NOTE: The following was received from the USSVI National Commander via our Region Director and District Commander. Please note that several of these links don't work but the one with PDF references can be retrieved if you go to the main address being referred to that does work and do your own lower level searches from there. I don't know what to do about the bad flickr link.

Subj: Information and Security Issues Associated with the Loss of the USS THRESHER (SSN-593) on 10 April 1963 and Information on the Loss of the USS SCORPION (SSN-589) on 22 May 1968 as it Relates to the Loss of THRESHER

Ref: (a) Loss of the USS THRESHER:
http://www.jag.navy.mil/library/jagman_investigations.htm
http://www.jag.navy.mil/library/investigations/USS%20THRESHER%20PT%201.pdf, 202.pdf, 203.pdf, 204.pdf
(b) THE SUBMARINE REVIEW, Winter 2012, pp 134
(c) Administration of Barack H. Obama, memorandum of 29 Dec 2009 Implementation of Executive Order: Classified National Security Information
(d) Presidential Executive Order 12958 of 17 April 1995
(e) Executive Order 13526 of 29 December 2009
(f) WHY THE USS SCORPION (SSN-589) WAS LOST, Nimble Books, October 31, 2011. ISBN 978-1-60888-120-8
(g) THE SUBMARINE REVIEW, Winter 2012, pp 151-152
(h) http://www.flickr.com/photos/oneillparker/3224878652/
(i) OPNAVINST 5513.5C: Security Classification Guide 05-37
(j) Naval Ordnance Laboratory Report 69-160 of 20 January 1970
(k) Naval Ordnance Laboratory Report AD/A-000-807 of 20 September 1974
(l) Robert S. Price Private Communication of 29 May 2002
(m) USS SCORPION SSN-589 - Court of Inquiry Findings

I. SUMMARY

This letter provides information concerning the loss of the USS THRESHER on 10 April 1963 derived from analyses of acoustic detections of the event, and, additionally, provides information on the loss of the USS SCORPION on 22 May 1968 that relates to analyses of the THRESHER acoustic data.

Analysis of Sound Surveillance System (SOSUS) detections of THRESHER confirms the initial casualty on 10 April 1963 was the failure at 0911 - after two minutes of line- frequency instability - of the primary (non-vital) electrical bus which shut down the submarine's Main Coolant Pumps (MCPs) resulting in the immediate scram (shut down) of the nuclear reactor, ((reference (a)) Unable to rapidly restart the reactor to regain propulsion and unable to deballast because of the formation of ice in the ballast system, THRESHER sank to collapse at 09:18:24 at a depth of 2400-feet (1070 psi).

Multiple, independent lines of evidence confirm there was no flooding prior to collapse of the THRESHER pressure-hull. Such flooding, conjectured by the Court of Inquiry (COI) to have been the initial event responsible for the tragedy, would have been a catastrophic event with the water-jet produced by the initial breaching of the pressure-hull or a pipe (OPINION 1a of

reference (a) estimated the ruptured pipe to have been between two and five inches in diameter) expanding into the interior of the submarine with a velocity of about 1800 mph (Mach 2.4) at THRESHER's depth of 1300-feet. Such an event would not have been reported by THRESHER to her escort ship, the USS SKYLARK (ASR-20), at 0913 as a (quote) experiencing minor difficulties (end quote). Additionally, the conjectured flooding and the associated water-jet, upon impacting structures within the hull, would have generated extreme noise levels not only within the breached compartment but also in adjacent compartments, and at reduced but still high levels throughout the submarine. Such noise levels would have made it extremely difficult for THRESHER to have communicated with SKYLARK. No such noise levels were evident during communications with SKYLARK nor were they detected by SOSUS.

Another compelling reason for rejecting the COI conjecture that flooding occurred at test-depth of 1300-feet (580 psi) is that water expanding into the relative vacuum (15 psi) within the THRESHER pressure-hull would have instantly atomized into a dense vapor (fog) upon impacting solid surfaces and/or vaporized in the low-pressure environment making it difficult to see within those spaces, yet immediately subsequent to telling SKYLARK at 0913 that she was (quote) experiencing minor difficulties (end quote), THRESHER transmitted (quote) will keep you advised (end quote). Neither of those transmissions are consistent with the disaster that flooding at test-depth (1300-feet) would have represented.

