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Looking Back: Canadian Government-Industry Marine Technology Success Stories

By Dr. Chris Madsen

In May 2009, the Marine Industries Working Group of the Canadian Association of Defence and Security Industries (CADSI) issued a position paper on shipbuilding in Canada, focusing on issues surrounding Government of Canada (GoC) ships designed, built, and supported by Canadian Industry. The report included an interesting historical appendix titled, "Export Sales Generated by Participation in Canadian Ship Acquisition Projects," that highlighted a number of marine technology success stories that had good potential for domestic and export sales.

The technologies represented significant advancements for the Royal Canadian Navy (RCN) and other government agencies in partnership with Canadian private companies. The full listing (https://www.defenceandsecurity.ca/UserFiles/File/pubs/cadsi-mir.pdf) includes familiar kit such as the highly successful "SHIN" series of digitally integrated shipboard systems, and "Beartrap" Helicopter Hauldown and Rapid Securing Device. However, there were other commercially successful technologies that are today less well-known, and in danger of being forgotten by the RCN's naval technical community.

Even though the technology narratives in the appendix were written 15 years ago, and the development and operational deployment of some of these systems have progressed, these important summaries represent an important historical artifact that deserve to be preserved in a wider forum. What follows is an abridged and edited précis of just a few of these fascinating GoC-Industry success stories, as they were described in 2009:

Sonar Systems

As a predominantly anti-submarine warfare (ASW) specialized navy, in the 1960s Canada began to develop sonars that could be towed behind a ship and streamed to depths better suited to detecting submarines. The Naval Research Establishment, now Defence Research and Development Canada (Atlantic), developed the concept of the variable-depth sonar (VDS), and worked with Canadian industry to produce streaming and handling systems that would permit use in the rough conditions of the North Atlantic. The next-generation AN/SQS 505 sonar was conceived by the RCN, and developed by Westinghouse (receiver and processing), and Edo, subsequently C-Tech (transducer and transmitter). This sonar was installed in both hull-mounted and variable-depth configurations on board the Improved Restigouche-class IREs and DDH-280 Tribal-class destroyers in the early 1970s.

Follow-on development focused mainly on improvements to signal processing, led by DRDC(A), and engineered by Computing Devices Canada (CDC, becoming General Dynamics Canada). All the sonar systems on the Canadian patrol frigates (*Halifax* class): the AN/SQS-510 medium frequency hull-mounted sonar, the AN/SQR-501 Canadian Towed Array System (CANTASS) processor, and the AN/UYS-503 sonobuoy processing system, were designed and produced by CDC. In each case, a research concept was converted into a ruggedized military system through a successful collaboration between DRDC(A) and the contractor. These sonars enjoyed significant foreign sales, and played a prominent role in the RCN by keeping Canada at the forefront of ASW on the world stage.

Stealth Technology

Naval ships conceal their presence by reducing signatures, such as infrared (IR) emissions from engine exhaust gases, and extremely low-frequency electromagnetic (ELFE) underwater signals generated by the alternating current flow between a ship's cathodic protection system and its propellers. The former can be detected by IR sensors in the guidance systems of in-coming missiles, and the latter by underwater influence mines that can trigger their detonation.

In the early 1980s, the Defence Research Establishment in Suffield, Alberta began working on devices to dilute exhaust gas emissions, and developed a configuration that became known as the DRES ball (image at right), due to its shape. W.R. Davis Engineering won the contract to develop the DRES ball, and would eventually install this system in the two main gas-turbine exhausts of the Canadian patrol frigates. A different configuration was fitted to the modernized TRUMP tribal-class destroyers. Davis became the world leader with this technology, to such an extent that it has no competitor in the western world, and its products have been installed on all programs that use IR suppression.

Similarly, early developments led to the production of an active shaft-grounding system that virtually eliminates the ELFE signature by grounding the propeller shaft to the ship's hull, so that a constant anode-to-hull current is achieved through the shaft rotation. This product is unique and has no competitors. It has a more limited market, but is being fitted to all new naval construction in the United States. In addition, it has been supplied to naval ships in Canada, Norway, the United Kingdom, Australia, and South Korea.

To complement its IR work, Davis developed the Naval Threat Countermeasures Systems software to model the infrared signature of a ship and its IR threats. This unique software has been adopted by both the USN and NATO. There are over 20 users as well as ongoing development contracts with some of those users.

