within the wreckage to collapse at greater depth. Six of these events were produced by the collapse of the SCORPION torpedo-tubes at depths between 3370- and

4560-feet.

There were no explosions from a torpedo or any other source external to the SCORPION pressure-hull. SCORPION was lost because of an onboard problem (the two internal explosions) the crew could not overcome. There was no involvement by Soviet forces as conjectured by several conspiracy-theory books.

An understanding of the four technically-complex letters provided by this document is critical to a full appreciation of how much has been learned from analysis of the acoustic data about what happened to SCORPION, and, as importantly, what DID NOT happen to SCORPION.

14 March 2009

From: B. Rule, 3931 Brookfield Ave, Louisville, KY 40207-2001
To: RADM Cecil D. Haney, Department of the Navy, Chief of Naval Operations 2000, Navy Pentagon, Washington, DC. 20350-2000

Subj: Analyses of Acoustic Data Associated with the Loss of the USS SCORPION

Ref: (a) USS SCORPION (SSN 589) RESULTS OF NOL DATA ANALYSIS (U) (NOLTR 69-160 of 20 January 1970) Robert Price and Ermine Christian
(b) EVALUATION OF DATA AND ARTIFACTS RELATED TO USS SCORPION (SSN 589), Prepared for Presentation to the CNO SCORPION Technical Advisory Group by the Structural Analysis Group dated 29 June 1970. CAPT Harry Jackson, Messrs. Peter Palermo, Dr. R. T. Swim, Robert Price, et al.
(c) USS SCORPION (SSN 589) - Court of Inquiry Findings

Encl: (1) Identification of the Initiating Events That Resulted in the Loss of the USS SCORPION (SSN-589) on 22 May 1968 (13 pages)
(2) Analysis of Acoustic Data Used to Support the 1968 Assessment that the USS SCORPION Reversed Course and Was on an Easterly Heading When Lost (7 pages)

I. BACKGROUND

In 1968, the SCORPION Court of Inquiry received erroneous information based on incomplete and inaccurate analyses of acoustic detections of the loss of SCORPION on 22 May 1968. Although conjecture that own-ship's torpedo was involved in the disaster was debunked by the 1970 Phase II Study, this conjecture was not officially refuted and, consequently, has become generatively responsible for recent conspiracy theories. Books that propound these theories have produced unwarranted confusion about this national disaster while SCORPION families still await a coherent official explanation from the Navy that is based on all available information.

This letter summarizes the initial results of the first reanalysis in 40 years of acoustic data associated with the loss of the USS SCORPION. These results, which are based on original unclassified data that have been in the public domain for 40 years, provide the Navy with the opportunity to fully, officially and publicly disclose what is now known about the events that preceded and resulted in the loss of SCORPION.

II. DISCUSSION

The exploitation of original Columbia University Hydroacoustic Station Canaries (CUHSC) and Sound Surveillance System (SOSUS) array 3141 detections of acoustic signals associated with the loss of SCORPION has provided important new information on the cause of that event, and, as importantly, what did not cause the event. This information, and discussions of the supporting analyses, already have been provided to the Naval History and Heritage Command (NHHC), e.g., enclosures (1) and (2). Additional information will be provided later in 2009.

This new information includes the following:

- (a) As discussed in detail by enclosure (1), four independent lines of evidence confirm the initiating events that resulted in the loss of SCORPION were two low-order explosions contained within the pressure hull. These events, of equal amplitude, occurred within a half-second period at 18:20:44Z on 22 May 1968. (NHHC has this analysis.)

- (b) As discussed in detail by enclosure (2), during the 111.6-second period when, in 1968, it was conjectured by Dr. John Craven that SCORPION reversed course to deal with an onboard torpedo problem, the horizontal movement of the submarine was not more than 100 feet. (NHHC has.)

- (c) The SCORPION pressure-hull collapsed (imploded) at 18:42:34Z, 21-minutes and 50-seconds after the internal explosive events. (NHHC has.)

