National Defence / Défense nationale

Maritime Engineering Journal

February 1994

Across the Atlantic under sail... A MARE's Journey

Also:

- *A Day in the Life of ADM(EM)*
- *Adventures in Black Water*

Canada

Calling all *FHE-400 Bras d'Or* crew! The Bernier Maritime Museum needs your photos...see page 23


CF PHOTO, ISC 69-048-1

HMCS *Bras d'Or* "cranking out the knots" in 1969

Maritime Engineering Journal

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DEPARTMENTS

FEATURES

OUR COVER
MARE Lt(N) Robert D'Eon "shoots" the sun during an Atlantic crossing on board a 12.1-metre yacht. *(Photo by John Russell)*

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 prelude to action..."

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

It gives me great joy to be home with the navy again after spending three years in the Training world — the last two as Director of Individual Training for the Canadian Forces. As productive as those years were, the DMEE position offers many of the challenges and rewards that attracted me to the navy initially, and to the submarine service later on. Such close involvement with the many facets of our complex, integrated naval platforms is an engineer's dream, but it carries with it great responsibility.

In the naval slogan *"float, move, fight*," the Directorate of Marine and Electrical Engineering is responsible primarily for the *move* part, and for some of the *float* part as well. In-service fleet support, project support, engineering change support, R&D support for the navy — these are our roles. Our success in dealing with the various technical and personnel challenges they present is essential to the fleet's engineering readiness and, ultimately, to the operational effectiveness of our seamen brethren and the navy. We may tend to focus more on the major systems as we go about our daily task of managing everything from gas turbines to reserve stokers, but the so-called minor systems are every bit as important. If we don't get *them* right....

The job of sustaining Canada's navy is a co-operative effort that depends on the close interrelationships that exist between the financial, personnel, materiel and operational groups of the military. We in DMEE recognize that "the prelude to action *is* the work of the engine room department," and for our part we aim to contribute to the future of our navy responsibly, co-operatively and with initiative. I look forward to "sailing" with navy crew once again.

For the record

In the News Briefs section of our July 1993 issue we omitted to identify the following contributors: **Valerie O'Callaghan** (Datatrap for CPF); **Lt(N) J.B. McLachlan** (Portugal: 510 sonar trials); **Capt(N) T.F. Brown** (Kuwait Liberation Medal); **Lt(N) J.R. Dziarski** and **Lt(N) M.B. Verret** (1992 MARE awards); and **LCdr André Gagné** (Naval reserve MAREs).

Maritime Engineering Journal Objectives

* To promote professionalism among maritime engineers and technicians.
* To provide an open forum where topics of interest to the maritime engineering community can be presented and discussed, even if they might be controversial.
* To present practical maritime engineering articles.
* To present historical perspectives on current programs, situations and events.
* To provide announcements of programs concerning maritime engineering personnel.
* To provide personnel news not covered by official publications.

Writer's Guide

The *Journal* welcomes **unclassified** submissions, in English or French, on subjects that meet any of the stated objectives. To avoid duplication of effort and to ensure suitability of subject matter, prospective contributors are strongly advised to contact **the Editor, Maritime Engineering Journal, DMEE, National Defence Headquarters, Ottawa, Ontario, K1A 0K2, Tel.(819) 997-9355**, before submitting material. Final selection of articles for publication is made by the *Journal*'s editorial committee.

As a general rule, article submissions should not exceed 12 double-spaced pages of text. The preferred format is WordPerfect on diskette, accompanied by one copy of the typescript. The author's name, title, address and telephone number should appear on the first page. The last page should contain complete figure captions for all photographs and illustrations accompanying the article. Photos and other artwork should not be incorporated with the typescript, but should be protected and inserted loose in the mailing envelope. A photograph of the author would be appreciated.

Letters of any length are always welcome, but only signed correspondence will be considered for publication.

Letters to the Editor

MARE duality

Commodore Faulkner's conviction that the duality of MARE is a myth reinforces the argument that the issue of MARE duality needs to be addressed by the MARE community.

I fully agree that the codes of ethics for both naval officers and professional engineers are based on identical values. However, I have difficulty seeing how the concept of duality implies any incompatibility between them. One useful analogy is that the two codes of ethics represent different "professional languages," each capable of addressing the same concepts in different ways. In our case, these languages would be the "professional engineer language" and the "naval officer language." Thus one aspect of the duality discussion boils down to: should we be professionally bilingual or professionally unilingual?

It is my opinion that it is essential we, as MAREs, be professionally bilingual. MAREs cannot be equal partners in the Naval Operations Branch without our dual heritage. The justification for this position is based upon two undeniable precepts of the essence of the Naval Operations Branch: naval officers go to sea, and MARE officers have less sea time than MARS officers. Thus we cannot claim equal partnership as naval officers on our afloat experience alone. We must augment our operational experience with our naval engineering expertise. It is these dual capabilities, working in concert, that make us equal partners in the Naval Operations Branch. Denying this duality and yet claiming equality with our MARS brethren, in my opinion, lacks credibility.

Regarding sea time, I agree that MARE credibility is based on much more than the single factor of sea time. Nevertheless, sea time, or rather the experience and expertise that sea time nurtures, is a leading factor in MARE credibility, both internally and externally. In our fundamental role of supporting the ships at sea, it becomes questionable whether or not we can satisfactorily perform our duties if a large portion of the MARE population has not had the opportunity to appreciate what effects confined spaces, hostile environment, manpower shortages and conflicting requirements have on implementing engineering decisions for the ships. While books may describe these aspects of naval engineering, they must be experienced to be understood.

Commodore Faulkner concludes that, due to the weakened linkage between MARE and the navy, we should perhaps set aside the notion of duality and accept that we have but one profession. But which profession? While it was stated once that it should be the naval officer profession, the remainder of the thesis supports the engineering profession. Such inconsistencies highlight the existence of the fuzzy MARE ethos.

