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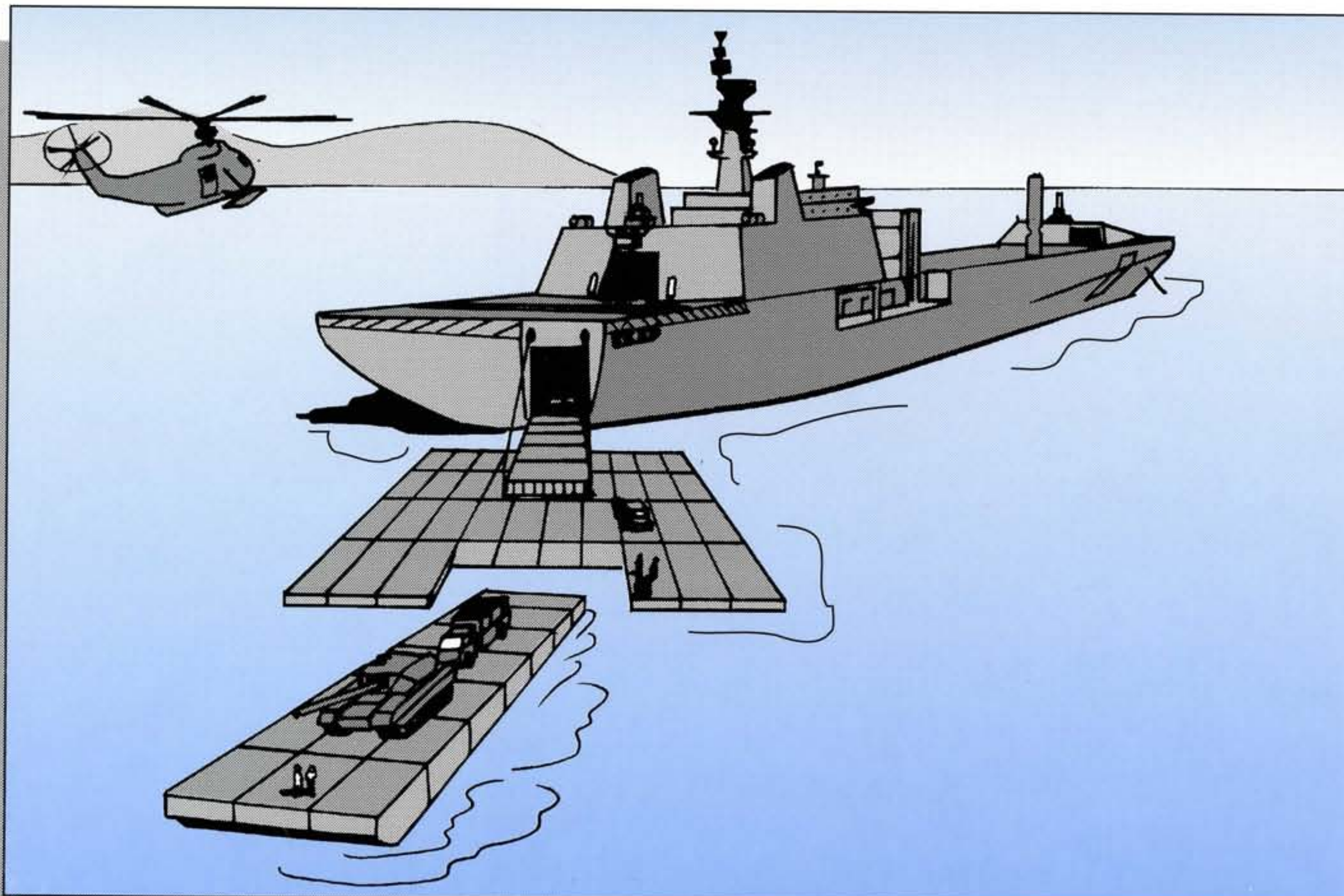
Maritime Engineering Journal

June 1994



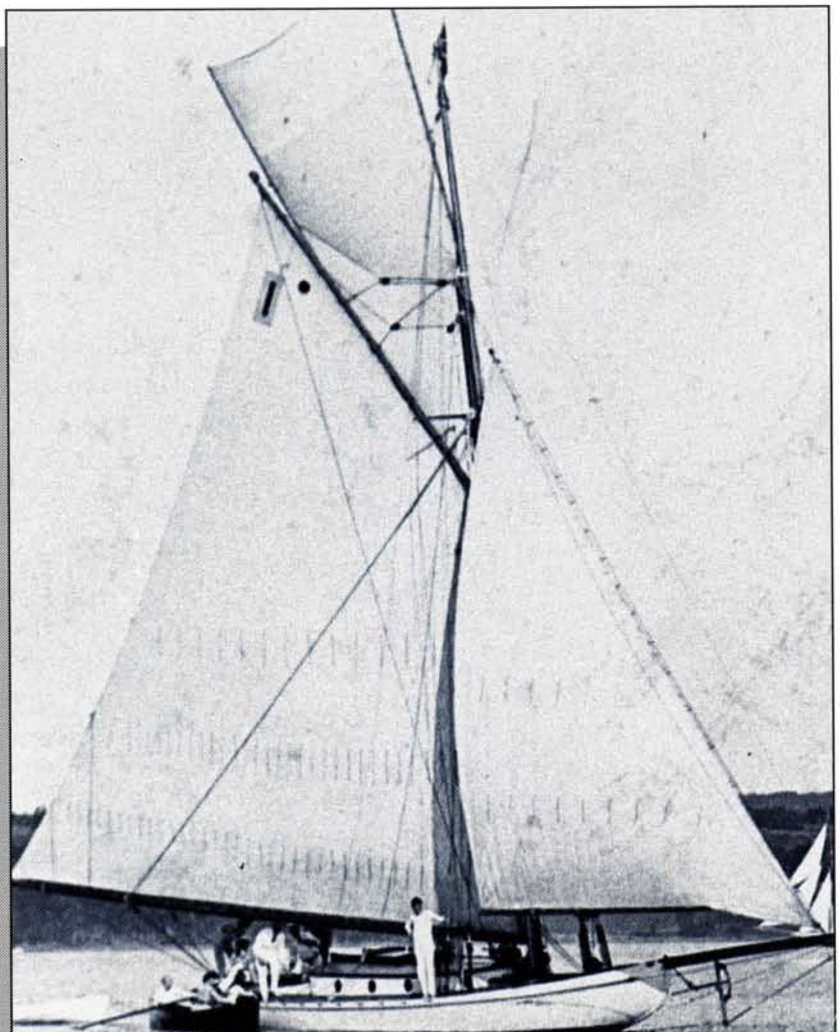
Afloat Logistic Support
The future is *now* for multirole ships

Also:

- *Greenspace: A Better OWS Mousetrap*
- *10th Ship Control Symposium Report*

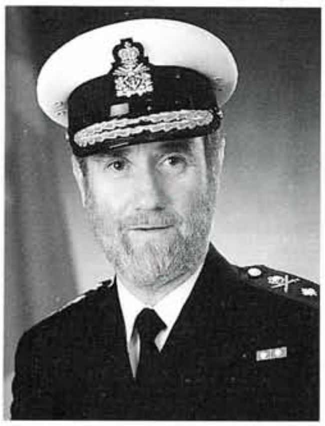
Canada

A 97-year-old sailing yacht with a familiar name is making a comeback thanks to some dedicated Canadians — see page 32



Maritime Engineering Journal

Established 1982



Director General
Maritime Engineering and Maintenance
Commodore Robert L. Preston

JUNE 1994

DEPARTMENTS

FEATURES

GREENSPACE:

LOOKING BACK:

OUR COVER
Canadian naval planners agree that the multirole support vessel is just what Canada needs in the wake of the Cold War. These versatile vessels even carry their own floating jetty and barge units along with them. *(Illustration by Edwin Chan)*

The *Maritime Engineering Journal* (ISSN 0713-0058) is an unofficial publication of the Maritime Engineers of the Canadian Forces, published three times a year by the Director General Maritime Engineering and Maintenance with the authorization of the Vice-Chief of the Defence Staff. Views expressed are those of the writers and do not necessarily reflect official opinion or policy. Correspondence can be addressed to: **The Editor, Maritime Engineering Journal, DMEE, National Defence Headquarters, MGen George R. Pearkes Building, Ottawa, Ontario Canada K1A 0K2.** The editor reserves the right to reject or edit any editorial material, and while every effort is made to return artwork and photos in good condition the *Journal* can assume no responsibility for this. Unless otherwise stated, *Journal* articles may be reprinted with proper credit.

Editor's Notes

The navy's "can do" attitude — a blessing or a curse?

By Captain(N) Sherm Embree, CD, P.Eng., CIMarE
Director of Marine and Electrical Engineering

If the Periodic Engineering Letters coming out of the fleet are any indication, it is probably safe to say that the navy's "can do" approach to things is intact. For that matter, take a spin through a few back issues of the *Journal* sometime. You might (or might not) be surprised at the number of articles that allude in some way to the ages-old navy tradition of never saying "can't be done."

On the face of it a "can do" attitude is a laudable virtue, especially in our line of work where taking risk to achieve a mission is generally thought (by the public and military alike) to be a good thing. Throughout our navy's 84-year history there have been countless instances where our willingness to take on seemingly impossible odds has helped us overcome the challenges of the sea, the enemy and our own bureaucracy. Saying "can do" agrees with our natural sense of cheerful initiative, imagination and gung-ho spirit — the true hallmarks of any sailor. And besides, there is nothing quite like achieving the impossible for building esprit de corps.

Still, if we were to rely excessively on our initiative, we might unintentionally ignore the wisdom of experience gained over many years in the form of policies and procedures — possibly at the expense of safety; likely at the expense of the interests of someone else. In the final analysis it might be that a "can do" approach is beneficial only when it is tempered by equal measures of co-operation and responsibility. "Ready, aye, ready" should not mean having to abandon our values and strengths under the press of expediency.

Can it be that the same ultrapositive outlook that helps us get a Gulf task force ready in record time is also a bad thing? Is the inherent industriousness of a "can do" attitude ever a vice? What's your feeling? Do we show too much "can do" in the navy? Too little? Is it ever okay to say "*Can't* do!"? Blessing or a curse — you tell us and we will publish a selection of your views in an upcoming issue.

Letters to the Editor

Article doesn't fit in

I received my copy of the February 1994 issue of the MARE journal this week and was surprised to see an article on a sailing trip across the Atlantic. Thinking that perhaps there was some marine engineering issue discussed in the article I set to reading the submission. To my surprise, although the article was very interesting, it did not contain any information which would render it a valid article for a technical journal.

At first I thought my concern was petty and perhaps the MARE journal should include articles of general interest, until I found the six objectives of the MARE journal on page 2. Try as I might I could not fit this article into any of these objectives.

I would suggest that either the objectives be expanded to include a category for general interest, or that the *Journal* objectives be followed more closely.— **Lt(N) G.F. Hallam, Directorate of Maritime Engineering Support, NDHQ, Ottawa.**

(The fact you found the article "very interesting" means the *Journal* was achieving its second objective of "providing an open forum where topics of interest...can be presented...." On the other hand, the fact that you view the *Journal* strictly as a technical publication means our editorial message could probably stand being a whole lot clearer. To this end we are already working on a readership survey to be included with our October issue. Thanks for writing. **— Ed.)**

Commodore's Corner

Management options deliver their own strengths

By Commodore David G. Faulkner
Assistant Chief of Staff Materiel

We have, over the past years, spoken often of the need for change, of the need to become more effective and efficient in the delivery of engineering support to the fleet. The recent budget not only drives us forcibly in that direction, but it provides us with the yardstick by which we are obliged to measure progress. Of course, the currency of measurement in the budget is dollars.

You should know that the future, at least in its appearance, promises to bear little resemblance to the world we have defined for ourselves over the course of our careers. Indeed, as I write this commentary, our professional lives are being redefined by three major studies. Each of these studies seeks, with the assistance of private consultants, to improve our delivery of naval engineering support to its ultimate customer, the Maritime Commander.

The Ship Repair Unit (SRU) Management Options Study has examined three alternative management frameworks: an extension of the existing structure (with an increased authority vested in the unit commanding officers), a single operating agency, and a government-owned/contractor-operated (GO/CO) option. Most significantly, the study found all three options to be feasible, with substantive improvements in management accountability, cost control and efficiency achievable more through the introduction of a business planning ethic than a new management framework.

Not surprisingly, each option delivers its own strengths. Enhancements to the existing structure, for example, promise more flexibility in meeting the Maritime Commander's operational requirements, and may offer an optimum balance of effectiveness and efficiency. The GO/CO option, on the other hand, tends to a narrower optimization on resource efficiency. Finally, the study suggests that the benefits of a single operating agency can be secured within the enhancements to the existing structure.

The Management Options Study will form an input to two more wide-ranging studies — ADM(Mat)'s evaluation of the NDHQ materiel group, and the Maritime Commander's Naval Engineering & Maintenance Functional Review. Both of these studies seek to reengineer existing processes, and both promise reductions in the cost of doing business of at least 20 percent. Both studies completed their initial phases in March, and will now be well into the detailed definition of the change requirement. We must begin to recoup savings in the immediate future.

"Business plans are being generated at the unit, formation and command levels, and already we have begun to see the benefits of a renewed cost consciousness."

ADM(Mat)'s study targets the overlap in three specific areas: engineering and logistic support in NDHQ, logistic support in NDHQ and the Command, and engineering support in NDHQ and the Command (that is, between DGMEM and the NEUs).

The MARCOM functional review examines the application of naval engineering and maintenance across the Command — specifically, in the NEUs, SRUs, fleet maintenance groups and the three Maritime Command headquarters. The relationship with other functional areas such as logistic support is also being defined, and the requirement for change in these related areas will be pursued through interface discussions.

It will be apparent to you that if we are to reach our savings target we must entertain the need for radical change. My aim is to replicate, to the extent practicable in a public enterprise, a business-like environment. In that vein, integrated business plans are being generated at the unit, formation and command levels, and already we have begun to see the benefits of a renewed cost consciousness.

Underpinning the MARCOM functional review is a philosophy which seeks to delegate decision-making authority to the lowest level practicable, and which seeks to hold decision-makers accountable within the framework provided by their respective business plans. The goal is to remove the vast majority of artificial constraints previously imposed by "the system," and to let managers manage.

The Maritime Commander has made it clear that our overriding objective must be the protection of the navy's core capability. While this core is most frequently expressed in terms of ships, we must not lose sight of the fact that it necessarily includes a minimum essential materiel support infrastructure. The navy's historic success in operations is attributable in no small measure to the support provided by that infrastructure. Accordingly, as we define that which constitutes the minimum essential infrastructure, it behooves each of us to measure the extent to which the prescribed changes will impact operational capability. The second currency by which we must measure the consequence of change is military effectiveness.

There is no question but that the naval engineering community has the talent to respond professionally to the challenge. Let me assure you, however, that if we fail to exercise the will to respond, it will be at our peril. We have met similarly demanding challenges in the past, and I am fully confident that we will succeed equally well in this.

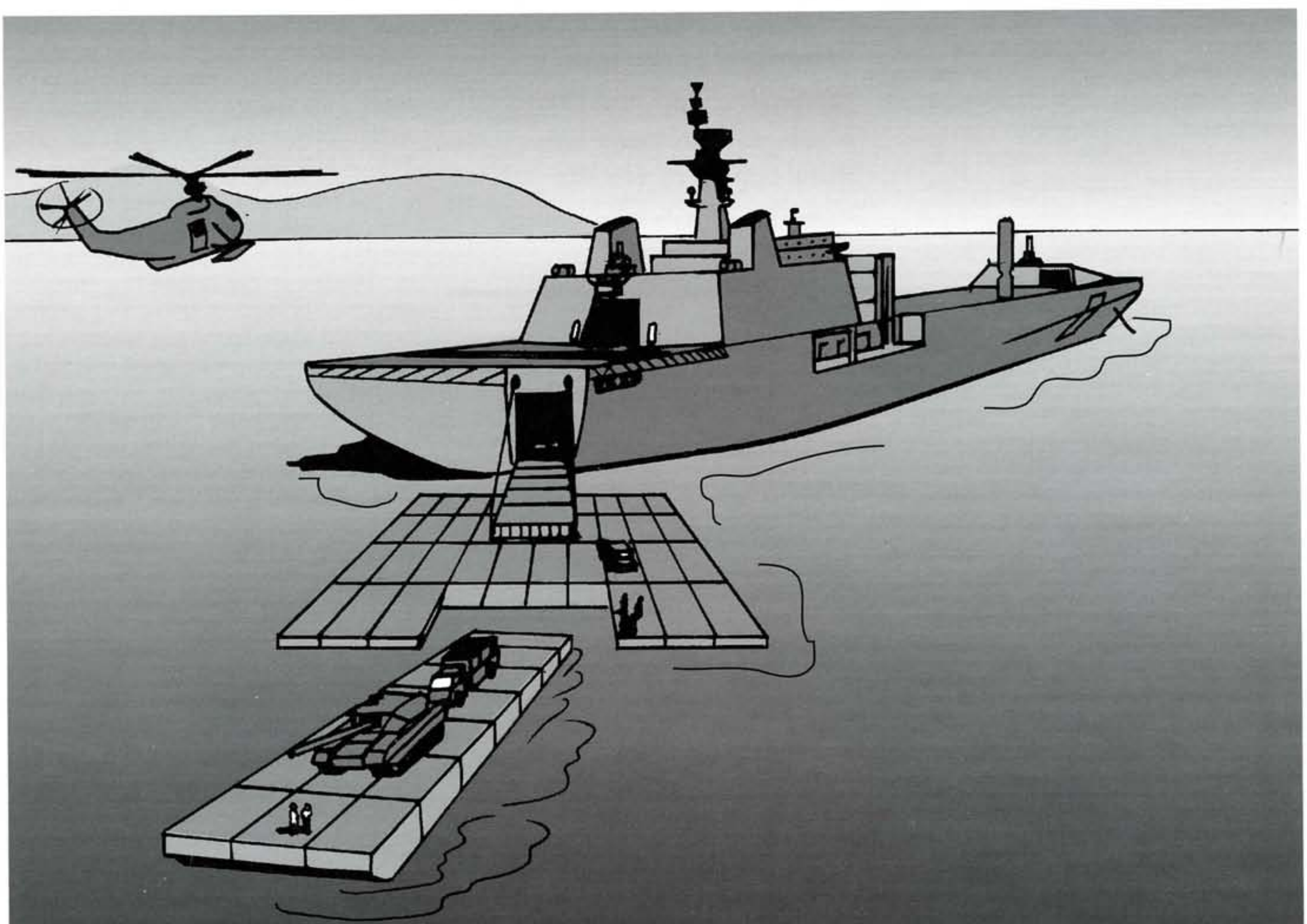
Afloat Logistic Support — The future is *now* for multirole support vessels

Take a look at the ship that naval planners agree is the one to support Canadian Forces operations at home and abroad.

