Defense does some of its own research

By Robert Stcklasa

MENTION DEFENSE research, and some people immediately conjure up visions of scientists devising doomsday weapons in their top-secret laboratories.

That image doesn't fit the Defense & Civil Institute of Environmental Medicine (DCIEM) in Toronto, where, in fact, little classified research is done.

"Our prime customer is the Canadian military, of course, but our prime mission is the effective utilization of man in man-machine systems and in hostile environments," says a senior official.

"Essentially, we are a human research institute and we use a multi-disciplinary approach in our study of how men interface with machines."

That means finding ways to make life safer for the pilot in his plane, the diver who works in the cold seas, or troops operating in the Arctic. But DCIEM also undertakes such projects as testing gun sights for their effectiveness in poor light, developing electrically heated clothing for cold climates, and evaluating the design of military vehicles and equipment for the Canadian military.

The institute, with an annual budget of $5 million and 270 employees, is one of six Defense research establishments in Canada (see summary below). It was founded in 1971 when the Canadian Forces Institute of Environmental Medicine merged with the Defense Research Establishment.

A $1.8 million deep-dive facility under construction at DCIEM will have the greatest pressure capability of any in the world — 2,500 pounds a square inch, equivalent to sea water depth of 5,600 feet.

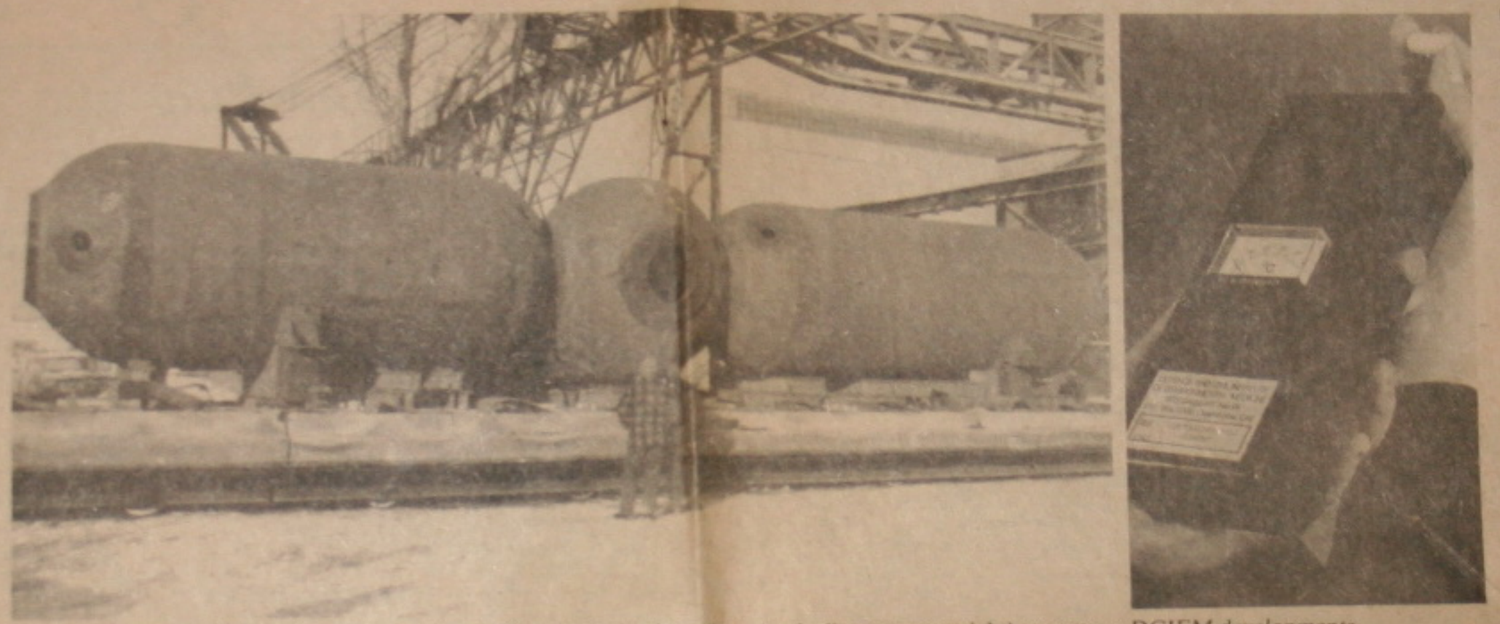
Fifty-five feet long and with steel walls six inches thick, it was built by Canadian Vickers Ltd., Montreal, and should be ready to take manned dives in 1978. The three-chamber structure weighs 380,000 pounds.

"When we first proposed this project, people laughed at us and said that it would have to be built in the U.S.," says an official. "This is quite an engineering feat and we are proud that it is Canadian in concept and is being built here."

DCIEM is acting as main contractor for the project to keep costs down. It designed the control system and the storage facility that will house 350,000 cubic feet of gas at a pressure of 6,500 pounds a square inch.

The dive facility will have living quarters in the first chamber, shower and lavatories and storage in the second, and a wet experimental area in the third, where equipment and physiological testing will take place.

DCIEM says the facility will be heavily used by industry and will help develop the skills and equipment needed to exploit offshore resources such as petroleum, other minerals and marine life. Scientists will study underwater pressure and its effects on men and equipment.



