Falling Up From the Ocean Floor

DARPA advances its remote-triggered deep-sea device that will store payloads and rapidly lift them to the surface.

BY SANDRA JONTZ

It has the trappings of a science-fiction film: Robot pods soundlessly lie in wait on the ocean floor until summoned to the surface, launching drones capable of hibernating inside the capsules for years at a time. But this scenario is far from fantasy thanks to the Defense Advanced Research Projects Agency's Upward Falling Payload program.

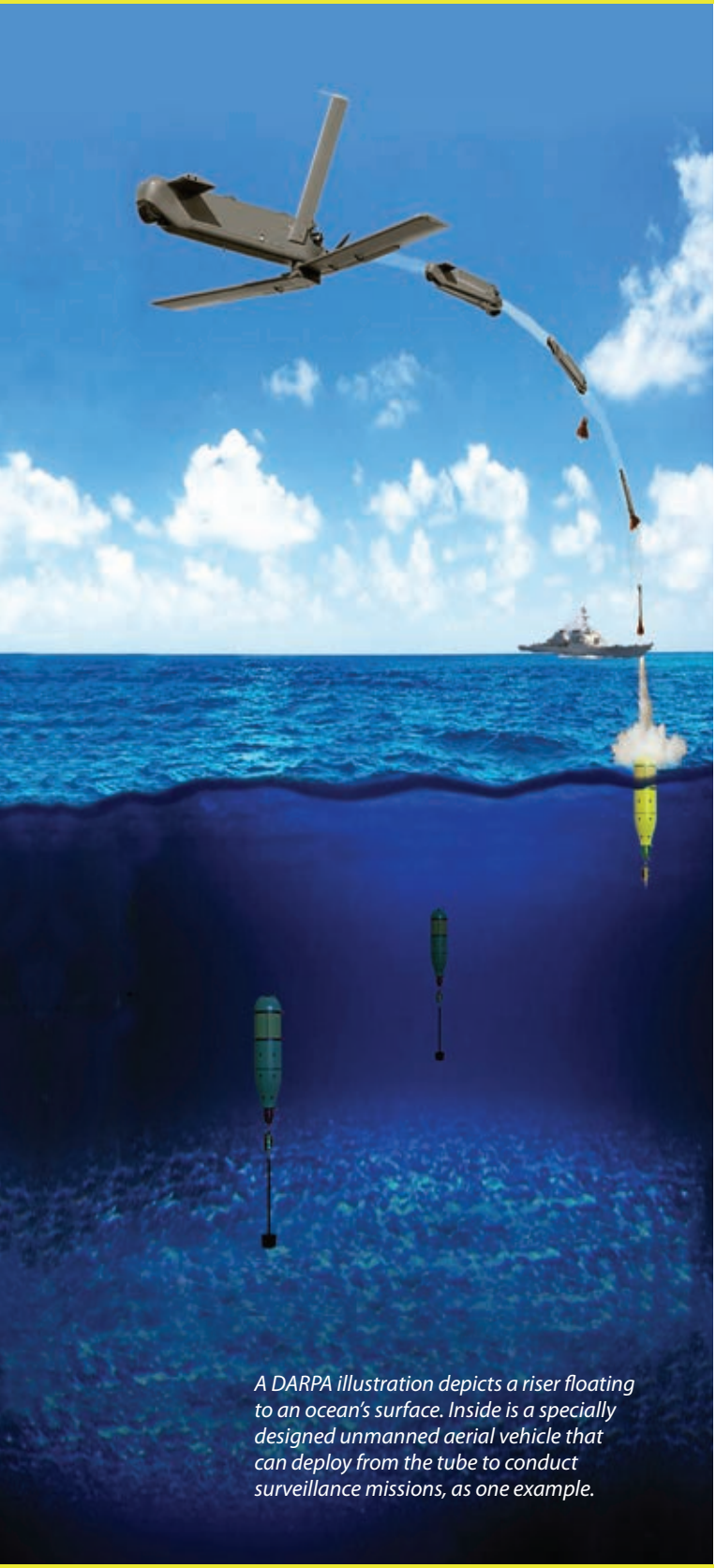
The capsules, known as UFPs, could be remotely triggered by the Navy when it requires surveillance or aerial support. Operators, even if positioned hundreds of miles away from the pods, could activate nodes on the devices to send them floating to the water's surface—falling upward. "The idea of UFP is to pre-deploy them far in advance, and then they will be there when you need them," says Jeffrey Krolik, the program manager in the Defense Advanced Research Projects Agency's (DARPA's) Strategic Technology Office.

The pods also were designed to save the military energy costs. The drones would not require fuel because they would be powered with energy generated by ocean currents.

Developers envision the UFP comprising three subsystems: the deep-ocean, pressure-tolerant "risers," or tubes, that would come to the surface on command; the encased payloads or platforms, such as unmanned aerial vehicles (UAVs) or buoy sensors; and the communications system to trigger the risers to launch across great distances.