These assessments are independently confirmed by THRESHER COI Finding of Fact (FoF) 153 from reference (a), i.e., provides compelling support of the conclusion there was no flooding before collapse. FoF 153 states: (quote) That during the course of proceedings, a test demonstration for the Court of Inquiry was held in Drydock No. 2 at the Portsmouth Naval Shipyard. A stream of water was released to atmosphere at Thresher's test-depth pressure against a piece of electronic equipment. The stream produced tremendous force, spray, fog and noise (end quote), conditions - to repeat - that would not have been reported by THRESHER to SKYLARK as (quote) experiencing minor difficulties (end quote).

Russell Preble, CDR USN (ret), who was in Portsmouth, NH, in April 1963, and who actually observed this test, made the following statement: (quote) A memory that stands out in my mind was watching one of the Board of Inquiry's tests. An old SS radar console was placed on the floor of one of the empty dry docks and a high-pressure stream of water was directed against the console. The noise was overwhelming. I remember thinking that nothing could be heard over the noise of the water smashing up against the radar casing and how at deep submergence no orders could be heard over the roar of water striking anything in its way. (end quote) Source: "USS Thresher, Lest We Forget", Burke Consortium, Inc, 2013, p. 5; file name: ThresherBooklet_printv2.pdf

In view of the discussions above - especially FoF 153 - and discussions that bear on this critical issue, which are expanded in Section IV of this letter, it is difficult to understand how the COI - having actually observed the test procedure described by FoF 153 - could conjecture that flooding occurred before the THRESHER pressure-hull collapsed at 09:18:24 at great depth. It also is difficult to understand why the Navy has, for 50 years, continued to support that erroneous flooding conjecture as the official explanation for the loss of THRESHER when it is not in consonance with the component COI documents - reference (a) - nor is it supported by the

analysis of acoustic detections of the tragedy known to the Navy since the COI hearings, as discussed by reference (a).

II. BACKGROUND

As the Analysis Officer at the SOSUS Evaluation Center in April 1963, the writer analyzed SOSUS detections of the loss of the USS THRESHER on 10 April 1963 and derived the position that provided the basis for the location of the wreck-site as discussed on the Integrated Undersea Surveillance System (SOSUS) website: http://www.iusscaa.org/history.htm

Much of the following timeline of THRESHER events, derived from that analysis, was provided by the writer in testimony before the THRESHER COI on 18 April 1963 with supporting testimonies by CAPT Patrick Leahy, Bureau of Ships Code 345, and by Edwin Savasten from the David Taylor Naval Ships Research and Development Center (DTNSRDC) at Carderock, MD, the activity responsible for the acoustic detectability trials of US nuclear submarines. The information provided by this writer's testimony in April 1963 is available, without attribution, in the public domain as reference (a).

III. TIMELINE OF EVENTS ASSOCIATED WITH THE LOSS OF THE USS THRESHER

The following timeline describes events and conclusions concerning the loss of the USS THRESHER on 10 April 1963 derived from analyses of the SOSUS data, all times ROMEO. Acoustic event detection times have been corrected for the sound-travel-time between the wreck-site and the position of the SOSUS array (1411/FOX) which detected the MCP acoustic components, the attempted deballasting events and collapse of the pressure-hull; therefore, these are actual event times ROMEO as they occurred onboard THRESHER.

- 0845: initial SOSUS acoustic detection of THRESHER MCPs in FAST (2-pole mode) while at or near a depth of 1000-feet.

- 0909: initial detection of THRESHER non-vital bus line frequency instability at test-depth: 1300-feet. MCPs still in FAST.

- 0910: ((Quote from reference (a)): At about 0910 a message from THRESHER announcing a course change from 090T to 000T and gave no indication of any difficulty (end quote). Note; however, that the first failed attempt to deballast - described immediately below - was initiated at 0909.8, approximately one minute before the failure of the non-vital electrical bus, also described below.

- 0909.8-0911.3: first failed attempt to deballast. The duration of that event included at least part of the rise time of whatever air escaped during the event. During that rise time, pressure-induced oscillations in the volume of that air (bubble) would have produced strong acoustic energy (bubble-pulse); consequently, the 1.5-minute duration of the detection does not represent the period during which the effort to deballast was effective.

- 0911: failure of the non-vital bus after two minutes of line-frequency instability; strong MCP acoustic signal abruptly lost.

- 0913: THRESHER transmits to SKYLARK (ASR-20): (quote) Experiencing minor difficulty... attempting to blow,,,,,(end quote), as discussed by reference (a). There was no mention by THRESHER of flooding at 0913 or at any later time.

