

Special to Undersea Warfare: Submarine Races

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High-tech meets low-tech, and college engineers compete against standout high school students—fully submerged. It all happens in the International Submarine Races, the human-powered engineering design competition held at the world's largest indoor tank, the Naval Surface Warfare Center's Carderock Division David Taylor Model Basin, June 23-27.

Drawing upon both brain and brawn, the scuba-clad future engineers and design entrepreneurs spend up to two years designing, building and producing submarines from the sublime to the surreal, all with the goal of conducting a submerged run on a 100-meter course, 20 feet deep, powered by human energy alone.

This year's race was the 7th in the biennial event that has been capturing the imaginations of would-be submariners since 1989.

The team chosen by judges to receive the top award for Overall Performance was the University of Quebec's Ecole de Technologie Superieure, Montreal, Canada. "OMER 5", the team's remarkably sleek 16-foot submarine, won the Absolute Speed Award with a sprint of 6.814 knots in the two-person propeller category and also won the prize for Best Use of Composites. The Overall Performance Award, sponsored by the IEEE Oceanic Engineering Society, carries a cash prize of \$1,000 and a trophy.

The prize for Innovation went to independent contestant Bruce Plazyk of Wheaton, IL, who has been competing in this event since the very first race was held in the ocean at Singer Island, FL. He created a one-person submarine called "Faux Fish" that looked like a mechanical fish, complete with a compartment for its pilot and an articulating tail and pumping system for propulsion. The Spirit of the Races Award went to the team from Florida Institute of Technology, whose submarine, "Miss FIT", was a bright red 16-foot-long six-sided torpedo-like creation. This award recognizes overall spirit, gusto, fortitude and support of other teams and is given in honor of the late ISR contestant Steve Barton of Spring Hill, FL.

Judges awarded the Best Design Outline and Report prize to Sussex County Technical High School of Sparta, N.J., whose first-time entry, "Umptysquatch-1" was completely designed, built and operated by high school students. A new prize, the Smooth Operator Award, went to "Sirius" from the University of Washington. The award recognizes overall team efficiency in handling their sub through the staging area, into the water and below the surface.

The competition featured 19 submarines from teams throughout the U.S., Canada and Mexico, including nine universities, two high schools, and several independents. More than 150 volunteers provided the resources required to conduct the races, including U.S. Navy safety divers from Mobile Diving and Salvage Unit 2, Little Creek, VA, and experts from the Carderock Division staff.

Speed awards:

One-person propeller, academic, first place: RSR Fourier, University of Maryland, 4.916 knots; second place, Hullabaloo, Texas A&M, 4.835; third place, Phantom 4, Virginia Tech, 4.516. One-person propeller independent, first place: Scuba Doo, Wheaton Submarine Works, Wheaton, MD, 4.875 knots. One-person, non-propeller, academic, first place: Specter 1, Virginia Tech, 3.520 knots. Two-person propeller, academic, first place: Omer 5, Ecole Technologie Superieure, University of Quebec, 6.814 knots; second place, Terpedo, University of Maryland, 3.149; third place, Umptysquatch-1, Sussex Technical High School, Sparta, NJ, 2.517. Two person, non-propeller, academic, first place: Miss FIT, Florida Institute of Technology, 3.417 knots.

This was the fourth time that the event was staged in the 3200-foot-long David Taylor test tank at NSWC. The ISR was created in 1988 with an open invitation to inventors and entrepreneurs of all stripes. The first race was held at Singer Island, Florida, the following year. The competition moved to Carderock in 1995, growing to include the participation of universities, colleges, corporations, research centers, high schools and privately sponsored teams from the United States, Canada, Mexico and Europe. Typical teams consist of student athlete/engineers, wearing scuba gear, who provide propulsion and navigation as their subs run against the clock along a fixed underwater course. The principal objective of the competition is education: to encourage innovation in the use of materials, hydrodynamic design, resistance, buoyancy, propulsion and underwater life support. ISR officials note with pride that many team participants have gone on to professional engineering careers in the Navy and other ocean technology organizations in the 15-year history of the competition.

Safety is a key concern. Navy divers line the course, ready to help extricate the crews in case of trouble. Each sub is built with a quick-release hatch, easily pulled free to allow crew members to escape if necessary. During the week, the teams went through safety and engineering examinations. Each team was required to make a 20-minute verbal presentation to the panel of judges explaining all aspects of their projects, from design to completion. Most undersea vehicles passed their examinations and made successful runs over the entire course. Some did not and withdrew.

