

SPAD - Sonobuoy Precision Aerial Delivery

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“Low Observable Remote Sensor Deployment”

PROBLEM STATEMENT

Antisubmarine Warfare a Key Capability in Future Conflicts

Initial engagements with submarine-capable adversaries will likely involve attempts to disrupt naval operations such as landing our forces ashore or transport of heavy lift forces through choke points and straits. Antisubmarine warfare (ASW), always a Navy core competency during the Cold War, remains a crucial element for successful engagements with increasingly capable hostile submarine fleets.¹

Potentially hostile nations, other than Russia, currently operate more than 150 submarines, of which 45 are non-nuclear and modern design. An additional 45 submarines are on order, and by 2030 it is projected that three quarters of non-US submarines will have advanced capabilities.²

Unfortunately, these potential adversaries have been able to quiet their submarines at a steady rate of about 1 db per year for the past 35 years. In fact, the US no longer enjoys the substantial acoustic advantage it once had against some of the best nuclear submarines or those operating on battery power. Whereas the detection range for low speed modern submarines used to be measured in hundreds of kilometers, today this range has shrunk to only kilometers in some cases.³

The challenge in ASW has been to increase detection capability at a faster rate than our adversaries can quiet their submarines. There are many aspects to enhancement of our detection abilities, one of which is the manner in which our ASW assets are deployed.

¹ “Directions for Defense,” Commission on Roles and Missions of the Armed Forces, Dept. of Defense, Washington DC, 1995.

² “Technology for the United States Navy and Marine Corps, 2000-2035”, National Research Council, 1997, <http://www.wcdebate.com/4bconnection/0102evpol.htm>

³ Defense Technology Area Plan, Sensors, Electronics and Battlespace Environment, 1997, http://www.fas.org/spp/military/docops/defense/97_dtap/sensors/ch070303.htm

Future Sonobuoy Delivery Requirements – Stand-Off, Stealth and Precision

Sonobuoy delivery in future littoral combat scenarios will differ from deep sea operations in three important ways:

- Stand-off delivery
- Covert delivery
- Precision placement

Littoral operations, conducted in close proximity to hostile positions, are inherently higher risk than deep ocean ASW. Aircraft such as the P3 are relatively slow, high signature platforms with limited self-defense capability and therefore are extremely vulnerable close to enemy shores.

Risk to aircrews and a desire for covert deployment suggest the need for remote or stand-off deployment. If sonobuoy networks can be deployed by air far from the target region (more than 25 nm), the risk to ASW air crews is minimized and probability of maintaining covertness of the sensor network is greatly enhanced.

For stand-off deployment to be effective, the delivery mechanism must be precise so that sensor location can be determined accurately without benefit of mark-on-top overflight. Eventually the sensors themselves will be equipped with encrypted GPS to enable self-positioning, but sonobuoys must still be placed on the target location with good accuracy (100 meters or better CEP).

Stand-Off Sonobuoy Deployment Requirements

Based on the evolving nature of ASW operations, the Navy envisions the need for a new means for air deployment of sonobuoys that meets the following requirements:

- Air deployable using existing sonobuoy aircraft (P3) and dispensers
- Stand off range of 25 nm or more
- Launched from 30,000 feet up to 370 KIAS
- System (sonobuoy and deployment hardware) shall conform with A-size sonobuoy geometry and mass specifications
- Minimum re-engineering of sonobuoy sensors and systems – focus is on a compatible delivery mechanism

WHO CAN BENEFIT?

In addition to ASW, there are similar missions (and markets) which require covert and stand-off delivery of a network of autonomous ground sensors similar to those used in sonobuoys, except for land applications. These include covert surveillance of hostile territory (e.g. Afghanistan and the Vietnam era Igloo White ADSID's (Air Delivered Seismic Intrusion Detector)), drug interdiction, homeland defense, and anti-terrorist missions.