In closing, the main intent of my "Duality of MARE" article was to stimulate discussion. The Commodore's letter confirms that an obvious diversity exists within the MARE community about what the essence of MARE should be. I hope that this latest exchange of ideas will stimulate more discussion from other MAREs. Let us make it so. — **LCdr M.J. Adams, DMEE 6-6, National Defence Headquarters, Ottawa.**

Call for Papers*

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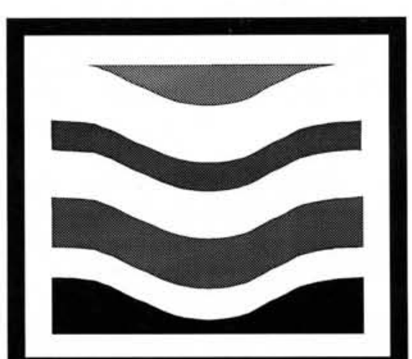


* Single-page, typed abstracts should be submitted to DGMEM/DMEE 4 by <u>Jan. 31, 1994</u>.

Commodore's Corner

The nineties — the decade of change, the decade of challenge

By Commodore Wayne Gibson
Project Manager, Canadian Patrol Frigate Project

As we all know, the navy is undergoing a period of rapid modernization. The first few Canadian patrol frigates are on the coasts, the TRUMPed Tribal-class destroyers are making their way back to the fleet, and the new maritime coastal defence vessels (MCDV) are not far behind. The world is also changing rapidly, if not more rapidly. What many fail to appreciate is the extent of this change and the challenge it brings.

First, let us consider the change. From an operational perspective, we are faced with the introduction of new capabilities — CPF introduces the Harpoon anti-ship missile, TRUMP introduces the SM-2 area air-defence missile, and the MCDVs will reintroduce minesweeping technology. In addition, both CPF and TRUMP bring highly integrated command and control systems that are at the leading edge of integrating man and machine. From a force structure point of view, we are faced with the introduction of the MCDVs and the full implementation of the total force concept. They will require that we become partners with the reserve force in the operation and maintenance of these ships. From a technical perspective, we are faced with a quantum change in technology and complexity. We are faced with new maintenance philosophies: refits and time-based maintenance are giving way to repair by replacement and maintenance by exchange. From a personnel perspective, we are faced with retraining ourselves to these ships, operationally and technically.

What impact will this modernization have on the MARE community? I leave this question to you, but I believe that it will affect every area of our profession. It means an intense learning curve over a short time period that will test us as a classification and as individuals. However, the change is one that I am sure we are all looking forward to — it has been a long time coming.

Now to the challenge. We all know that the world has changed dramatically in a very short time. The bipolar world is gone, but much of the nationalistic and religious-based strife formerly held in check is now in the open. The world appears to be moving in a freer, more democratic direction, but there are still many, less predictable threats to world stability and, by extension, to our national security. Closer to home, there is an increasing recognition and acceptance that our country must grapple with its deficit or face the economic consequences to our national security. There is also an increasing voice for the peace dividend based on the simple appreciation that the threats to Canada have gone away.

"Our taskings are likely to increase and be much more diverse and unpredictable than what we have been used to."

What does all this mean? First, it means that our country still requires a general-purpose navy capable of working anywhere in the world if it is to continue to participate in the maintenance of world order, and that our taskings are likely to increase and be much more diverse and unpredictable than what we have been used to. Second, it means there will be less funding with which to do it. The "more-with-less" syndrome is alive and well.

What does this require of us? First, it requires that we accept this reality and this dichotomy. Do we ignore or resist this reality and hope that the good old days will return? Take this position and I can assure you that others will take control of our destiny. Second, it requires us to come to grips with the cost of doing business and to come to grips with how it can be done for less. It requires that we introduce a business-like management approach across the breadth and depth of the naval engineering and maintenance process. We are, after all, running the biggest and most complex ship engineering, modification, maintenance and repair industry in the country.

Does this mean we should conduct the navy's engineering work with an industrialist's eye toward profit and loss? I think not. There is much we can stand to learn from the private sector, but "loss" carries a much stiffer penalty when you are dealing ultimately with Canada's security and sailors' lives. What we do need is to develop an acute awareness of the cost of doing business and how to do it for less. Make no mistake. If there is one thing that can affect what we do as a navy in a peacetime environment, it is funding. It pays to pay attention to managing the capital and O&M expenditures. Every dollar that we save is a dollar "increase" to our allocation.

Lest I be accused of diffusing the focus from the sharp end, let me assure you that these issues must be pursued so that the Maritime Commander will still have an effective naval force at the end of the decade. A continuing ship replacement program will not be possible unless we can stem the increasing cost of operations & maintenance. The Maritime Engineering community has historically been recognized for its ability to get the job done, but that's no longer good enough in today's fiscal reality. We must get it done and must get it done for less. I will be the first to acknowledge that the issue of costs is not strictly a Maritime Engineering issue — it is a broad naval issue — but the vast majority of the expenditure envelope comes under our control. We must therefore take the lead in controlling costs and in identifying the cost of doing business to those whom we support.

"The Maritime Engineering community has historically been recognized for its ability to get the job done, but that's no longer good enough in today's fiscal reality."

I am not the first — and neither will I be the last — to suggest to you that the one constant that we can expect throughout this decade is change. If we face one key challenge as leaders, it is in learning to adapt to, and take advantage of change so that we may continue to satisfy the Maritime Commander's operational requirement. Our task remains to keep the fleet at sea, and to introduce new ships and equipment sometime in advance of obsolescence. Our job is to ensure the maximum operational capability and effectiveness within the imposed constraints. Our goal as leaders, then, must be to define and implement change without losing sight of the aim. We must help our subordinates overcome their natural resistance to change, and demonstrate the initiative to solve the inevitable problems at the lowest practicable cost. Above all else, each of us must set the example.