Article by Cdr S.E. King *and* LCdr P.J. Brinkhurst
Illustrations by Edwin Chan

On the face of it, it was business as usual. Two of the navy's three AOR underway replenishment ships were once again being dispatched to foreign shores. The missions of the two 25,000-tonne tankers involved neither battle nor, surprisingly, NATO exercises. Far from it. It was late 1992 and HMCS *Protecteur* was on her way south to provide disaster relief in the wake of Hurricane Andrew, while her sister ship *Preserver* was being sent halfway around the world to support peacekeeping operations in Somalia.

Upon closer inspection the two deployments illustrate the new reality facing military policy makers and planners — the Cold War is over and Canada can no longer afford the luxury of grooming her navy for a few, well-defined missions. Now more than ever, Canadian naval forces must be prepared to respond to the unpredictability of a world rife with regional conflict. At the same time they must meet new challenges in our own back yard regarding the national fishery, environmental protection and other areas of concern to the federal government.



MRSV

HMCS Preserver

That same year, in response to these pressures, NDHQ naval staff reexamined the range of missions the navy could be expected to undertake or support during the next several decades. What they found reflects a need for flexibility in our naval forces, rather than such Cold War specializations as protecting sea lines of communication and conducting antisubmarine warfare. Going a step farther, they identified the equipment the navy would need to meet the new challenges. Nowhere is the emphasis on flexibility more clearly evident than in the current initiative to acquire four new multirole support vessels (MRSVs) to add a much-needed sealift capability and replace the AORs.

Afloat Logistic Support

Long before *Preserver* dropped anchor in the roadstead off Bosasso on Somalia's north coast in the autumn of 1992, the Director of Naval Requirements (DNR) in National Defence Headquarters in Ottawa/Hull was responding to the changing strategic environment. DNR development staff was studying the subject of military sealift (or more precisely, afloat logistic support) comprising:

- **underway support** to naval units;
- **sealift transport** of large volumes of equipment and supplies over long distances in support of deployed forces; and
- in-theatre, sea-based **support to joint forces ashore** (such as was *Preserver*'s mission in Somalia).

Underway support is a stock-in-trade with the Canadian fleet. As well it should be — our three AORs were designed specifically for the task. HMC ships *Preserver*, *Protecteur* and *Provider* have been supplying fuel, food, ammunition, spare parts, fresh water, stores, essential medical services and second-line aircraft maintenance support to the ships of Canadian and allied task groups for years. For that matter, as far as refuelling goes, an AOR's 13,000-tonne cargo fuel capacity far exceeds the 8,000 tonnes naval planners estimate an MRSV would need to maintain a task group at sea for 60 days (*Fig. 1*).

Replenishing ships at sea is no problem for the AORs. It is with the other two aspects of afloat logistic support that they fare less well. No one knows better than the navy that the tanker crews have done yeoman (and innovative) service over the years, but the AORs simply were not designed for military sealift operations and sea-based support to joint forces ashore.

Sealift Transport

Consider the AOR's 500 lane metres of vehicle cargo space (i.e. 500 metres of deck space 2.5 metres wide). Handy in a pinch, maybe, but it comes nowhere near the 2,500-lane-metres identified by a joint services study team as the *minimum* essential for Canadian Forces sealift operations. And what about containers? Standard cargo containers are the most efficient means of transporting non-vehicular equipment, yet the AORs aren't fitted to carry them. At the very minimum, the study indicated, an MRSV should carry enough containers to transport vehicles and equipment for two CF-18 squadrons or a rapid response ground force.

Naturally, the ease with which vehicles and stores can be loaded or offloaded is of great importance to any sealift mission. As *Preserver* discovered in Somalia, inadequate harbour facilities can seriously hamper loading and unloading operations. The most efficient way of handling vehicles is to simply drive them onto and off the ship — a procedure known as roll-on/roll-off (ro/ro). It's no coincidence that 42 percent of the 127 USN vessels activated for Desert Shield/Storm were ro/ro configured!

When it comes to handling stores, the modern sealift vessel must be capable of offloading its own containers. A self-unloading ship is a much more versatile asset to the maritime commander as it can be deployed to just about anywhere in the world. No jetty? No problem. A sealift vessel carrying its own self-propelled pontoons, such as GEC Engineering Limited's "Mexeflote" system (*see box*), can easily construct a temporary landing stage and motorized ferry for personnel, vehicles, equipment and stores.

Joint-force Support

Supporting an embarked joint-force HQ staff means more than just providing living quarters and ops room space. For instance the MRSV must be fitted for, or with, a broad range of communication and command and control equipment to ensure interoperability with other ships, shore-based forces and national facilities. Such a ship should also be capable of maintaining national rear-link communications. The AORs can provide some measure of this. Apart from the absence of VHF-AM equipment needed to communicate with troops ashore, their normal communication equipment fit meets minimum requirements. Their command and control and ops room configurations, on the other hand, while adequate for the ships themselves, fall short of the requirements for a joint-force headquarters.

By its very nature, joint-force support can be a strange brew of requirements and taskings. For instance, which joint-service mission can do without helicopter support these days? The MRSV must be capable of carrying, operating and maintaining large helicopters suitable for tactical surveillance, personnel transport, medevac and cargo airlift operations. A multirole support vessel must also be capable of providing full military hospital facilities, including comprehensive surgical and dental services, and fully tooled technical facilities such as metal and woodworking shops for basic construction work and battle damage repair. Of course, extensive hospital and shop facilities would not have to be built into the ship as these could be carried in containerized modules that could tap into ship's power, water, waste and ventilation systems.

On the Home Front

In addition to the three main ALS categories there are some aspects of afloat logistic support that have a more national context. Both the 1992 defence policy and the government's Green Plan call for DND to be ready to respond to national emergencies. This could well mean having to provide:

- command and control support
- temporary communication facilities
- security and rescue services
- transportation and convoy assistance
- temporary accommodations
- logistic support, equipment and personnel

REQUIREMENT	MRSV	AOR
Ice Capable	Y	PARTIAL
Underway Support		
Fuel	8,000 tonnes	13,200 t
JP5	533 t	510 t
Ammunition	300 t	300 t
Sealift		
Deck Space (incl. upper deck)	3,305 lane m	500 lane m
Container System	Y	N
Jetty Independence	Y	N
Joint Force Support		
Naval Communications	Y	Y
Shore Comm.	Y	N
Command/Control	Y	N
Helo Capability	3+	3
Hospital	Full	Limited
Contingency Ops		
Temp. Accommodations	300+	N
Environmental Ops	Y	N
Ship Particulars		
Crew Size	111 (+30 spare)	334 (Somalia deployment)
Length	193 m	172 m
Beam	28 m	23.2 m
Draft (Deep)	8.2 m	10.6 m
Depth	21 m	12.4 m
Displacement (Deep)	21,800 t	26,389 t
Speed	20 kts	21 kts
Propulsion	Diesel	Steam
Shaft	Single	Single
Range	10,800 nm @ 15 kt	7,500 nm @ 11.5 kt

Fig. 1. MRSV/AOR Comparison Table (Courtesy of Edwin Chan)

A dedicated naval MRSV designed to meet the stringent requirements of tactical military sealift support is perfectly suited to any and all such operations. For example, if Canada were to suffer an environmental disaster similar to that caused by the *Exxon Valdez* spill off Alaska, DND would likely be tasked with transporting equipment and personnel to the spill site, and possibly with coordinating the clean-up operation as well. An MRSV could handle the job just as effectively as it could handle a disaster relief mission or a full-blown military sealift operation anywhere in the world.

A Multirole Support Vessel

As early as mid-1992 the Director of Naval Requirements was anticipating the growing importance of having a proper sealift capability. Everything seemed to be pointing to a new type of vessel, one which could meet the three elements of afloat logistic support cost-efficiently. A series of concept studies was duly initiated with the Directorate of Maritime Engineering Support (DMES) to develop potential designs for vessels that could fulfil the entire ALS role.

Designing a ship to cover off all three legs of afloat logistic support is a tall order. What the designers came up with (*Fig. 2*) looks rather like an ordinary replenishment ship, except for the large ramp openings fore and aft which hint at a roll-on/roll-off capability. At 193 metres, the MRSV is 21 metres longer than HMCS *Preserver*, but has a deep displacement of 21,800 tonnes, as opposed to the AOR's 26,389 tonnes. The ship has a mean deep draft of 8.2 metres, and a beam of 28 metres. Ice strengthening will permit the MRSV to patrol near arctic waters and transit first-year ice up to one metre thick.

Twin diesels provide 15,400 kilowatts of power to a single controllable-pitch-propeller, driving the ship at a top speed of 20 knots in sea state two. A bow thruster is provided for low-speed manoeuvring. The MRSV carries enough fuel and stores to give it a range of 10,800 nautical miles at 15 knots, and an endurance of 90 days. Electrical power is supplied by three 1,000-kW, and two 500-kW diesel generators. The ship is capable of providing fuel and equipment for portable water and power generation equipment if necessary.

A fixed ramp at the forward end of the upper deck leads down to the MRSV's dual vehicle decks which provide nearly 2,400 lane metres of vehicle space. Stern and bow access ramps from the main (lower) vehicle deck allow a full ro/ro capability, while a 20-tonne crane gives the MRSV a considerable lift-on/lift-off capacity. The combination of ramps, crane and a large vehicle elevator means the vessel can land a full load of nearly 200 vehicles — jeeps, tanks, tractor-trailers, you name it — in short order. Attached to the ship's sides are enough portable pontoons to establish a small dock where traditional shore facilities are unavailable.

Forward along the weatherdeck is a single goal post, with stations to port and starboard for transferring solids and

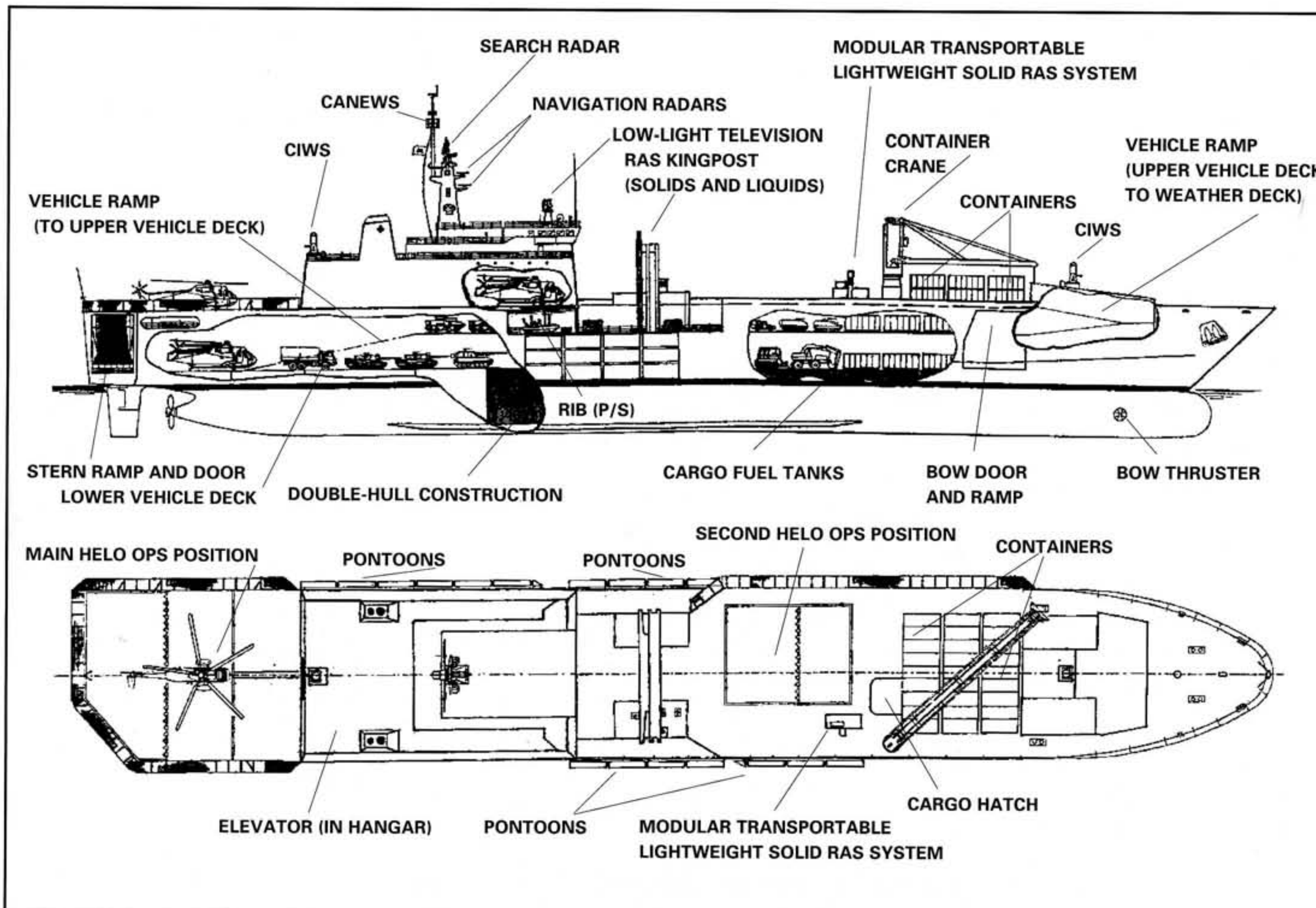


Fig. 2. MRSV Side (cutaway) and Plan Views

liquids to other naval vessels. A modularized jackstay system can be rigged at three locations. The MRSV has a total cargo capacity of 11,000 tonnes, of which 2,300 tonnes is dry cargo stowage and 8,000 tonnes is cargo fuel stored in double-sided, double-bottomed tanks. The remainder is stowage for fresh water and miscellaneous liquids.

Depending on the mission, the ship can load a maximum of 227 standard containers on the vehicle decks and upper deck. For disaster relief operations the containers can be packed with stores, or be specially outfitted as accommodation modules below decks for up to 300 relief workers or refugees. Other specialized modules can be carried to expand the MRSV's permanent four-bed medical facility into a full, 84-bed field hospital complete with operating theatres. Any of the special-purpose, containerized modules can be fitted with galleys, heads and washplaces, as required, and hooked up to ship systems for power, air conditioning and drainage. Auxiliary systems on board the MRSV, including all environmental protection measures, would be sized to handle such an increase in load.

Modular, naval standard accommodation is provided for 111 crew and 60 contingency staff. Galley and lounge complexes are located next to the accommodation centre, while ship's offices, laundry and canteen spaces are located around the outside of the hangar. Below these spaces, on the main deck, are the store and workshop areas.

Other than adhering to naval standards for habitability, all aspects of the ship would be designed and built according to less expensive commercial practices. One consequence of this is that special survivability features in the ship would be limited. Apart from some relatively inexpensive features like superstructure shaping to reduce radar cross-section, and degaussing to reduce the risk of mine attack, no signature reduction measures would be provided. Similarly, the design will not be shock- or blast-hardened, but instead will rely upon the considerable post-damage strength of a ship of this size and a comprehensive damage control system.