- 0913.6-0914.3: second failed attempt to deballast. As discussed above, this period does not represent the duration of an effective effort to deballast. The duration of this event - half

that of the first failed attempt to deballast - indicates ice-blockage created by the first attempt was, as expected, still present.

- 0917: THRESHER message to SKYLARK includes the number 900 possibly suffixed by the letter "N." That number is accepted to have been a reference to test-depth as required by the deep-dive OP-ORDER security directive, I.e., at 0917, THRESHER was 900 feet below test depth or at 2200-feet.

- 09:18:24: The THRESHER pressure-hull and all internal compartments collapsed in about 100 milliseconds (ms) at a depth of 2400-feet with an energy release equal to the explosion of 22,500 pounds of TNT at that depth, a value consistent with acoustic detection of the event by multiple SOSUS arrays as a very high amplitude signal at ranges as great as 1300 nautical miles.

Reference (b) discusses the analysis method used to derive these depth and energy-release values, i.e., the empiric relationship that exists between the volume of a collapsing structure and the frequency of the bubble-pulse acoustic source generated by the collapse.
As also determined, the 100 ms duration of the THRESHER collapse event (complete destruction of the pressure-hull and all internal compartment) was significantly less than the minimum time required for human perception of the event: 50 ms for retinal integration plus 100 ms for cognitive integration; hence, those onboard THRESHER were unaware of the actual collapse event; it occurred too fast to be apprehended.

There were no SOSUS detections on 10 April 1963 of any THRESHER main propulsion system activity as should have occurred had speeds above about 14 knots been employed. Additionally, had THRESHER accelerated significantly after 0910, a Doppler component should have been detected by the 1411 SOSUS array. No such component was identified.

It is concluded the use of propulsion subsequent to 0909 was not an option available to THRESHER; otherwise, there probably would not have been an attempt to deballast at 0909.8; THRESHER would have used propulsion to drive to the surface ((reference (a)).
Note again that use of the term (quote) minor difficulties (end quote) by THRESHER in her 0913 UQC transmission to SKYLARK is inconsistent with flooding at test-depth.

During the 1959 to 2007 period, the writer analyzed thousands of hours of acoustic detections of S5W and other US nuclear reactor electrical system components and never identified another event during which there was a non-vital bus line-frequency instability similar to that exhibited by THRESHER from 0909 to 0911.

IV. COMMENTS AND OBSERVATIONS ON THE LOSS OF THRESHER

The above timeline and conclusions are consistent with the assessment that THRESHER was lost because of a reactor scram that resulted in a loss of propulsion, and, as subsequently verified by a dock-side test with the USS TINOSA (SSN-606), the formation of ice in the air-lines which made attempts to deballast ineffective.

There was not in 1963 - nor is there now - any evidence to support the conjecture by the COI that THRESHER experienced flooding before pressure-hull collapse which, as discussed above, was determined in 2009 to have occurred at a depth of 2400-feet (1070 psi), more than 400-feet below the design-based estimate for collapse.

During the instrumented hydrostatic collapse of a decommissioned US diesel submarine at a depth of 1000-feet, the velocity of the intruding water-ram was measured as about 1650 mph (Mach 2.2). Complete collapse of that pressure-hull occurred in about 100 ms. Had the initial loss of water-tight integrity involved only a small opening such as a pipe several inches in diameter, conjectured by the COI in the case of THRESHER, the intruding high-velocity water jet - literally a fluid hammer - upon both passing through the rupture point and impacting the opposite side of the THRESHER pressure-hull and/or structures attached to the pressure-hull, would have produced extreme levels of broadband noise (COI Finding of Fact 153) which would have made it almost impossible for THRESHER to have communicated with SKYLARK even from a compartment other than the site of the conjectured flooding. The water-jet also would have excited the pressure-hull and internal structures (like a bell being continuously struck) to radiate multiple acoustic resonances, also of extreme amplitude. No such resonances were detected by SOSUS from THRESHER subsequent to the conjectured time of the leak - circa 0912 - nor were high levels of broadband noise detected by SOSUS for more than several seconds. That broadband noise was produced by the collapse of the pressure hull at 09:18:24 and by the pressure-induced oscillations (pulsing) of the collapse event air-cavity (bubble).
Although the failure of SOSUS to detect any high-amplitude resonances is "negative" information, it still represents a compelling line of evidence supporting the conclusion there was no rupture of any sea-connected, silver-braze pipe before collapse as conjectured by the THRESHER COI.