I have no crystal ball to read the future, no way to say "choose this path and this will happen." What I do have is an opinion and a hope that you will consider my thoughts as you chart your own course for the future. The stakes are high, for the way we as naval officers and a classification approach the change and the challenge will shape the navy of the future and, more importantly, the navy's ability to meet its raison d'être. It has been said that, "Within change there is opportunity." Our current climate of change presents us with an opportunity to refine our navy's engineering support structure so that it can continue to satisfy the navy's needs for years to come. Put another way, we will have so much opportunity we won't know what to do with it.

Forum

The Characteristics of Leadership

By LCdr Barry S. Munro

In the January 1993 issue of the *Journal* Capt(N) Kling offered an interesting perspective on leadership. This is an extremely important subject, given our declining resources and growing emphasis on total quality management. While I would not suggest that the *Journal* become a vehicle for spreading the gospel, as it were, I do submit that the following condensed extracts from Martin Broadwell's book *The New Supervisor*[1] present an infallible recipe for becoming a successful leader. The best part is that these are personal qualities that can be learned! Perhaps you will identify one or two people who exemplify these classic leadership characteristics.

What is leadership? Ask a dozen people and you'll probably get a dozen different answers. Perhaps the easiest way to define it is to say that it is the ability of a supervisor to inspire workers to work hard to achieve the goals of the organization. The idea that leaders are born, not made, is out of date. All of us can be better supervisors than we are. There are skills of leadership that can be practised, learned and measured.

Successful leaders usually have the ability to see other people's points of view. They don't necessarily agree with them, but they at least have some empathy for those positions. They are sensitive to other people's problems and know why people feel the way they do. Perhaps most important: successful leaders don't just write off every undesirable behaviour to "bad attitude."

Another characteristic good leaders have is the ability to see themselves as others see them. Good leaders know their own weaknesses and faults and try to build around them. The important thing about self-awareness is that we are more likely to treat other people fairly.

Something else we can all learn is the willingness to work. There are very few substitutes for hard work. Leaders are willing to put in long hours on tasks that are not exciting or rewarding — just to get the job done. This doesn't mean they don't know how to delegate; it means they don't shirk from those tasks that have to be done sooner or later. Of all the characteristics of a successful leader, this may be the most difficult to learn.

Still another common characteristic of successful leaders is their ability to generate enthusiasm among their people. The workers tackle their jobs with interest and excitement, get satisfaction from their jobs and don't think of their work as that "miserable interlude between weekends." Leaders may differ in how they project this enthusiasm, but they most likely don't have what is sometimes thought of as enthusiasm — the running-around-and-shouting kind. It can best be described as an intenseness that is contagious.

A final characteristic common among good leaders is the willingness to accept responsibility. Good leaders become bored when there is little or no responsibility connected with what they are doing. They aren't afraid to accept the challenge of doing something that has risk to it. They are willing to take on a job that may allow them to fail, provided it also allows them the opportunity to succeed. If ever they get called on the carpet, it will be for taking on too much responsibility, not too little.

There are as many styles of leadership as there are leaders. Broadwell's is just one recipe for successful leadership. There are others. The difficulty is adopting characteristics that suit your own personality. The next step, of course, and perhaps the hardest step, is to "walk the talk." Good luck!

Reference

[1] Martin M. Broadwell, *The New Supervisor*, 2nd ed., (Reading, Mass: Addison-Wesley Publishing Co., 1979), pp. 51-53.

LCdr Munro is attending the Canadian Forces Command and Staff College in Toronto.

Across the Atlantic under Sail

By Lt(N) Robert "Bear" D'Eon

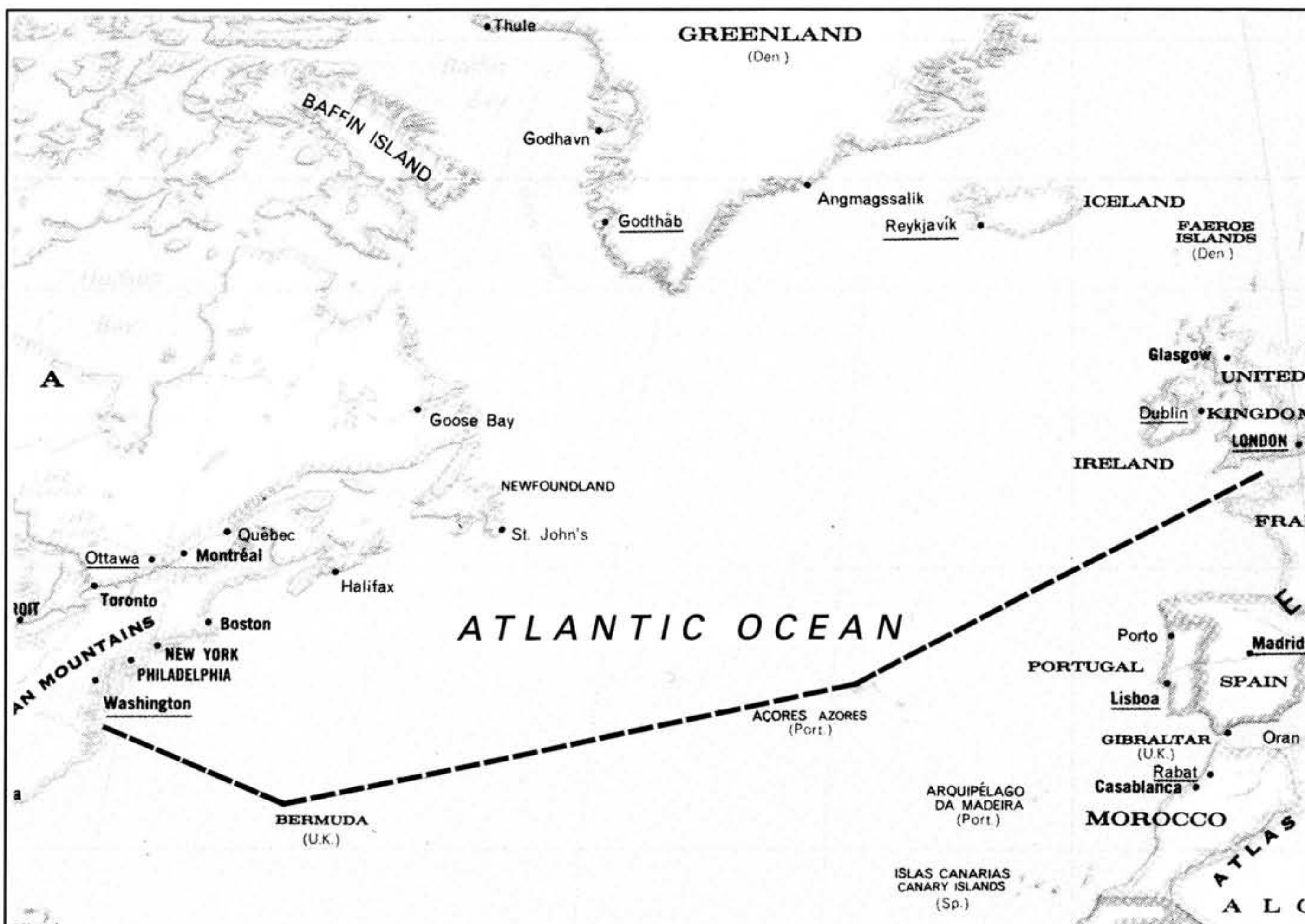
Last summer I took advantage of a once-in-a-lifetime opportunity — to cross the Atlantic Ocean under sail in a 12.1-metre yacht. For two golden months, from May to July, I lived my dream of iron men and wooden ships (even though the reality was a mixed-gender crew and a glass-reinforced plastic yacht). Across nearly 5,000 nautical miles of ocean I stood deck watches, learned to handle a sextant, turned-to as cook and... yes, even pulled my weight as an engineer.