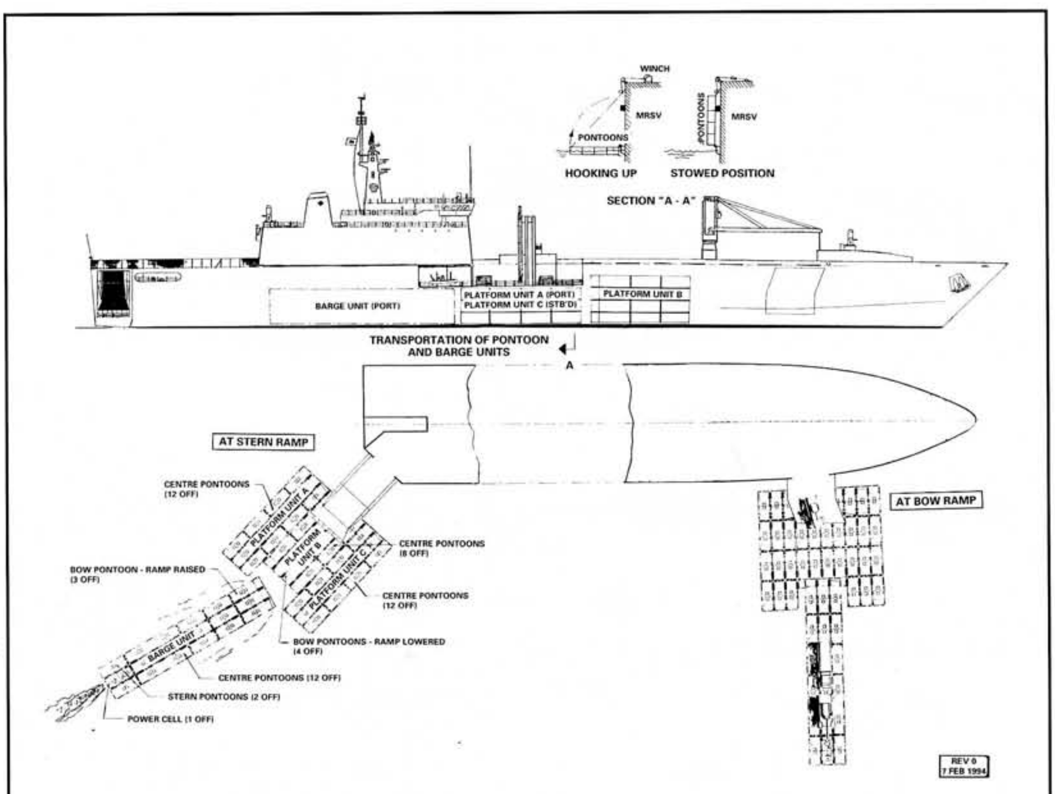
Though not to full warship specifications, the value of an asset such as the MRSV, especially fully loaded, has been recognized. A defensive combat system has been fitted, with room for expansion if required. Two close-in-weapon-systems such as Phalanx are mounted and

Mexeflote: The Porta-Jetty

The innovative Mexeflote portable jetty system is made to be used by sealift ships in places where docking facilities are limited or nonexistent. Designed by GEC Engineering Limited of Accrington, England, the system consists of a number of modular floats that can be carried flat against a ship's sides during transit, and then lowered and assembled at the disembarkation point. The floats can be lowered and configured to form a staging jetty and a separate, powered barge. Vehicles are driven from the ship onto the Mexeflote jetty, then transferred to shore via the self-propelled barge module.

The floats are specially designed as either bow, stern or centre sections for both jetty and barge, or as a power module. A six-cylinder Hydro-Master outboard diesel derated to 83 b.h.p. at 1,800 r.p.m. drives a 38-inch, three-bladed prop to move the barge at a speed of seven knots.

An entire Mexeflote jetty and barge assembly would be carried by the MRSV, at a cost of roughly $3 million.



Mexeflote modular pontoon system for loading/unloading

there is ample space for fitting newly designed deck-mounted weapons. Sensors include a surface/air-search radar, dual navigation radars, and a hull-mounted mine-avoidance sonar.

The MRSV does not have a traditional operations room. Rather, space and equipment have been incorporated for contingency staff to set up a headquarters situation room for controlling any of the multitude of missions the MRSV might encounter. Abaft and beneath the situation room are the ESM/ECM and radar equipment spaces, and a fully equipped military communications complex.

Last, but far from least, the MRSV features a serious capability for operating large maritime and utility tactical transport helicopters such as the Sea King and Chinook. The main flight-deck and hangar are aft, and there is a second helo ops position forward of the superstructure. An elevator located in the hangar is capable of lifting a 15-tonne helicopter from the main vehicle deck, thus greatly increasing the number of helicopters the ship can effectively carry or operate. This significant helicopter capability is a primary source of the MRSV's flexibility. Studies by the Directorate of Maritime Operations Research have demonstrated that an MRSV with three helicopters would be at least as capable as a purpose-built corvette for surveillance and sovereignty enforcement missions.

Cost

All of this capability carries a price tag — roughly $1.5 billion (93/94) over six years for a four-ship AOR replacement, including Mexeflote-style portable jetty systems and project costs. Admittedly this is a "D-class" estimate — plus or minus 25 percent — but designers were generally able to keep costs reasonable through careful selection of commercial practices and equipment. (By comparison, building and operating the MRSV to full "mil spec" would increase the cost by roughly 30 percent.) Sailaway cost of one fully loaded ship is about $250 million.

Do the Canadian Forces really need *four* multirole support vessels? The navy could manage with two if the vessels were designed strictly for sealift (i.e. with no RAS capability), but that would mean keeping two AORs in service along with them. On that note, planners agree that acquiring four RAS-capable MRSVs with their smaller crews and more efficient propulsion plants simply makes better operational and economic sense. According to DMES, commissioning four new support ships and retiring the less efficient AORs early would increase fleet life-cycle costs by only one percent. Such a strategy would also yield significant savings to the Crown through reduced ship-design costs and the tangible benefits of a four-ship construction learning curve. Finally, given that two MRSVs could be called on for sealift duty at any time, the navy would need at least four vessels to allow for refits and replenishment duties in home waters.

A project entitled "Afloat Logistics Support Ship" has recently been accepted into the Defence Services Program (DSP). Upcoming adjustments to the DSP (based on changes in the role of the Canadian Forces over the past several years) are expected to provide for a $1.5-billion ship acquisition project while still reducing overall DSP expenditures. Work on the next level of documentation is already well under way, and once that has been approved the navy can begin studying options in detail.

It's all manageable. Project costs for a logistic support ship could be significantly reduced if DND were to engage in a joint-design approach with both the design contractor and the shipbuilder, beginning with TSOR definition and preliminary design. A ship specification agreed upon and understood by all three parties could be frozen to severely restrict the costly change orders that typically plague warship construction. Moreover, costs could be kept in even tighter rein by restricting the personnel overhead of the project management office to about 20 employees, and the integrated logistic support (ILS) requirements to a level commensurate with those for a commercial design. During construction the reduced PMO could continue to provide guidance by having employees join the shipyard team. ILS activities would continue, but the emphasis would be on providing support not readily available in the marketplace. Existing training and infrastructure would be used whenever possible.

Conclusion

The potential of a multirole support vessel is enormous. It fulfils the primary requirements of support to naval operations and sealift and could contribute significantly to resupply and military/humanitarian shore-support activities. Its small crew size, reduced operating cost and significant helicopter capability make it suitable for sovereignty patrol missions. Its fuel capacity and RAS capability mean that four MRSVs alone would resolve many of the deficiencies facing the fleet, without a significant increase in operating costs.

Make no mistake. The MRSV described here is not some kind of navy "dream" ship, boasting all the latest bells and whistles. It has been designed with restraint and with focus on function. It is in all respects a flexible vessel, as opposed to one that is role-specific, and is thus fully in sync with Canada's immediate and future needs. If ever there were a support ship for our time, the MRSV would be it. The multirole support vessel is, after all, an all-services requirement that offers the Government of Canada a suitable vehicle to backstop its domestic and international maritime commitments.

Cdr King is the acting Director of Naval Requirements at National Defence Headquarters.

LCdr Brinkhurst is a naval architect and deputy project manager for Future Ships in DMES 3.

Towed Array Technology — The AN/SQR-19 "Wet End"

Article and Photos by LCdr Stephen Monkhouse

Research and development work conducted by the Defence Research Establishment Atlantic has put the Canadian navy in the forefront of passive anti-submarine warfare. In January 1987 the work headed up by Bob Trider, leader of DREA's Advanced Digital Systems Group, resulted in the installation of a Mk III Experimental Towed Array Sonar System (ETASS) in HMCS *Fraser*, giving the navy its first towed array sonar capability. An ETASS Mk IV followed in October 1992.

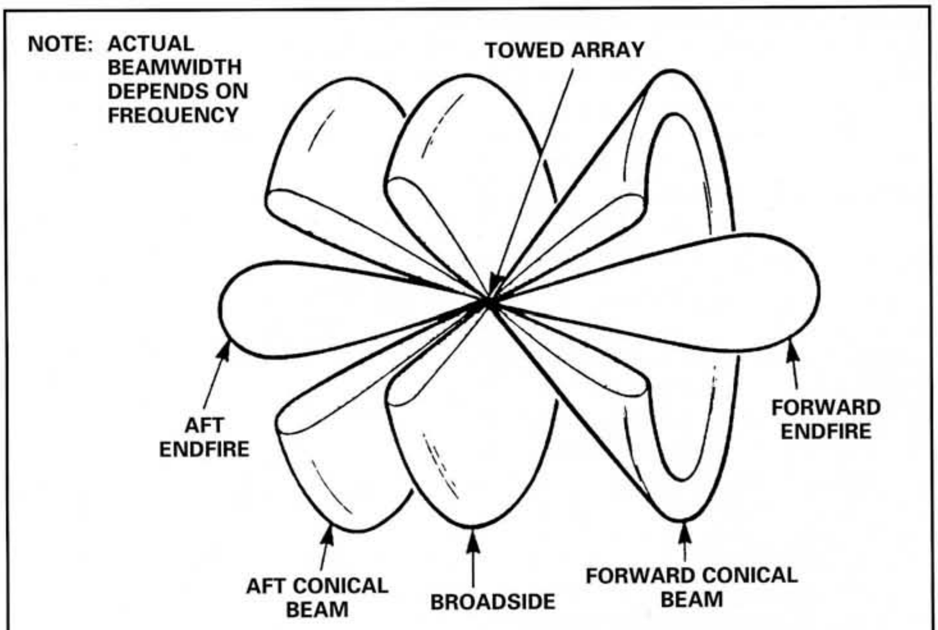


Fig. 1. AN/SQR-19 Beam Shape

The technical and operational success of the ETASS project set the foundation for the production of the Canadian Towed Array Sonar System (CANTASS) currently installed in HMCS *Annapolis* (and soon also to be installed in the *Halifax*-class frigates). Both systems — ETASS and CANTASS — use the American navy's AN/SQR-19 towed array as the "wet end."

The advent of widespread usage of towed array technology in the fleet presents an interesting challenge, especially as training in towed array technology is just now being introduced into the Combat Systems Engineering Applications Course. To date, the whole of the navy's towed array engineering knowledge has resided with relatively few individuals who have served either on towed array fitted ships, or in a project capacity in DMCS 3, DREA or the naval engineering units.

The aim of this article is to give the general engineering community a synopsis of the unclassified information that is available on the SQR-19 array. Specific details of the ETASS Mk IV signal processing "dry end" will have to wait for another day.

General

The AN/SQR-19 towed sonar array detects acoustic noise in the water, performs preliminary signal processing, digitizes the data and passes it up a tow cable to the ship. Once on board, the data enters the system "dry end" for digital signal processing using Fast Fourier Transforms (FFT) to convert time-domain noise into frequency domain artifacts. Beamforming, performed at the FFT stage by applying coefficients from a complex trigonometric look-up table, results in 43 conical beams (*Fig. 1*).

A more powerful signal processor allows a higher sampling rate to be processed giving finer resolution and an improved ability to extract signals of interest from the background noise. The heart of the success of the ETASS lies in the excellent processing capabilities of the dry end's UYS-501 teamed- architecture signal processor (TASP) which has a sustained throughput of 320 million floating-point operations per second.

AN/SQR-19 Towed Array

The SQR-19 towed array is a complex electrical and mechanical system comprising a tow cable and a towed array. The tow cable is 2.7 centimetres (1.05") in diameter and 1,707 metres (5,600 ft) long. It weighs 3,583 kilograms (7,900 lbs) and has a breaking strength of 31,752 kilograms (70,000 lbs).

The array itself consists of 20 modules and a rope drogue. It is a nominal 8.58 centimetres (3.38") in diameter and weighs 1,416 kilograms (3,123 lbs). Each module is 12.2 metres (40 ft) long and the drogue is approximately 20 metres (65 ft) long, for a total length of 264 metres (865 ft). The array modules are neutrally buoyant and contain structural components made up of a skeleton of wire strings which support environmental sensors, electronic cans (assemblies) and hydrophones. The outside skin of the modules is a flexible hose filled with ISOPAR M, a colourless, electrically non-conductive fluid.

The modules have watertight aluminum bulkheads at each end fitted with ports for filling and bleeding-off ISOPAR M. Each module end has a stainless steel locking ring with toothed locking tabs. Acoustic modules have 60-pin connectors which are protected from seawater ingress by O-rings and back-up rings (*Fig. 2*).

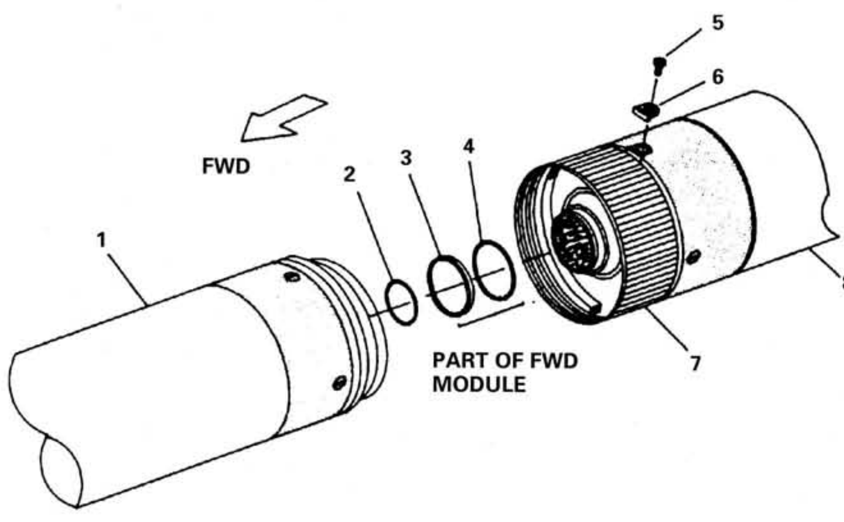
The towed array consists of 16 **acoustic modules**, which include: eight very low frequency (VLF) modules, four low-frequency (LF) modules, two medium-frequency (MF) modules and two high-frequency (HF) modules. The array's four **non-acoustic modules** include two vibration isolation modules (VIMs), one telemetry drive module

(TDM) and one heading-depth-temperature module (HDTM). With the exception of the VIMs, array modules of a given type are functionally and mechanically interchangeable. However, module types cannot be interchanged due to the timing requirements for signal processing. The 20-metre rope drogue provides stability during towing by providing additional drag which tends to keep the array straight and dampen oscillations.

Electro-Mechanical Description

An array receiver provides the interface between the dry and wet ends. It provides a constant current 47.5 VDC, 2.75 amp power to the array via the tow cable, receives all data and transmits all command signals. The array receiver is located in the ETASS compartment and is linked to the tow cable via a deck cable connected to the rotating winch drum used for stowage and handling. The deck cable attaches at a coaxial rotary joint located within the slip-ring unit on the side of the winch drum.

A hydraulically controlled level-winder assembly, consisting of two vertical rollers, and a rotating fairlead on the stern of the ship guide the tow cable and array during launch and recovery (see photos). The AN/SQA-501 VDS hydraulic power unit provides power for stowage and handling. Mechanical brakes secure the winch drum when not in use to prevent it from accidentally free-wheeling, which could lead to the loss of the array.



ITEM	DESCRIPTION	QTY
1	Telemetry Drive Module	1
	Low Frequency Module	4
	Mid Frequency Module	2
	High Frequency Module	2
	Very Low Frequency Module	8
2	O-Ring	1
3	Backup Ring	1
4	O-Ring	1
5	Locking Tab Screw	1
6	Locking Tab	1
7	Coupling Ring	1
8	Low Frequency Module	4
	Mid Frequency Module	2
	High Frequency Module	2
	Very Low Frequency Module	8
	Heading, Depth, and Temperature Module	1

Fig. 2. Typical Module Coupling

Tow Cable

The tow cable is made up of a single coaxial cable core wrapped in a polyethylene shield surrounded by four torque-balanced layers of galvanized steel armour with an outer jacket of high-density polyethylene. The coaxial shield provides array signal ground. The tow cable carries three signals simultaneously — data from the array, command tones from the dry end, and the array power.

Vibration Isolation Modules

Two of the VIMs act as shock absorbers for the array, isolating it acoustically from the tow cable by preventing strumming from passing to acoustic modules. The VIMs, constructed of black rubber hosewalls which contain dual contra-helical layers of nylon cord reinforcement, can stretch up to 50 percent of their original length under towing loads. A centre strength member made of nylon-Kevlar cord prevents excessive stretch of the VIM by acting as the load-bearing member if the VIM stretches more than 50 percent. This cord is attached to each end by an eye splice tied to an aluminum clevis attached to the bulkheads. The nylon-Kevlar cord is coated with a composite of polyether polyurethane. The coaxial cable is wrapped around this and is slightly longer in length to prevent it from becoming the load- bearing member under strain. Once the array is stretched past the 50-percent point it loses its ability to isolate vibration, thereby increasing self-noise. The VIMs have coaxial connectors at each end and are not interchangeable.

