David F. Pence, M.S.
Setpoint Hawaii

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David G. Concannon
Law Offices of David G. Concannon, LLC
200 Eagle Road, Suite 116
Wayne, Pennsylvania 19087

Re: Revised Report of Dr. Alex Deas, regarding Barrett v. APD.

Following is my supplemental report of observations and opinions regarding the changes and revisions to findings expressed by Dr. Alex Deas in his most recent revised report dated 4 April 2008, regarding the cause of death of Robert Barrett at Bainbridge Quarry in August of 2002 in support of Plaintiff's position in the lawsuit, Barrett, et.al. vs. Ambient Pressure Diving, et.al.

In preparing my opinions, I have relied upon my review of the reports, depositions and other documents which I previously cited in my original report to you, Document 138-5, as well as the following new documents:

- Your email of 07/25/08
- Documents No. 166-2, 166-3, 166-4, and 166-5. Alex Deas' Revised Report, "Robert Barrett's Accident on 3rd August 2002", submitted in four sections, Filed 4/18/08.
- Document 149-3 Exhibit A. Motion by Defendant to Strike Deas' Second Report, Filed 4/10/08
- Document 202-2, Defendant's Memorandum of Law in Support of its Objection to the Expert Report of Alex Deas Ph.D. and Motion to Strike, Filed 06/16/08.
- Document 202-3 Exhibit A, Inspiration Logic Demonstration, Filed 06/16/08
- Document 202-4 Exhibit B, Deposition of Lt. Steven Englert, taken 02/28/08, Filed 06/16/08
- Document 202-8 Exhibit F, Letter of Dr. Gavin Anthony to T. M. Moyle, Coroner of Inquests, regarding determination of Inspiration breathing loop gas volumes, written 03/26/08, Filed 06/16/08
- Bainbridge Scuba Shop Chart of Bainbridge Quarry
- Document 221-2. Deposition of Martin Parker, Filed 08/08/08
- Deposition of Michael Fowler, Volumes 1 and 2, Taken 07/17/08
- Models of Barrett O2 consumption
- Supplemental Report of Dr. David Sawatzky to David Concannon, dated 27 August 2008.

This document is the result of my own work. The document was prepared as a living document. There are no drafts.

Much of the revised report from Deas (Doc. 166-2 through 166-5) is unchanged from his original, including a large number of unproven statements and assumptions made by Deas that contradict documented evidence and witness statements. These are well described in Doc. 143-3, Motion to Strike, many of which were addressed in my original report.

Deas still insists that Barrett must have drowned due to unconsciousness from hypoxia, that he properly prepared and switched on his Inspiration rebreather, that it was functioning properly until the time of entry (now moved to time of descent – see below), and that Barrett made no error or omission in protocol that would have prevented his unconsciousness. This is in opposition to evidence from his dive team that they did not observe him using a checklist, never saw Barrett look at his handsets at any time (including during pre-dive preparation), and never heard any audible alarm beeps from Barrett's unit at any time (including during pre-dive preparation).

As addressed in my previous report, proper monitoring of the handsets (at least once per minute) would have been obvious, and certainly would have alerted Barrett to a problem long before it reached a critical phase, and certainly at a point when he could have taken one of several actions that would have prevented his death from drowning due to a hypoxic event. Failure to engage in proper, diligent handset monitoring behavior, as specified by the manufacturer and as covered exhaustively in Barrett's training, are directly contributory to his inability to avoid a hypoxic event. Deas can discount, but not scientifically disprove this, and Barrett must bear the responsibility for this failure.

The Inspiration audible alarms are not subtle, and are ubiquitous, sounding separately upon power-up of both the master and slave controllers, upon completion of calibration, and at the onset of fault conditions such as a low battery. The low battery alarm in particular is not a simple double beep as Deas opines, but a continuous pattern of one-second-on/one second off beeping that begins at battery voltages well above the brown-out level and continues until the situation is corrected or the battery dies. In my opinion, it is absolutely not possible for all four divers to have missed hearing any audible alarm. This is extremely strong indication that Deas is wrong and the rebreather was simply not switched on, due to Barrett's distraction with teaching and time pressure. It is a set of events Deas rejects but does not disprove.