I joined the trip at the invitation of boat-owner John Russell, 60, a British Channel Islander who I met in 1990 while I was on course at Manadon. In 1992 he sailed his yacht *Periplus* to the United States for the "Americas 500" celebration of Christopher Columbus's 1492 voyage of discovery. He was now in Virginia recruiting crew for the return voyage to his home in Alderney. Our route would take us to Bermuda and the Azores.

There were four of us on board, and a mixed bag of adventurers we were. Apart from Russell (himself a former SAS brigadier general), there were Sara Cowley, a middle-aged Manxwoman looking for adventure; Scott Brennan, 27, an American tax accountant from the U.S. Virgin Islands who was trading in his ledgers for canvas and hemp (Scott actually joined us in Bermuda to replace original crewmember Roy Ackrill who had to fly home to Guernsey on urgent business); and me, a 26-year-old MARE with a pocketful of leave.

On May 7, 1993, we set sail from the Chesapeake, bound for Bermuda. The weather was clear for the first few days, the nights still quite cold until we hit the Gulf Stream on the third night out. The sudden change to warm winds allowed us to break out the shorts and T-shirts. After a good passage of seven days, *Periplus* sailed into the subtropical climes of St. George's Harbour, Bermuda.

And what a paradise Bermuda was. This "island in the stream" has to be one of the best places on the planet for golfing, scuba diving, snorkelling and sightseeing — and I did them all. I even turned my hand to things more professional, repairing the return spring on the pull-cord for the outboard (which I broke), and helping out some Swiss



"yachties" with an engine problem. Altogether we enjoyed eleven days of R&R as we waited for favourable weather and fair winds for the Atlantic crossing. On May 24 (Bermuda Day) we left St. George's and pointed our bow northeastward for the long passage to the Azores.

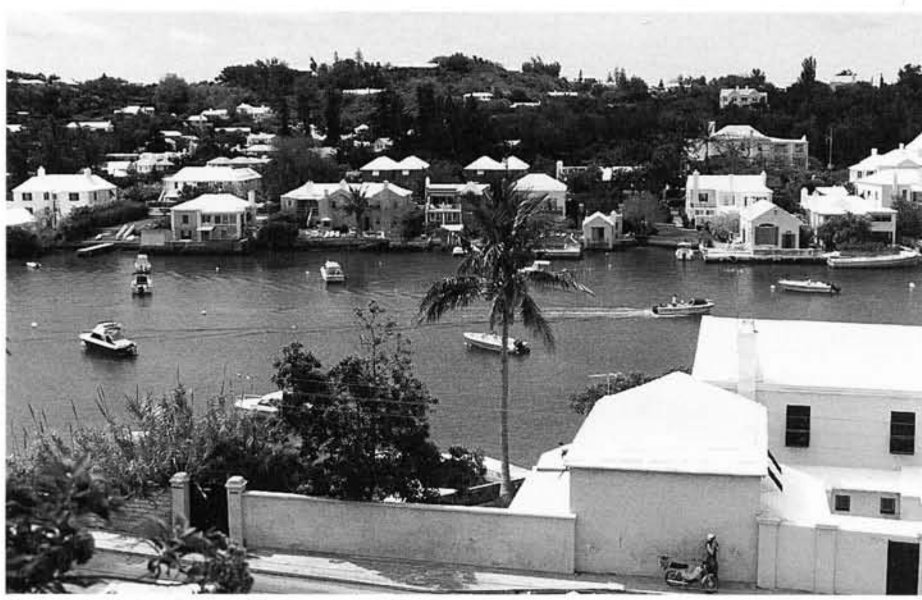
The good conditions didn't last long. We were soon plagued by variable winds that slowed us right down. About a week out of Bermuda a tropical storm brewed up and battered *Periplus* for two days with 35-knot winds (gusting to 55 knots) and four-metre seas. Conditions got very uncomfortable. Salt water worked its way inside my wet-weather gear, and there was no way to dry off properly. At the end of a watch I would peel out of my wet clothing, climb into a damp, cold sleeping-bag and get tossed around in my bunk for three hours until it was time to go back on watch. Then I had to fight a real psychological battle to put my still-damp clothes back on and climb through the hatch into the rain and wind again. After the weather abated we were glad to settle back into some semblance of a normal routine.

