

BASIC DESIGN REPORT

11TH INTERNATIONAL HUMAN-POWERED SUBMARINE RACE

TEAM SUBLIME

OVERVIEW AND GOALS

SubLime is more than just a human-powered submarine. It is a vehicle whose purpose is to transport high school students on a voyage of discovery through the world of theoretical and practical engineering and construction. The students are the driving force in a project that begins on the drawing board and culminates at the Naval Surface Warfare Center. The goal is to introduce them to basic concepts of physics, mathematics, composite construction and hydrodynamics, as well as practical experience in bringing a project from a concept to a reality. Along the way they become scuba certified and adept at teamwork and pragmatic problem solving. The team practices every weekend in the Gulf of Mexico, exposing each member to piloting , loading and unloading, and recovery of the submarine. This cross-training builds depth in our team and exposes everyone to all facets of the project.

TEAM SUBLIME

The original two-man Sublime ran in 1991 and 1993 and again in 1997 . In 2003, Steve Barton, in conjunction with Hernando County Schools, built and raced a new one-man submarine, which raced again in 2005 and 2007. In 2009, Sublime took 1st place in Overall Performance in the 10th International Human Powered Submarine Race. We are currently training a whole new team of high school sophomores and juniors who have become certified divers for this event.

DESIGN PHILOSOPHY

Sublime is designed to be high performance, reliable, and, by necessity, extremely cost effective. It is an instructional tool for high school students in areas of math, physics, composite construction, hydrodynamics, propulsion and teamwork.

DESIGN AND FABRICATION

HULL - Sublime is entering the 2011 race with the same winning hull. The design was taken from an NACA 66-0015 airfoil, which was modified to meet the design criteria. The submarine was fabricated by creating appropriate sections. Then plywood and foam plugs were constructed and faired out. A female half mold was pulled from the plug. Two males were laid up and joined to make the hull. Sublime was originally constructed for the 2003 race. Further modifications were made to the hull to enhance performance in 2009.

PROPULSION - Sublime uses a sprocket and chain to a right angle bevel gear connected to a lightly loaded two bladed airfoil based on lifting line theory. We anticipate that this change from the 2009 system will improve our speed. The pilot is in a prone position and the pedal mechanism is at the rear of the sub.

CONTROL – Sublime has a rudder and elevators that steer the sub. Stationary fins, located amidship, provide tracking and a center of resistance for the control surfaces to work against. A plexiglass window in the underside of the bow allows the pilot to see the course markers.

LIFE SUPPORT – Sublime runs with a single 30cf tank as well as a spare air system.

SAFETY – Sublime’s deadman handle is cabled to a spring-operated emergency buoy which is incorporated into the hull. The main hatch can be released by the pilot using a hand-operated release or a foot operated release. The hatch can, of course, also be released by a rescue or support diver and is clearly marked.

TESTING

Sublime has been tested in the Gulf of Mexico, Weeki Wachee Springs, and is a veteran of the David Taylor Model Basin.

TRAINING

All team members are SCUBA certified. Thirteen new students are involved, most of whom have recently completed scuba training. We are spending quite a bit of time just practicing with scuba gear in the Gulf of Mexico to allow the students to get comfortable with diving as well as in the sub. We believe in allowing all students who have participated and worked so hard to have an opportunity to pilot during the race. We don’t selectively use only the fastest driver, as we believe this is primarily an educational experience for the students involved, above and beyond winning the race, although we still plan to be very competitive. In addition, the entire 2009 team is returning to compete and supervise the new team members. In-water team members follow an aerobic and weight training program and participate in in-water trial runs.

PROJECT SUMMARY

The thought crossed our mind to quit as a winner after 2009, but the opportunity to bring a whole new batch of students through this outstanding experience has brought us back again. Our student participation has more than doubled and community support has been bolstered by our previous success but we are still, of course, working on a limited budget. Changes in Sublime for 2011 have been minimal as it’s difficult to mess with success; however, there’s always room for improvement. Additional streamlining, a better propeller, and an improved steering system will hopefully increase our performance

CONCLUSION

Sublime plans to be consistent, reliable, and ready to race . The team’s focus will be on keeping things working and allowing everyone to participate to the fullest.