

Cyclops Next Gen New Hull Design and Testing

Narrator: Critical milestones for *Cyclops*, a new submersible designed to take as many as five people deep beneath the ocean's surface, eventually as deep as 4000 meters — more than three and a half miles. At the University of Washington in Seattle, the first test of a scale model of the *Cyclops* filament wound carbon fiber hull designed and manufactured by Spencer Composites in collaboration with OceanGate and APL-UW.

Stockton Rush: We're testing a one-third scale model of the pressure vessel used on *Cyclops 2*.

When we launched the *Cyclops* program, we planned to have *Cyclops 2* go to 3,000 meters. And we found out through our engineering that, in fact, we can achieve at least 4,000 meters and maybe more. *Cyclops 3* is planned to be 6000 meters."

Narrator: The pressure at 6000 meters — about 8762 pounds per square inch. By comparison, Navy submarines commonly operate at depths of 180 to 250 meters.

Rush: The pressure vessel is three parts: a cylinder and two hemispheres. One of the unique elements of this test will be the hemisphere. The hemispheres are also carbon fiber, which has never been done to this size and to this depth.

Narrator: The goal of this test: pressure of 6,000 pounds per square inch. The pressure was raised gradually.

At the 71 minute mark, the pressure increased to 4,000 pounds per square inch. At 72 minutes the pressure was turned up to 5000 psi. But three minutes later, at a pressure of 4,285 PSI, representing a depth of about 3000 meters, the test was aborted by apparent water intrusion into one of the carbon fiber domes.

Rush: That is the most risky part of the test and the most difficult to analyze since it's never been done. There's no test data on how carbon fiber in a hemisphere will respond to the pressures.

Narrator: This initial test was deemed a success at 4000 PSI, the equivalent of 2800 meters. The hemispheres are now back at the manufacturer, Spencer Composites in Sacramento, for analysis ahead of additional testing down the road.

In September, this successful test of another APL-UW/OceanGate design collaboration: LARS Launch And Retrieval System.

To avoid surface turbulence, the *Cyclops* vehicle on LARS is submerged 5 to 10 meters providing a stable underwater launch platform. To surface, the process is reversed. LARS eliminates the need for large and costly vessels.

Rush: We can use an ocean going tug that might be ten-thousand dollars a day versus a specialized research ship that runs, say, a hundred thousand dollars a day."

Narrator: The idea, says Rush, is for *Cyclops* to enable deep ocean diving for explorers, archeologists, scientists, movie makers, and commercial users.

Cyclops submersibles and related systems are the products of a commercial venture partnership: OceanGate and APL-UW

Rush: We couldn't have done it without the partnership. The Applied Physics Lab has been effectively our engineering partner.

This is APL — The Applied Physics Laboratory at the University of Washington in Seattle.