Telemetry Drive Module

The TDM is the first electronic module of the array. It is constructed of a black thermoplastic hosewall with nylon cord reinforcement. The skeleton steel wire stringing assembly supports 21 electronic can assemblies and seven junction assemblies and their nylon spacers. The first can at the forward end of the TDM is the cable line driver/ isolation and tone coupler, which drives data signals up the tow cable and decouples power and command signals. Other cans process acoustic and non-acoustic data for transmission.

The forward end of the TDM connects to the after VIM by a coaxial connector. The TDM contains a switching mode regulator and linear regulator circuits to provide power for the array. Array power is partitioned by the TDM so that a short in one area will not drag the power down in all areas. Voltage monitoring circuits digitally encode status for transmission to the array receiver.

Heading Depth Temperature Module

The HDTM is the last module in the array, and contains sensors for determining the array's heading and depth, and the sea temperature. The module is constructed of black rubber hosewalls with longitudinal and circumferential reinforcement. The HDTM also has a skeleton. The last half of the HDTM contains no components and its skeleton is made of a braided polyester cord in a zigzag fashion.

Heading data accurate to one degree is provided by a magnetic compass that uses LEDs and phototransistors to provide digital output. Temperature data is provided by a platinum resistance temperature detector whose voltage output is then digitized. Digital array depth data provided by a pressure transducer is accurate to ± 1 percent.

The HDTM power supplies regulate power received from the TDM and then distribute it to the VLF modules and the HDTM.

Acoustic Modules

The 16 acoustic modules are constructed in a similar manner to the TDM. The skeleton stringing assembly supports electronic assembly cans including hydrophones which convert sound-pressure waves into electrical impulses. The impulses are sent to a preamplifier/filter which amplifies the analogue acoustic signal by five decibels and passes it through a bandpass filter to eliminate frequencies outside the range of interest. The signal is then multiplexed into a time division analogue data stream which is then sent via a differential line driver, providing the first stage of amplification of zero- or 24-decibel gain.

The acoustic data stream from each module's line driver travels through other acoustic modules before reaching the differential line receiver in the TDM for the LF, MF and HF modules, and in the HDTM for the VLF modules. The differential line drivers and receivers ensure that if one line is down the expected output will be down by six decibels. The hydrophones in the acoustic modules are grouped into 96 channels, and 24 other channels carry non-acoustic data. *Figure 3* contains a functional diagram of this arrangement.

The HDTM forms a single chain of VLF acoustic data using multiplexers. Both the HDTM and the TDM have gain control amplifiers, as well as sample and hold circuits, which allow instantaneous data samples to be amplified in the second stage of amplification in three-decibel steps from zero to 21 decibels and held until the timing is correct for data from that channel to be queued into a multiplexer and analogue/digital converters. Note that both stages of amplification provide a total range of zero to 45 decibels that is controlled by the array receiver as a variable of ambient noise levels.

The order in which channel data is multiplexed is fixed. The array receiver, therefore, must receive the data in the expected order (which explains why module types cannot be shuffled about the array). This digital chain of acoustic data is then multiplexed with digital heading, depth and temperature data, and with performance monitoring and fault location status data. This acoustic/non-acoustic data chain is amplified by a line driver and transmitted to the TDM. The TDM multiplexes this data chain with digitized acoustic data from the LF, MF and HF channels from the forward half of the array.

The combined data chain is amplified through another line driver and sent as biphase, encoded eight-bit digital data via a coaxial cable up through the VIMs and the tow cable to the array receiver. Non-acoustic data is sent at 16 Hz, except for sync and parity which are sent at the higher rate of acoustic data.

The TDM contains system timing and control circuits that co-ordinate the sequencing of multiplexers and the sample and hold circuits. These circuits provide the timing control signals for the HDTM's timing circuits so that the TDM and HDTM are synchronized.

System control circuits also receive test signals or calibration tones from the array receiver and distribute test signals of different frequencies and reference levels to hydrophone preamps. They also

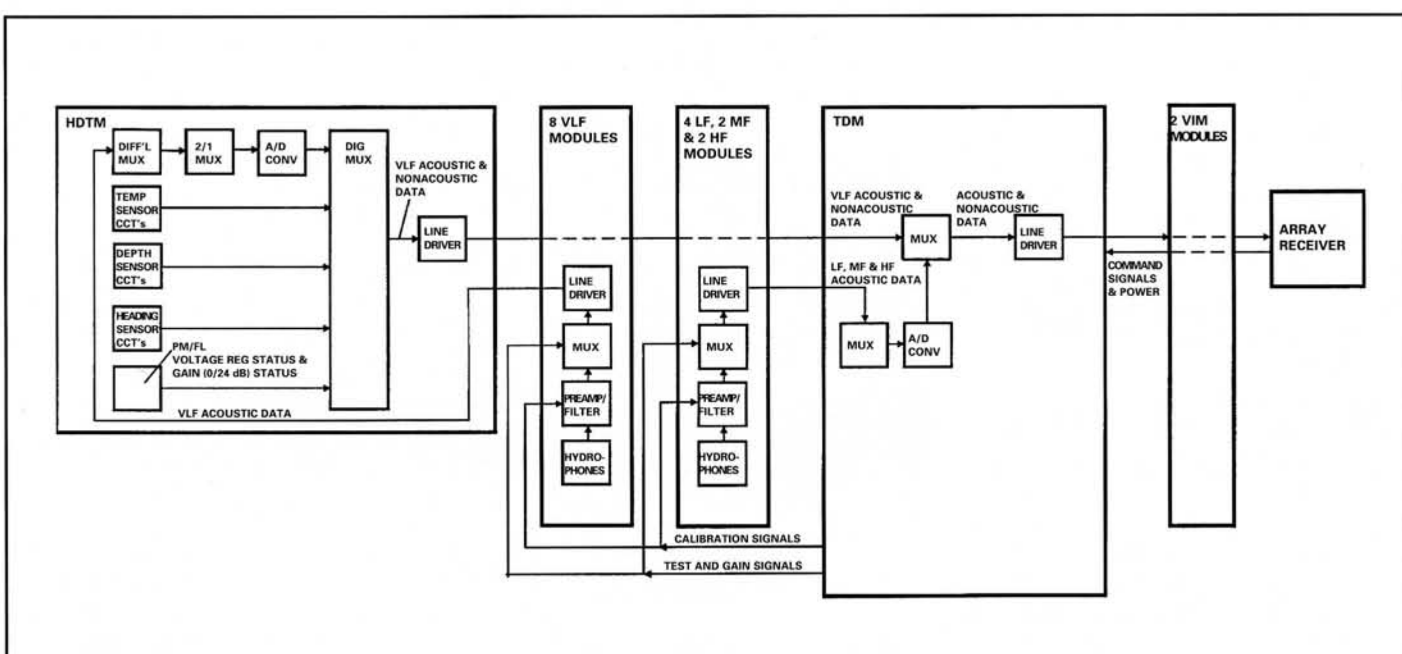


Fig. 3. General Signal Processing Diagram

control the level of the gain control amps in the HDTM and TDM as ordered by the array receiver. Performance monitoring/fault location circuits monitor voltage levels and array current as well as the integrity of the control and multiplexer address lines for the gain control amps. Performance/fault data is sent as non-acoustic data and is monitored by the array receiver.

Fault Isolation

The array has four modes of operation — three invasive test modes and a normal mode. The invasive test modes cause various DC levels to be transmitted by acoustic multiplexers in place of acoustic data. These DC tones should be visible on the spectrum analyzer connected to the digital/analogue converter output of the array receiver. Zeros are substituted for non-acoustic data. This checks out the proper operation of the multiplexers and the gain control amplifiers.

The other method of testing is the Fault Isolation Test Set (FITS) which can detect errors in the tow cable and array. Inserted at any point in the array, FITS will simulate all functions abaft that point. If the insertion of FITS at a given point rectifies a fault, the fault must lie somewhere abaft the insertion point. This can be used to localize the fault using calibration tones or by checking performance monitoring/fault location data. FITS also provides a load simulator which can detect opens and shorts for fault isolation of the VIMs and the tow cable right up to the array receiver.

Maintenance

Thanks to the design of their stowage and handling gear, USN ships can break a deployed array to insert FITS or to run other maintenance procedures. *Fraser* does not have this capability. The absence of lay-by trays makes module-switching a somewhat risky evolution. The array is examined closely upon retrieval for gouges or signs of obvious damage, but a cut in a module deeper than .018 centimetres (0.02"), or a cut in the tow cable deeper than .16 centimetres (1/16") must be repaired by Martin Marietta in the United States. (Plans for a Canadian repair facility are well under way.)

Fraser relies on the support of Ship Repair Unit Atlantic to inspect the array more fully (usually during short work periods if the array has more than 200

Naval Weapons Technicians land HMCS *Fraser*'s towed array in Dockyard Halifax. The cable can be seen passing from the winch drum, aft through the horizontal and upright rolling fairleads of the level-winder, and out the stern of the ship through a bell fairlead.

towing hours on it). The array is inspected for proper operation and correct ISOPAR M fluid levels.

Normally, several modules normally require refilling. Proper fill levels are vital to ensuring the array is towed along the horizontal plane. Overfilling can stretch a module's hosewalls and create positive buoyancy, while underfilling can create negative buoyancy. (Overfilling an HDTM would also affect the depth sensor.) In either case the beams of the array would be skewed, making target prosecution difficult. In a pinch, *Fraser* could refill a module with its onboard hose-filling rig and supply of ISOPAR M, even though the procedure is not recommended at sea.

(In the category of tall fish stories, one leaking telemetry drive module was found to have two small punctures. Closer examination revealed eel's teeth embedded in the hosewall! The USN has reported similar experiences during operations in the South Pacific. Apparently, the low-frequency vibrations of the towed arrays were attracting shark attacks.)

Conclusion

The success of the SQR-19 and ETASS Mk IV combination has given *Fraser* the most "in-contact" time on passive sonar of any surface unit in the fleet. The range at which targets can be successfully tracked by ETASS IV has provided HMCS *Fraser* with a potent underwater sensor. The ETASS Mk IV will be transferred to HMCS *Nipigon* when the venerable *Fraser* is paid off in July.

Future developments in array technology include a passive-active array which would provide the current benefits of VDS technology, such as being able to provide range data and more accurate localization of targets at close ranges. The passive aspect provides bearing information for targets at great ranges. Target-motion analysis would continue to be used for range prediction.

Possible growth areas would be to use the increasing power of modern digital signal processing computers to process more data from longer arrays. Longer arrays would mean more hydrophones could be carried to cover off greater portions of the frequency spectrum. Also, the sampling rate of acoustic data could be increased to provide a finer frequency resolution. The combined effect of these improvements would be an ability to detect smaller acoustic signals, over a greater frequency range at greater distances.

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* To present practical maritime engineering articles.
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Letters of any length are always welcome, but only signed correspondence will be considered for publication.

An AC Electric Propulsion Concept for a DDH-280-class Replacement*

Article by LCdr M. Tinney, W.A. Reinhardt, P.Eng., J. Hensler, P.Eng. *and* LCdr M.J. Adams, P.Eng.

**This article is based on a paper originally presented at the Canadian Maritime Industries Association 45th Annual Technical Conference held in Ottawa February 16, 1993.*

When electric propulsion first came into use, DC technology was used exclusively because of the difficulty in attaining speed control over AC motors. In the past few decades, however, advancements in AC technology have resulted in AC drives challenging their DC counterparts, particularly for high-power applications. Power semiconductors can now control megawatts of power at several kilovolts. Propulsion system designers are thus now able to incorporate many of the advantages of electric drive, thereby avoiding the disadvantages of DC systems such as commutation limits, maintenance requirements and size.

Until recently electric drives had the disadvantage of being more expensive, heavier and bulkier than their mechanical equivalents. The reason for these shortcomings lay with the fact that electric drive systems were developed for land-based industry. DND studies have shown that AC propulsion systems developed specifically for naval use can reach the power density values of equivalent mechanical systems.[1,2]

The Royal Navy has already installed an electric cruise propulsion system in its Type 23 frigate. In this case an off-the-shelf DC system was used to minimize design/development costs. The overall propulsion system is more reliable, more fuel efficient, and less maintenance-intensive than a comparable conventional plant.

This paper describes a potential semi-electric propulsion system for a DDH-280-class replacement vessel (DDH-280R). The plant consists of AC electric cruise propulsion, with geared gas turbines for boost power — i.e. a CODLAG (combined diesel electric and gas) arrangement.

Attributes of Marine Electric Propulsion

The benefits of a modern marine AC propulsion system cover a wide spectrum:

Performance

- Infinite bi-directional speed control of the propulsion train eliminates the need for controllable pitch propellers and reversing gearboxes.
- Independent torque control (i.e. independent of propeller speed) permits virtually unlimited propeller force at zero shaft speed. This feature is particularly useful when trying to free propellers trapped in ice.
- Simulation results indicate that a full electric ship can match or exceed a similar mechanical ship in terms of reversing time, stopping distance and acceleration.[3]

Survivability

- Decreased infra-red and noise signatures make the AC-propulsion-equipped ship less susceptible to detection.
- Decentralization of the propulsion prime movers lessens the vulnerability of the system to single-point failure and catastrophic (i.e. fully disabling) battle damage.

Reliability/Maintainability

- Reliability of the overall system improves due to the use of more-reliable electric components and more (available) prime movers. Shorter shaft lengths and fewer components in the shaftline also serve to increase reliability.
- The simplicity of electric motors and solid-state control circuitry offers reduced maintenance requirements, especially compared with the maintenance required by CODOG/COGOG propulsion plants and ship's service generators which may be operated at low loads for prolonged periods.

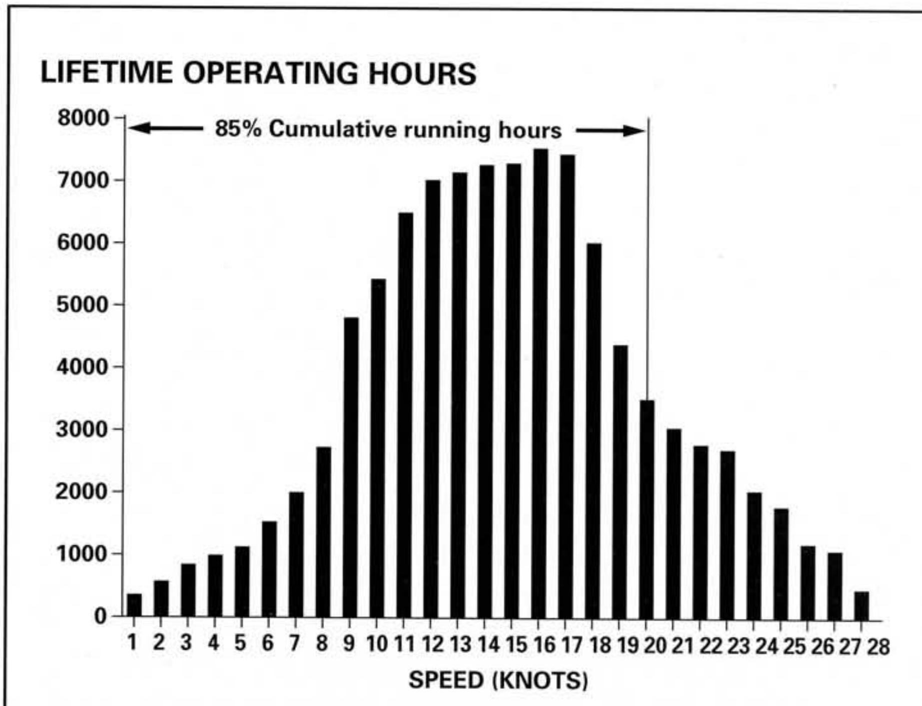

Fig. 1. Typical Frigate Operational Profile

Efficiency

- An AC propulsion system achieves improved fuel economy by efficiently matching propulsion load requirements with power generation components, and by using more efficient, less expensive fixed-pitch propellers. A 1985 "full electric frigate" concept design study estimated fuel efficiency to be 30 percent better than for an equivalent CODOG frigate.[3]

A CODLAG DDH-280R

It is likely that Canada's navy will, to some extent, continue to play a role in drug interdiction, fishery and sovereignty patrol, search and rescue, and UN and other allied operations such as blockade enforcement. It is suggested that these requirements could be met, at the minimum, by a multirole, frigate-sized vessel. For the purposes of this paper, then, equipment selection has been based on the propulsion needs of a baseline 124-metre ship, displacing 4,200 tonnes and having a top speed of 30 knots.

An operational profile for such a vessel (*Fig. 1*) shows that it spends 85 percent of its time operating at 20 knots and less. For this reason it is highly desirable to have a propulsion plant that is fuel efficient at low patrol speeds, yet capable of the high speeds necessary for interdiction and other requirements.

From the speed/power curve (*Fig. 2*) it can be seen that to reach the 20-knot level requires seven megawatts (i.e. 20 percent) of the total available propulsion power needed to take the ship up to 30 knots as specified.