It is compelling information because another submarine collapse event - during which a high-velocity water-jet was documented - produced multiple narrowband resonances acoustically detected as strong sources for an extended period at a range (distance) 25 times the range of THRESHER from the 1411/FOX SOSUS array. To repeat, THRESHER was lost when the entire pressure-hull was destroyed almost instantaneously at a depth of 2400-feet without any prior flooding.

Based on imagery of the wreck, the water-jet created by the initial breaching of the THRESHER pressure-hull nearly instantaneously tore that structure, both longitudinally and vertically into six major sections. The velocity of the water-jet at the calculated collapse depth of 2400-feet (1070 psi) was about 2600 mph (Mach 3.5). Thus, the condition of the wreck also supports the conclusion the pressure-hull collapsed in less than 100 ms; there was no gradual flooding of a still-intact pressure-hull.

During the instrumented sinking of the USS STERLET (SS-392) in January 1969, discussed by reference (f), the sink-rate of the post-collapse event hulk was measured as 12.9 knots in 10,700 feet of water. Detailed analysis of acoustic recordings of the loss of the USS SCORPION (SSN-589) confirm the post-collapse sink rate of components of the pressure-hull discussed by reference (f) was less than 28 knots.

It is concluded the sink-rate of sections of the THRESHER pressure-hull subsequent to its destruction by hydrostatic pressure at a depth of 2400-feet was 10-15 knots. Speculation made during the COI hearings that the still-intact THRESHER pressure-hull broke apart upon impacting the bottom at a speed of 100 knots is not supported by analysis of the acoustic data or

by the relationship of speed to power which indicate that, even in vertical descent, many multiples of THRESHER's installed horsepower would have been required to reach a speed of 100 knots, i.e., more than 600,000 horsepower. As discussed by reference (f), no World War II US depth charge - designed to be a hydrodynamically efficient as possible - had a sink-rate in excess of 30 knots.

Sections of the THRESHER pressure-hull fell to the bottom from the collapse depth as individual components. The erroneous 100 knot speculation was based on the assumption that the very high amplitude acoustic signal that occurred at 09:18:24 was bottom impact rather than collapse of the pressure-hull. Acoustic detection of an associated bubble-pulse frequency unambiguously identified the 09:18:24 event as collapse of the THRESHER pressure-hull. Note: the extreme forces associated with pressure-hull collapse events that occur at great depth are sufficient to cancel all pre-existing directions of motion.

In the case of the USS SCORPION (SSN-589), sections of the pressure-hull, which collapsed at a depth of 1530-feet with an energy release equal to the explosion of 13,200 pounds of TNT at that depth, followed trajectories that deviated from the vertical by less than 100-feet over a distance of 9600-feet. Reference (f) discusses analyses of acoustic detections of the loss of SCORPION from which this information was derived. A comprehensive understanding of the complex technical issues discussed by reference (f) is a prerequisite to apprehending why SCORPION was lost.
Reference (g) provides the following review of reference (f): (quote)...it is a superbly prepared technical report based on empirical evidence and written to high forensic standards...(end quote).

V. CONCLUSION: WHY THE USS THRESHER WAS LOST
The initial event in a cascade of events that resulted in the loss of THRESHER was the failure of the non-vital electrical bus while the MCPs were operating in FAST, the normal full-power lineup for the propulsion plant. That failure caused the MCPs to fail which, in turn, caused an immediate scram (shut-down) of the nuclear reactor which resulted in a loss of propulsion at test-depth.

(As repeatedly discussed above, there is no evidence to support the COI conjecture, still widely accepted at high levels within the Navy, that there was flooding before the THRESHER pressure-hull collapsed at the extreme depth of 2400-feet.)

Those who may dispute identification of the source of the SOSUS detection as THRESHER MCPs in FAST - as did members of the COI - are advised that the acoustic detection was so evaluated not only based on frequency content but also on identification of a mathematical ratio between acoustic sources - measured from the SOSUS data to the second decimal place - that was unique to S5W MCPs.

