

# Department of the Navy SBIR/STTR Transition Program

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ONR Approval #

Topic # N151-078

Development of a Diver Biometric Device (DBD)

Quantum Applied Science and Research Inc.

## WHO

**SYSCOM:** ONR

**Sponsoring Program:** Warfighter Performance ONR Code 34

**Transition Target:** Seal Delivery Vehicle & Shallow Water Combat Submersible Program ACAT III

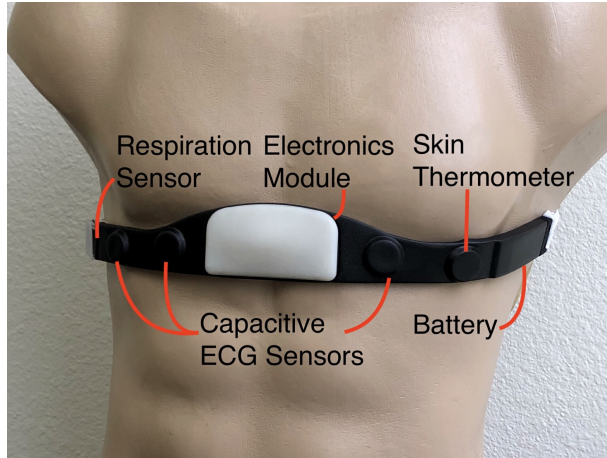
**TPOC:**

Sandra Chapman  
[sandra.chapman@navy.mil](mailto:sandra.chapman@navy.mil)

**Other transition opportunities:**

Marine Corps Reconnaissance, Naval Training, United States Special Operations Command (USSOCOM), and commercial diving equipment providers.

**Notes:** Quantum Applied Science and Research Inc.(QUASAR) Diver Biometric Device



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## WHAT

**Operational Need and Improvement:** Physiological state monitoring of Navy divers is of importance in research health assessment as well as performance augmentation. Diver mission success requires maintenance of an appropriate gas supply, high situational awareness, and avoidance of operational hazards. Divers are also at risk from health hazards, such as cardiac health issues, stress, and fatigue. Current systems require labor intensive and uncomfortable taping to function underwater, and the tape pulls away from the divers' bodies with time and activity, allowing water ingress and ending the measurement. In addition, the Navy desires a variety of measurements such as temperature and respiration, in addition to electrocardiogram (ECG) and currently the measurements are performed by separate pieces of equipment. There is a need for a waterproof, integrated device for multiple physiological measurements.

**Specifications Required:** The DBD must provide full function and communication while immersed in salt water and exposed to increased hyperbaric pressures of 300 feet of sea water (FSW) (threshold)/1000 FSW (objective) at a temperature range of 32-95 Degrees F.

**Technology Developed:** Demonstration module that provides ECG, respiration, and temperature measurements while retaining the capability to add actigraphy, pulse ox, blood pressure and other desired measurements. The Phase II device is planned to record data for download later or transmit to the surface with a tether, but real-time wireless transmission may be possible if the project proceeds to later phases.

**Warfighter Value:** QUASAR offers to the warfighter robust, functional, and user-friendly technology to provide physiological measurements from a diver at depth to monitoring personnel at the surface. This will allow for greater diver safety and performance enhancement.

## WHEN

**Contract Number:** N00014-18-C-7006 **Ending on:** March 31, 2020

| Milestone  | Risk Level | Measure of Success   | Ending TRL | Date         |
|--|------------|--|------------|--------------|
| Demonstrated function of novel capacitive sensors underwater in demonstration system | Med        | P-Wave, T-Wave, and QRS complex were readily discernable in ECG data gathered under an active test condition in a 10m pool | 6          | 4th QTR FY18 |
| Completed electrical and mechanical design of physiological sensors                  | Low        | Robust and manufacturable design of sensors achieved and tested for function in saltwater                                  | 6          | 3rd QTR FY19 |
| Completed design of software and firmware  | Med        | ECG, Respiration, and Activity data saved to SD Card and streamed in real time   | 6          | 3rd QTR FY19 |
| Completed design of electronics module and harness                                   | Med        | All electronics tested and integrated into physical prototype  | 6          | 3rd QTR FY19 |
| In-Vivo testing of DBD in 10m salt water pool and open ocean                         | Med        | High signal to noise ration (SNR) ECG, Respiration, Activity, and Skin Thermometry Data gathered                           | 7          | 4th QTR FY19 |

## HOW

**Projected Business Model:** QUASAR intends to carry out the planned research to successful completion, and initially make the DBD available to the DoD customer. Concurrently, QUASAR is also pursuing commercialization of the DBD and technologies developed through this program for the consumer and commercial diving markets. QUASAR has already received interest from DoD and other researchers in dive medicine in acquiring a future research-grade version of the device. QUASAR has also held discussions with manufacturers of dive equipment for commercial and consumer markets. To address the consumer market, we anticipate offering a DBD or the constituent technologies by partnering with established diving equipment manufacturers. However, QUASAR could become an original equipment manufacturer (OEM) of the DBD for a distributor or manufacturer. In addition, QUASAR could license its technologies to a firm with existing diving products, such as dive computers and rebreathers.

**Company Objectives:** QUASAR would like to reach potential customers in the DOD involved in diving. This includes the Navy and Marine Corps, but may also include other segments such as USSOCOM. The goal after the Phase II project will be Phase III transition. Different customers may be interested in different versions of the base technology.

**Potential Commercial Applications:** There are potential market opportunities in both consumer and commercial diving. The consumer diving equipment industry forms a significant portion of the estimated \$50B global market for sports equipment. Total annual sales for diving equipment are estimated at \$3B. The market experiences modest 2-4% annual growth, driven largely by rising household incomes in developing countries. The commercial diving customer segment is relatively small, with fewer than 3,500 individuals employed in the US and perhaps twice that number worldwide. Nevertheless, there is a compelling need for capabilities offered by the DBD for this segment, as divers typically operate at high physical strain and are exposed to hazardous environments. Commercial diving firms carry considerable purchase power for diver-worn equipment, and would benefit from increased safety and diver monitoring capabilities of the DBD.

**Contact:** Stephen Hibbs, VP of Business Development  
[stephen@quasarusa.com](mailto:stephen@quasarusa.com) 8584121839