The conceptual DDH-280R cruise propulsion system shown in *Fig. 3* consists of two 3.5-megawatt AC synchronous motors, each controlled by a cycloconverter, providing power to a fixed-pitch propeller. The main motors are connected in the shaftline and the cycloconverters are powered from a 4.16-kilovolt propulsion bus supplied primarily by three separate propulsion diesel generators. The AC motors take the ship up to 20 knots ahead, and are used for manoeuvring and astern movements. With all propulsion generators on line, the ship has seven megawatts of power available for ahead and astern movements in cruise mode.

In boost mode, two 15-megawatt (maximum continuous rating at ISO) gas turbines are brought on line with the AC electric propulsion motors to supply the additional 30 megawatts of power needed to take the ship from 20 knots up to 30 knots and beyond. Gear-meshing noise is no longer a concern at these speeds since it will be masked by the hydrodynamic noise of the hull and propellers. The gas turbines connect to the shaftline through a simple reduction gearbox and clutch arrangement, which allows the GT machinery to be isolated for quietness during cruise operation. CODLAG power-sharing is achieved by controlling the load angle of the propulsion electric motor by setting the angular displacement of the armature and pole flux vectors via the cycloconverter.

Between 20 and 30 knots the ship's speed can be controlled by adjusting the speed of the gas turbine. Although operating the gas turbines at slower speeds reduces efficiency, such operation would only be required for a relatively small percentage of time in the DDH-280's life cycle. Any inefficiency would also be mitigated by the fact that the load would be kept high on the turbines by reducing the contribution of the electric motors while the turbines were operating in that range.

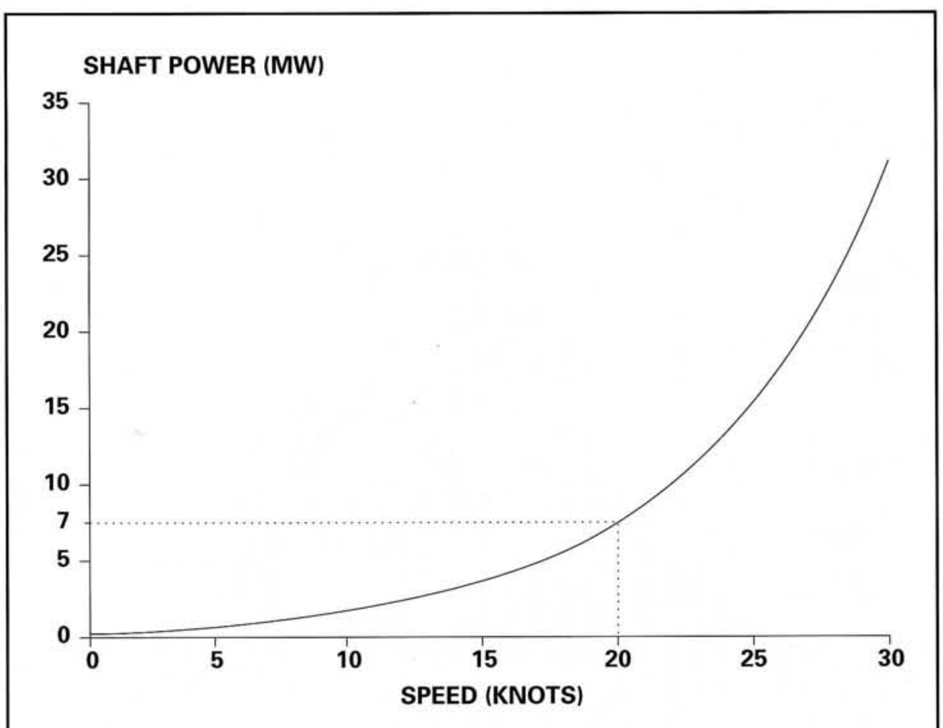

Fig. 2. Speed/Power Curve for a Typical Frigate

Power Generation

Electrical power is provided by three propulsion generators distributed conveniently throughout the ship. By carefully selecting the size of the generators at the outset, an efficient combination of prime movers can be configured to closely match the vessel's speed/power requirements. The DDH-280R requires approximately seven megawatts of installed cruise propulsion power, and about one and a half megawatts of ship's service power. Allowing for 100-percent standby redundancy in ship's service power, a total of 10 megawatts of installed generating capacity is therefore required for both cruise propulsion and ship's service power.

Three propulsion diesel generators rated at 1.5, 3.0 and 4.0 megawatts were selected to provide the necessary power and ensure maximum operating efficiency. Along with two 750-kilowatt ship's service generators, the electrical load can be configured to provide power at 750-kW increments all the way up to 10 megawatts. (For ease of support, all three diesel engines would be of the same type.)

For maximum efficiency, power for the auxiliary 440V ship's service bus will normally be provided by two 750-kW reversible synchronous motor-generator sets connected to the main bus. Synchronous motor-generators were selected over transformers to significantly reduce the level of harmonics transmitted from the propulsion bus to the ship's service bus. With motor-generators, harmonics are effectively attenuated as they pass through the air gaps in the motor and generator. A ring main system was selected for improved survivability and ease of maintenance. The two motor-generators and two ship's service diesel generators each feed an independent section of the switchboard, each section being joined by bus tie-breakers.

Braking requirements for the vessel are met by feeding regenerated power from the propeller back into the main propulsion bus. This option was selected since it involves recovering the kinetic energy of the moving ship and converting it back into electric power to be used by the auxiliary bus. If the regenerated power were too great to be absorbed by the auxiliary bus, the excess would be absorbed by the diesel generators (acting as motors) and by the diesels (acting as compressors). A power-management system slows the diesels in sufficient time to receive the regenerative power. As the regenerative power is absorbed it causes the diesels to speed up. Proper-sized generators ensure that the slowing-down and speeding-up of the generators does not cause the bus frequency to exceed the allowable limits.

Some Important Considerations

Power Density

Using state-of-the-art technology for cycloconverter design, the overall volume of an AC electric propulsion plant is now only eight percent to 10 percent larger than that of a comparable geared propulsion system. What is more, if the maturing technology of high-powered gate turn-off devices can be used in place of silicone-controlled rectifiers, the converter size could be decreased by an additional 70 percent — enough to make the difference between electrical and

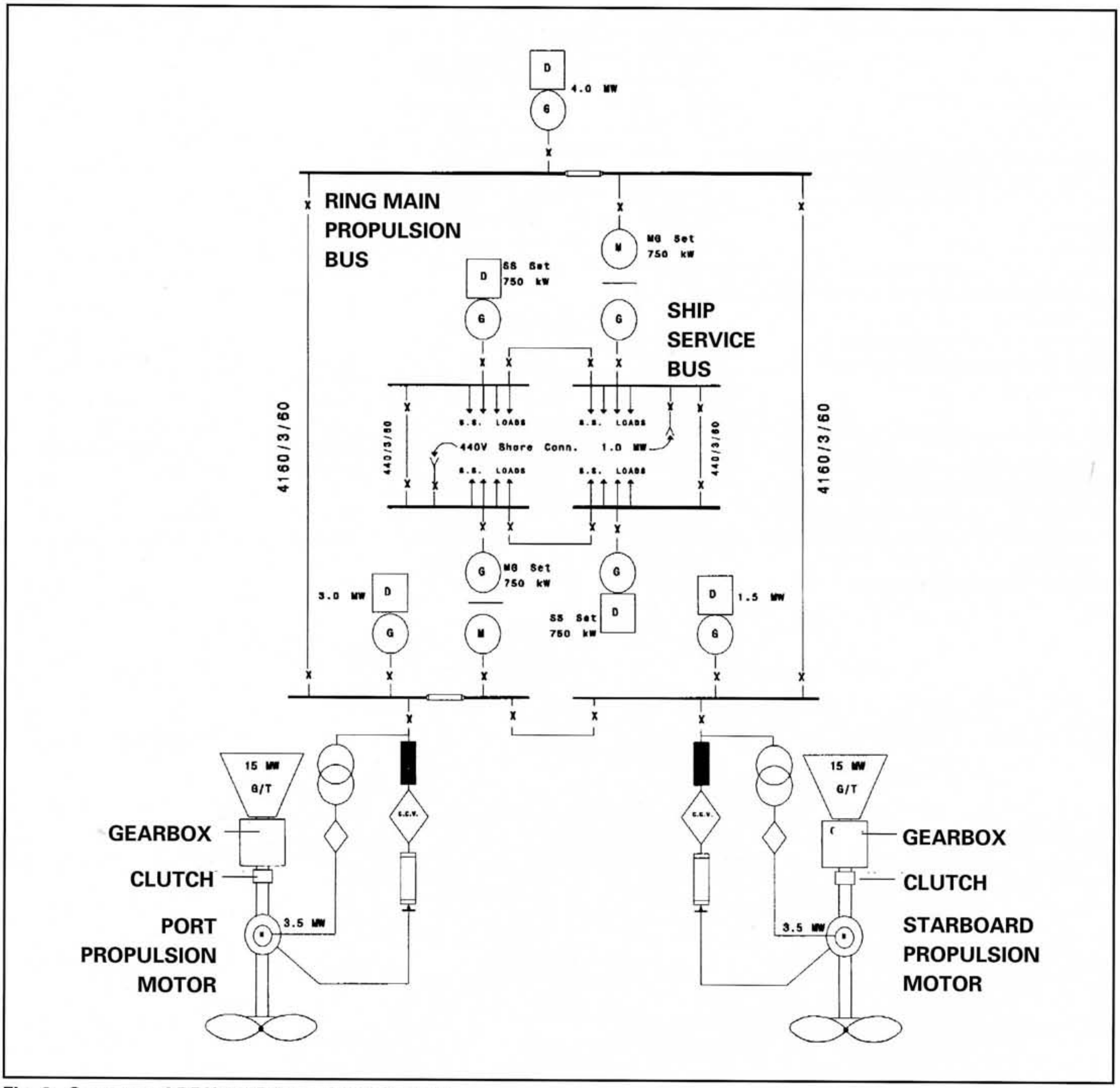

Fig. 3. Conceptual DDH-280R Propulsion System

mechanical drives negligible. Any weight penalty is compensated for by the absence of large, heavy reduction gearboxes and controllable pitch propeller systems.

Noise

A study conducted for DND showed that cycloconverter-based AC drives have the potential to reduce a ship's underwater acoustic noise by as much as 20 decibels.[4] This translates into a hundred-fold decrease when compared to a geared mechanical system with a controllable pitch propeller. Computer simulations and verification tests presently being conducted in Canada and the U.K. also seem to converge on identical conclusions.[5]

System Vulnerability

Several studies conducted for DND used a Monte Carlo probability simulator to prove that locating propulsion components freely in a ship's envelope can improve a vessel's survivability.[6] Results from computer-simulated missile firings against a design variant of the MCDV with generators dispersed throughout the vessel showed that the probability of losing all propulsion power because of one hit was virtually non-existent.

Reliability/Availability

A study carried out on behalf of the MCDV project showed that the inherent flexibility of an electric propulsion system virtually rules out the likelihood of a catastrophic loss of system due to a single-component failure *at any time during the life cycle of the vessel*. In fact, the period between two catastrophic failures for one option of the MCDV was calculated to be in excess of 60 years![7]

Conclusions

While a full costing study has yet to be conducted, it is recognized that *production* costs for a conventional electric propulsion plant, such as suggested in this paper, are currently more expensive than for geared mechanical propulsion schemes. The advantage of an electric plant is realized through savings in fuel costs and operating and maintenance costs throughout the life of the vessel. Despite the fact that the power train's transmission efficiency is only 90 percent versus the 97 percent for a geared mechanical drive, the optimum match of design points over a relatively large percentage of the ship's operational profile yields savings in operating and maintenance costs. For these savings to be realized, however, it is important that the right size and number of generators be selected to ensure efficient operation at (or very near) their optimum design points.

The capabilities of existing high-power AC technology now make AC marine propulsion systems feasible. The DDH-280R propulsion system described here offers the potential for reduced operating costs (as seems to be borne out by the U.K.'s experience with the Type 23) and increased survivability. Any negative impact of greater system size, weight and production cost may soon be eliminated by advances in AC power technology such as gate turn-off components.

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Conference Reports

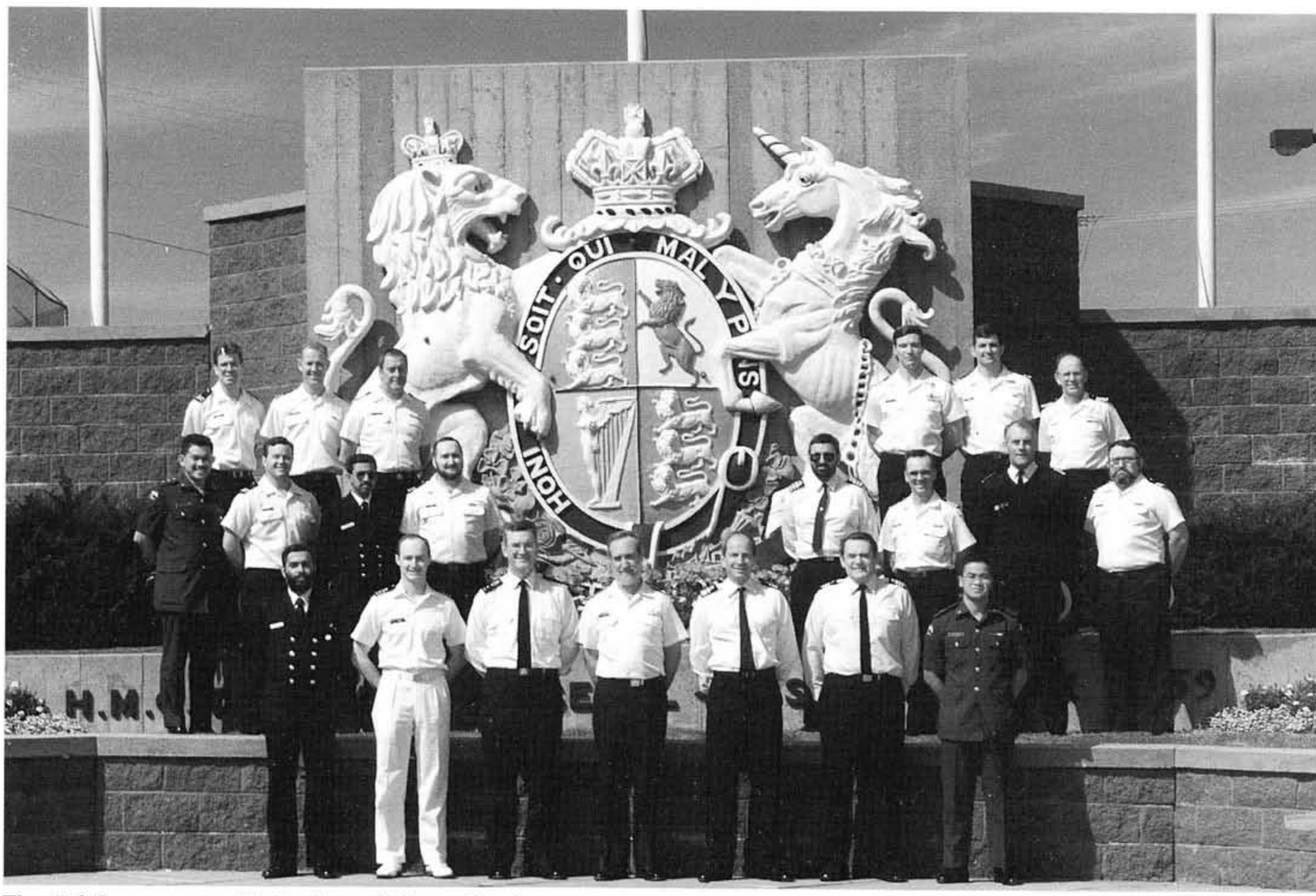
65th Commonwealth Engineer Officers Conference

The 65th Commonwealth Engineer Officers Conference was hosted in Halifax, Nova Scotia last Sept. 20-24 by the Director General Maritime Engineering and Maintenance (DGMEM). Seemingly in keeping with the conference theme of "Shrinking Budgets — Spending Wisely," only nine of the 26 delegates hailed from foreign commonwealth navies. They included three officers from the Royal Navy, one from the Royal Australian Navy, one from the Royal New Zealand Navy, two from the Indian Navy and two from the Royal Brunei Navy.

The week-long conference opened with a Monday evening welcoming reception at the Stadacona wardroom. Besides giving delegates a chance to meet one another, the informal occasion set the tone for the rest of the conference. Other social functions of the conference included a boat tour of the dockyard waterfront, a tour of HMCS *Toronto* and dinner at Royal Artillery (RA) Park.

In his opening address, conference chairman **Cmdre Robert L. Preston** (DGMEM) pointed up the current climate of shrinking budgets and the need to reduce costs of fleet support. His call for innovation and imagination in meeting the challenge of reducing costs was warmly received.