As of March 2007, the Office of Naval Intelligence (ONI) still held a photo-copy of the original SOSUS data upon which the MCP in FAST assessment provided to the THRESHER COI in 1963 was based. Concerns about the validity of that MCP in FAST analysis can be allayed by requesting the data retained by ONI be reviewed by DTNSRDC personnel familiar with the design characteristics and acoustic signatures of S5W reactor system MCPs. Those personnel should be

shown this letter. The term of consequence for the DTNSRDC personnel will be (quote) whirl (end quote).

If, after 50 years, the Navy considers it appropriate to (1) potentially advance an understanding of why the THRESHER non-vital failed, (2) officially dismiss the erroneous COI conjecture that pre-collapse flooding of the pressure-hull occurred, and (3) exculpate the Portsmouth Naval Shipyard personnel implicated as responsible for the flooding through the failure of a silver-braze pipe fixture, the SOSUS data still held by ONI should be further reviewed to refine the characteristics of the instability exhibited by THRESHER's non-vital electrical bus from 0909 to 0911, i.e., period and magnitude.

VI. DISCUSSION OF THE LOSS OF THRESHER: CLASSIFICATION ISSUES

Reference (c), published in the Federal Register on 5 January 2010, provides guidance concerning the long-term classification of documents with reference to content. Specifically, reference (c) defines (quote) damage to the national security (as) harm to the national defense or foreign relations of the United States from unauthorized disclosure of information, to include the sensitivity, value, and utility of that information. (end quote)

Reference (d) establishes the criteria for classification of information as material the disclosure of which would damage the national security and requires the original classification authority to identify or describe the damage, i.e., information cannot be classified by fiat. This is the standard against which any security concerns about the timeline of events that occurred onboard the USS THRESHER (SSN-593) on 10 April 1963 (derived from acoustic data) must be validated. Part 3 of reference (e) also applies to this classification/release issue.

In summary, any contention that conclusions in this letter about the loss of the USS THRESHER derived from acoustic data are classified must meet the requirements for classification established by references (c), (d) and (e), and also must acknowledge information that may be in question is available in the public domain as Finding of Fact 153 and/or OPINION 45 of reference (a) or can be derived from that information, e.g., MCPs operating speeds (modes): FAST and SLOW.

Reference (h) is one of many internet sites that provide information germane to that specific subject area, e.g., (quote) Coolant pump switch. 6 pumps, each with fast and slow speeds. Only used 4 at a time underway.... they're running 2 slow-2 slow (2 slow speed pumps port, and another 2 starboard. (end quote)

Reference (i) cannot be applied to the contents of this letter because this letter does not provide information on (quote) overside noise (by identifying frequencies, radiated noise levels, structures or specific bandwidths of that noise), platform noise or sonar self-noise signatures (end quote) beyond that already provided by reference (a) and in the public domain.

VII. DISSEMINATION OF INFORMATION ABOUT THE LOSS OF THE USS THRESHER (AND THE USS SCORPION)

In 1974, ADM H. G. Rickover directed research that established the US battleship MAINE (ACR-1) sank on 15 February 1898 in Havana Harbor because of an internal explosion and not because of

a Spanish or Cuban mine. The Admiral took that action, 76 years after the MAINE sank, because, as discussed in the 1995 Forward to his book, HOW THE BATTLESHIP MAINE WAS DESTROYED, (quote)...the Admiral could not believe the Navy did not make use of all available information to determine the cause of so great a disaster. (end quote)

The same situation now exists concerning the loss of the USS THRESHER 50 years ago. This letter provides the basis for rectifying that situation.
Reference (f) provides the basis for a similar elucidation of why the USS SCORPION was lost almost 45 years ago; an elucidation that should be officially acknowledged by the Navy and publicly disseminated.

As extensively discussed and documented by reference (f), the SCORPION Structural Analysis Group (SAG) - the Navy's own experts in the fields of submarine design, submarine structures and the effects of underwater explosions, respectively Peter Palermo, CAPT Harry Jackson and Robert Price - correctly concluded in their report of 20 January 1970 that SCORPION was lost because hydrogen out-gassed by the main storage battery exploded, killing and/or incapacitating the crew with an atmospheric over-pressure of 150-200 psi at the site of the explosion which occurred 21 minutes and 50 seconds before hull collapse. Analysis reported by reference (f) indicates there were acoustic detections of two explosions associated with the 126-cell TLX-53-A battery one-half second apart which were contained within the SCORPION pressure hull. They occurred 21minutes and 50-seconds before collapse.