New devices for divers: a deep-dive facility (left) and monitoring pill (held in fingers at top right) are among DCIEM developments.

Lieutenant Commander Fred Fox says the present diving chamber at DCIEM can take manned experimental dives to 300 feet and equipment experimentation down to 1,000 feet — the deepest in Canada.

"But North Sea contracts call for 1,000-foot manned dives," Fox says. "Current diving techniques enable a diver to go down 900 feet where he can work for several hours."

He thinks DCIEM's multi-disciplinary approach, where engineers work with medical researchers, for example, will be a big plus for Canadian underwater research.

"No other research diving facility in the world has, under one roof, all the disciplines required to investigate man operating in a hostile environment."

The deep-dive facility is only one of many unique projects carried out at DCIEM, where scientists often find they have to invent special instruments for the military. Lately, businessmen have begun to see the money-making potential in some of these. Two of the institute's inventions are already being manufactured by Canadian companies.

Reuter-Stokes Canada Ltd., Cambridge, Ont., has sold 150 DCIEM-developed heat stress meters at $900 a unit. The meter determines, within minutes, whether the environment is too hot for people to work in.

"It was designed specifically for military training of recruits working in a hot environment," says Dr. Lorne Kuehn, head of biophysics. "But it can also be put into cockpits, tanks and boiler rooms of ships."

Wayne Joslin, vice-president and general manager of Reuter-Stokes, says unions are also starting to take interest in the meter for testing the working environment in smelters, mills and refineries.

The heat stress meter, he explains, measures air speed, radiation from the sun or indoor lighting, air temperature and humidity.

The Canadian firm has put in a bid to supply the U.S. Navy with 800 units and is anxiously awaiting the decision.

"There will be a lot of whooping here if we win the bid," Joslin says. "I think we have better than a 50-50 chance of pulling it off, even though we are competing against a large U.S. firm. Our product is smaller and five times faster."

Reuter-Stokes took the original DCIEM prototype meter that had been successfully tested and re-designed it to produce a commercial model. The firm is developing its own new features for the meter, with advice of DCIEM scientists.

"I am very impressed with them," Joslin says. "They are doing high quality work — they do practical, usable scientific research and they are committed to help industry develop their products. They aid in transferring technology from the lab into a usable commercial product, something too few government labs do."

Meanwhile, CTF Systems Inc., an engineering electronics firm in Burnaby, B.C., has received a DCIEM contract to manufacture a dozen prototype models of a decompression computer, which divers are now using to help avoid the bends.

The bends occur when a diver surfaces too quickly, causing gas bubbles to form in his body tissue. The result: pain in joints and limbs — possibly paralysis, unconsciousness and death.

DCIEM biophysicists say a mathematical model programmed inside a small chip tells the diver how fast he should surface.

At the moment, these micro-computers are being used only where divers are connected to a vessel by tether cords. The computer itself, which is on the vessel, is the size of a shoe-box and costs about $5,000. CTF Systems has another DCIEM contract to produce a portable model that could be strapped to the diver's wrist.

"We expect that it would cost about $1,500 a unit," says Dr. Randy Lomnes, CTF Systems vice-president. "This is a very new concept for divers, since they are not used to a machine telling them how fast to descend or ascend. Usually, they have to depend on decompression tables."

The wristwatch computer will tell the diver how fast he should surface, how long he would have to wait at the various depths, how long it would take him to reach the surface, and how long he could stay at a certain depth without decompression.

"We have good potential for developing a consumer product if we can keep the price between $200-$300 a unit," Lomnes says. "But that would require a lot of engineering."

Two more DCIEM inventions are now ready to be developed commercially. One is a radio pill, which the diver would swallow before plunging into cold water.

The pill sends out a signal that can be picked up by a receiver, which converts the electronic signals to register the diver's body-core temperature. Ordinarily, a rectal thermometer would be used for this.

Radio pills are not new, but DCIEM's costs only $10 and does not have to be retrieved by the diver once he is finished with it. The electronic pills can also be used in hospitals.

Perhaps one of the most ingenious DCIEM inventions is the Malcolm artificial horizon, designed by Captain Richard Malcolm, a physicist and physiologist.

An airplane pilot can look at a display which tells him where he is in relation to the ground.

However, he must use his central vision to monitor the instrument panel, which contains many other dials. Malcolm's artificial horizon makes this reading an effortless procedure.

This is a projector that produces a bar of light across the instrument panel. It is connected to a gyro platform which senses the motion of an aircraft. The bar of light then becomes a mini-horizon in the cockpit.

"The peripheral vision is very sensitive to your motion relative to the ground," Malcolm says. "Although the inner ear contains a balance mechanism, your eyes actually provide 10 times more information about how you stand relative to the ground."

Pilots often cannot see the outside world, so what Malcolm has done is to put meaningful peripheral vision back into the aircraft. The artificial horizon has been tested on various aircraft and has been praised by pilots.

The unit is now being reduced so that, when mounted, it will be no bigger than a large paperback.

DCIEM also allows industry to use some of its equipment although a fee, set by Treasury Board, is charged. One of the most frequently used is the high altitude chamber, which can achieve a vacuum and is ideal for drying out documents soaked by water during a fire.