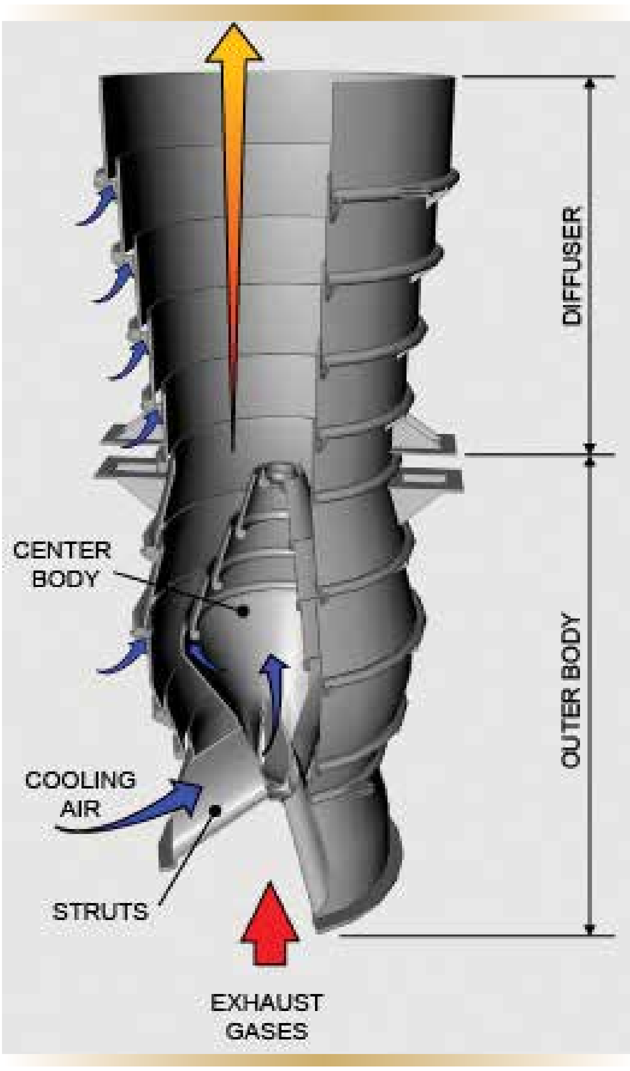

Image courtesy W.R. Davis Engineering Ltd

Stealth technology: DRES ball IR suppressor

Modelling and Simulation of Naval Propulsion Systems and Machinery Control

One of the key components of the Integrated Machinery Control System (IMCS) implementation for the Canadian patrol frigate was the development of an LM 2500 (GE gas turbine) engine controller. GasTOPS, a Canadian private company with expertise in marine gas turbines controls and dynamic simulation, developed a high-fidelity simulation model of the LM 2500 that accurately depicted gas-turbine rotor dynamics, fuel control and combustion processes, as well as a digitized version of the hydromechanical control algorithms for the engine.

GasTOPS would expand its dynamic modeling and simulation capabilities, and go on to develop world-class simulation-based processes to assess and design control solutions for naval propulsion systems for the RCN and international navies, ship propulsion system integrators, and marine control system equipment vendors. Keeping pace with the emergence of integrated electric propulsion as a viable solution to naval and marine propulsion, GasTOPS went on to include simulation solutions for the assessment of both mechanical and electrical propulsion dynamics in its suite of simulation tools.

Reconfigurable Synthetic Training Systems

The arrival of the Canadian patrol frigate and its complex systems underlined the need for more effective and less costly training methods for both operator and maintenance procedures. Past practice had used a complete set of ship's equipment in a shore-based training facility, but in the early 1990s it was recognized that the evolution of personal computers and synthetic training environments had reached a level of maturity that could be practically exploited.

The RCN contracted with Canadian industry to develop synthetic trainer solutions that would allow personnel to be trained in a more efficient and cost-effective manner. One of these was the MacDonald, Dettwiler and Associates (MDA) reconfigurable, PC-based, Naval Combat Operator Trainer (NCOT) that emulated the shipboard systems and equipment.

NCOT, in turn, led MDA to develop the Reconfigurable Maritime Training System (RMTS), an exportable, modular training solution that could be readily adapted to suit specific requirements for naval training systems around the world, including those of NATO navies. This resulted in an export contract with the Royal Navy to train combat personnel on Type 42 and Type 45 destroyers, with potential to expand the system to other ship classes, and into much broader training schemes that would generate additional sales.

(Continues next page...)

Active Phased Array Radar

In the early 1990s, Canada was a significant participant in the NATO Anti-Air Warfare System (NAAWS) study. The study generated a recommended combat system configuration to counter the threats navies would face entering the 21st century. A significant component of this was the development of a Multi-Function Radar (MFR) and a long-range Infra Red Search and Track system (IRST).

At the time, the RCN was developing the replacement ship for the *Iroquois* class, known as the Command Air Defence Replacement (CADRE) Project. In pursuing technologies that embraced the NAAWS concept, Canada entered into a memorandum of agreement with the Royal Netherlands Navy and the Federal German Navy for the development of a multi-function radar, which became known as APAR. The prime contractor for this activity was Thales Nederland, with several Canadian companies involved in critical product development of this revolutionary radar system. These companies included Brecon Ridge (Nortel at that time), Lockheed Martin Canada, Stork Canada, Thales Canada, and CMC Electronics.

Although the CADRE Project did not proceed to contract, APAR became a major success story in the international market, allowing Canadian companies to reap a significant 4:1 return on the RCN's investment.

As the 2009 CADSI Annex concludes: "These notable developments by Canadian industry resulted directly from their involvement in Canadian government ship projects, and supporting R&D programs. Without the ship projects, these developments, resulting export sales, and ongoing employment would not have occurred."

Dr. Chris Madsen is a Professor in the Department of Defence Studies at the Canadian Forces College and Royal Military College of Canada in Toronto, Ontario.

Honorary "Maritime Engineer"

On June 21, CNTHA Executive Director **Tony Thatcher** (left) and former NDHQ engineering division Director General Cmdre (Ret'd) **Bill Broughton** presented longtime MEJ Production Editor **Brian McCullough** with a certificate, recognizing him as an Honorary Maritime Engineer for his more than four decades of service to the RCN's technical community.