(Multiple explosions associated with the forward group of the 504-cell TLX-53 main storage battery installed on the USS POMODON (SS-486) occurred, with five fatalities, on 21 February 1955 while the unit was conducting a dock-side charge at the San Francisco Naval Yard.)

The SCORPION COI dismissed the SAG battery-explosion assessment - which was based on microscopic, spectrographic and x-ray diffraction analysis of a recovered SCORPION battery component by Portsmouth Naval Shipyard personnel - and erroneously conjectured SCORPION was lost because of (quote) the explosion of (a) large charge weight external to the submarine's pressure hull (end quote). That conjecture, a second conjecture that SCORPION reversed course to deal with an onboard torpedo problem, and a third conjecture that the bubble-pulse acoustic source created by a submarine collapse event could be "swallowed" by the pressure-hull and not be acoustically detected are debunked by reference (f). It may have been this last conjecture - disproven by the temporal dynamics of the SCORPION collapse event - that influenced the COI to ignore the SAG identification of a bubble-pulse component and postulate the external (to the pressure-hull) explosion theory. Basically, the SCORPION pressure-hull was destroyed faster than the expansion-rate of the oscillating bubble-pulse air cavity from the point of maximum compression, i.e., no structure remained intact to contain (swallow) the bubble-pulse which was acoustically detected by SOSUS at a range of 976 nautical miles.

Of the 17 SCORPION COI "Findings of Fact" that were based on or inferred from acoustic data, 14 (82 percent) are wrong.

All concerned with verifying the assessment immediately above should compare the assertions made by the SCORPION COI Findings of Fact numbers 2-5, 8, 14-17, 31, 32, 43, 45 and 46 with

the content of reference (f) which, as noted by reference (g): (quote) is very technically complex - the very same characteristic that makes it so credible. (end quote) The comparison should also include reference (j).

Such a comparison would be a useful exercise for those concerned with the technical accuracy and classification of information provided by this letter on the loss of THRESHER, the determination of which should involve the following: (1) the application by the reviewers of general knowledge of the design and operating characteristics of US nuclear submarines with S5W reactors, (2) in-depth (expert) knowledge of the mechanisms by which US nuclear submarines unintentionally radiate acoustic energy, the characteristics of the acoustic energy as radiated by THRESHER generally and, specifically, on 10 April 1963, and the acoustic, dynamic and temporal characteristics of submarine pressure-hull collapse events, and (3) a determination of the extent to which information in this letter already is available in the public domain as reference (a) or other documents.

In summary, those who review technical documents for accuracy and classification should know at least as much about the subjects discussed by such documents as the authors of the documents, and thus be able to provide essentially a "peer review" that evaluates the scientific and technical accuracy of information in the reviewed document and edit such documents accordingly.

Below are examples of what occurred because this was not the case with SCORPION documentation reviewed and approved for public release.
Those who reviewed reference (j), "USS SCORPION (SSN 589), Results of NOL Data Analysis," for public release were not technically qualified to perform that function which resulted in the unintended disclosure of classified acoustic source frequency information. The reviewers assiduously redacted acoustic event frequency information for events listed in TABLE A-4 of reference (j) where the number values were associated with the abbreviation "Hz" but failed to redact the period information for those same acoustic events listed in TABLE A-2 of reference (j). Since frequency is the reciprocal of period, the classified frequency values could be recovered (derived) from reference (j) after it was "sanitized" (became unclassified) and approved for public release. A similar oversight compromised the redacted frequency scales of frequency vs amplitude charts shown as Figures C1 through C16 of reference (j). This allowed the writer, who has never had access to the original classified (unredacted) version of the document, to compare those acoustic spectra with spectra produced by the hydrostatic collapse of cylinders of known diameters, reported by reference (k), to determine - as discussed for the first time by reference (f) - that six of the SCORPION post-pressure-hull collapse acoustic events were produced by the collapse of the submarine's torpedo tubes at depths between 3370- and 4570-feet. It is significant to note that while more than 17 post pressure-hull collapse events were acoustically detected from SCORPION, none were detected from THRESHER. That apparent anomaly is explained by the force (energy release) of the THRESHER event (22,500 pounds of TNT at 2400-feet) compared to 13,200 pounds of TNT for SCORPION at 1530-feet. That additional energy destroyed all THRESHER internal structures that survived on SCORPION to collapse at greater depth.