- (d) Collapse occurred at a depth of 1530-feet and produced a strong bubble-pulse frequency of 4.46-Hz. These values indicate the energy release of the implosion was equal to the explosion of 13,200-lbs of TNT at that depth. This energy was produced by the nearly instantaneous (less than 0.01-seconds) conversion of potential energy in the form of 46.7-bars (680-psi) pressure on the SCORPION hull to kinetic energy, the motion of the intruding water-ram which entered the atmosphere within the pressure-hull at supersonic velocity.

The conclusions provided by sub-paragraphs (a) through (d) above were derived from acoustic data detected at ranges of 821 and 976 nautical miles from the position of the SCORPION wreck-site by CUHSC hydrophone A and SOSUS array 3141, respectively.

With respect to conclusions provided by references (a), (b) and (c), the above information modifies/changes/adds to those conclusions as follows: (a) confirms a previously suspected but until now unproven association of the acoustic precursor events with the loss of SCORPION and identifies these events as low-order internal explosions; (b) disproves the course reversal/active torpedo conjecture by Dr. John Craven; (c) refines SCORPION event times; (d) changes SCORPION collapse depth from 2000-feet to 1530-feet, identifies detection of a strong bubble-pulse frequency whereas OPINION (3) of reference (c) states no bubble-pulse was detected from the first acoustic event (hull collapse), and provides the first estimate of the energy release of the collapse event.

In the context of the issue of collapse event bubble-pulse generation, FINDING of FACT 8 of reference (c) states that it was the opinion of the Technical Director of

Research at the Naval Research Laboratory "that it is possible to detonate an explosive devise against a submerged air-filled container or a submarine without observing a bubble-pulse. This conclusion was based on the assumption that a bubble-pulse would expand into the collapsing structure and be "swallowed." Note that when a torpedo-fuel fire within the pressure-hull of the Russian nuclear submarine KURSK ignited multiple torpedo warheads and breached the pressure-hull, a bubble-pulse frequency of approximately 3-Hz was seismically-detected at a range of 3100 statute miles. FINDING OF FACT 8 is thus invalidated. Based on the empiric relationship of depth to bubble-pulse frequency to energy release, the yield of the KURSK internal explosive event was about 10,000 lbs of TNT at a depth of 320-feet which compares with the 13,200-lbs of TNT for the SCORPION implosion (pressure-hull collapse) event at 1530-feet.

The SCORPION acoustic data analysis discussed above can be further advanced if the Director of Submarine Warfare will locate the original CUHSC magnetic tape recording of the SCORPION precursor events which is not now in the public domain. This recording is known to have been in the custody of the Naval Ordnance Laboratory in 1971. The precursor events were detected by CUHSC hydrophone A at 18:37:41Z on 22 May 1968, and six seconds later, at 18:37:47Z, by CUHSC hydrophone D.

Analysis of the precursor event tape has the potential to provide the following:

- The extent to which the internal explosive precursor events produced acoustic energy characteristic of specific locations within the SCORPION pressure hull.

- Detections, if any, of SCORPION main propulsion activity before or after the precursor events.

- Identification of other low signal-level events, if any, that may have occurred before or during the 21-minute and 50-second period between the precursor events and pressure-hull collapse.

Note: since the precursor events did not breach the pressure-hull, no bubble-pulse was generated; hence, no depth determination can be made.

III. COMMENTS

The responsive participation of your staff in an effort to recover of the SCORPION precursor event tape recording would be the most effective approach to fully exploiting all SCORPION-associated acoustic data.

Considering the importance of the new information already derived from reanalysis of the extensive unclassified SCORPION acoustic data that has been in the public domain for 40 years, the continued classification of any still-existing recordings of the precursor acoustic events would appear to be unnecessary.

If the original CUHSC iron-oxide recording of the SCORPION precursor events is recovered, it will be extremely brittle (friable) and should not be processed without first being subjected to a special conservation process that may not be available to the Navy. This process was successfully applied to the high-quality CUHSC recording of the SCORPION pressure-hull collapse and subsequent acoustic signals.