Deas still dismisses without due consideration any likelihood that Barrett's improper packing of the CO_2 absorbent, possible exhaustion of the absorbent, or use of absorbent not approved by the manufacturer might have caused a contributory hypercapnia event, despite evidence that all three may have occurred. The casual dismissal as un-important of the improper brand of absorbent was accompanied by comments such as "I have done it many times" and "this is used

successfully by many divers in many rebreathers". This is not scientifically valid proof that the event is impossible, and is not sufficient to reject the possibility. It is unfortunate that, despite suggestions that the information was important, the Plaintiff neglected to ensure that Barrett's used absorbent material was analyzed to determine its end efficacy.

Deas dismisses without due consideration any likelihood that Barrett's addition of environmental caps and "over-balancing" chambers to the Apeks oxygen and diluent regulators of his Inspiration (in opposition to recommendations of APD) could have resulted in stoppage of oxygen addition to the loop. Since he is an expert in electronics design, perhaps his training and expertise does not extend to the engineering and function of pneumatic systems. As delineated in my original report, the risk of hypoxia possibility, even in water as shallow as 30fsw. The oxygen regulator was shown at inspection to be at the upper end of the allowable range. Any increase in IP would have placed added work on the solenoid and increased the risk. As such, Deas may have dismissed the possibility, but he has not scientifically excluded it.

Finally, had Barrett chosen to not engage in the risky practice of diving solo, his death would have been easily preventable through rescue by his three dive team members. Deas completely misses this key point.

The revised Deas report is, however, significantly modified from the original Deas report upon which I commented (Pence, Doc. 138-5) in at least the following several key places:

A. ALTERATION OF DEAS' TIMELINE OF EVENTS

Deas original postulate was that Barrett properly conducted all recommended pre-dive checks and preparations, and his Inspiration rebreather was functioning correctly when he started to enter the water. However, Deas proposed that a "battery bounce" transient power interruption (TPI) to the slave controller occurred when Barrett waded into the water, and, after a surface swim of some minutes, the main controller's battery suffered a "brown-out', losing power in the moments immediately after Barrett submerged at the dive site. Deas states these two events are the sole causes of Barrett's disabling hypoxia and subsequent drowning – a position that has been disputed repeatedly on multiple points in my previous report (Pence, Doc. 138-5).

Deas scenario above suffered from criticism on several points, including that (1) the wading entry was too gentle to have realistically caused sufficient impact to cause the TPI, and (2) if following proper protocols consistent with his training and manufacturer's recommendations Barrett should have detected the problem before it became life threatening.

Apparently in response to these criticisms Deas has significantly changed his timeline of the hypothesized "battery bounce" / brownout scenario. In the new timeline, Deas now asserts that the wading entry was in fact not the issue and that the unit was in operating mode until the

start of the dive. The revised version now suggests that the TPI occurred at the start of the dive, when Barrett submerged by "flipping over" and performing a "duck dive", followed almost immediately in less than 45 seconds by the master controller battery brown-out. With such a change in his story, Deas removes questions of whether the wading entry was insufficiently rough to cause the required TPI, as well as reduce the time interval in which Barrett would have been able to detect the condition during the surface swim.

However, as with several of the revisions made in this new version, this seems to be a case of following the rule, "If the facts do not fit your hypothesis, make up new facts!" Deas' statement that Barrett performed a duck dive to submerge is unsupported by any statement or testimony for the members of his dive team and appears to be his own fabrication. No actual mention of the method of descent has been made.

In my experience, employment of a duck-dive and is very improbable. Given his equipment, Barrett would have had difficulty performing a duck dive to submerge. The over-the-shoulder style of the Inspiration counterlungs provides a buoyancy center in the upper portion of the diver's torso. At the same time, documents show Barrett, wearing a dry suit, was heavily weighted with 27 pounds of lead, including significant amounts at the waist and as ankle weights. With a center of ballast well posterior of the center of buoyancy, an inordinate effort would have been required to descend by extending one's legs above one's head. In such a configuration, it is much easier to simply exhaust gas from the buoyancy compensator, drysuit, and counterlungs until achieving a slightly negatively buoyant state and descending. Such a descent is very low exertion and extremely low-impact.

If it were the case that Barrett could have been able to do a duck dive, it is unproven that even this type of dive would generate sufficient impact to cause the postulated TPI. Even Deas' own report brings this into question. A review of the unvetted, unsubstantiated and anecdotal internet accounts of "battery bounce" phenomena he presents as "evidence" in Appendix K (Doc. 166-5) shows no accounts where such a descent was involved. Cited were substantially more energetic giant stride entries, back-rolls and side-rolls from boats, but none during in-water initiation of descents.