As discussed above, those who review technical documents for public release should examine such documents not only for classification but also - of equal or greater importance - for accuracy. A

cascade of uninformed technical assessments by those who reviewed references (j) and (m), the SCORPION Court of Inquiry Findings, for public release allowed the erroneous COI assessment that SCORPION was lost because of a large explosion external to the pressure-hull to become available to the public when it should have been refuted or redacted.

Issues: first: the reviewers carefully redacted most of the discussion of the erroneously estimated SCORPION collapse depth of 2000-feet but left intact the statement on page 19, Para 6.10 of reference (j) that SCORPION started to sink following collapse at a depth of (quote) 2000-feet (end quote); second: although all tabular discussions of the frequencies of SCORPION-associated acoustic events were redacted, the statement in para C.3.3.3 on page C-6 of reference (j) that the peak energy associated with the first major SCORPION-associated acoustic event was (quote) something like 5 Hz (end quote) was not redacted. Had the reviewers extended that assessment - also in para C.3.3.3 of reference (j) - that the first SCORPION acoustic event (quote) might reasonably be associated with the collapse of the SCORPION (i.e., bubble-pulse) (end quote) and applied the formula on page C-4 of reference (j), they should have realized that the explosion of 18,125 pounds (nine tons) of TNT would have been required to have produced a 5-Hz bubble-pulse frequency at a depth of 2000-feet. Note that, as discussed by reference (f), refinement in 2008 of the SCORPION bubble-pulse value to 4.46 Hz indicated pressure-hull collapse occurred at 1530-feet (not 2000-feet) with an energy release of 13,200 pounds of TNT. ((Reference (b) provides further discussions of this analysis method.))

Thus, competent technical review of reference (j) would have determined that the first major SCORPION acoustic event - equal in force to the explosion of nine tons of TNT at the conjectured depth of 2000-feet - could not possibly have been, as postulated by the COI, (quote) the explosion of (a) large charge weight external to the submarine's pressure hull (end quote). That acoustic event had to have been collapse of the pressure-hull as concluded by Robert Price and Ermine Christian who wrote on page 5.2 of the SAG Report: (quote) the first major (SCORPION) acoustic event was caused by catastrophic hull collapse (end quote). (Note: nine tons of TNT significantly exceeded the explosive yield of the entire SCORPION load of conventional weapons.)

This letter provides OPNAV N97 the opportunity to correct misinformation now in the public domain concerning why the US nuclear submarines THRESHER and SCORPION were lost.

In this regard, Robert Price, a co-author of the SAG Report, stated in reference (l) in May 2002: (quote) I see nothing in the loss of SCORPION that should be concealed, except the details of the listening systems (now open source)....I think the concealment of the few facts and conclusions concerning this tragedy are a disservice to the United States and to relatives of those lost at sea. (end quote). That assessment applies equally to THRESHER.

VIII. THE FINAL WORD

The final word on what happened to THRESHER should belong to THRESHER, and that "word" was not "flooding;" it was, as discussed above, (quote) 900 (end quote) transmitted to SKYLARK at about 0917. That value is accepted to have been an indirect reference to test-depth as required by security directive in deep-drive OP-PLAN, i.e., 900-feet below the 1300-foot test-

depth. THRESHER was at 2200-feet at about 0917, a depth consistent with the acoustically-derived collapse depth of 2400-feet at 09:18:24.

As stressed in the SUMMARY, the fact that THRESHER was still able to communicate with SKYLARK after THRESHER acknowledged that (quote) minor difficulties (end quote) already had occurred is evidence those difficulties did not involve flooding with the catastrophic effects such flooding is known to create at great depth. The acoustic data provides additional confirmation of this conclusion by identifying that those difficulties involved the loss of the primary (non-vital) electrical bus with the resulting shut-down of the nuclear reactor and the loss of propulsion capability.

Copies of this letter, which contains information on the loss of the USS THRESHER, the loss of the USS SCORPION and the acoustic, dynamic and temporal characteristics of submarine collapse events not available from any source other than reference (f), should be provided to SECNAV, the Chief of Naval Operations, the Head of the Navy's Nuclear Propulsion Program, ONI, CUS, DTNSRDC, the Shipyard Commander, Portsmouth Naval Shipyard, Portsmouth, NH, the Naval History and Heritage Command and the office of U.S. Senator Susan Collins, R-Maine.