DARPA has partnered with five companies on the $22 million multiyear project, now in its second phase. The businesses include Lockheed Martin, General Dynamics, Boeing, Sparton and Global Aerospace Corporation (GAC).

Each firm has invested to overcome many unprecedented challenges, with some tackling more than one portion of the project. For example, GAC is developing nodes to contain underwater communications hardware, a riser and a small UAV that operators can cue to a desired location, according to the California-based firm. GAC and its research and development partners are working on a



A DARPA illustration depicts a riser floating to an ocean's surface. Inside is a specially designed unmanned aerial vehicle that can deploy from the tube to conduct surveillance missions, as one example.

mission node capable of launching a payload from a depth of more than 6 kilometers (3.7 miles). "By exploiting environmental conditions and basic physics, it is anticipated that the riser and the UAV will enable powerful effects with a large influence range at low cost and risk," says a GAC statement about the company's contribution to the DARPA-led effort.

Krolik predicts the U.S. Navy will be the largest user of the technology as the service looks to autonomous systems to reduce costs and eliminate complexities that diminish its inventory of weapon systems and platforms. "Unmanned systems and sensors are commonly envisioned to fill coverage gaps and take action at a distance," Krolik says. "[The Navy has] a need to get these unmanned assets far forward and call them up from long ranges in a short period of time."

Roughly half the world's oceans measure deeper than 2.5 miles—providing optimal conditions for concealment and storage of UFPs, he adds. "If you are going to pre-deploy them, though, you better put them in a place where they are going to be there when you need them and the adversary can't get to them," Krolik advises. "The notion of UFP is you store them at the very bottom of the deepest parts of the ocean so that it's really hard to find them and expensive to bring them up. When you need them, you just trigger them from far away with some kind of communications device."

The vessels likely will be made of incredibly thick aluminum with a special coating to withstand corrosion. "We're going to leave these down [there] for years, so it can't be some rusty bucket of bolts at the end of five years," Krolik notes. Prototypes use a special cowling and syntactic foam.

Researchers are working on three varieties of pods—all nonlethal and sized according to the payload they will carry. The smallest device measures roughly 5 feet tall and a few feet wide, and the largest is about 15 feet tall and 6 feet wide. "We are not putting any weapons of any kind at the bottom of the ocean," Krolik emphasizes.

One key task for scientists and engineers is the development of an inner container core that will remain at one atmospheric pressure, no matter the submerged depth of the UFP.

Three types of cargo to be contained inside the risers are under development: two UAVs and a novel lightweight kite-and-tow-body payload. "They're all basically payloads that can either do surveillance imaging of one kind or another; find other things that are on the [ocean's] surface in these far-forward areas; or reconstitute communication should the communications networks go down," Krolik says.

In the coming months, DARPA will launch at-sea demonstrations to test the integrated riser, communication system and deployment of the various payloads.

Engineers also face the challenge of developing an enduring, reliable power source that will not only keep the UFPs listening for the signal to rise to the surface, but also provide enough power to make the ascent, Krolik says.

The sheer depth at which the UFPs will lie in wait actually offers some advantages, he explains. For one, it will protect them from damage caused by ocean life. "There is no marine life at those depths, so we don't have to worry about anything

picking them up or interfering with them down there. And it's pretty hard to find [the UFPs] that far down," Krolik says.

However, the sheer depths alone might not be enough to protect either the UFPs or the fiber optic cables that line the ocean floors and transmit almost all the world's telecommunications, says Pamela Collins, a principal investigator and senior program manager for the Department of Homeland Security's Federal Emergency Management Agency programs at Eastern Kentucky University's Justice and Safety Center. While monitoring the massive ophidian network of undersea communication lines was not part of UFP's genesis, the project could be tailored to surveil the critical system.

"Generally, there is an assumption that most of the emails and phone messages that we send back and forth without thinking about it occurs through satellites, when the fact of the matter is that's not the case," states Collins, also a professor of safety, security and emergency management at Eastern Kentucky University. An estimated 99 percent of U.S. and international data and phone traffic is transmitted over the 285 undersea cables that flow from the United States to other countries.

"These cables [are] only about the size of a magic marker, or only 1 or 2 centimeters in thickness, with a rubber insulation on the outside of that," Collins says. Despite the depths at which they lay, the cables are actually quite vulnerable, particularly to adversaries intent on disrupting such a critical lifeline, she says (*SIGNAL* Magazine, November 2015, page 64, "The Peril and Promise ...").

The system's vulnerability was highlighted recently following reports of increased Russian sea activity around the globe, and notably, deep-sea submersible craft spotted last fall off U.S. shores in the Atlantic Ocean. In 2013, Internet traffic across the cables measured 5 gigabytes per capita, with demand projected to triple by 2018, she says. Increased demand means increased reliance on the cables, which means increased desire by adversaries to take down the network. The cables are owned and maintained by private telecommunications companies, and the military and intelligence communities have access to 22 redundant, or "dark," secret cables.

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