

# DEPTH CHARGES



## NAVY SBIR LEADS TO RESILIENT, RECHARGEABLE BATTERIES POWERING AUTONOMOUS UNDERSEA APPLICATIONS

**O**n March 8, 2014, Malaysia Airlines Flight 370 disappeared over the Andaman Sea. After an erratic flight path, it slipped off the radar and under the waves, carrying 239 passengers and crew members. The disappearance triggered one of largest, most extensive, and expensive multinational aviation search efforts in history.

A few weeks later, Phoenix International, a marine service contractor that provides worldwide manned and unmanned underwater services, deployed a Bluefin-21 autonomous underwater vehicle (AUV)—powered by Bluefin’s 1.5kWh subsea battery—to conduct

underwater sensor sweeps, aiding in the search.

The Bluefin-21 AUV was developed by Bluefin Robotics—a small business founded in 1997 by a group of engineers from Massachusetts Institute of Technology’s AUV lab. In February 2016, Bluefin Robotics was acquired by General Dynamics Mission Systems, a business unit of General Dynamics. Since the acquisition, General Dynamics has continued to invest in, and advance, the Bluefin Robotics AUV products and related subsea power solutions. They are now fielded worldwide, across both defense and commercial industries.

Regarding the Malaysian Air search, Chris Moore,

Director of Commercial Operations, Phoenix International, said, “We had a lot of great support from Bluefin Robotics, and we successfully dove 15 times down to 5,000-plus meters, doing side-scan sonar surveys looking for a debris field from the airplane crash. On one of our dives, we achieved 27 hours of endurance off one of the Bluefin battery banks.” The endurance and depth both earned world records for the Bluefin-21 AUV, which was powered by technology developed with the help of a Navy SBIR award.

Certainly, undersea search and rescue is a vital activity. But the applications for the Bluefin battery to power AUVs, or autonomous robots for underwater applications, extend beyond search and rescue.

The Bluefin-21 is a torpedo-shaped AUV that can be used to conduct both military and civilian oceanic operations. Within the Bluefin-21 (and other untethered robots) the Bluefin 1.5kWh subsea battery is the operational foundation for use in deep water, keeping sailors out of harm’s way. The AUV can be used for mine countermeasures, anti-submarine warfare, and mapping of the sea floor. It also has applications in oil and gas exploration, archaeological investigations, and for assessing infrastructure safety.

Bluefin Robotics’ subsea batteries leverage a rigorously tested, fully submersible, modular design that eliminates a need for the battery to be packaged in a heavy, sealed vessel. The rechargeable lithium-polymer cells provide high energy-density and the modularity of the batteries enable rapid battery swapping and speedy redeployment of subsea devices or AUVs.

“Instead of a heavy vessel that can withstand pressure, the unique battery design saves on weight and space, and that increases the energy density,” said Adam Mara, Director of Power Systems for the Bluefin Robotics product line of the Maritime and Strategic Sys-



tems business unit within General Dynamics Mission Systems.

The 30-pound battery can not only be placed directly into the water, the battery electronics include built-in protection, monitoring, power control, and battery conditioning. Its functional design allows a user to simply replace a discharged battery with a charged one, enabling battery “swappability” and the rapid turnaround of submersible equipment.

“You can change out the equipment very fast. Instead

of having to open up a pressure vessel, which takes a lot of time, you just get the AUV out of the water, swap out the batteries, and it is ready to re-use—all in half an hour,” said Mara.

Finally, the Bluefin 1.5-kWh subsea battery has a fully automated charging system. Full battery re-

charge can be accomplished in six hours or less. And it can operate for up to 16 consecutive hours.

“Power is the driving technology behind all autonomous robots. Our original goal was to develop a battery to withstand pressure at underwater depths. This pressure-tolerant battery technology allows our AUVS to operate efficiently at deep depths for long durations,” Mara said.

Creating a reliable underwater electric power source is a challenging engineering task. With a Small Business Innovation Research (SBIR) contract from the Navy’s Office of Naval Research in 2001, Bluefin Robotics was able to achieve this feat, and emerge as a world leader in AUV products designed for defense, commercial, and scientific applications.

Mara said, “This SBIR funding, as well as internal investment, helped us develop and test our new battery capability down to 6,000 meters. That spun off into a new power line that is now available to everyone. If Bluefin Robotics didn’t have the SBIR, we would not

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Working in Boston harbor, a specialist installs a Bluefin battery into an autonomous underwater vehicle.

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have been able to go to deep depths.”

Its UN-certified, stainless-steel shipping container allows AUV deliveries by ground, sea, or air, making it highly desirable for subsea emergency-response operations, both in military and civilian theaters. “One of the most important features concerning developing a battery that is not housed in a vessel,” Mara said, “is the ability to respond rapidly. Our batteries can be shipped anywhere, ready for use.”

The Bluefin battery can power multiple types of payloads, including geophysical payloads that collect bathymetry data and backscatter data; high resolution cameras; and mineral survey payloads. The battery also powers electric field sensors, magnetometers, conductivity

temperature and depth sensors, and navigation, telemetry, and propulsion systems.

The Bluefin battery is now a critical part of the General Dynamics Mission Systems product family of AUVs. These batteries have also been used to power remotely operated vehicles (ROVs), profilers, buoys, and submersible systems.

Mara added, “The AUV industry is expanding rapidly. Demand for a reliable power system is increasing. The number of sensors that people use, and the number of applications for subsea power, are expanding. This unique power solution gives users surface access to the deepest depths of our oceans in order to carry out thousands of different kinds of activities.” 



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**Bluefin Robotics Corp. (General Dynamics)**

Modernization Priority: Autonomy

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