Smoke!

As day followed day we stood farther out into the Atlantic. Scott and I soon became solitaire junkies — anything to relieve the boredom — and even staged our own "Solitaire Olympics." Sixteen days out our quietude was broken. I was on galley duty and doing some brightwork after lunch when Sara and I noticed smoke in the cabin. Fire at sea is a yachtsman's greatest fear, and Sara's shrieks of "Smoke! Smoke!" roused Scott from his bunk and brought John running from the helm. The problem was quickly identified. John had been charging the batteries and, somehow, the connectors from the generator had come loose and short-circuited. Something had to give, and the insulation in the cabling overheated. I pulled the melting wire away from the seat cushions, singeing my hand in the process, and shut down the generator. The emergency was soon over. It gave us a start, but there was little damage done.

Several days later, before dawn, we were treated to a marvellous sight. We had been visited by a great number of dolphins along our route, sometimes seeing as many

Periplus **under full sail on the Rappahannock River at the start of the voyage.**



Bermuda: Island paradise in the Gulf Stream

Skipper John Russell, Scott Brennan and Sara Cowley enjoy a few moments of leisure in mid-Atlantic.

The four amigos in the Azores. At the end of the long haul from Bermuda, Sara Cowley, Scott Brennan, author Lt(N) Robert D'Eon and skipper John Russell pose next to the sign (one of thousands painted along the quay at Horta, Faial) created by D'Eon to commemorate *Periplus*' landing in the Portuguese archipelago.

as 25 to 50 of these beautiful creatures at once. On this morning we watched spellbound as the ghost-like images of dozens of dolphins torpedoed through the phosphorescence around the boat. It was a moment of incredible magic. At daybreak, after 19 days at sea, we made landfall on the island of Faial in the Azores.

During the eight or nine days we stopped over in this Portuguese archipelago thrusting up from the Mid-Atlantic Ridge, we licked our wounds and recuperated from our passage. The islanders were extremely friendly and helpful to us. From the town of Horta, where we berthed, I ventured out for some sightseeing. Picturesque, green and fertile, the islands bear a remarkable resemblance to the British Isles. Faial boasts two volcanoes, one of which is a million-year-old textbook example of a cone & crater. The other is a subterranean vent that erupted in 1957, adding a kilometre of land to the island and nine metres of ash to the northern part of the island. My main objective was to photograph the 2,500-metre-high volcano on Faial's neighbouring island, Pico, 10 kilometres away. We had heard that people have seen it from 45 miles out to sea, but with all the haze we didn't even see the island until three days after we tied up.

On June 20th we slipped from our berth in Horta for the final stage of our voyage. Three days out we ran into a severe gale and torrential rains that actually seemed worse than the tropical storm we had weathered on the previous leg. At the height of the gale three pigeons took refuge on board and stayed with us for 800 miles. I was all for shooing the filthy things off the boat, but was firmly overruled by Sara. The day after the storm a swallow alit and perched by the radar display in the cabin for a half-day's rest. *Periplus* was turning into an aviary! We later had the rare pleasure of watching what appeared to be a surfaced whale giving birth. Thank goodness *she* didn't try to bum a lift with us too!

At one point we were becalmed for five days, the sea looking more like Lake Ontario at dawn than the North Atlantic. Some judicious use of the motor kept us headed in the right direction and saved me from going *too* much adrift on my

Postcard perfect! The volcano on the neighbouring Azorean island of Pico lies some 10 kilometres distant.

Peeping pigeon? The white-breasted swallow preening itself atop the radar display seems oblivious to the presence of a fellow feathered hitchhiker.

leave. (RASing from jerry-cans is definitely the way to go!) True to form, the doldrums were swept away by a 50-knot gale. Finally, after more than two weeks at sea, we arrived at our destination of Alderney in the British Channel Islands. *Periplus*, dressed overall, entered harbour to a heartwarming welcome by the local sailing club.

And so ended my trip of a lifetime. I flew back to Ottawa from London a few days later, with only my photographs, journal and memories as keepsakes of my 4,500-mile adventure with open ocean sailing. It was an unforgettable experience. Not only did I hone my sailing skills and become fairly proficient at celestial navigation, but I made good use of my MARE knowledge as well. After three successful engine repairs I began to be introduced to fellow "yachties" as the diesel expert. (I can hear the groans from the chiefs and petty officers who trained me — but it's true!) I also gained an appreciation for deckwork and especially for shipboard cooking after being in the galley every fourth day. One thing I discovered on this long-distance cruise is that there is a lot more to sailing than just wind and sails.

Lt(N) D'Eon is a Marine Systems Engineer in DMEE 7.