Keynote speaker for the conference, **RAdm M.T. Saker** (Assistant Deputy Minister Engineering and Maintenance), expanded on this theme by suggesting that we face a significant challenge as we attempt to reduce costs during a period of fleet renewal. Deficit reduction is the order of the day, he said, but cautioned that at best that meant no real growth in DND's budget. He pointed out that we



The 65th Commonwealth Engineer Officers Conference:

Top row: **Lt(N) Curran, Cdr Duinker (Conf. Co-ordinator), Capt(N) Chiasson, Capt(N) Embree, LCdr Findlay, Capt(N) Brown**

Middle row: **Capt Hussein (Brunei), Lt(N) Garbe, Cdr Kar (India), LCdr Adams, Cmdr Ayers (United Kingdom), Capt(N) Sutherland, Capt(N) Baller (United Kingdom), LCdr Staples**

Front row: **Cdr Athalye (India), LCdr Hudson (Australia), RAdm Saker (Keynote Speaker), Cmdre Preston (Conf. Chairman), RAdm Walmsley (United Kingdom), Cdr Dudley (New Zealand), Maj Nooradin (Brunei)**

Absent: **Capt(N) Marshall, Cdr Eldridge, Cdr Johnson, LCdr Brown, LCdr Munro, Capt Larouche, Tina Rumble** must strive constantly to find ways to spend wisely because, while funding cuts have so far been generally absorbed by future projects, further cuts will have to be borne by current projects.

RAdm Saker highlighted the fact that we contract out 33 percent of our engineering support work and more than 60 percent of our production work. He also pointed out that the current allocation of $17.7 billion for naval acquisitions covers such projects as CPF, TRUMP, MCDV and others. To make matters worse, he said, industry is hungry and is applying political pressure to have DND contract out more work than it already does. Because the operation and maintenance of the fleet accounts for over 77 percent of the navy's budget, that is where most of the room exists to trim expenses. Therefore, "devolution," or decentralization, is being looked at to help reduce costs. This means that the decision levels for some of the fleet operation and maintenance functions would be lowered to a more practical, hands-on level, and that those who make the decisions would be held accountable for their decisions.

Admiral Saker's speech was followed by a presentation from **RAdm Walmsley** (RN), Director General Submarines and Chief of Naval Engineering, who summarized the RN procurement process and current difficulties. He extolled the virtues of the competitive process and even suggested that portions of sole-source contracts should be tendered for competition to maintain a baseline from which to compare non-competitive proposals. Another cost-cutting measure, the transference of design authority to industry, was also presented. This requires a "hands off, eyes on" approach — hands off to reduce the cost of never-ending design changes, and eyes on to ensure that what is being produced is what is wanted. In the course of his presentation RAdm Walmsley succinctly defined the cost-effectiveness of the "devolution" principle: "Once you have to pay for it," he said, "you'll want less of it."

The remainder of the conference reinforced the difficulties introduced by the senior presentations, and verified that the pressures were indeed international. Over the next three days delegates presented 14 papers, covering such topics as contracting out ship-level support, the cost benefits of improved information and personnel management, and the potential savings associated with improved requirements definition — everything from R&D to project management.

The last afternoon of the conference consisted of a free forum discussion period. RAdm Walmsley introduced an article from the June 1992 issue of the *Journal of Naval Engineering*, entitled "Should Engineers Wear Purple Caps — A Way Ahead for Technical Officers in the RN." This stimulated much discussion among the delegates as to how the operator-maintainer relationship, both at the officer and NCM levels, should best be tackled.

The Indian Navy is apparently close to embracing the principle of requiring officer candidates to hold technical degrees. This is familiar territory to Canadians. An RCN training scheme of the late '50s and early '60s required naval officers to obtain both engineering charge tickets and bridge watchkeeping tickets. The scheme had its advantages, but in the end it proved to be too expensive and was a serious impediment to officers wishing to pursue only engineering or bridge careers. Delegates agreed the best course of action for Canada would be to continue our streamed MARS and MARE training, with opportunity for officers to cross-train if so inclined.

The remainder of the forum discussion covered the recognition of the cost-effectiveness of the competition process. It was agreed that the first step toward developing cost-effective procedures was to implement cost-accounting procedures.

In conclusion, the conference was a valuable forum for sharing ideas concerning the universal problem of coping with shrinking budgets. Different approaches and new ideas provided seeds for thought as to how we might advance the cause for cost-effectiveness within the navy. The fruit borne from this conference will assist the department in supporting the fleet with ever-diminishing resources.

Papers from the 65th Commonwealth Engineer Officers Conference are available from: DGMEM/SPO, NDHQ (4 LSTL), Ottawa, Ontario, Canada K1A 0K2. The 66th Commonwealth EOs Conference is tentatively scheduled for 1995 in India.—**by LCdr M.J. Adams, DMEE 6.**

10th Ship Control Systems Symposium

The Tenth Ship Control Systems Symposium was held in Ottawa during the last week of October 1993. The symposium was attended by 232 speakers and delegates from 14 countries, and more than 100 papers were presented during the week-long meeting. The Canadian federal election on the opening day of the symposium (and the stunning election results) did more than a little to break the ice as delegates made acquaintances and renewed friendships.

The symposium is held every three years to discuss advancements in marine control philosophy and technology. The role of symposium host rotates between Canada, the United States, the United Kingdom and the Netherlands. Canada last hosted the event in 1981. This latest symposium was sponsored by DMEE 7, under the chairmanship of **Cdr Peter MacGillivray**. Organizational responsibilities were managed by co-ordinator **Lt(N) Carlos Zaidi** and **Jim Hayes** (administrative chair). The technical chair was filled by **Francine Portenier**.

In his opening address, **Cmdre Robert L. Preston** (DGMEM) spoke on the role of IMCS in the Canadian navy, adding that these symposia have been "a cornerstone of our machinery systems development." Over the course of the week a variety of topics were discussed, including intelligent damage control systems, intelligent health monitoring systems, and new-generation machinery control systems.

One paper of particular interest in today's climate of fiscal restraint was titled, "Reducing Overall Ship Costs using Improved Techniques for Control and Monitoring." In his paper, **Michael Glover** (U.K.) discussed the possibilities of reducing a ship's complement by enhancing machinery automation. Earlier in the proceedings **Barry Smith** (U.K.) had touched upon this theme with his "Conjecture on the Continuing Development of Machinery Control." Artificial intelligence may replicate human performance, Smith said, but added, "We have no desire to replicate human shortcomings!"

Capt(E) Nicolaas Osseweyer (RNLN), in his overview "Platform Control Developments in the Netherlands," posed several difficult questions: "How do we keep a watchkeeper keen and interested during his watch when everything is normal and the machine is doing the job? What do we do with a highly educated engineer when a considerable part of his working time is consumed with work on a rather low level — for example, cleaning, repairing defective toilets?"

Although the symposium timetable was hectic, participants did have time to socialize at a midweek banquet and end-of-symposium luncheon. (The Radisson Hotel's chef was formerly a cook in the Royal Netherlands Navy!) In his banquet speech **RAdm M.T. Saker** talked about the fiscal challenges facing the world's navies, and explored future Canadian advancements for IMCS technology.

A well-received spouses program conducted by **Melanie MacGillivray**, wife of symposium chairman Cdr Peter MacGillivray, included a full schedule of tours in and around Ottawa. "Peter said it was going to be a lot of work," said Melanie, who had to book time off from her job as a Leader/Trainer with Weight Watchers. "But I really feel it's been a privilege — I got to meet all these women."

Language teacher **Reidun Lutje-Schipholt**, the Norwegian wife of senior Netherlands delegate **RAdm Ruurd Lutje-Schipholt** (SACLANT Assistant Chief of Staff, CIS in Norfolk, VA) said she thoroughly enjoyed the spouses program. "We saw the sights, but we were spoiled by all the lunches," she laughed. "It was a mixed group (of women), and still we got on very well. We had a lot to talk about," she said.

Melanie MacGillivray, Spouses Program Co-ordinator. "It was great fun. I loved every minute of it."

Symposium Chairman Cdr Peter MacGillivray poses with international co-ordinators Barry Smith — U.K. (seated, chair-designate for 11th SCSS in 1996), Capt(E) Tony Flameling, RNLN (Ret.) — Neth. (standing, left) and John Moschopoulos — U.S.A. (chair of 9th SCSS in 1990).

Staff for the 10th Ship Control Systems Symposium received top marks from speakers and delegates alike.

Front: **Ann Roberts, Valerie O'Callaghan, Carol Rosengren, Colleen Donis, Barb Gricken**

Back: **Francine Portenier (technical chair), Keith Santo, Gerry McCauley, Dan McEachern, Carlos Zaidi (symposium co-ordinator), Paul York, Cdr Peter MacGillivray (general chair), Jack Sinclair, Jim Hayes (administrative chair), Marge Chartrand, Lt(N) Jody Curran.**

Missing: **David Atkins, Jeff Hill**

As a humorous memento of their trip to Wakefield, Quebec on the steam train, the ladies gave Melanie (Mother Hen) a wooden souvenir "train" whistle she could use to keep her charges on schedule — *toot, toot!* They later presented Melanie and Peter MacGillivray with a restaurant gift certificate and enough babysitter money to let them get out for a quiet meal.

Overall, the Tenth Ship Control Systems Symposium was highly successful. It was both interesting and exciting to learn about the advancements in control technology from such a diverse group. If any one idea captured the mood of the symposium, it might be Cdr MacGillivray's sentiment that, "As far as we thought we were going (with IMCS) ten years ago — today, it doesn't seem as if we went far enough."

Copies of the symposium proceedings are available by contacting DMEE 7, NDHQ, Ottawa.**—by Lt(N) D.J. Curran, DMEE 7-2, with *Journal* files.**

CMIA 46th Annual Technical Conference and Canadian Shipbuilding & Offshore Exhibition — CSOE'94

This year marks the 50th anniversary of the Canadian Maritime Industries Association, and in February the Association celebrated with a first-rate technical conference and exhibition at the Ottawa Congress Centre. The occasion was also used to introduce new CMIA president **André Lafond** who takes over from **J.Y. Clarke**.

Don Wilson's presentation, "Quality Management for the Marine Sector," sparked a great deal of discussion among delegates. Wilson, chief executive officer of the Canadian General Standards Board, delivered a hard-line message on the benefits of quality management and the importance of the ISO 9000 series in government/industry relations. "Most people think quality costs," Wilson said. "It does, up front, but before too long quality actually pays and becomes an investment." The key to improvement in all sectors, he said, is the unequivocal acceptance of QM principles. "Breakthrough thinking is needed," he emphasized.

Brian Keefe, co-ordinator for DND's Marine Engineering Technician Training Plan at St. Lawrence College in Cornwall, ON, was on hand with a number of his METTP students. "For one day in their college career they've come to be part of the marine business," Keefe said.

Second-year METTP student **AB Richard Cenerini**, 25, of Logan Lake, BC seemed typical of the motivated, young engineering technicians who were visiting the CMIA conference. Cenerini, who will complete a third year at St. Lawrence College and a technical course in Halifax before moving on to the fleet, was unsuccessful in his first bid to join the Canadian Forces right after high school. He was eventually accepted into the METTP as a third-year science student from Cariboo College in Kamloops. "I'm enjoying the program," he said. "I think it's well worthwhile." Cenerini said he particularly enjoyed an informal tour through HMCS *Toronto* last summer. A great believer in computer controls, he said he was impressed by the absence of hand-operated controls in the patrol frigate.

The number of exhibitors at CSOE'94 was reportedly down from previous years, a sign some said of the desperate economic climate the industry finds itself in. **Steven Rapley**, the Ontario Marine Manager for International Paints (Canada) Limited, said his company is better off than many others because of the navy work they have been able to pick up. "If it wasn't for the frigate program and a few other things," he said, "we would be hurting."

Also represented at the exhibition was the Transportation Safety Board of Canada. "We try to avoid repetition of casualties," said **Eric Asselin**, a nautical specialist for investigations. "We are working for the public — to make them aware of the dangers and of safety (issues)."

The conference wrapped up with a splendid banquet at the Westin Hotel. Guest speaker Industry Minister **John Manley** spoke strongly about the need for Canada's industry to sell itself abroad. "We have to get the word out to potential customers around the world," he said, "that Canadians are innovators, that we're capable of competing with the best, and that we mean business."

Manley cited this summer's planned government/industry-sponsored tour of the Far East by HMCS *Toronto* to promote sales of advanced technology in the marine and other sectors. Referring to the Canadian patrol frigate as "one of the crowning achievements of Canada's marine industry," Manley said the potential sales payoff of the Far East tour could reach $1 billion. Still, he cautioned, the government can only play a support role in initiatives such as the Far East deployment. The lead, he said, must come from the private sector. "We can no longer solve all of the problems on our own," he said.

CMIA president André Lafond responded to the minister's comments in his closing remarks. "We need the federal government as a full partner in our effort to succeed internationally," he said.

The membrane oil/water separator — a better mousetrap

Article by LCdr Keith Dewar *and* Lt(N) Robert de Wit

The international maritime community has long recognized the discharge of oily wastewater as a significant threat to the marine environment. This concern has manifested itself in various international agreements such as MARPOL 73/78, and in legislation such as the Canada Shipping Act. In Canada, the Act's strict requirements form the basis of the Maritime Command discharge policy for ships fitted with oil/water separators. The discharge policy is quite specific:

- discharge must contain less than five parts per million (ppm) of oil in water in inland waters (zero discharge in the Great Lakes);
- less than 15 ppm in internal waters and territorial seas; and
- less than 100 ppm beyond 12 nautical miles.

As many marine engineers know, it can be a challenge to meet these standards consistently with the oil/water separator (OWS) technology available today. What is more, the standards will become even more stringent in the near future. In July 1998, for example, the Canada Shipping Act will be amended to reduce the allowable content of oil in wastewater from 100 ppm to 15 ppm in waters beyond 12 nautical miles.

Fortunately, it appears that the technology to meet naval requirements is on the horizon. So-called ultrafiltration oil/water separators employing semipermeable membranes are showing great promise for use at sea. Naval engineers are probably more familiar with a derivative of these units — the reverse osmosis desalinator.

Like most oil/water separators the SAREX units (*Fig. 1*) prevalent throughout the fleet are based on the simple principle (known as Stokes Law) that oil and water do not mix. When a small amount of oil is mixed with a larger amount of water it becomes suspended in the form of small droplets. The difference in the specific gravities of oil and water results in a buoyant force on the oil droplets which causes them to accelerate rapidly upward until they reach a terminal velocity. (By the same reasoning, water suspended in oil will go downward.)

Foregoing the development of the relevant equations, the design factors for a simple separator (a vertical cylindrical tank) based on Stokes Law are: the specific gravities of the fluids, the kinematic viscosity of the continuous medium (water or oil), the flow rate, tank diameter and droplet diameter.

For example, if it were desired to build a simple separator to produce an effluent flow of 19 litres per minute with less than 15 ppm oil content (assumed to be MIL-9000H @ 20°C), the tank would have to be 4.75 metres in diameter! Even if the fluid were heated to 90°C to reduce its viscosity, the tank diameter would only drop to three metres. Clearly, such a design would be impractical for naval use.

All current shipboard oil/water separators use a *multiplier* to make larger droplets out of smaller droplets which can then rise more rapidly against the flow to the primary oil/water interface. Multipliers, which can be filters (such as in the SAREX), parallel plates, or mixed media, create additional interfaces where droplets can coalesce, normally by providing surfaces which are alternately oil-attractive and water-repellent.

The United States Navy has experimented extensively with parallel plate technology (*Fig. 2*). This technology was attractive due to the potentially small unit size offered and the lack of moving parts. Although high hopes were placed on applying this technology in our own navy's Maritime Environmental Protection Project, it is unlikely that it will meet the stringent requirements placed on oil/water separator technology in the future.

Real World Problems with Stokes Law Separators

Despite the simple physics involved with gravity separation, the oil-content alarms continue to sound on conventional oil/water separators. It turns out that the Achilles' heel of these systems is that they only remove droplets down to a given size. If the distribution of droplet size changes so that many droplets become too small to be caught by the filters, the oil content of the effluent will increase. Conditions that can decrease the size of oil droplets are all too common in the real world.

Emulsions (suspensions of very small droplet size) are easily created through mechanical or chemical means. Mechanically produced emulsions can be partially avoided through design by avoiding turbulent flow or agitation. Large pipes and slow-turning, positive displacement pumps such as the MOYNO pumps used with the SAREX separator are normally employed.

Chemically produced emulsions, where the average droplet size may be less than 0.1 microns, are much more difficult to handle. Chemicals called surfactants actively break the oil down into smaller droplets — the same process used by most detergents and cleaning solvents. Studies conducted at NETE and elsewhere have shown that even small amounts of AFFF fire-extinguishant introduced to an oil/water separator can cause massive oil discharge.

It is perhaps easy to issue an edict that states that surfactant chemicals are not to find their way into bilges. The reality is that there are many legitimate uses for such products: gas-turbine detergent washing, removing oil from deck plates and other surfaces for safety, and (facing facts) Admiral's inspections. But until better technology comes along, we have little choice but to try to minimize the entry of these chemicals into the bilges, or to switch to detergents such as GAMLEN Clean-Break that have minimal effect on OWS performance.

Furthermore, bilge contaminants such as paraffins, fungus, grit and a host of others frequently plug the coalescer filters, thereby increasing maintenance loads and cost. The disposal arrangements alone for these oil-soaked filters represents a serious environmental aspect of the whole problem of bilgewater treatment. Clearly, a better mousetrap is needed.