For example, DARPA is funding the Unattended Ground Sensors (UGS)⁴ program and the associated Capstone exercise to provide a non-line of sight, round-the-clock, all-weather situation awareness and precision targeting capability to detect, track, classify, and identify specific mobile time critical targets (TCTs). ARGUS (Advanced Remote Ground Unattended Sensor) is a similar program.

The payload portion of SPAD, currently delivering a sonobuoy, could be repackaged with other sensors with minimal effort. The Air Delivery Vehicle (ADV), aft portion of SPAD, would remain unchanged, thereby limiting the need for additional development funds. This design would allow any payload of similar volume and mass to simply "plug-in" to the ADV. Therefore, additional commercial opportunities are likely to arise from successful development of SPAD.



BASELINE TECHNOLOGY

The baseline sonobuoy deployment technology requires low altitude (<1000-ft.) release from P-3 for sufficiently accurate placement. This technology also requires the surveillance aircraft to fly over the target which emphasizes the need for standoff delivery and covert placement. The P-3 cannot place sensors inside international boundaries without violation of national sovereignty.

A great advantage of passive sonobuoys is that they provide detection capability without their target's awareness of their presence. However, deployment and mark-on-top operations of conventional ASW aircraft such as the P3 or SH60 can be easily detected, especially close to shore, and therefore are likely to alert the adversary to the presence of our sensors. This would encourage employment of countermeasures and minimize the effectiveness of our detection assets.

Also, the new Multi-Mission Maritime Aircraft (P-8), scheduled to replace the P-3 by 2013, designed to operate at high altitudes, has no means of deploying sonobuoys at 30,000 feet.