A CPF Combat System Performance Monitoring and Analysis System

By Louis Caron

Introduction

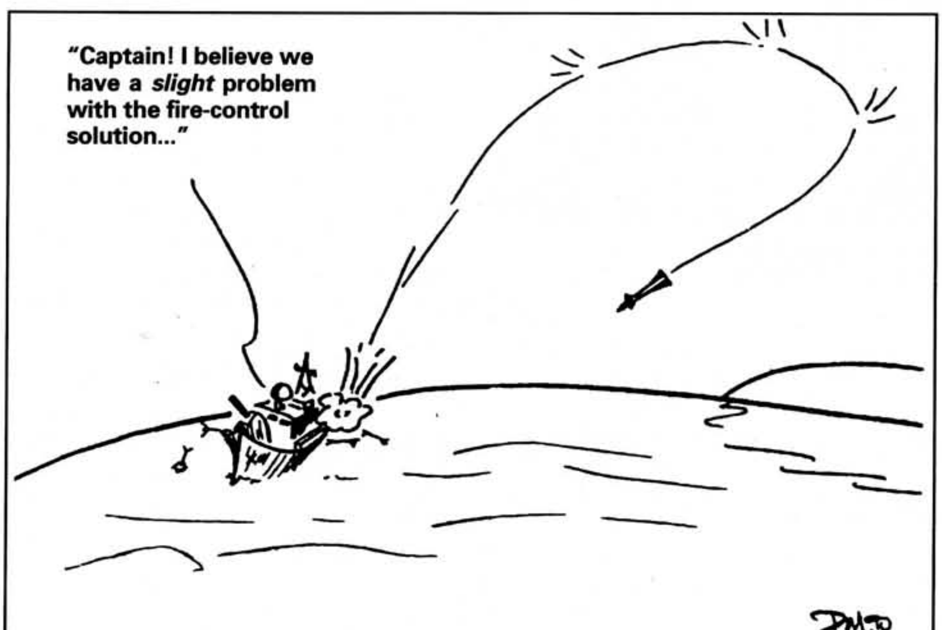
The level of integration and automation found in today's naval combat systems has never been more extensive. By the same token, the need for a tool that can continuously monitor and assess the combat readiness and performance of a ship's weapon and sensor subsystems has never been greater. The information gathered by such a tool would serve to validate combat simulation models whose results must themselves be validated against live data. Ideally, the tool would be compact (space is always at a premium in a ship), reliable yet inexpensive, and easy to operate and maintain. It is a tall order, but just such a tool has been developed for the Canadian patrol frigate (CPF).

Background

The Canadian navy has long recognized the need for a shipboard system that can gather on-line, real-time data during surface-and-air weapon trials. The requirement was driven mainly by the cost of targets and ammunition, and by the cost and schedule limitations associated with the test ranges. The Surface and Air Weapons Information System (SAWIS) was eventually developed and fitted in the DDH-280 Tribal-class destroyers where it proved to be invaluable in performing detailed assessments of surface-and-air weapon systems during operational tests and evaluations.

Given the specialized application of SAWIS to the DDH-280 weapon fire-control system, it was decided not to use the SAWIS for the new TRUMP and CPF ships. Instead, a history recording (HR) capability was incorporated at the command and control system (CCS) level. Unfortunately, HR captures only combat system data which has already been processed by the CCS software modules. What's more, the in-depth analysis and presentation of the HR data can only be done ashore, rendering a quick assessment of a trial impossible. Although some weapon and sensor subsystems possess limited data logging and reduction capabilities, there is no provision for synchronizing data collection or correlating significant events between each subsystem.

For these reasons, a CRAD-funded prototype surface-and-air weapon monitoring and analysis system was developed specifically for CPF acceptance trials and future combat system trials. The Performance Monitoring and Analysis System, or PMAS as it is called, comprises separate subsystems for data acquisition and recording (DAR), and for data analysis and presentation (DAP). The PMAS contract was awarded to Software Kinetics Limited of Stittsville, Ontario.



CPF Combat System Architecture and PMAS

The CPF combat system architecture is characterized by several separate processes exchanging information via a communication network. The CPF distributed architecture utilizes the global system bus, SHINPADS, to communicate between several AN/UYK-505 computers and AN/UYQ-501 displays. To prevent increasing traffic on the SHINPADS bus (as HR does) additional external support is required to allow passive real-time examination of the combat system traffic. Furthermore, each AN/UYK-505 computer contains dedicated software modules that handle the Naval Tactical Data System (NTDS) interfaces to the off-the-shelf sensor and weapon subsystems.

Figure 1 shows the relevant sections of the CPF combat system architecture. It also shows the major components of the above-water warfare (AWW) system whose interfaces (NTDS A, B and D) can be tapped and analyzed by the PMAS. These include the separate track and illumination radar (STIR) control console, the missile launch controller (MLC), the close-in weapon system, the Harpoon, the SPS-49 long-range radar, the Sea Giraffe medium-range radar and their associated CCS software modules.

PMAS Overview

The DAR subsystem of PMAS is based on five personal computers (PCs), referred to as tap units, which provide a transparent passive connection to the interface components of the CPF combat system. These compact tap units monitor the NTDS interfaces and, upon time synchronization, record the message traffic. The tap units can also filter the recorded messages before the data is viewed by the tap unit operator or transferred via magnetic tape cartridge to the DAP subsystem of PMAS.

The DAP subsystem workstation is used to gather data from all interfaces being tapped by the DAR subsystem. This voluminous data is then reduced, converted to engineering units and placed into a relational database from which it can be extracted for report generation. The Tempest-certified workstation allows classified data analysis to be performed either on board ship or ashore.

