IDEAS

HUMAN-POWERED SUBMARINE RACE

Pedals to Metal Underwater

Inaugural competition encourages entrants to be innovative, cost efficient, and fast

By Simson L. Garfinkel
Special to the Christian Science Monitor

NORTH FALMOUTH, MASS.

STRAPPED on his back in a tank of water, Mitch Dmohowski furiously peddles a bicycle with no handlebars or rear wheel.

With a scuba mask on his face and an air regulator in his mouth, Mr. Dmohowski, a graduate student at the Massachusetts Institute of Technology, is training for the First Annual International Submarine Race, being held later this week in Florida.

The race is the brainchild of Henry A. Perry, whose nonprofit foundation has been funding underwater vehicle research at colleges and universities for the past three years. By having a human-powered submarine contest, Mr. Perry hopes to catalyze innovative developments in submarine design.

"The speed at which something goes through the water is a function of two things: the power you are putting into the water, and the drag of the body that you are pushing," explains Perry.

Limiting the submarines to the power of a single person forces the contestants to spend their creative energies designing efficient propulsion systems and low-drag hulls, rather than trying to see who can "design the best motor."

The biggest impact of the developments will probably be in deep-sea exploration, where small craft are limited by the amount of fuel that they can carry.

When the idea for the contest was floated two years ago, "we anticipated that if we could get five teams in the water . . . at a one-day event, we would have done very well for ourselves," Perry confesses.

Instead, 19 teams from universities and companies have entered submarines in the race, which is now likely to span four days, starting June 23. The race will be featured on the National Geographic Society's weekly "Explorer" television program, aired by the Turner Broadcasting System in a half-hour show this fall.

The subs are all shapes and sizes. Most are 10 to 20 feet in length and 2 to 4 feet in diameter. In compliance with the rules, each sub is designed to hold a two-man crew: one person to pedal, the other to steer and monitor the air supply.

The subs are also all filled with water, technically called "wet subs." That makes them easier to design and construct than "dry subs" that have pressurized hulls. Both the pilot and pedaler must both be certified scuba divers.

"A lot of the rules and regulations are very heavily geared to safety," explains Anthony Joseph, a graduate student in electrical engineering, who has worked on the MIT sub in his spare time.

For example, most submarines are neutrally buoyant: They neither sink to the bottom nor rise to the surface when released underwater. But in the interest of safety, the contest subs have to float to the surface in the event that something goes wrong.

"That's unfortunate, because that means [the pedaler is] spending some energy to stay underwater," Mr. Joseph says.

Other safety features include escape hatches that can easily be opened by the crew or by rescue divers, strobe lights that can be seen for at least 55 feet underwater, and a "dead man's" switch that will release a safety beacon in the event that either crew member becomes disabled. The plans for the subs have all undergone a comprehensive safety evaluation; one of the early contestants was disqualified.

"It is an inherently dangerous event," says Ben G. Allen, who is heading the sub team at Benthos, a Cape Cod-based company that manufactures undersea robots. Twenty people at the company have been working in their free time under Mr. Allen to get the sub prepared for the contest, and the company has donated $5,000 in equipment.

"We feel confident in our design and training to overcome those dangers," Allen says.

But even if Benthos doesn't win, says Allen, many of the design and construction techniques developed while employees were working on the sub will prove useful in future undertakings.

The subs will race in pairs, completing three laps around the canoe-shaped, six-tenths-of-a-mile course in water 15 feet deep. Contest organizers expect most of the subs will complete the course in less than 10 minutes. The race will continue, elimination-style, until there is a winner.

The course has been put together by the department of ocean engineering at Florida's Atlantic University, which is sponsoring the race along with the H. A. Perry Foundation.

The subs will also be judged for speed, innovative design, and cost effectiveness, with a $500 prize awarded for each category. The grand prize of $5,000 will go to the entry judged the overall best.

Spending a "ton of money" to make the fastest possible vehicle might win the speed category, but would probably lose points for cost effectiveness, says Maggie Linskey Merrill, director of the Perry Foundation. For that reason, the 11 student entries have a chance against subs from groups like Benthos and Lockheed Advanced Marine Systems, which has also fielded an entry.

The 19 submarines in the contest have adopted different strategies for smoothing the flow of the water to achieve "laminar flow," a term used to describe the movement of water over a surface in which adjoining layers of the water do not mix.

"Icarus," the MIT entry, has a cigar-shaped hull based on an experimental, declassified Navy project from the 1950s. The low-drag hull is articulated, or jointed, so it can bend around the tight turns of the underwater course. An added feature of the sub is a special vacuum system designed to suck turbulent water away from the sub's hull, smoothing the water's flow and further reducing the ship's drag.

Another way of reducing drag is employed by the Knuckle Ball, a 60-inch, transparent, acrylic sphere constructed by Innerspace Corporation in Covina, Calif., which builds underwater motors.

"[A sphere] is perfect for a hull that is designed to resist external pressure," says Calvin Gongwer, Innerspace's president. To propel the sphere, Mr. Gongwer is using a patented propeller he designed that creates a laminar flow by sucking water from the bow of the sphere to the stern.

Gongwer doesn't expect to win the race with a vessel powered by an arm crank instead of foot pedals. The 72-year-old inventor says he is entering "to publicize the marvelous performance of the sphere that we had shown in [our] free-running underwater models, which is largely overlooked by the hydrodynamic community."

Just as important as the hull design is the sub's propulsion system. Two entries have abandoned traditional propellers entirely and are using fishtail-like flippers instead. The other teams are trying to make the most efficient propellers possible.

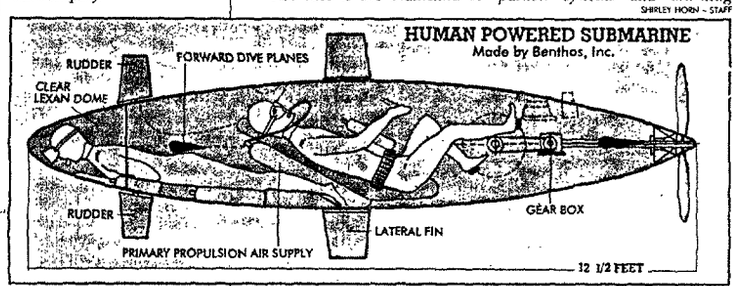
The Benthos propeller was designed by computer programs that Allen says took more than 80 hours to develop; the blades are cut from a 2-foot block of aluminum on a computer-controlled milling machine, a process that takes eight hours.

While Benthos is not likely to market a human-powered submarine, says Peter Zentz, a spokesman for the company, such a vehicle might have applications. Just as a person can go farther on a bicycle than on foot, a swimmer in a human-powered submarine could certainly outswim someone who just has a pair of flippers.

The Navy might be interested in such a vessel. "Because it doesn't have any electronic devices on board, it would be very quiet," says Mr. Zentz. "It could also be used for recreation. There is a big recreational diving industry; people are always looking for new toys."

Indeed, says Ms. Merrill, companies like Yamaha and Suzuki have already contacted the Perry Foundation to explore the commercial possibilities of the technology.

CLOSE QUARTERS: *Two people, one to pedal, the other to steer and monitor air supply, will shoehorn themselves into the propeller-driven entry of Benthos, a Cape Cod-based company.*



SHIRLEY HORN – STAFF


MELANIE STETSON FREEMAN – STAFF

LEARNING CURVES: *Benthos team leader Ben Allen (l) thinks building a sub could benefit the company in future projects.*

BOOKS

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