Hugh Popenoe & Rob Lewis

ENGINEER & ENGINEERING ASSISTANT

Tom Kleindinst/WHOI

Popenoe: We're getting ready to do pressure tests on an optical penetrator. *Alvin* has fourteen electrical penetrators and six optical penetrators in the hull.

Lewis: Fiber-optic penetrators bring in the fiber-optic lines from outside the sub to the inside. Electrical penetrators are almost the same, except that it's all electrical wires.

Popenoe: All the electronic and optical data is housed outside the sphere, and all that information has to come through these penetrators to the pilot in the sphere. All the commands from the pilot to the thrusters and instruments also travel out through the penetrators. They mount to holes in the personnel sphere.

Lewis: The penetrators plug the holes, and that's why we're testing, to make sure they don't leak when they're at depth.

Popenoe: They have to be able to withstand the same pressure as the sphere, at depths down to 6,500 meters, or just over 4 miles. Right now *Alvin* is being certified to go to 4,500 meters, but in a few years when we try to certify it to go deeper, the penetrators will already be cleared for that depth and we won't have to re-test them. Each penetrator has two O-ring seals to it. An O-ring leak or structural failure would potentially doom the lives of the occupants inside. In the pressure testing, we try to defeat one seal at a time. The idea is that each seal individually can hold that pressure, but there's a second seal that can also do it. One of the requirements for *Alvin* is that there's a backup for everything.

Lewis: There's a pressure gauge on the chamber, and when we run the tests, we monitor that to make sure the pressure doesn't drop.

Popenoe: If a seal fails, water would be coming out through the hole in the end cap of the test chamber where the penetrator is mounted.

Lewis: We also test the optical fibers and confirm that they're still working under pressure. We've got a light meter that measures the amount of light loss down each fiber.

Popenoe: With electrical penetrators, we monitor the functionality of the wires.

Lewis: In this picture, I'm controlling the overhead hoist, and we're lowering the end cap of the test chamber. The fiber-optic lines in the chamber are about eight meters long. They're in a tube that hangs down from the penetrator.

Popenoe: The chamber is about four feet deep.

Lewis: We're spinning the end cap to make the tube coil into the chamber.

Popenoe: Then we'll seal the chamber and pressurize it to 14,700 pounds per square inch. The whole series of tests takes a full day to complete. Fortunately, we didn't see any failures at all. Every implodable component on the sub had to be pressure-tested to a defined depth, even the cameras and lights. Rob and I spent about four months just testing the penetrators.

Popenoe: I just got my ten-year certificate at WHOI. My background is in electrical engineering. I do a lot of different projects, but they're always a variation of the same thing— data and power for vehicles and instruments.

Lewis: I started here in the beginning of November.

Popenoe: Really? That's it?

Lewis: Yeah, I'm the new guy. Pretty much thrown right into assembling and testing the penetrators. My background is in electronics. I worked over at the Marine Biological Lab for just shy of 12 years. I've done a lot of different things over at MBL, but this is my first time working on a submarine. ▲