WHY THE SCORPION PROPELLER AND SHAFT SEPARATED FROM THE HULL

Mr. Bruce Rule

Bruce Rule analyzed acoustic detections of the loss of the USS Thresher (SSN 593), testified before that Court of Inquiry, and subsequently was the lead acoustic analyst at the Office of Naval Intelligence for 42 years. In 2008, confirmed the USS Scorpion (SSN 589) was lost because the main battery exploded. (1) In 2009, established - for the first time at any security level - that the GOLF II Class Soviet SSB (K-129) was lost because two R-21/D4 ballistic missile fired sequentially to fuel-exhaustion within in the pressure-hull, killing the crew and causing enormous structural damage. (2) BACKGROUND In 2008, Daniel McMillin (1929-2015), an electrical and mechanical engineer who was part of the AT&T Bell Labs "brain trust" involved in the development and evolution of the Navy's Sound Surveillance System, provided the author with a three-minute tape recording of acoustic signals produced by the loss of the USS Scorpion as detected at a range of 821 nm by a single hydrophone located near the island of LaPalma in the Canary Archipelago.

DISCUSSIONS OF ACOUSTIC DATA

Analysis of that recording confirmed the Scorpion pressure-hull collapsed at a depth of 1530-feet (680 psi) at 18:42:34Z on 22 May 1968 while the more pressure-resistant torpedo tubes survived within the wreckage to collapse at depths of 3370-, 3750-, 3810-, 3950-, 4510-, and 4750-feet. (1) In 2017, refined analysis of those data identified - for the first time - the temporal asymmetry of the compression and expansion phases of the THE SUBMARINE REVIEW SEPTEMBER 2017 82 acoustic signal (bubble-pulse) produced by the collapse of a submarine pressure-hull. The duration of the compression phase of the Scorpion hull-collapse was 0.037s ((37 milliseconds (ms) or 1/27th of a second)) while the duration of the expansion (rebound) phase of the noise-radiating bubble-pulse was about 190 ms. Temporal asymmetry exists between the compression and expansion phases of the bubble-pulse acoustic signal because the duration of the collapse phase is truncated by the collapse phase pressure wave encountering the compacting mass of the hull and internal structures whereas the expansion phase terminates less abruptly when the falling pressure of that expanding wave and its momentum are overcome by the ambient pressure at the collapse depth.

DISCUSSIONS OF IMAGERY OF THE SCORPION WRECKAGE

Extensive imagery obtained of the Scorpion wreck by the US submersible Trieste confirmed the engine room had symmetrically "telescoped" 50-feet forward when the cone-to-cylinder transition junction failed between the auxiliary machine space and the engine room. The propeller shaft - with the propeller still attached - was found to have separated from the after section of the hull. It fell separately to the bottom at a depth of 11,100-feet. Whether loss of the propeller shaft caused the loss of Scorpion or was the result of collapse of the pressure-hull at great depth has been a subject of continuing debate. CONCLUSION As discussed above, analysis confirmed the duration of the collapse phase was 1/27th of a second (0.037 seconds), a time within which the telescoping after hull sections traveled 50-feet, values that require an average velocity of about 900 mph. The velocity of the intruding water-ram which produced that compressive force was 2000 mph. It was this enormous axially-aligned forward vector - opposed (primarily) by inertial forces (a body at rest tends to stay at rest) acting on THE SUBMARINE REVIEW SEPTEMBER 2017 83 both the shaft and the propeller, and (secondarily) by the resistance of the water acting on the effective blade area of the propeller that tore the shaft - with the propeller still

attached - from the thrust block and out of the submarine where it fell separately to the bottom to be imaged near the telescoped after hull sections by Trieste.

Imagery also showed the retention flange of the shaft was separated from the body of the shaft. Basically, the after sections of the Scorpion accelerated forward (away from) the propeller and its attached shaft at 900 mph leaving the unsupported shaft to sink to the bottom.

This assessment resolves the long-standing issue: was loss of the propeller shaft the cause or the result of the loss of the USS Scorpion? The acoustic data confirms it was the result of collapse of the pressure-hull. An alternate explanation - that the propeller had lost ("thrown") a blade and the resulting rotational imbalance separated the shaft causing the loss of Scorpion - is disproven.

ENDNOTES 1. "WHY THE USS SCORPION (SSN 589) WAS LOST." Nimble Books LLC, ISBN 978-1-60888-120-8, 31 Oct 2011 2. THE SUBMARINE REVIEW, Spring 2012 (Pages 98-105), "Russian SSBNs – A 'Dead Man' Launch Capabili