Interestingly, other factors contributing to battery bounce proposed in the emails in Appendix K, such as wiring corrosion, use of mis-sized batteries, battery contact spring corrosion or fatigue, or battery box lid fatigue also do not appear to be present in this case. Barrett's unit was in almost new condition, and the type of batteries used was as specified by APD. Considering the unit's like-new condition, in the benign diving environment of flat, still water of a quarry lake in summer, and with such a gentle descent, it is highly improbable that any impact-induced TPI occurred. The probability that this event would occur so perfectly timed as to immediately precede a brown-out of the second battery, and that both would occur in correct sequence on the correct controller that would generate the specific scenario that Deas requires to maintain his hypothesis, is entering into the realm of miracles.

B. NEW OXYGEN METABOLISM CALCUALTIONS

A new section attempting to predict oxygen levels experienced by Robert Barrett in support of Deas' failure hypothesis is inserted to the Deas revised report, apparently to replace the calculations previously provided by Crockford. Through this endeavor, Deas attempts to "prove" that the only way Barrett could have lost consciousness after the 10 minutes elapsed time indicated by interpretation of the dive computer downloads and documented statements of Bress, Baird and Seacreast is if (1) the unit had been previously properly prepared functioning correctly before entering into the water with an elevated oxygen level in the loop and (2) the TPI/brown-out scenario had occurred. If the loop had been off and filled with air at the start of the dive, given Deas' estimations of Barrett's oxygen consumption rate and depth profile, loop volume, Deas estimates that Barrett could only have remained conscious for approximately 6.5 minutes. Deas takes the fact that Barrett was conscious as long as 10 minutes as "proof" that the TPI/brownout explanation was the only correct one.

Some basic mistakes are made in Deas' assumptions, and he obviously has made little attempt to learn the critical geography of Bainbridge Quarry. Deas describes the approximately 50 yard walk from the point of gearing up to where the divers waded into the water, and the surface swim from there to Platform B as strenuous. He increases his VO2 estimates for these reasons, as well as to account for Barrett being heat stressed, above average weight, and a smoker.

From a search of aerial images on Google Earth, Deas erroneously assumes that the divers entered the water from Access Point "B", much farther from the training site at Platform "B" that the correct Access Point "A". The estimated swimming speed to cover that distance in the approximately 2 minutes specified by the surviving dive team members approaches impossibility. Perhaps this error contributed to Deas' incorrect conclusion that the surface swim required a high oxygen consumption rate.

I have evaluated the scale chart of Bainbridge quarry, which includes the sites of major submerged features including Access Point "A" where the dive team entered the water to surface swim to the dive site, Platform "B", where Barrett's dive team descended and the "cement mixer", which Barrett departed solo to find. The chart is overlain with a scale grid of squares representing 25' increments. Measurements of the scale show approximately 125ft of abscissa and 37.5ft of ordinate change between the Access "A" and Platform "B". By the Pythagorean Theorem, the linear distance along the hypotenuse is approximately 130ft. Surface swimming this distance in 2-3 minutes on their backs as described by the dive team is not a strenuous pace. Further, upon immersion, Barrett would be cooled, so thermal stress would be reduced before the start of the dive.

As a dive instructor, technical rebreather trainer, and university diving safety officer with graduate training in biology, biochemistry, and microbiology, I believe that I have a firm grasp of the basics of oxygen metabolism. However Dr. David Sawatzky, a medical doctor with nationally

recognized expertise in diving physics, medicine, and physiology, and with specific professional expertise and peer-reviewed publications in this exact area, has done so in his report (Sawatzky, 27 August 2008) at a supremely higher level of quality. Significantly, Sawatzky identifies and clearly communicates several points of error in Deas' calculations, including (but not limited to):