The originator would be available to consult on the content of any Navy position-paper on SCORPION but has no requirement to be identified as a source of any information in such a document or to be compensated for any support effort, i.e., *pro bono*.

B. Rule

karasjok@aol.com

Identification of the Initiating Events that Resulted in the Loss of the USS SCORPION (SSN-589) on 22 May 1968.

I. ABSTRACT

The first reanalysis of SCORPION-associated acoustic data in nearly 40 years indicates one, more probably two, low-order explosions contained within the SCORPION pressure hull occurred at 18:20:44 Greenwich Mean Time on 22 May 1968. These acoustic events, which occurred in a half-second period, were detected by underwater sensors (hydrophones) located near the island of La Palma in the Canary Island archipelago. These explosions were the initiating event that caused SCORPION to lose depth control and collapse 21 minutes and 50 seconds later at 18:42:34 GMT at a depth of 1530-feet.

Association of these precursor acoustic events with SCORPION was first considered in 1969 by Robert Price, co-author of reference (a) cited in Section VII below and an expert in the characteristics and effects of underwater explosions, and by the authors of reference (b), also cited. The precise measurements of acoustic signal arrival times at the La Palma hydrophones that confirmed this association, and are discussed in Sections III and IV below, were first made in July 2008.

All times listed in this technical assessment are Greenwich Mean Time (GMT) or, in military parlance, ZULU (Z). All acoustic events were detected on 22 May 1968.

II. BACKGROUND

This technical assessment describes the characteristics of one. more probably two, precursor acoustic signals (events) detected by the La Palma Island hydrophone sensor A 21 minutes and 50 seconds before detection of the first of a series of more than 15 main sequence acoustic events from the USS SCORPION. Detections by hydrophone sensor A, which occurred during the 199-second period from 18:59:32 to 19:02:51 on 22 May 1968, are shown by Table 1. This table also provides the detection times of these events by La Palma Island hydrophon sensor D located 4.76 nautical miles. bearing 101 from hydrophone A.

The actual event time of the first main sequence event (SCORPION pressure hull collapse) was 18:42:34. Based on an estimted speed of sound in water of 4905 f/s, the signal required 16 minutes and 57.5 seconds to travel from the point of origin (the known position of the SCORPION wreckage) to La Palma Island hydrophone A, and an additional six seconds to La Palma Island hydrophone D.

Analyses of the original La Palma Island station high-time-resolution helicorder paper displays made directly from the outputs of hydrophones A and D for the 23.4-hour period from 0914 on 22 May to 0836 on 23 May have provided four independent lines of evidence that indicate the precursor events were associated with SCORPION.

The precursor events were significantly weaker than most of the more than 15 main sequence events. The precursor events did not have the characteristics expected from a ballast tank blow, e.g., was too short (1.3 second duration above ambient sea noise level) and displayed discrete energy peaks. Ballast-blow events have typical durations in excess of 20 seconds because the associated acoustic energy is produced by the expansion-contraction cycles of the released air, and not by the mechanical action of a value which may be significantly shorter. No tape recording of the precursor acoustic event is known to still exist; only the paper helicorder displays, sections of which are shown by the first and second attached figures, discussed below.

All information provided by this assessment has been derived from unclassified documents and material available in the public domain for between 15 and 40 years.

III. DISCUSSION OF HELICORDER FIGURES

- The figure, entitled "La Palma Island Hydrophone A - Detection of SCORPION Main Sequence Acoustic Events" is a detail from a helicorder display that recorded ambient sea noise levels detected by La Palma Island Station hydrophone A for the 23.4-hour period from 0914 on 22 May 1968 to 0836 on 23 May 1968.

The original helicorder paper display was produced on a drum recorder by an electrically-charged stylus and, as such, resembles a seismograph display. The stylus inscribes a 30-minute record of sea noise with calibraton marks every minute on the 36-inch length of the paper attached to the outer circumference of a rotating drum. The drum completes one revolution every 30-minutes. The stylus then advances one-quarter inch to the right of the previous record and begins to record the next 30-minute period below the previous trace as the drum continues to rotate.