Competition began early Monday morning of race week with a pleasant surprise: the first submarine in the water ready for safety checks--ahead of the more experienced college teams--was "Sublime II" from Springstead High School in

Spring Hill, FL. Attempting to take its first run, however, the Florida team made it to the starting gate, only to run out of air. But they were soon back in the race, finishing with a number of successful runs.

A frequent challenge is the achievement of neutral buoyancy, permitting the sub to attain a level position to start its run. At the ISR, propellers break, shear pins snap, hatches float off, guidance fins sometimes don't work and control mechanisms jam or break. Crashing into walls due to navigation mishaps is not uncommon, occurring to a number of vessels including the sleek sub named "Miss FIT" from the Florida Institute of Technology, which on one of its runs veered sharply and shattered its nosecone against the wall. But in the spirit of the races, other teams came forward with offers of help and after repairs, the sub was back and running again within hours. These were just a few of the mishaps that befell the teams and become learning experiences as they sought to take their inventions from the concept level of classroom, laboratory, workbench (or backyard garage) into the unforgiving underwater environment of the test tank.

Jerry Rovner, race director, said the ISR operations team conducted 189 individual submarine runs during the five-day event. "It's to be expected that submarines will have breakdowns. That's the nature of building a complex machine and trying to make it work underwater. We're pleased to note that for safety, our record remains 100 percent intact," he said. Mr. Rovner manages the process of all race operations including diving, safety, emergency procedures, course lighting, underwater video and timing, "This was the smoothest operation we've ever run. We owe a huge debt of thanks to the Navy, to our volunteers and to the submarine teams."

Team Omer from Montreal, Quebec, which holds the world's record for speed in both one- and two-person submarines, brought a brand new submarine to the race, dubbed "Omer 5". The Canadian team was unable to make its first run until Thursday, due to computer problems, but then achieved a blistering speed of 6.814 knots. "Omer 5" is an incredibly sleek, two-person submarine outfitted with sophisticated, computer-driven speed and directional aids for the propulsor and navigator. The sub has a breakthrough propulsion system, which enables both occupants to provide human power. Team officials had hoped to be able to shatter the eight-knot barrier, but technical problems in the new elaborate computer control system got in the way.

"As teams learn, from year to year, they get better. We've seen some excellent designs from the student teams," said chief judge Claude Brancart, a retired expert in autonomous underwater vehicles from Draper Laboratories. "We anticipated lively competition and that's exactly what we got. Many teams experience the same types of problems from too little practice time in the water, and little to no experience in the 60 degree temperatures of the test tank. It is gratifying to see these teams react, respond, repair and get back in the competition."

Among those competing here for the first time was Sussex County Technical School from New Jersey. The team designed and built a 12-foot, two-person sub that not only moved successfully through the course but achieved a speeds of 2.32 knots from its twin propeller propulsion system. The team achieved such popularity that race officials engineered a special challenge contest, giving U.S. Navy divers a chance to operate the sub and see if they could match the time of the students. To the good-natured gibes of spectators, the veteran Navy divers failed to finish the course.

Carderock managers praise the event as an outstanding way to get young people interested in engineering. A number of former ISR submarine team members have joined various Navy engineering programs as employees.

“The increasing interest among students to compete in the educational arena of human-powered submarines is gratifying,” said Nancy Hussey, chairman of the Foundation for Underwater Research and Education, parent organization of the ISR. “To design and complete a racing submarine is a very difficult challenge. Taking an idea from paper and classroom theory to actual practice in the water demands the very best minds and ultimately, experience and teamwork. We look forward to our next competition in 2005 and are delighted at the success of our partnership with the U. S. Navy here at the Naval Surface Warfare Center’s Carderock Division.”

“The Naval Surface Warfare Center has been proud to host the 2003 International Submarine Races at its David Taylor Model Basin,” says Captain Steven Petri, USN, Division Commander. “We are pleased to be able to continue our support of such an outstanding educational and engineering endeavor.”

Participating teams:

Texas A&M University (Hullabaloo)	University of
Washington (Sirius)	
Virginia Tech University (Specter 1)	Virginia Tech
University (Phantom 4)	
University of Michigan (Mercury)	Ecole Polytechnique
de Montreal (Archimede 2)	
University of Maryland (RSR Fourier)	University of Maryland
(Terpedo)	
Merchant Marine Academy (Flying Fish)	University of
Veracruzana, Mexico (Archangelo III)	
Millersville University, PA (Redemption)	Springstead High
Schools, FL (Sublime)	