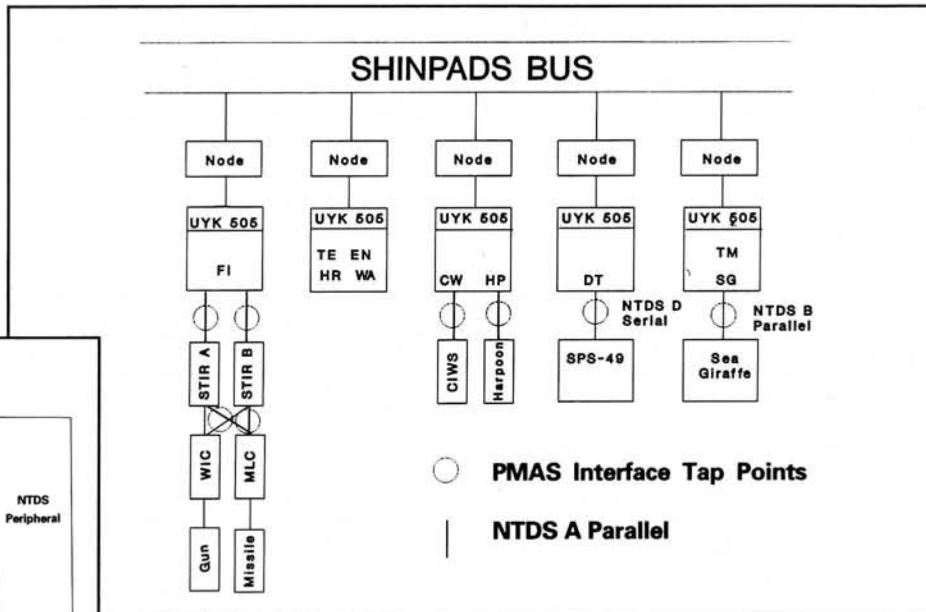


Fig. 1. CPF Combat System Architecture

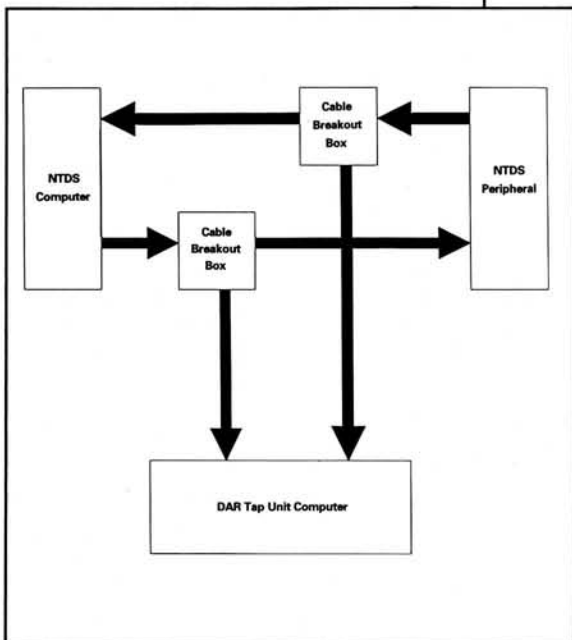


Fig. 2. PMAS Bidirectional Passive Tap

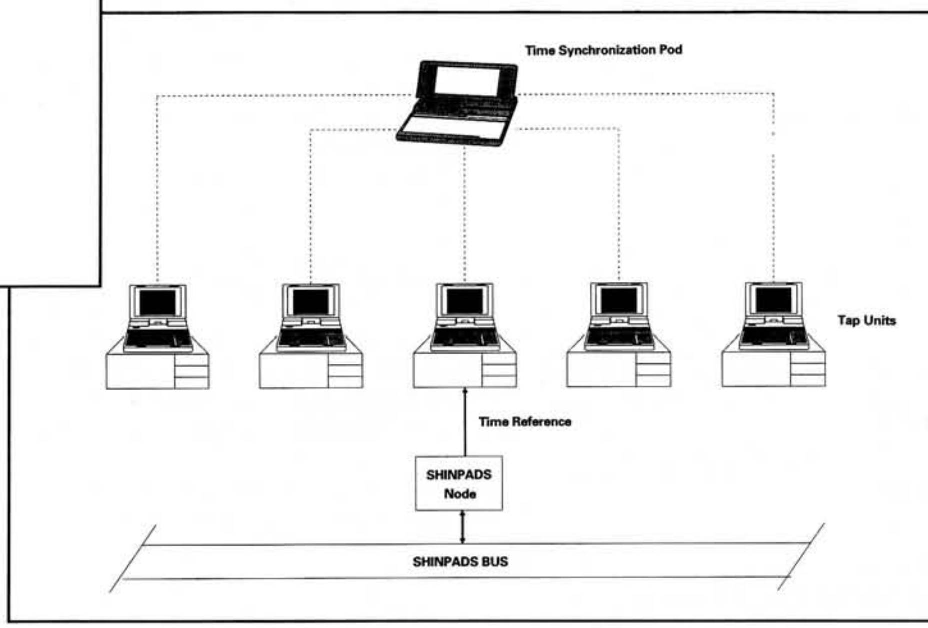


Fig. 3. PMAS Time Synchronization Configuration

Critical Design Concepts

The operation of PMAS revolves around two main design concepts. The first is the tapping design, which has to be completely passive in that it must not utilize receive/retransmit concepts or corrupt the interface data in anyway. The design of the PMAS tap connection itself is based on commercially available NTDS cards developed by GET, an American company. (These same cards are widely used by the U.S. Navy.)

Figure 2 shows a typical bidirectional passive tap configuration. Tap unit connections to interfaces are made by disconnecting the existing interface cable from its computer and plugging it into a breakout box (in the case of the NTDS D serial interface, a **T** connector is used). A short extension cable from the breakout box completes the connection to the computer. The **T**-type connection feeds a copy of the interface traffic to a personal computer for recording. Qualification and field tests have shown that no data corruption or time delays are introduced on the combat system interface, and that the interface's message traffic has been correctly time-stamped and recorded by the tap unit.

The second critical design concept is time synchronization. The system time, stamped on all tap unit recordings, must be synchronized to enable post-trial correlation of each interface's message data. To synchronize physically separated tap units (*Fig. 3*), one of the units connected to the SPS-49 NTDS D interface with the CCS receives a combat system time reference. This time reference is passed to the portable time synchronization pod which carries the reference from one tap unit to the next until all five units have been synchronized. An optional IRIG-B time reference is being investigated for the added capability of correlating the PMAS data to missile telemetry.

The time-sync pod consists of a laptop computer, a time synchronization card and a temperature controlled crystal. The time-sync card is comprised of a set of divider and counter circuits which are used to generate a time-stamp value with a resolution of 50 microseconds. The frequency source is a highly precise, stable oscillator housed within a double-walled oven to overcome the effects of temperature fluctuations and can provide stable frequencies for at least seven hours.