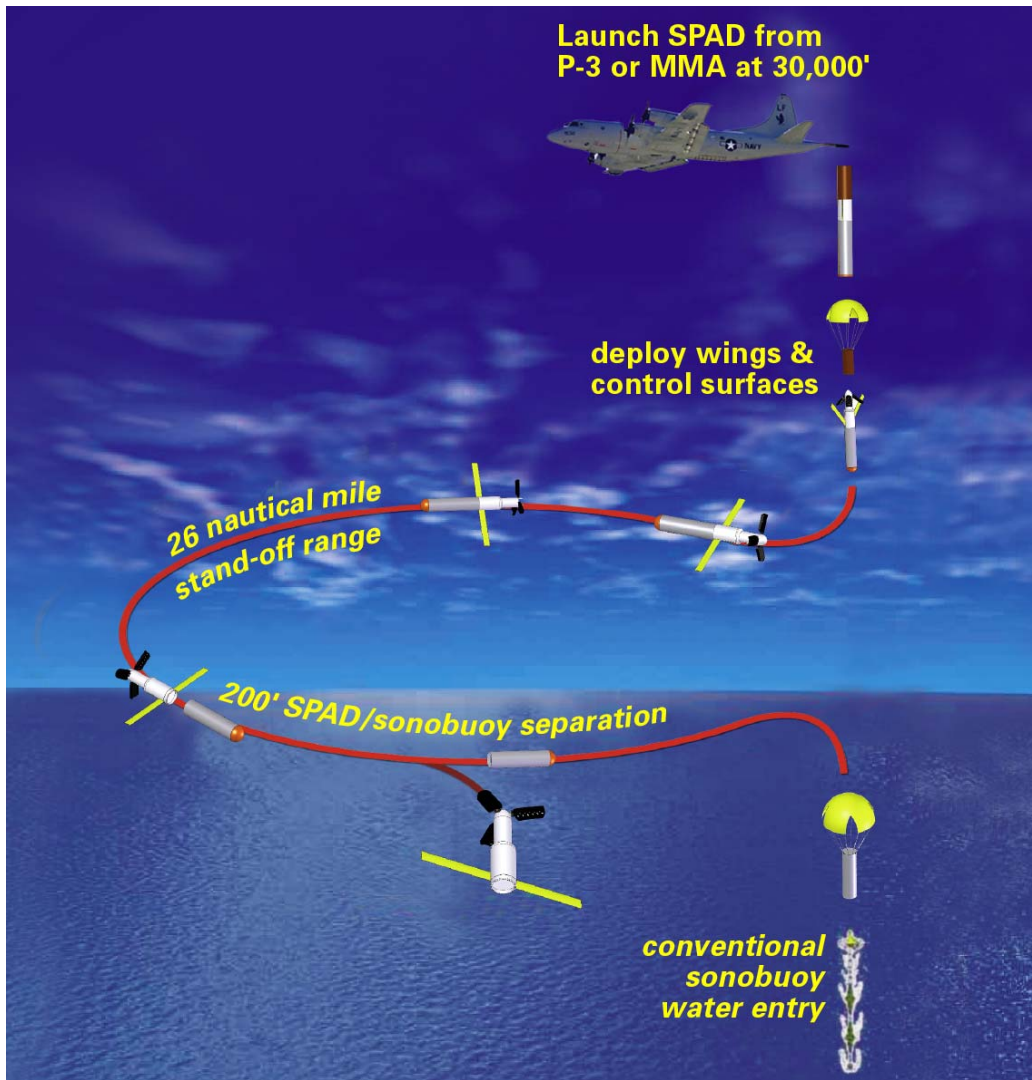
TECHNOLOGY DESCRIPTION

The SPAD is designed to utilize the sonobuoy launching technology currently used in the Maritime Aircraft Patrol's P-3's. The SPAD's destination and waypoints are preprogrammed and the unit is loaded into the Sonobuoy Launch Canister (SLC). The SLC launches the SPAD with the same Cartridge Actuated Device charge as a conventional sonobuoy @ up to 30,000ft and 370 KIAS. Upon ejection a parachute orients the vehicle into the air stream, jettisons, then the wings and fins are deployed. Assuming a 1000ft altitude loss upon launch the SPAD will then glide up to 26 nm.

⁴ "Tactical Sensors - Unattended Ground Sensors", DARPA Information Exploitation Office, <http://dtsn.darpa.mil/ixo/programdetail.asp?progid=29&action=vision>

The SPAD then navigates to the release point, where the sonobuoy and ADV separate. The sonobuoy deployment from the ADV to the water is identical to that of a P-3 launch. The sequence of flotation bag deployment, cable and sensor deployment, detachment of the outer sonobuoy shell, sensor stabilization and operation are identical with present sonobuoy practices.

Features	Advantages	Benefits
A-size Sonobuoy Volume	Utilize Current Launchers	Trusted/Proven Technology
G-Size Sonobuoy Payload	Currently Used by NATO	Easily Inserted in to SPAD System
Capable of Carrying Other Payloads/Sensors	Used Across Many Platforms	Interchangeability
Long Glide Range	Stand-off Deployment	Aircraft Out of Harms Way
High-Altitude Drops	No Need to Descend to Deck for Deployment	Save Fuel, Wear/Tear on Aircraft



SPAD Vehicle Concept of Operations

CURRENT STATE OF DEVELOPMENT

The SPAD Program is currently in the last phase of ground testing before the initial flight test scheduled for July 2007.

Working closely with USSI, the nation's largest sonobuoy manufacturer, KaZaK has incorporated proven sonobuoy technology into the SPAD package. The parachute, parachute deployment sequence and the payload attachments are identical to current field tested systems on USSI's sonobuoys.

The Wing and Grid Fin deployment mechanisms have been completed and tested for operation in the wind tunnel. Wind Tunnel testing, conducted at the Wright Brothers Wind Tunnel at MIT, ensured proper mixing of the fin servos to control the vehicle. The autopilot, supplied by MicroPilot, programmed with the gains resulting from wind tunnel testing has been successfully flown in a simulator program. The SPAD has been successfully test fired from sonobuoy launch tubes at NSWC Crane using the current Cartridge Actuated Device (CAD).

