Diver Tools Program

New tools for underwater work

By JERRY THOMAS

Navy divers have evolved into skilled underwater technicians. They have assumed more complex assignments, heavier workloads, and tasks that have taken them into greater depths.

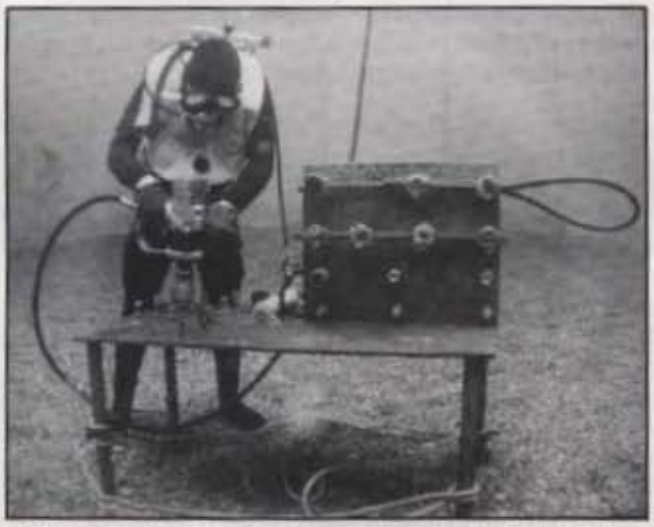
For almost 20 years, divers have been relying largely upon the Naval Civil Engineering Laboratory (NCEL), Port Hueneme, Calif., for the newest technology and hardware. To support their needs for greater efficiency and productivity, the Laboratory has been developing new tools, techniques and power sources.

Today's divers must adapt to extreme underwater environments, from arctic to tropic, and adjust to various surface support systems, from small inflatables to larger diving vessels expressly equipped to support their work.

NCEL is confident that the technology it develops today will lead to improved capabilities for tomorrow, enabling all classifications of divers (construction, maintenance, repair, rescue, salvage, saturation) to work faster, more safely, and with more freedom of movement. They will be able to meet their technical responsibilities by using new generations of tools, procedures and power systems developed under the Laboratory's Diver Tools Program.

The Diver Tools Program today uses the talents of six engineers and two technicians. Sponsored by the Naval Facilities Engineering Command, and the Naval Sea Systems Command, the $2 million program concentrates on two major areas of development, Technology and Hardware.

Within the Diver Tools Program, the Underwater Construction Systems (UCS) project is development a multi-function tool system, grout dispenser, emergency diver recall system, diver navigation and survey system, underwater work repair manual, geotechnical tools, metal detectors, oil- and seawater-powered lightweight hydraulic power supplies mounted on an inflatable boat, and a cable tracking system.



Diver operates prototype seawater hydraulic impact wrench in NCEL's shallow-water test tank. The tool is powered by a 3hp motor. Only one hose is required because the return fluid is conveniently exhausted into the surrounding water. At the right is a steel panel with various test bolts in place.

NCEL was named lead laboratory two years ago for the UCS project. The Laboratory's Ocean Systems and Seafloor Engineering Divisions are conducting 16 projects to assist divers in overcoming limitations imposed by equipment not specifically designed for them and the tasks they must perform.

Project Leader Stanley Black said new developments in underwater tools systems incorporate the latest technology. Under the program, NCEL's recently developed seawater hydraulic motor is being adapted to the multi-function tool system. The system consists of a seawater power source and four tools: rock drill, rotary impact wrench and drill, high-speed rotary abrasive disc, and portable bandsaw.

The system also features two design innovations never used previously by Navy Underwater Construction Teams. First, the tools are designed specifically for underwater construction; they are not simply modifications of tools originally designed for use on land. Also, the system is powered by pressurized seawater instead of pressurized oil. Seawater hydraulics is the newest advancement in power tools, Black said, providing a safe, clean and convenient source of working fluid. The system would be available to Navy divers by January, 1986.

Following are brief descriptions of the components of the multi-function tool system:

Seawater Power Supply — The full-duty 30hp Diesel-driven power source is capable of delivering 2,000 psi seawater at flow rates up to 14 gallons a minute. Skid-mounted on a trailer, the unit features a 50-foot inlet lift and can power two tools at the same time.

Rock Drill — The tool incorporates an interchangeable nose piece for light- and heavy-duty drilling. The light-duty drill produces holes 1/4-inch to 1½-inch in diameter. It can be operated to water depths of 190 feet, drilling 3/4-inch diameter holes in granite at a rate of three to four inches a minute. Using the heavy-duty drill, divers can drill holes up to 3½-inches in diameter. The tool can be used at greater depths because none of the parts are ambient pressure sensitive.

Portable Bandsaw — Previously it took a team of divers, using a hand hacksaw, four to eight hours to cut through a double-armored 3½-inch diameter cable. With the portable hydraulic bandsaw developed by NCEL, divers can cut the cable in less than a minute.