Immediatety after the start of each new hour, the position of the stylus is offset half the distance back to the previous trace for two minutes to provide easy identification of the hour marks which are hand-annotated

The second attached figure is a 6X enlargement of another section of the original helicorder display. The second figure shows four-minute periods that include the 1600 to 2100 hour marks.

The arrival times of acoustic events present on the helicorder gram can be measured to within less than one-half second relative to the one-minute calibration marks.

- Discussion of the First Figure

This figure shows rapid changes in recorded sea noise levels, the first of which (SCORPION Event 1: pressure-hull collapse) was detected by La Palma Island hydrophone A at 18:59:32. The position of the stylus, and the resulting trace were sufficiently displaced by this and subsequent changes in sea noise levels that they "over-wrote" several earlier tracings. All 15 SCORPION-associated events (signals) discussed by the below referenced document are labeled in red. At least four other lower-amplitude signals are evident, one following event 14 and three following event 15 for a total of at least 19 SCORPION-associated acoustic events. The helicorder display that recorded sea noise levels detected by La Palma Island hydrophone D showed identical detections of these signals but with a slighty lower amplitudes and a time delay of about six seconds for each acoustic event..

- Discussion of the Second Figure

The second figure, entitled "La Palma Island Hydrophone A - Detection of SCORPION Precursor Acoustic Event" is a 6X enlargement of a detail from the same helicorder display but shows one-minute periods that include the 1837 to 1838 period on 22 May 1968. Detection of the first precursor event occurred at 18:37:41.3, the second, 0.5 seconds later at 18:37:41.9

- Discussion of the Third Figure

- The third figure is a chart that shows the 821 nautical mile (nm) line of bearing from the position of La Palma Island Station hydrophone A to the known location of the SCORPION wreck site. This chart also shows the Cruiser Seamount Ridge discussed below as the bathymetric feature that probably altered the amplitude wave form of both the precursor and main sequence acoustic events in the same way. See Section IV (2) below.

IV. DISCUSSIONS OF FOUR FACTOR SUPPORTING ASSOCIATION OF THE PRECURSOR EVENT WITH SCORPION

- (1) Bearing (Direction) of the Precuror Event from the La Palma Island Hydrophone Sensors

La Palma Island hydrophone sensors A and D were located, respectively, at 28-36-48.8N, 18-01-02.1W at a depth of 3960 ft, and at 28-35-53.6N, 17-55-42.9W at a depth of 2574 ft.

The distance from D to A was 4.76 nautical miles (nm). The bearing from D to A was 281 degrees. The sound travel time from A to D at 4905 f/s was 5.90 seconds.

The known bearing of the SCORPION wreck site was 292 degrees from both A and D or 11 degrees from the D to A axis of 281 degrees. The change in the time difference of signal arrivals at hydrophones A and D can be corrected from the extended A to D axis value of 5.90 seconds to the value that applies for an 11 degree offset from the axis by applying the cosine of 11 degrees which is 0.9816. The resulting value is 5.79 seconds.

These values indicate the position (point of origin) of any acoustic sources with A to D time differences (delays) of about six seconds will lie near a hyperbolic curve - essentially a locus, every point along which satisfies the measured time difference - that intercepts the position of the SCORPION wreck. For ease of discussion, such hyperbolic curves are referred to in this assessment as "bearings" or "lines of bearing."

Measurements made from the helicorder displays indicate the precursor events were detected first by hydrophone A and about six seconds later by hydrophone D.

Measurements also made from the helicorder displays indicate the detection time of the first SCORPION main sequence signal was 18:59:32 at hydropone A and about six seconds later at 18:59:38 at hydrophone D. (The difference in detection times between the precursor events and first main sequence event was 21 minutes and 50 seconds for both hydrophones A and D.)