- As a diving physician, Sawatzky opines that the evidence from the coroner's report is not inconclusive with arterial gas embolism as a cause of death, rather than hypoxia. Deas failure to address and disprove this point invalidates his TPI hypothesis as the only possible explanation.
- The autopsy revealed that Barrett was suffering from significant atherosclerosis and ventricular hypertrophy for someone of his age, and as such the possibility of cardiac arrest could not be ruled out. Such an event could also be consistent with Barrett's dive profile, including the aborted ascent attempt. Deas erroneously states that by all accounts Barrett was in good health, completely ignoring this evidence. His failure to address and disprove this point invalidates his TPI hypothesis as the only possible explanation.
- Deas, with training in computer systems and electronics, mistakenly underestimates the total breathing loop volume (rebreather system and diver's lungs) by as much as 20% as compared to the calculations of Gavin Anthony, an expert with QinetiQ, the British equivalent of the US Navy Experimental Diving Unit. This would lead to an under-estimation of the possible survival time by a proportional amount.
- The oxygen metabolic rate (VO2) of 1.6 to 1.7 lpm used by Deas is much higher than accepted values from diving medical sources such as Bennett and Elliot, unless Barrett was maintaining an extremely high swimming speed. Given the light duty diving activity of descending down a taut line to a platform and observing student divers perform static skills, a VO2 of less than
  1.0 lpm is indicated, suggesting that Deas is, on this one point, in error enough to account for the total time discrepancy. This error alone invalidates Deas' argument.
- Deas justifications for the higher VO2 due to Barrett's larger than average size are not valid, and drawn from sources not consistent with diving (nutrition studies and terrestrial cycling studies). Such errors bias Deas' results to an underestimation of time of survivability.
- Deas' justifications for using such an elevated VO2 due to diver workload (the "Burly Norwegian Diver Study") and heat stress (the "St. Petersburg Communal Sauna Study") are deemed akin to "junk science", with no professional methodology, no independently peer-reviewable results, are not replicable by other researchers, and have no statistical rigor. As such, these "studies" provide no justification for increasing VO2 estimates above nominal.

These errors and inadequacies invalidate Deas' TPI/brownout hypothesis as the only possible explanation of events, and cast questions on his knowledge and expertise in this area, and his

worthiness as an expert. Indeed, I find it interesting that every one of Deas' errors leads to a change in his result in a direction that supports his position.

C. PROPOSITION THAT LACK OF AN "AUTO-ON" SWITCH IS A DESIGN FAULT

In this revised report Deas raises a new argument not included at all in his or previous reports, making the novel suggestion that the Inspiration should have been designed with an automatic-on switch that would be activated either by water pressure or moisture from immersion. Further, he states that such a feature would have prevented Barrett's death and APD should be liable since the Inspiration does not have one. As justification for this position, he cites the incorporation of such features into modern dive computers. He further reports that a panel of experts on rebreather design and general consensus of experts agreed with this position at a recent Diver's Alert Network (DAN) Technical Diving Conference in January of 2008.

On the former point, I find this assertion puzzling, as to my knowledge no commercially marketed rebreather was designed with auto-on switching in 2002. As such, it is impossible to assert that absence of auto-on switching capability was a violation of an industry standard. Such would be tantamount to holding General Motors at fault for a traffic collision fatality in 1960 because there were no air bags in a 1957 Chevrolet.

Since I was an attendee and participant at the DAN Technical Diving Conference in question, I can absolutely state Deas assertion regarding the DAN panel consensus is a mischaracterization of the findings of the workshop. While some, including Dr. Deas, were dogmatic about such features, the expert panel was not in consensus. In addition, participant comments during the open comment period were strongly mixed as well.

Concerns with a requirement for auto-switches are various. Moisture-activated (wet) switches have a tendency to not switch off after removal from the water unless diligently dried, a phenomenon Parker described in his deposition with regards to a dive computer marketed by APD (the same design has also been marketed by other parties). Such a failure would result in the depletion of the system batteries. Wet switches have also been documented to not work in waters of different conductivities (fresh versus salt). Pressure-activated switches are only activated on descent, and would not automatically turn on a system being used in shallow water. Such a situation would place a diver breathing from a rebreather on the surface of hypoxia.

The most universal objection to automatic switch-on systems is its likelihood to promote diver complacency towards pre-dive planning and preparation, allowing a diver to simply "turn it on and forget it". My 30+ years of experience training and supervising recreational and science divers at all levels has left me with the absolute opinion that this has occurred within the diving community, with the adoption of real-time dive computers in lieu of dive tables. In light-duty no-stop open-circuit sport diving, this can be a hazard. If a similar attitude were to be adopted

towards rebreather life support, with its exponentially higher requirements for life support system preparation, checking, calibrations and monitoring the results would undoubtedly prove fatal. An auto-on switch would not prevent a rebreather diver from starting a dive without ensuring that the unit was properly calibrated, that the CO2 scrubber was functioning, or the gas supplies turned on and filled, and the solenoid functioning. Indeed, it may in fact encourage him to do so. At some point, responsibility for ensuring proper function of underwater life support must shift from the design responsibilities of the manufacturer to the personal responsibility of the diver for proper preparation, operation and monitoring, a point made by Parker (Doc. 221-2), and repeated in the DAN workshop.

Respectfully Submitted,

David F. Pence, M.S.