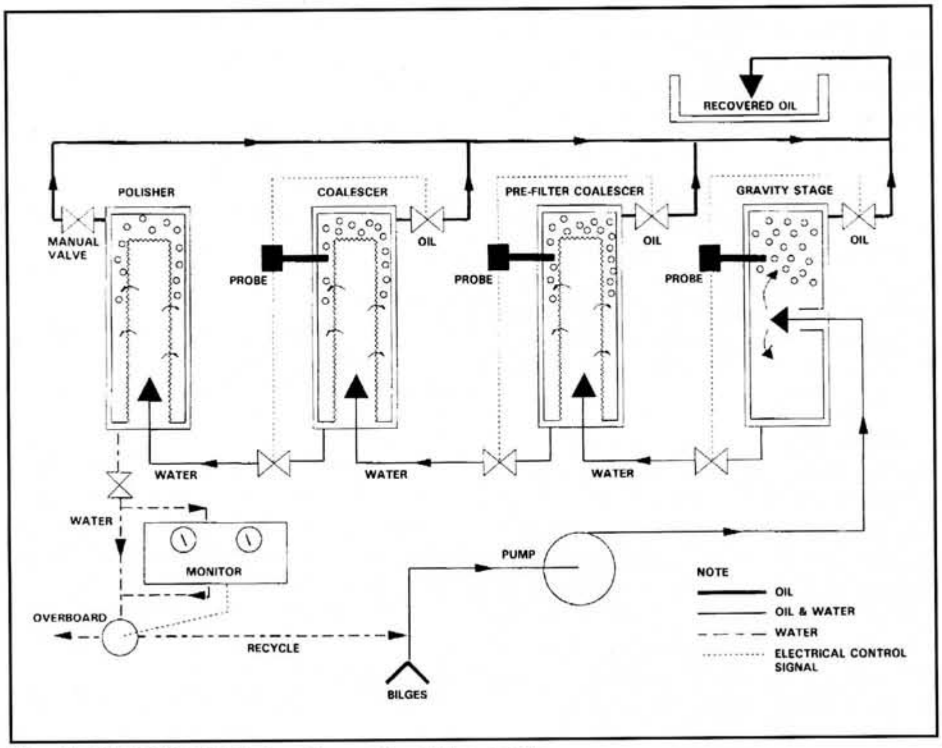


Fig. 1. SAREX Oil/Water Separator Schematic

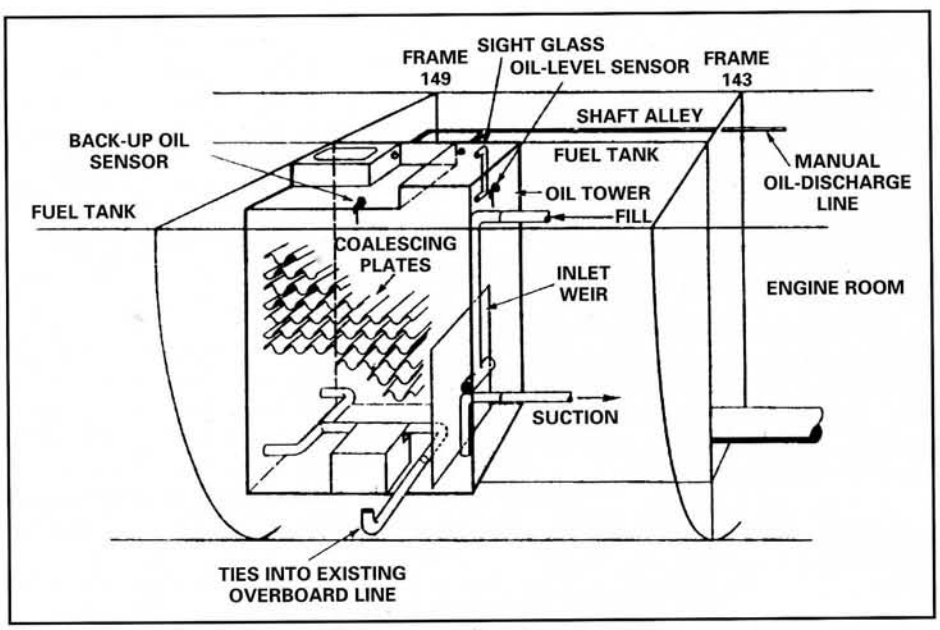


Fig. 2. Parallel Plate "In-Tank Separator"

Membrane Oil/water Separators

The answer might very well lie with separators that employ *semipermeable* membranes. Rather than relying on gravity separation and coalescer multipliers, the pore size of a membrane oil/water separator is selected to be impermeable to oil. The semipermeable membranes now used in reverse osmosis desalinators, for instance, are capable of filtering out particles of very small size indeed — something in the order of one to 10 Angstroms. Since oil molecules are considerably larger than the pore size of a reverse osmosis membrane, an OWS employing such hyperfiltration membranes could certainly be effective.

The drawback to these membranes is that they are very expensive, require large transmembrane pressures of 1.3-10.3 MPa (190-1,500 p.s.i.), and are not terribly resistant to contaminants such as chlorine and strong cleaning chemicals. Oddly enough, membranes with a slightly *larger* pore size, in the ultrafiltration (UF) range, offer a better potential solution.

Although they might pass single oil molecules, UF membranes will reject oil droplets as small as .001 microns, which is orders of magnitude smaller than the droplets found in a severe chemical emulsion. Moreover, UF membranes require much lower transmembrane pressures of 0.1-1.4 MPa (15-200 p.s.i.) and are available in a number of materials such as ceramics and polymers which have been shown to reliably achieve oil contents of less than two ppm.

Ultrafiltration membrane separators display other advantages, too. For instance, where emulsifiers can render a coalescer-type of separator ineffective, in a membrane feed they can actually help prevent oil from building up on the membrane and reducing the efficiency of the separator. Membrane oil/water separators are thus able to use common high-flow centrifugal pumps and small-bore piping, and in contrast to coalescer units are capable of variable flow.

Since an ultrafiltration membrane will reject oil whether or not it has been emulsified, it can be washed periodically with highly concentrated detergent to restore the membrane output. This, of course, would be impossible with a coalescer separator. The washwater can even be returned to the bilge collection tank for later processing through the same membrane separator. A ship equipped with a membrane oil/water separator is thus free to use detergents and other cleaning agents selected for cleaning ability rather than their gentleness on the OWS. The period between chemical cleanings can even be extended by increasing the shearing force on oil deposits by increasing flow rate, backwashing or pulsing the flow.

Membrane oil/water separators are failsafe. Operator error or electrical malfunction will not cause oil to pass through the membrane into the effluent. Seal failures and membrane rupture have been shown to be rare occurrences. Although the membranes are subject to gradual fouling through deposition of oil and other contaminants on their surfaces, this merely reduces the *quantity* of effluent oil content (known as permeate), not the quality.

Current Development Work

Ultrafiltration membrane separation techniques are not new. Some of their many successful uses include clarification of beverages, protein removal from wine, concentration/dewatering of juices and concentration of blood.

Membrane oil/water separators for naval applications are under active development in Germany and Holland. Although not yet fully developed, both systems have been tested at sea with encouraging results. Several Canadian companies certainly possess the experience and capability to develop a system for shipboard use, though none currently has a system available.

Figure 3 illustrates the principle of operation and characteristics of a potential naval system — the German Blohm & Voss Turbulo Membrane Separator, designed for fully automatic, continuous operation. The basic process flow is: waste water is drawn from the bilge into a gravity separator where gross oil is removed and discharged into a holding tank. Pumps then raise the system pressure to approximately 0.4 MPa (58 p.s.i.) and the feed velocity to about six metres (20 feet) per second to minimize fouling. After passing through the UF membranes, the separated oil is returned to the gravity separator. Permeate is sampled by an oil-content monitor prior to its being discharged either overboard or back to the bilge as appropriate. At periodic intervals the system measures permeate output and initiates an automatic detergent cleaning cycle if the level falls below a preset minimum.

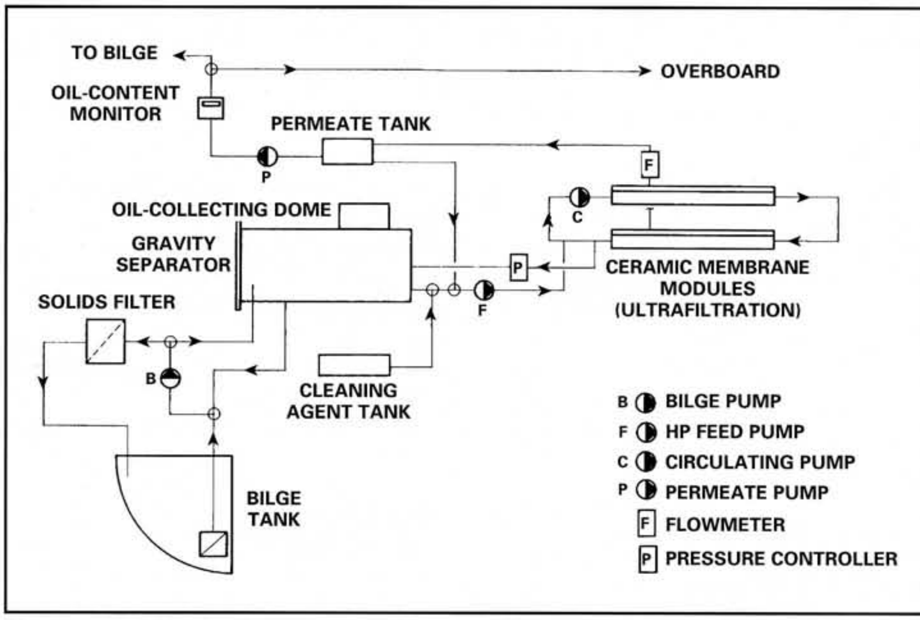


Fig. 3. Turbulo Separator Process

It is intended that the SAREX systems fitted on board the *Halifax*, *Iroquois*, *Protecteur*, *Cormorant* and AGOR classes will be replaced under the auspices of the Maritime Environmental Protection Project. Whatever technology is finally selected for use, the Canadian navy will watch the development of membrane oil/water separators with great interest.

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LCdr Keith Dewar is the subsection head for environmental protection equipment in DMEE 5.

Lt(N) Robert de Wit is the DMEE 5 project officer for oil/water separator replacements.

Looking Back

Ontario's "*Beaver*" takes 1st prize in 1950 regatta!

Article by LCdr(R) Brian McCullough

Take a close look at HMCS *Ontario*'s prize-winning "float" for the May 24, 1950 West Coast regatta. Shipwrights built a scale replica of the Hudson Bay Company steamship SS *Beaver* atop *Ontario*'s pinnace during the training cruiser's southern deployment that year.

The original *Beaver* was built in England in 1835 for the Hudson Bay Company. Rigged initially as a sailing vessel to withstand the rigours of a passage to Canada's West Coast, she was outfitted for steam as a side-wheeler only after she reached British Columbia in 1836. With her two side-lever, 35 h.p. engines she became the first steamship to operate on the north Pacific coast.

From 1862 to 1870 the ship wore navy colours as "HMS" *Beaver* to conduct hydrographic survey work for the Royal Navy. In 1874 *Beaver* was bought by a private interest for general towing duties. She survived a sinking at First Narrows in Vancouver in 1883, only to be raised and laid up in Victoria until 1887. She met her demise a year later when she ran aground on Prospect Point below the Lions Gate Bridge. Not worth salvaging, *Beaver* was left to endure the harsh treatment of souvenir hunters and vandals until, four years later, her stripped hull broke up in the wake of a passing steamer.

Today, a full-size replica, *Beaver II*, operates out of Vancouver Harbour, conducting commercial cruises to nearby Howe Sound.

Acknowledgment

The assistance of **John MacFarlane**, curator of the Maritime Museum of British Columbia in Victoria, is gratefully acknowledged. His enthusiasm for the *Beaver* story led me to pull this short article out of what began as a simple photo caption.

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RCN PHOTO: OC-286-1, MAY 1950

This scale replica of the SS *Beaver* was built by shipwrights on board HMCS *Ontario* in 1950. Built atop *Ontario*'s pinnace, it won first prize in the West Coast regatta that year.

News Briefs

ADaCC Advanced Damage Control Console system

In October 1993, DMEE 4-2 and the Naval Engineering Test Establishment (NETE) conducted formal qualification shore testing of an advanced development model (ADM) of the ADaCC shipboard damage control console system. The state-of-the-art system, designed by Array Systems Computing Inc. of Downsview, Ont., is one of several initiatives the navy is pursuing to develop a more capable DC information system for the CPF mid-life refits and the next generation of ships. The evaluation team unanimously judged the qualification testing a success and confirmed the viability of displaying DC information graphically.

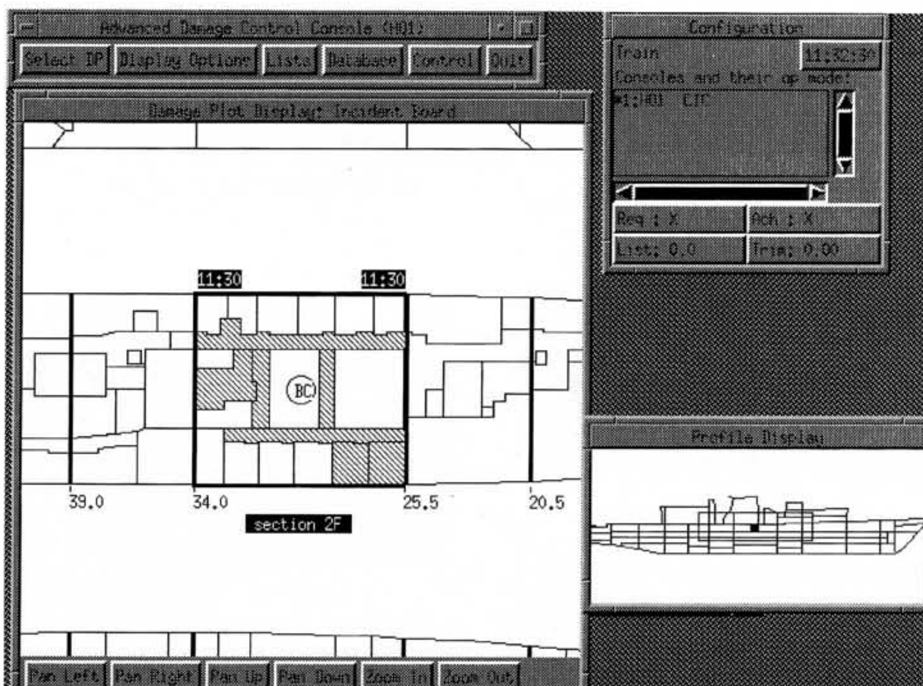
The aim of the ADaCC development project is to demonstrate the feasibility of integrating portable DC consoles with a main, fixed console in HQ1 — the damage control "central" on Canadian warships. The idea is that operators using portable consoles throughout the ship will co-operate in updating a common DC plot. Apart from relieving HQ1 of the burden of having to generate the entire plot, the system will deliver timely, accurate information to the damage control decision-makers.

Despite the modernity of damage control arrangements in *Halifax*- and *Iroquois*-class ships, little use has been made of current information transfer technology. Nowadays it is considered paramount that a damage control system maintain an accurate picture of a situation, allow effective communications and offer advice on possible corrective procedures (especially since future ships will have fewer crew to handle damage problems). This is the basis of the Advanced Damage Control Console system, whose primary role is to display a global view of all shipboard damage control sensors, actuators and fitted systems either in the normal, alarm or warning state.

The value of ADaCC is demonstrated in the first minutes of a damage situation. After sounding the initial general alarm, and while section base teams are still mustering, an ADaCC console operator can be pinpointing and monitoring damage, initiating the establishment of damage control boundaries and controlling ventilation. As the situation unfolds, ADaCC continues to monitor and log all events and actions, and can be used to activate major fitted systems. At this ADM stage, ADaCC does not feature any decision-making capabilities. On-the-scene action and decision-making are still the responsibility of DC personnel.

The generic design of the ADaCC system reflects a CPF damage control layout, with the full functionality of DC information and control of the operational shipboard unit. Fitted systems are shown graphically on a computer screen, similar to the existing MIMICs and stateboards, and data can be entered manually using standard DC symbology. The database is presently capable of reporting fire-fighting, structural damage, fire-main rupture, ventilation and casualty power information. A crucial feature of ADaCC is that, in the event of disconnection from the network, the database remains intact and usable by the ADaCC operator. Similarly, a reconnected ADaCC can be used to update information to and from HQ1.

Further evaluations of ADaCC must still be conducted on each coast, along with system familiarization and training for fleet personnel. Once all land-based evaluations and any resulting upgrades or modifications have been completed, a development evaluation (DEVAL) will needed to prove the feasibility of a shipboard network of ADaCCs. The ultimate aim, of course, is to outfit our ships with the best possible system for matching personnel, equipment and system resources to damage control activities.— **by LCdr Tony Lafrenière, DMEE 4-2, and Peter Michetti, NETE.**



Fire report: ADaCC's computer-generated incident board shows the general area of the ship that is on fire (at right). The enlarged close-up plan view of the affected compartments shows fire areas (cross-hatching), boundaries and report times.

ILLUSTRATION: COURTESY ARRAY SYSTEMS COMPUTING INC.

Terra Nova *SHMaPT trial a success*

The Naval Engineering Test Establishment, in co-operation with DSE 6 and HMCS *Terra Nova* (IRE-259), has successfully tested Shipboard Machinery Performance Testing (SHMaPT) procedures for certain auxiliary machinery. The procedures were put to the test when *Terra Nova* underwent a standard baseline refit (rather than a condition-based refit) beginning in September 1992.

