RCN DIVING BRANCH HISTORY – Part 7 **By Charles Rolfe 2015**

This Part details some of the history of the **Defence and Civil Institute of Environmental Medicine (DCIEM),** and the Diving Officers and Men who served therein. It is a major military research organization located at the former site of CFB DOWNSVIEW. A short background shows that its roots go back to June 1939 when the **Associate Committee on Aviation Medicine Research** was formed to study pressure physiology at the Banting and Best Institute at the University of Toronto. It was here that the first decompression chamber for human studies in Canada was set up. The **No. 1 Clinical Investigation Unit (No. 1 CIU)** was then formed in 1940 at 1107 Avenue Road, with a low-temperature low-pressure chamber installed for the RCAF. In 1954 a new building was constructed at Downsview for the **Defence Research Medical Facility (DRML)** which became the **Defence and Civil Institute of Environmental Medicine** in 1971. Finally, on 1 April 2000 it became what is now named **Defence Research and Development Canada (DRDC),** as Canada's leader in Defence and National Security.

As written by Robert "Red" Larsen, the Diving Research Facility (DRF) was developed and constructed to provide the Defence and Civil Institute of Environmental Medicine (DCIEM) with a deep diving capability, under controlled and simulated environmental conditions. DCIEM is dedicated to the resolution of problems associated with men living and working in a hostile environment. Therefore, with the DRF as a research tool, the physiological and equipment problems associated with deep diving may be investigated by DCIEM, with particular emphasis to the uniquely cold waters which are encountered on Canada's three coastal frontiers. Responding to the requirement to increase the depth and time to which man can work in the underwater environment, DCIEM began in mid 1972, conceptional planning for a high-pressure diving simulation facility. This would answer the requirements not only of the Canadian Forces, but also be available to other Government Departments, such as: Energy, Mines and Resources; Ministry of Transport; Ministry of State for Science and Technology; Department of Industry, Trade and Commerce; etc., as well as to any Canadian Industrial concerns or groups which would be interested in either equipment testing and development, or physiological research.

The first step in the planning process was to determine the size, configuration and depth capability which would be required. A survey was made of research groups involved in hyperbaric research activities in other countries to acquire some insight into problem areas expected, optional design features, sizing, rating, scientific procedures and auxiliary equipment requirements. One of the most commonly heard opinions, was that the depth capabilities of existing installations were seldom adequate by the time the facility became operational. Consequently, it was decided that in order to preclude early obsolescence, the DCIEM facility should have a minimum depth capability of 5000 fsw. This decision was based on trade-offs between pressure rating, size and capability of Canadian fabricators to build the large vessels required. Configuration of the facility was also decided upon by comparing the merits and shortcomings of other installations. The design was based on two major considerations: the equipment to be used had to have as high a Canadian manufacturing content as possible, and as much as possible equipment had to be available "off-the-shelf" design or manufacture. Mr. John Canty, an Engineering consultant in Buffalo, New York, USA was retained to assist and advise DCIEM personnel in the conceptual design of the facility. His extensive experience in the design and building of the hyperbaric installation at the University of Buffalo, which is similar in many respects to DCIEM's facility, proved quite advantageous. The assembly of the complex was completed primarily by

DCIEM staff, in conjunction with outside sub-contractors managed by the DCIEM Hyperbaric Systems Engineer. The chamber complex, weighing 170 tons, and consisting of three vessels joined together, was fabricated by Canadian Vickers Limited in Montreal, and delivered to DCIEM in July 1977. The supporting sub-systems were assembled by DCIEM in-house personnel, with the first experiment being carried out in early 1979. Necessary modifications and additional equipment will be installed as funding permits. It is envisioned that this will be a continuing situation over the next few years.

The operating principle is that this facility is designed primarily for saturation type diving, but can be utilized for shorter bounce type dives. Designed for four occupants, with provisions for one additional subject, the complex has a 5600 fsw simulation capability. During saturation dives, the complex is pressurized through a series of gas distribution manifolds and control consoles, with the diving mixture from an array of high pressure gas banks having a storage pressure of 6000 psi. One portion of the pressure vessel is identified as the Living Chamber, the centre portion is the Transfer Chamber, while the other large vessel is known as the Dive Chamber, and is approximately three quarters filled with water. This chamber is divided vertically by plexiglass water containment barriers which allow the Diver's Tender to continually observe and assist him, as necessary, while the Diver is in the "wet" portion of the chamber. All three chambers are fitted with pass-through medical locks, television monitoring cameras, communications and built-in breathing systems. After pressurization of any or all parts of the complex, it is of paramount importance to ensure that the occupants, who are housed in a closed environment, have adequate life-support capabilities. This is accomplished by an elaborate monitoring and control system, known as environmental control loops. This system ensures the elimination of metabolic contaminants such as; CO_2, methane gas, water vapour and odours. Additionally, it supplies the desirable amount of Oxygen for life-support of the occupants. Incorporated with the control instruments of this system, are a series of gas pumps and contaminant chemical scrubbers and purifiers, for continuous purification of the internal atmosphere. Due to the relatively high cost of Helium, a reclamation system for the recovery of the Helium gas after usage has been incorporated in the complex. This is primarily in use when the complex is depressurized, or "returning to the surface". In order for the complex to operate in the above described manner, and to provide suitable safety and operational parameters necessary in deep diving, an elaborate number of supporting sub-systems are required. These include fire suppression, potable water, sanitary, pressurization, depressurization, pressure-sensing, tracking, gas mixing, gas boosting and communication systems. All of these systems, in conjunction with the main pressure vessels, constitute the Diving Research Facility(DRF), and are necessary for the operation of this experimental diving and equipment complex.

This section only briefly covers some, but not all, general safety aspects of the diving complex. Normal safety aspects have been implemented during two periods. First, during design and construction, and then through the operational use of the DRF. With reference to the design of the DRF and physical hardware that comprises the facility, backup sub-systems in critical life-support areas have been provided, beginning with the chambers; each can be independently isolated if desired. An integrated Fire Suppression System is provided for each chamber. A BIB (Built-in-Breathing) system, with multiple outlets is also provided independently to each other. One ECL loop is provided, with the capability of cross-connecting any loop to any chamber. There are three independent gas supply sources for each chamber, along with backup Oxygen input for metabolic make-up requirements; emergency power supplies and cross-connecting availability for air operating control systems; check valves on all inflowing lines combined with hull isolation valves, all providing safety features for safe operation of the complex.