The six-second difference in the arrival (detection) times by hydrophones A and D for the precursor events and the 15+ SCORPION main sequence eventsindicate all signals came from the same bearing (direction) relative to the La Plama hydrophones.

Event times in this assessment were determined by measuring the initial rise time of the minute calibration marks on the helicorder displays. These measurements indicate all SCORPION associated acoustic events occurred about three seconds earlier than times provided by collateral documents.

In summary, the measurements of the delay in detection times from hydrophone A to hydrophone D indicate the bearing (direction) of the precursor events and the main sequence events from the La Palma Island hydrophones was essentially the same as the known bearing of the SCORPION wreck site.

- (2) Range (Distance) of the Precursor Events from the La Palma Island Hydrophone Sensors

The position - and thus the range (distance) of the precursor events relative to the La Palma Island sensors - could not be determined by the time-difference fix method used for the SCORPION main sequence acoustic events because the weaker precursor events were only detected by the La Palma Island hydrophones. Time-difference positioning requires detection by at least three sensors that are geographically dispersed relative to the point of signal origin.

The only method by which an estimate of the range of the precursor events from the La Palma Island sensors can be made is by comparing the amplitude wave form of the precursor events with the wave forms of the main sequence events.

The more than 15 main sequence SCORPION acoustic events did not display the classical slow build-up of noise level over time followed by a sharp drop in signal level. The main sequence acoustic events displayed initial bursts of energy followed by decreasing signal levels. Although significantly weaker than most of the main sequence events, the precursor event, as detected by hydrophone D, displayed the same relatively slow decrease in level following the initial rapid rise in level.

This similarity indicates both the main sequence events and the precursor event were subjected to the same long range signal propagation effects.

The reversal of the normal time-distribution wave form energy common to the precusor and main sequence acoustic events can occur only if a high angle rays clears a signal path obstruction - such as a seamount - that cuts off most of the slower, deep sound channel axis rays that normally build up to the sharp signal cutoff.

A detailed bathymetric chart of the Canary and Madiera Basins shows just such an obstructing bathymetric feature: the Cruiser Seamount Ridge. As shown by the chart (third figure), this ridge is located in a NE to SW direction across the 292 degree line of bearing from the La Palma Island hydrophones to the known location of the SCORPION wreck. This ridge, which includes the Irving Seamount/Cruiser Tablemount (guyot) (32N, 28W) to the north of the signal transmission path and the Hyeres Seamount (31.5N, 29W) to the south, is about 560 nautical miles (nm), from the La Palma Island hydrophones. It is the only bathymetric feature along the entire 821 nm length of the line of bearing from the hydrophones to the wreck site that rises far enough above the general level of the Canary Basin abyssal plain to block the deep sound channel axis ray paths. A western extension of the Cruiser Fracture Zone Valley bisects the Cruiser Sea Mount Ridge along the 292 degree bearing of the wreck site from hydrophone A. The floor of this valley rises at the western edge of the ridge to form a "sill" before dropping back to the level of the abyssal plan. It is this sill, or a feature that extends from the north into the valley (talus from the Irving Guyot) just east of the sill. that appears to have been the bathymetric feature that blocked most of the "slower" (late arriving) energy from the SCORPION precursor and main sequence acoustic events from being detected by the La Palma island hydrophones

During the initial investigations of the SCORPION signal transmission path in 1968-69, it was recognized that the signals had been detected by La Palma Island sensors only because some of the acoustic energy had passed through a lower elevation (deeper) region of the Cruiser Seamount Ridge.

As discussed above, the Cruiser Seamount Ridge appears to have been the bathymetric obstruction that affected in the same way the amplitude wave forms of both the precursor and main sequence acoustic events associated with SCORPION. This conclusion requires that the range (distance) of the point of origin of the precursor signal had to have been greater than about 560 nm from the La Palma Island hydrophones, i.e., west of the sill at the end of the western extension of the Cruiser Fracture Zone Valley. If the range of the point of origin of the precursor signals relative to the La Palma hydrophones had been less than the position of this bathymetric feature, or to the east of the seamounts, the precursor event amplitude wave forms detected by hydrophone D would not have been altered the same way as the main sequence events.