High-Speed Rotary Abrasive Disc — This versatile tool can grind, clean and cut. Featuring an interchangeable arbor, it can be adapted as an abrasive saw, grinding wheel, or cleaning brush. It also cuts steel and aluminum underwater, as well as bolts, rebar, cable, and 1¼-inch synthetic lines. A safety guard minimizes viscous drag.

Rotary Impact Wrench and Drill — The tool provides maximum torque of 400-ft.-lbs. to tighten 5/8-inch bolts. It can be used to drill holes into wood and metal with drill sizes from 1/4-inch to 1-inch in diameter. Weighing 15 pounds, it can be operated in forward or reverse directions using commercially-available impact sockets and drill bits. Flow range is 4-10 gpm and the pressure range is 500-1500 psi.

In other areas of hardware development, Laboratory engineers have developed six geotechnical tools to assist divers in obtaining reliable geotechnical data. The tools are designed for scuba divers at a depth limit of 130 feet.

The tools — impact corer, miniature standard penetration tester, vane shear, rock classifier, vacuum corer, and jet probe — will be available next summer. They will enable divers to gather in-situ data and take samples for laboratory testing. Data and test results will be instrumental in the design and installation of a variety of seafloor facilities.

Black said prototypes of the tools have performed well when tested by NCEL divers on several projects. Tests have provided worthwhile geotechnical data.

The Laboratory's Ocean Systems Division also has developed the following:

Grout Dispenser — The tool provides the diver an improved technique to simultaneously mix and dispense two-part epoxies from disposable cartridges during installation of rebar anchor bolts in soft, porous coral. The diver-operated dispenser, simple and safe to operate, increases grouting rates. Holding capabilities in excess of 40,000 pounds can be achieved for rebar grouted with epoxy in concrete block.

Emergency Diver Recall System — The Benthos Diver Signaling System has been modified to produce an emergency diver call system more suitable for Navy divers. The battery-operated device transmits voice and alarm signals directly through the water. The system consists of an underwater transducer connected to the audio control unit by a 25-foot shielded, waterproof cable. The alarm signal can be heard to recall distances of more than 300 yards in both open water and harbor environments.

A new seawater hydraulic band saw for cutting armored cable and pipe up to four inches in diameter. The one-of-a-kind tool is an improved version of the Laboratory's oil hydraulic saw. It can cut through a 3½-inch diameter double-armored cable in approximately one minute.

Cable Tracking System — This device locates and tracks buried and surface laid submarine communication cables. The system consists of a diver probe, a surface signal injector, and a submersible signal injector. A hand-held electronic probe detects the presence of a 25-hertz magnetic field. Depending upon the strength of the impressed signal, the probe can track the cable's exact location from several hundred feet away. The tracking tone is impressed by either the surface or submersible signal injectors.

Saturation Diver Tools Package Program — Participating in a program with the Naval Ocean Systems Center, Hawaii, NCEL is developing a completely self-contained tool package to be deployed to depths of 1,000 feet that increases the saturation diver's working capabilities. The primary missions include submarine rescue, deep ocean salvage, and deep ocean recovery. The tool package consists of five basic subsystems: a silver-zinc battery pack to provide primary power to the package, a submersible electric DC motor, an hydraulic converter unit using a waterbased working fluid, an electronic monitoring system, and the tools. The package features special design precautions to protect against accidental hydraulic fluid contamination from the system's tools. The battery pack contains 40 cells (60 volts) and provides a total power delivery of 350 amp-hours.

Underwater Work Repair Techniques Manual — The manual was developed to increase the effectiveness of Underwater Construction Teams and help divers plan and perform future work. The manual, available in January, is based upon Navy diver experiences and applicable commercial practices. It is primarily designed to provide general information but does contain specific information on selected subjects. The publication covers work techniques, operational procedures, and assists (by examples) in the planning and estimating of resources and time.

Lightweight Oil Hydraulic Power Supply — This power source allows divers to operate hydraulic tools from an inflatable boat. The supply consists of hydraulic components (pumps, filters, valves, etc.) driven by a 35hp outboard motor mountable on the transom of the boat. Power source controls are located inside the boat.

Diver Electrical Safety Systems — This program is developing safe electrical power transmission systems for Navy divers. The use of electrical power underwater requires an improved ground fault detection system. The developed detection and shutdown system will remove all power from the transmission line in less than 10 milliseconds if the insulation resistance of the electrical load drops below 50,000 ohms. Systems have been tested for use with 120 Vac single-phase, and 220 Vac three-phase, at power levels up to 25kW. Also, an underwater electric field detector has been developed to allow divers to survey equipment, not protected by a ground fault system, for potentially hazardous leakage currents. □