SHMaPT is designed to collect various performance data on machinery operating under normal (or near-normal) conditions. The data is gathered at increments measuring about 10 percent of a unit's maximum output, and is presented graphically as a performance curve against a predefined reference for comparison. NETE developed the procedures in an effort to reduce life-cycle costs and improve the reliability of shipboard equipment. The trial amply demonstrated the potential benefits of the SHMaPT procedures.

For the trial, NETE used the SHMaPT techniques to make assessments of the pre-refit condition of selected machinery units, which were then compared to internal inspection reports made by the prime and R&O contractors. The results suggest that the techniques were effective and reliable in determining the condition of machinery.

Initially, the inspection reports confirmed 9 of the 11 SHMaPT assessments. The other two assessments were later proved reliable after investigation revealed that the *design point* reference that was used was not representative of the "as-new" operating condition of the equipment. From this it is evident that significant reductions in R&O costs could have been realized if the SHMaPT results had been considered prior to the removal of equipment from *Terra Nova*. Moreover, the advantages of this technique will surely escalate as the proper baselines and performance references are acquired.

The outcome of this trial, detailed in NETE Report No. 09/94, confirms earlier findings that suggest SHMaPT should be made available to shipboard maintainers. A collaborative pilot program should now be introduced for life-cycle material managers and maintainers responsible for *Halifax*-, *Iroquois*- and AOR-class equipment.**—by Fernando Nirchi, Project Engineer, EHM Section, NETE.**

Gas turbine water wash and detergent cleaning

Statistics show that the major cause of marine gas turbine performance degradation is fouling of the gas turbine compressor. In marine environmental conditions, sea salt is the chief contaminant. Experiments conducted at NETE, under direction from DMEE 2, have demonstrated that water washing is effective in removing salt deposits from compressor blades and restoring gas turbine engine performance. In cases where contaminants are other than salt, water washing alone might not be effective and detergent cleaning is necessary.

The drawbacks to using detergents are that they are toxic (and therefore harmful to the environment), and if introduced into the bilge will reduce the effectiveness of an oil/water separator. Over the last two decades the Solar gas turbine compressors of the Tribal class frequently required detergent cleaning to combat build-ups of soot and oil. An installation design flaw, which delivered engine intake air and enclosure cooling air through the same duct, allowed the engines to draw contaminated air from inside the engine enclosures. A shipalt corrected the problem and today the Solar engines operate for long periods before detergent cleaning is necessary.

DMEE 2 policy currently specifies water washing for all fleet gas turbine compressors, with the exception of pre-shipalt Solars. Moreover, NETE is now exploring alternatives to find a non-toxic, aqua-based detergent which is environmentally friendly enough to be discharged overboard.**—by Ahmed Abdelrazik, NETE, and Peter Cheney, DMEE 2.**

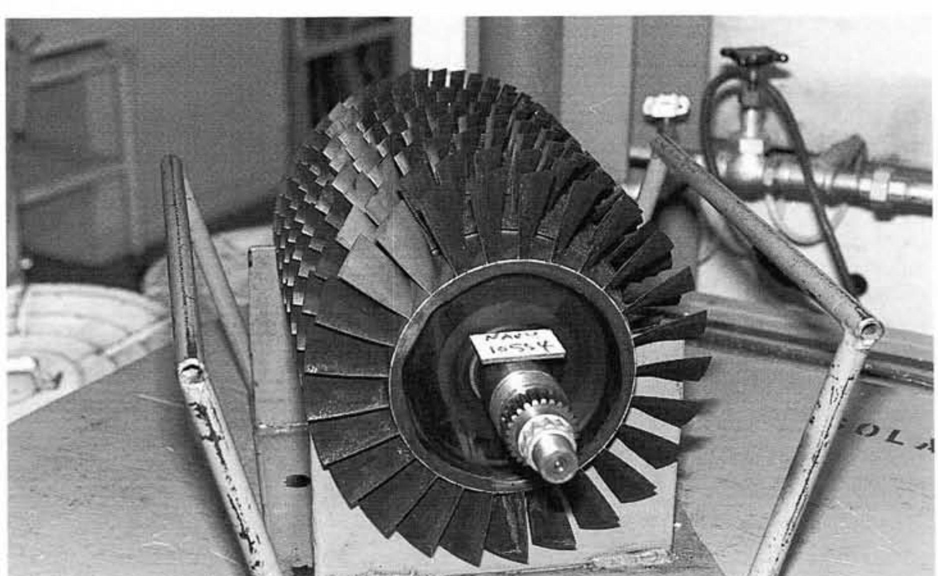


PHOTO: A. ABDELRAZIK

Solar compressor rotor blades contaminated with baked soot.

News Briefs

Command Machinery and Gearing Inspector retires

Douglas C. Nickerson has retired after 45 years of combined naval and civilian service to Canada. His retirement from Naval Engineering Unit Atlantic on Dec. 31, 1993 marked the end of an era for the East Coast naval engineering community.

During his 25 years in uniform and 20 years as a civilian, Doug came to the aid of many an MSEO and CERA in need. After retiring from the navy in the rank of chief petty officer first class, Doug worked at Ship Repair Unit Atlantic first as a maintenance mechanic, then estimator and finally ship's co-ordinator. For the last 10 years he served as the Command Machinery and Gearing Inspector at NEUA.

For more than four decades Doug has represented the navy, SRUA and NEUA in an exceptionally professional manner. As remarked by numerous well-wishers at his retirement luncheon last November, his renown for turboblower repairs and solid advice on mechanical matters was without equal. Doug Nickerson's presence will be sorely missed around the dockyard. The commanding officer and staff of NEUA, along with the rest of the Maritime Engineering community, wish Doug a long and happy retirement.—**Cdr G. Trueman, NEUA.**


CANADIAN FORCES BASE HALIFAX PHOTO

Cmdre D.G. Faulkner, Assistant Chief of Staff Materiel, presents Doug Nickerson with a 45-year service medallion on the occasion of Doug's retirement from the Public Service last December.

Bob O'Neil retires from John Crane Marine

The CMIA banquet in February was an appropriate venue for bidding farewell to **LCdr Robert K. O'Neil (Ret.)** of John Crane Marine. For the last 20 years Bob has been the driving force behind John Crane Marine's Canadian naval and commercial marine seal applications.

Bob O'Neil joined the RCN as an electrician's mate in 1948, advancing to C2SN[4] and, eventually, lieutenant-commander before retiring in 1974. During his 26-year naval career Bob served in everything from aircraft carriers to high-speed launches, and even spent nine years as a submariner on loan to the Royal Navy. He obtained his commission in 1964 and was appointed Sonar Performance Officer at Dockyard Halifax. He spent the last five years of his naval career involved in submarines, with more than half of this period spent on staff at CDLS London, England. After his retirement, Bob's naval experience proved particularly beneficial to John Crane Marine's efforts with the navy's surface-ship modernization program and the Canadian Patrol Frigate project.

All those who have served or worked with Bob over the years extend their best wishes to him and his wife **Pam** for a happy retirement. We feel certain we will continue to hear from them (along with Bob's own brand of good advice) from their home in Hamilton, Ontario.—**by Barry Rising, John Crane Marine U.S.A., and Mike McQuillen, DMEE 2.**


PHOTO COURTESY OF BARRY RISING

Bob O'Neil

News Briefs

Certificate of Merit!

PHOTO: DCIEM

In December Cmdre Robert L. Preston, DGMEM, presented the ADM Mat Certificate of Merit to LCdr Barry S. Munro "in recognition of his contribution to the Materiel Group" during his service in DGMEM/DSE 3 from 1990 to 1993. LCdr Munro was attending the CF Command and Staff College in Toronto at the time of the presentation. Bravo Zulu, Barry!

Long Service Awards!

CANADIAN FORCES PHOTO BY CPL. CHRISTIAN PROVOST

Congratulations to DGMEM stalwarts (from left) John McKee (35 years), Jim Mimnagh (45 years), Garth Jackson (35 years) and Jim Northcott (25 years) for their years of dedicated military and civilian service. Sr ADM(Mat), Mr. R.N. Sturgeon, presented the awards last December 22.

Westinghouse Award

SLt Greg Bannister (left) accepts the prestigious Westinghouse Award for professional excellence in Combat Systems Engineering training (CSEC 9301) from Fleet School Halifax CSE Division Commander J.C. Tremblay.— by SLt J.R. Pedersen.

Merit Awards!

CANADIAN FORCES PHOTO BY CPL. CHRISTIAN PROVOST

ADM(Mat) Merit Awards and Certificates of Merit were presented to (from left): CPO2 James Christie (Award), Steve Lamirande (Certificate), Bob George (Award), Ian Wilson (Certificate) and Erik Wessman (Award). Sr ADM(Mat), Mr. R.N. Sturgeon, made the presentations to the five DGMEM personnel last December 22.

News Briefs

Bravo zulu!

The Maritime Engineering community congratulates **Capt(N) Bob Starchuk** and **Capt(N) Peter McMillan** on their recent promotions. Capt(N) Starchuk is the new Acting Director General Nuclear Safety at NDHQ, while Capt(N) McMillan becomes the new Deputy Chief of Staff (Engineering and Maintenance) at MARCOM.

RNEC Manadon closure — commemorative dinners

To mark next year's closing of the Royal Naval Engineering College, Manadon, a series of Saturday-evening dinners is being planned for the coming fall and winter at Manadon. Final details have still to be confirmed, but the following schedule has been drafted to give former mess members an opportunity to attend with their contemporaries:

22 Oct 94	(former Keyham mess members)
19 Nov 94	(members from the 1940s and 50s)
14 Jan 95	(1960s members)
21 Jan 95	(1970s)
04 Feb 95	(Quart Club Dinner)
18 Feb 95	(1980s)
11 Mar 95	(1990s)
12 May 95	(Engineer Officers' Dinner)
?? July 95	(Final Graduation Ball)

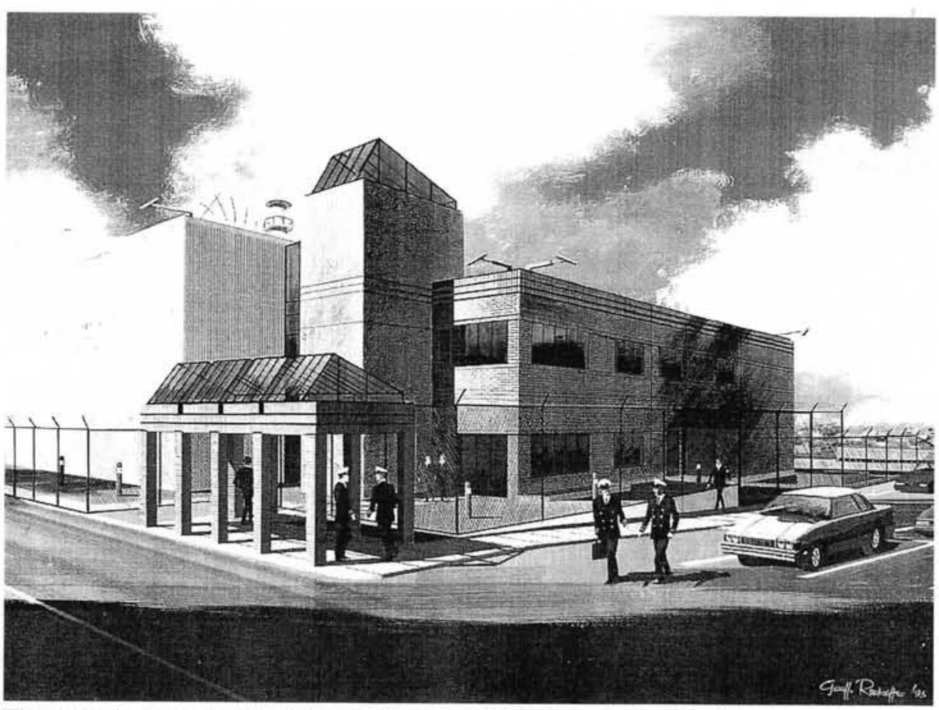
Although tentative, the dinner program is likely to commence at 1600 with Tea on the date of the dinner and complete with breakfast and church service the following morning. Cost per head is expected to be less than £30. For more details, contact: **Cdr S.W. Haines, Head of Management and Defence Studies, RNEC Manadon.**

Joint CF/USN surveillance centre to open in Halifax

In the wake of the USN downsizing of its naval facility at Argentia, Nfld., the Canadian navy and the USN are working together to locate an Integrated Underwater Surveillance System (IUSS) processing facility at CFB Halifax. According to **LCdr Gordon Fleming**, the DMCS 3 manager of the Canadian Forces IUSS Centre project, the state-of-the-art MARLANT facility will be part of the U.S. Navy's Atlantic IUSS network, but will function under a "joint operational arrangement" between the two navies. Acoustic surveillance intelligence processed through the Halifax centre will be shared with Canadian operational units and other centres in the IUSS network. Construction at the Halifax site is virtually complete and the centre is expected to be fully operational by next spring.

Argentia has been used as a base for gathering and processing acoustic surveillance data since 1959. In 1991, as part of a general downsizing, the USN announced it would close its IUSS operations there by October 1994. Automated collection of raw acoustic data from the fixed arrays on the ocean floor will continue at the Newfoundland site. Canac/Microtel of Vancouver, BC has been contracted to establish a satellite link to relay the data to Halifax for processing.

The new, three-storey Halifax facility is located behind the Maritime Warfare Centre. It encloses some 4,200 square metres of floor area, more than a third of which will be electromagnetically shielded. Virtually none of the processing equipment now at Argentia will be moved to Halifax. Instead, the USN will provide the latest in IUSS technology for the new site. The centre will employ 137 military employees, including 30 USN personnel. An additional 10 people will be employed by CFB Halifax to offset the support requirements of the centre. The facility will conduct its own training program for new personnel.— **with files from MS Paul Lavigne, CFIC project clerk, DMCS 3.**



The navy is expected to have the new CF/USN Integrated Undersea Surveillance System centre up and running at CFB Halifax by spring 1995.

News Briefs

Vernon cadet camp reunion, July 22-24, 1994

The Army Cadet Camp at Vernon, BC held its first-ever reunion this year from July 22 to 24 at the camp. A reunion was originally planned for the camp's 50th anniversary in 1999, but the schedule was advanced under pressure of a planned closing of the Vernon site after the summer of 1994.

Since 1949, well over 138,000 Canadian and 2,000 American teenagers have attended the Vernon Army Cadet Camp. According to Reunion spokesman **Jeffrey Aitken**, the organizers would desperately like to hear from as many ex-Vernons as possible. By the end of April some 3,000 of them had confirmed their attendance, Aitken said.

The reunion committee can be contacted by writing to: **P.O. Box 88560, 101-13753 72nd Avenue, Surrey, BC V3W 0X1**; or by calling the Vernon reunion hotline at **(604) 268-9977.**

Vernon Army Cadet Camp Reunion '94

RCAC

Vernon, B.C., July 22-23-24, 1994

The yacht Canada restoration project

In 1898 when the yacht *Canada* was launched at Saint John, NB she was proud confirmation of this country's reputation as a premiere builder of sea-going yachts. Today, nearly one hundred years later, Canada's oldest registered sailboat lies rotting in a Kemptville, Ontario boatyard. But not for much longer.

The Canada Boat Restoration Fund, established as a non-profit corporation in 1993, has taken up the cause of this unique piece of Canada's heritage, with plans to turn the yacht back into the polished and pristine vessel she was at the turn of the century. Two DGMEM employees have already joined the effort: **Malcolm Wall** (DMES 4) is providing project management assistance; **Terrance Hounsell** (DMES 4-2-2) is drawing up a set of ship's lines. More help is needed. Enthusiasts who wish to assist either directly, or through donations to the project, are encouraged to contact corporation president **Gary Strike** at: **"CANADA" Boat Restoration Fund, Carleton Place, Ontario, K7C 3X2**. Donations should be made out to the Fund.

The editorial staff of the *Maritime Engineering Journal* shares this hope and wishes the project well. Watch this space for updates.—**LCdr Paul Brinkhurst, DMES 3-4.**

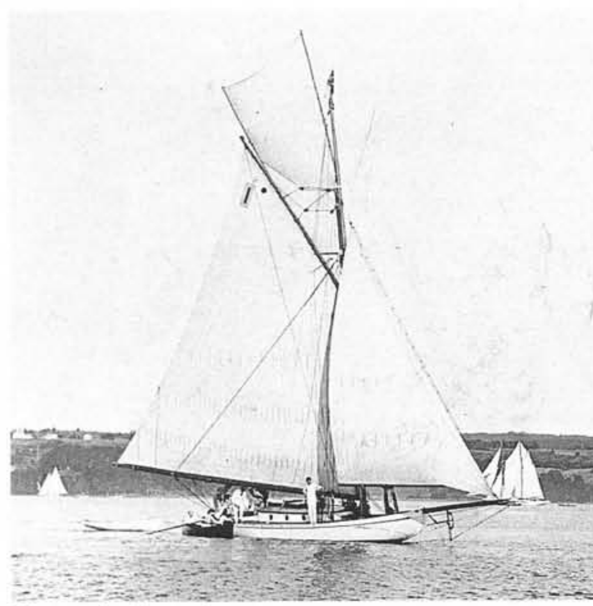


PHOTO COURTESY OF GARY STRIKE

The yacht *Canada*.

A Readership Survey

Coming up in our October issue