- (3) The Relative (Compared) Signal-to-Noise Values of the Precursor and Main Sequence Events at Hydrphones A and D

Comparison of the helicorder displays of the SCORPION main sequence acoustic events indicates the signal levels received by hydrophone A were higher than the levels of the same main sequence signals received by hydrophone D. The level of the precursor event showed the same difference, i.e., the hydrophone A detection was stronger than hydrophone D. This difference may have been due to the shallower depth of hydrophone D.

This congruence indicates the precursor and main sequence events were subjected to the same signal path attenuation factors as should have been the case if they were co-located.

- (4) The Presence/Absence of Other Detections by Both Hydrophones of Transient Signals on 22-23 May 1968 Similar to the Precursor Events

To determine how unique the detection of transient events by both La Palma Island hydrophones A and D was, the helicorder displays for both sensors for the 23.4 hour period from 0914 on 22 May to 0836 on 23 May were analyzed. In addition to the SCORPION-associated events, four other transient detection events were identified.

On 22 May 1968:

- (1) At 17:27:23.9 by hydrophone A; 0.3 seconds later by D.

On 23 May 1968:

- (2) At 07:49:40.1 by hydrophone D; 2.7 seconds later by A.
- (3) At 08:03:15.4 by hydrophone D; 0.2 seconds later by A.
- (4) At 08:20:05.6 by both hydrophones.

The differences in arrival times of events 1, 3 and 4 are, within measurement error, the same. This similarity indicates the sources of these transient signals were located close to lines of bearing essentially perpendicular to the midpoint of the 281 degree hydophone D to hydrophone A axis, or to the north or south. The 2.7-second difference for event 2, with detection by hydrophone D first, indicates the lines of bearing were to the east. In all four cases, the lines of bearing were either approximately parallel to the coast of La Palma island on which the hydrophone cables terminated or were toward the island (event 2).

Thus, the precursor signals and the SCORPION main event signals were the only transient acoustic events detected by both hydrophones during the 23.4 hour period on 22-23 May 1968 that had bearings to the west toward the site of the SCORPION wreck site in the deep ocean.

V. GENERAL CONCLUSIONS AND COMMENTS

Collectively, the four factors discussed above indicate it is highly probable the precursor acoustic events were associated with SCORPION. These signals probably were produced by two explosive events that occurred nearly simultaneously at 18:20:44 on 22 May 1968 and were contained within the SCORPION pressure hull. The still-intact pressure hull collapsed 21 minutes and 50 seconds later at 18:42:34 at a depth of 1530 feet. If the pressure hull had not been intact, it would have flooded before it reached collapse depth and collapse, verified by imagery of the wreck, would not have occurred.

With reference to the 18:20:44 time of the explosions, note the following statements on pages 7.2 and 7.3 of reference (b) cited in Section VII below: (1) "it is plausible that SCORPION could have been at periscope depth at 1805Z for communications purposes;" and (2) "The external communication antenna - BRA 9, VLF loop - were in the raised position. This would be in agreement with the possibility that SCORPION was receiving communications at 1805."

The basic conclusion of this assessment (association of the precursor events with SCORPION) confirms (adds credence to) the statement on page 8.1 of reference (b) that "an emission detected 22 minutes earlier was possibly from SCORPION"

VI. TECHNICAL CONCLUSIONS AND COMMENTS

The 1.3-second duration of the precursor acoustic event was too short for the signal to have been produced by the blowing ballast. Additionally, acoustic energy produced by the blowing of ballast does not contain discrete energy peaks similar to the precursor events.

The actual durations of the precursor events (less than 0.1-seconds each, their extremely short rise- and decay-times, and the detection of two energy peaks, are consistent with impulses from either small implosions or low-order explosions. Although the explosion-implosion ambiguity cannot be resolved from the helicorder data, the fact that a strong (recorded) implosive (collapse) event occurred at great depth 21 minutes and 50 seconds after the precursor event indicates the precursor events did not breach (rupture) the SCORPION pressure hull.