The SPAD first flight tests are scheduled for July 2007. Ten flight tests are scheduled over land with a Recoverable Version (RV) of the SPAD. This effort will conclude the Phase II Basic portion of the program. The Phase II Option will include over water flight tests. These tests will incorporate a fully functional G size buoy that will be deployed over water by the SPAD. This sonobuoy will transmit signals to the launch aircraft from the deployed hydrophone. The conclusion of the Phase II Option will see the delivery of three SPADs to NAVAIR for range testing. Technology readiness level is expected to be a 5 at the conclusion of the Phase II program.

TECHNOLOGY DEVELOPMENT MILESTONES (SBIR)

Milestone	TRL	TRL Date	Risk	Measure of Success
Phase I - Design Concept and Build Prototype	2	Sep-05	Low	Complete Prototype
Phase II, Year 1 - Detailed Design, Wind Tunnel Tests	3	Dec-06	Moderate	Gain Stability Coefficients
Phase II, Year 2 - Recoverable Version (RV) Flight Tests	4	Jul-07	Moderate	Sonobuoy signals received after deployment
Phase II, Option - Over Water Flight Tests	5	Mar-08	High	Accurate Placement of Functioning Sonobuoy

TECHNOLOGY AVAILABILITY

The KaZaK SPAD will be ready for commercial delivery in the summer of 2009, with flight tests planned for initialization in mid 2007 and 2008.

TECHNOLOGY TRANSITION OPPORTUNITIES (PHASE III)

Required Test and Demos	TRL	Target Date	\$ Needed	Performing and Funding Organization
High Altitude Drop Test	6	Aug-08	\$150k	USN
Production Capacity Tooling	7	Dec-08	\$250k	Boeing/EDO
Production G-size Sonobuoy	8	Dec-08	\$500k	USSI
SPAD Production	8	Jun-09	\$250k	KaZaK

REFERENCES

The following individuals can provide information on the KaZaK SPAD:

Primary TPOC: Jason Payne, Naval Air Warfare Center AD, Bldg. 2185, S1190-B6, 22347 Cedar Point Road, Unit 6, Patuxent River, MD 20670-1161, jason.payne@navy.mil, (301) 342-2140

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ABOUT THE COMPANY

KaZaK Composites Inc. is a Massachusetts based company that designs, develops, manufactures, and markets high performance composite structures. By integrating innovative engineering design and proprietary low cost manufacturing processes, with specialization in large and unusual pultrusion processing, the Company provides superior value products for the aerospace, military, and commercial markets.

A privately held company, KaZaK Composites Inc. was established in 1992 and has grown to nearly 35 employees, most of whom are degreed engineers and scientists. KaZaK's expertise is in composite materials, mechanical & structural design analyses. The Company is headquartered in Woburn, Massachusetts and maintains a manufacturing facility in Hudson, New Hampshire. The

Hudson facility houses the world's largest pultrusion equipment, capable of pultruding 10 foot wide panels up to 6 inches thick.

KaZaK has been extremely successful in commercializing SBIR-initiated technology. For example, KaZaK was recently awarded a Phase III commercial contract from NASSCO, a General Dynamics-owned military ship-building company, to produce up to 100,000 high performance stanchions used to secure cargo in the T-AKE class of next-generation cargo ships. Contract value for the first two ship sets is approximately \$10 million, with options for ships already in production totaling another \$40 million when executed. The first year, \$10 million Phase III SBIR contract alone made KaZaK one of the leading SBIR technology commercialization firms.

The founder, Dr. Jerome Fanucci, has over 25 years experience in the military composites industry. Before starting KaZaK Composites, Dr. Fanucci held positions at several aerospace and composite manufacturing facilities, where his efforts included design of composite nuclear hardened structures and verification of composite structure for the B2 bomber. He was manager of composite shelter development programs at the US Army Natick RD&E Center.