PRESERVING CANADA'S NAVAL TECHNICAL HERITAGE

NEWS

Canadian Naval Technical History Association

CNTHA News
Est. 1997

CNTHA Chairman
Pat Barnhouse

CNTHA Executive Director
Tony Thatcher

Directorate of History and Heritage Liaison
Michael Whitby

Maritime Engineering Journal Liaison
Brian McCullough

Webmaster
Peter MacGillivray

Webmaster Emeritus
Don Wilson

CNTHA News is the unofficial newsletter of the Canadian Naval Technical History Association. Please address all correspondence to the publisher, attention Michael Whitby, Chief of the Naval Team, Directorate of History and Heritage, NDHQ
101 Colonel By Dr
Ottawa, ON K1A 0K2
Tel. (613) 998-7045
Fax (613) 990-8579

www.cntha.ca

IMCS Development for the Canadian Patrol Frigate – A Poster Project for RCN Innovation

By Cdr (Ret'd) Peter MacGillivray, MSc, PEng

We are all familiar today with sophisticated computer-based controls, but as recently as 1995 it was common in warship control systems to find direct controls and gauges.

Until almost the close of the 20th century, the machinery control system (MCS) technologies in operational RCN ships included post-Second World War technologies for the *Restigouche*-class destroyer escorts (Figure 1), discrete digital hybrid technologies for the DDH-280 tribal-class destroyers (Figure 2), and the Integrated Machinery Control System (IMCS – Figure 3) for the *Halifax*-class Canadian Patrol Frigates (CPF).

Through the efforts of innovative Canadian pioneers, the RCN led the world's navies in the implementation of what is so common today: computer-based integrated platform control technology. The computer revolution was beginning to shape the modern world in the late 1970s, and with amazing foresight, energy, and determination the staffs of DGMEM/DMEE 7 (machinery control section) drove a 10-year development program that saw Canada lead the world with IMCS in the CPF, with the support of the Defence and Civil Institute of Environmental Medicine (DCIEM), as well as key contractors.

Six of the International Ship Control Systems Symposium (SCSS) proceedings from 1978 through 1993 (5th-10th SCSS) chronicle the innovative efforts by RCN staff, both military and civilian, working with Canadian industry, to develop the world's first computer-based IMCS. Canadian technical papers presented at these conferences paint a vivid picture of these uniquely Canadian developments, driven completely by the Navy.

(Continues next page)

DND/CAF photos

Figure 1. The steam throttles and other machinery controls and gauges on the engine-room console of a *Restigouche*-class destroyer escort.

Figure 2. The machinery control console aboard a DDH-280 tribal-class destroyer.

Figure 3. The Integrated Machinery Control System console designed for the *Halifax*-class frigates.

At the 5th SCSS in 1978, the United States Navy's lead paper questioned whether or not automation itself, let alone computer control, was even feasible with computers. Other national papers addressed rudimentary implementation of digital electronics for secondary surveillance only. Canada argued that use of IMCS technology carried promises of improved reliability, operator capability, as well as savings in procurement and through-life costs. Skepticism was tangible, and critical non-believers numerous.

At this same conference, Canada presented papers describing the detailed requirements for a computer-based Ships Integrated Machinery Control System (SHINMACS), and the RCN plan for developing such a "glass control room" (i.e. on a computer screen) system. At successive symposia, technical papers described the developments the RCN was driving to meet these goals. Finally, at the 10th SCSS in Ottawa in 1993, the Navy presented the first-of-class results for the IMCS in CPF — we had succeeded! No other Navy in the world had even yet to attempt a fully integrated IMCS.

It should also be noted that marine system technologies were becoming much more highly sophisticated with the introduction of gas-turbine engines, electronic controllers and the like, and there was an emerging need to reduce the risk of human error when operating highly complex equipment. The major advantage of the SHINMACS man-machine interface (MMI) was in relieving the watchkeeper from having to monitor a plethora of gauges and dials in order to maintain a mental picture of the machinery plant's behaviour.

The development of the IMCS for CPF was challenged by having to meet "off-the-shelf requirements." The 1977 specification was based largely on the DDH-280 machinery control system that used discrete digital components such as NOR and NAND logic gates, etc., and the staff had to forecast which "off-the-shelf" components might be available in time for the first CPF delivery in 1990. Note that the first militarized chip microprocessor (Intel 80186) was not certified until 1982 — the same year the CPF proposals were evaluated.

SHINMACS development was driven by the belief that, by executing strategic research and development to take advantage of the explosive growth in computer technology, IMCS could be realized in CPF with near-state-of-the-art components. Key R&D projects over a span of years to develop SHINMACS to meet the CPF requirement included:

- developing a sophisticated simulation that could be used to refine the ergonomic requirements developed earlier by DCIEM to support the SHINMACS MMI;
- developing a mock console known as the Standard Machinery Control Console to run the simulation, delivered in December 1983; and
- delivering an Advanced Development Model (ADM) that demonstrated the distributed architecture to prove the concept (June 1985).

The ADM contract was let to CAE Control Systems, with a requirement to use the RCN's then-standard AN/UYK-502 computer. When the AN/UYK-502 proved incapable of handling the SHINMACS requirements, it was replaced on the fly with the Intel 80186 processor. As the ADM progressed, various components nearing military certification (memory, displays, I/O devices) were implemented. By delivery time, the shipbuilder had selected CAE IMCS as the system for CPF. CAE pioneered the naval use IMCS "glass controls," and revolutionized the industry.

The rest, as they say, is history, but it is worth reminding ourselves that it was the vision and determination of RCN engineers that were instrumental in driving Canada to lead the world in the field of computer-based integrated platform control technology.

Cdr MacGillivray was IMCS Project Manager from 1982 to 1984, and DMEE 7 section head of the machinery control systems section in DGMEM from 1990 to 1993.