This reanalysis of the La Palma acoustic data provided no information useful in assessing the actual cause (sources) of the precursor events.

If, as concluded by this assessment, the precursor acoustic events occurred at a shallow depth compared to the later main sequence acoustic events, a direct comparison of the relative signal levels on the helicorder display cannot, at this time, be used to accurately quantify the size of the precursor event in terms of pounds of TNT required to produce the observed signal level. This is because of the possible effects of depth on the long range propagation of these signals.

Additionally, the precursor events had to have been contained within the SCORPION pressure hull whereas the pressure hull collapse event occurred in "open" water where the energy would have been transferred more efficiently to the water.

It is estimated that the energy levels associated with the prescursor events were orders of magnitude lower than the first of the main sequence events (hull collapse), i.e., probably less than about 10-20 kg of TNT each.

VII. REFERENCE DOCUMENTS

(a) USS SCORPION (SSN 589) RESULTS OF NOL DATA ANALYSIS (U) (NOLTR 69-160 of 20 January 1970) Robert Price and Ermine Christian

(b) EVALUATION OF DATA AND ARTIFACTS RELATED TO USS SCORPION (SSN 589), Prepared for Presentation to the CNO SCORPION Technical Advisory Group by the Structural Analysis Group dated 29 June 1970. CAPT Harry Jackson, Messrs. Peter Palermo, Dr. R. T. Swim and Robert Price, et al.

Table 1: SCORPION Acoustic Signal Detection Times by La Palma Island Hydrophone Sensors A and D

All listed times are Greenwich Mean Time (GMT) (ZULU) on 22 May 1968. Sound travel time from the SCORPION wreck site to hydrophone A: 16 minutes, 57.5 seconds; to hydrophone D: 17 minutes, 03.5 seconds.

Detection Ttmes by hydrophones A and D for both Precursor Events (PRE) and Main Sequence Events (MSE) one and two were measured from La Palma Island station Helicorder grams.

Detection times for MSE 3-15c for hydrophones A and D relative to MSE two were measured from a La Palma Station Sanborn display.

MS-1 was SCORPION pressure-hull collapse at a depth of 1530-feet. All MSE detection times are to the nearest second.

As noted in Section IV (1) above, the Helicorder time measurements indicate all SCORPION associated acoustic events occurred about three seconds earlier than times provided by references (a) and (b).

Event	Hydrphone A Detection	Hydrophone D Detection	A to D Delay	Elapsed Time from MSE 1 A Detection	Interval
PRE 1	18:37:41.3	18:37:47	6s		
PRE 2	18:37:41.8	18:37:36.8	6s		0.5s
MSE-1	18:59:32	18:59:38	6s	0	
MSE 2	18:59:59	19:00:05	6s	27s	27s
MSE 3	19:01:04	19:01:10	6s	92s	65s
MSE 4	19:01:08	19:01:14	6s	96s	4s
MSE 5	19:01:14	Not Detected		102s	6s
MSE 6	19:01:23	19:01:29	6s	111s	9s
MSE 7	19:01:26	19:01:32	6s	114s	3s
MSE 8	19:01:33	19:01:39	6s	121s	7s
MSE 9	19:01:45	19:01:51	6s	133s	12s
MSE 10	19:02:01	19:02:07	6s	149s	16s
MSE 11	19:02:04	19:02:10	6s	152s	3s
MSE 12	19:02:12	19:02:18	6s	160s	8s
MSE 13	19:02:17	19:02:23	6s	165s	5s
MSE 14	19:02:25	19:02:31	6s	173s	8s
MSE 15	19:02:45	19:02:51	6s	193s	20s
MSE15a	19:02:48	19:02:54	6s	196s	3s
MSE 15b	19:02:49	19:02:55	6s	197s	1s
MSE 15c	19:02:51	19:02:57	6s	199s	2s