DAR Hardware and Software Components

The DAR subsystem consists of five PCs based on the Intel 80386 microprocessor. Each PC incorporates a maximum of two NTDS interface cards. Only the receive side of the NTDS interface card is used since these cards are used only to provide the passive tapping of the bidirectional interface. A time synchronization card provides the time reference as previously described.

A small-computer-system interface card controls two cartridge tape drives — a 150-MByte drive to record/archive the raw combat system message data, and a 60-MByte drive to transfer the archived data to the DAP subsystem. A floppy disk drive provides storage for the DAR subsystem and holds the executable file for the DAR software. Finally, a portable terminal forms the interface between the DAR software and the tap unit operator.

The DAR software, written in C-language and in accordance with DoD-STD-2167A, controls the operation of the tap unit hardware. Its operation is initialized automatically by turning the unit on with the DAR executable software in the floppy disk drive. The primary role of the tap unit software is to monitor and record the message traffic on combat system interfaces to which it is connected. The tap unit displays the status of the tap's operation.

The secondary roles of the DAR software are to provide a means of viewing the recorded message data, and to transfer the data to the DAP subsystem for further analysis and presentation. The viewing and transferring functions can be used in conjunction with a message filter which, using predefined filter criteria, removes unwanted and periodic non-changing messages from the recorded messages as they are being transferred to the DAP subsystem or viewed by the tap unit operator.

DAP Hardware and Software Components

The DAP subsystem consists of a Sun 3/260 Tempest workstation to provide the processing power to reduce the data and present it in various formats in a timely manner. A keyboard and 19-inch colour monitor provide the operator-machine interface by presenting health-monitoring messages and providing access to various data, file and output management menus. A 300-MByte removable disk stores the DAP software and database while a fixed 60-MByte tape cartridge accepts the data generated by the DAR subsystem. A laser printer is used to produce hardcopy output of any of the presentation formats generated by DAP analysis.

The DAP subsystem makes primary use of off-the-shelf software such as the INGRES DataBase Management System, and the PV-Wave graphics package. The DAP custom software is written in the same language and to the same standard as the DAR subsystem. The DAP menus are designed in a hierarchical, or tree, structure beginning at the master menu. A status window displays messages identifying the current state of the system, or an invoked command.

The DAP system caters to three levels of user: general, privileged and system manager. The general user is allowed to analyze data, manage reports and text files, and shut the DAP subsystem down. A privileged user may do all of that, and manage trial data as well. Overall system management rests with the system manager who is the only person authorized to perform system set-up and maintenance tasks.

Field Testing

A PMAS certification test procedure was conducted to enable the system's use during CPF combat system acceptance trials. The first step was to run tests at the Fleet Software Support Centre where NTDS interfaces are used by the CANEWS software testing facility. This proved the DAR's ability to operate without degrading the communication interface it was attached to. The next step should have been to have the system undergo testing at a fully CPF compatible facility such as the Combat System Test and Support Facility in Montreal. Unfortunately, at the time, the CSTSF was being used to capacity by Paramax. The next stage of PMAS DAR testing eventually took place on board HMC ships *Halifax* and *Vancouver* on a non-interference basis while the ships were alongside. The PMAS was then used in both ships' acceptance and engineering trials in March and June 1993 (again on a non-interference basis). The data is currently being analyzed to ensure correctness of the PMAS DAP reduction by comparing it to data collected by other recording systems during these same trials.

Conclusion

The navy's Performance Monitoring and Analysis System should provide the CPF's readiness team with a much-needed onboard capability to assess the health and detection-to-engagement performance of the CPF above-water warfare system. The PMAS is aimed primarily at satisfying this requirement, but is also being viewed as the building block for the next generation of Surface and Air Weapons Information System. Several applications are anticipated for the PMAS, including use with the TRUMP combat system whose architecture and subsystem interfacing parallels CPF's.

Louis Caron is the PMAS project manager in DMCS 2.

The Coming of Age of Electromagnetic Computer Simulation*

By Lt(N) M. Fitzmaurice, B.A.Sc.,M.A.Sc.,P.Eng.

Adapted from the author's M.A.Sc. thesis entitled: "A New Finite-Difference Time-Domain Method Applied to an Open Waveguide Structure," Dept. of Electrical Engineering, University of Ottawa, September 1992.

Introduction

This article will discuss a numerical method for calculating electromagnetic (EM) field propagation and distribution and show that it has the potential to be applied to naval engineering problems. The technique is known as the Finite-Difference Time-Domain (or FDTD) method and has been around since 1966, yet only recently is it being widely used. This is due primarily to the quantum leaps in computer technology that have occurred over the past 25 years; advances which have put large and costly mainframe computers into desktop-sized packages and prices.

The FDTD method was first proposed by K.S. Yee[1] in 1966 and basically involves direct, discrete approximations of partial differential operators which appear in Maxwell's equations. It sounds more ponderous than it is.

James Clerk Maxwell (1831-1879) predicted that electromagnetic waves in a stationary (i.e. the reference frame isn't moving) and sourceless (i.e. in free space) medium must satisfy the following curl equations:

$$\varepsilon \frac{\partial \vec{E}}{\partial t} = \nabla \times \vec{H} \qquad (1)$$

$$\mu \frac{\partial \vec{H}}{\partial t} = -\nabla \times \vec{E} \qquad (2)$$

ε and μ are, respectively, the permittivity and permeability of the medium. $\vec{\mathbf{E}}$ and $\vec{\mathbf{H}}$ are the respective electric and magnetic fields and are functions of space (x,y,z) and time (t).

Maxwell formulated equations **(1)** and **(2)** more than 100 years ago and he has yet to be proven wrong. In a sense, these equations are the acme in any effort to mathematically simulate EM field behaviour. The trick is to express them in a more workable form since few computers (and fewer humans) can think in terms of curl operators.

Once **(1)** and **(2)** are separated into vector components, the discrete approximation for a partial differential operator is used:

$$\frac{\partial}{\partial t} f(x,y,z,t) \approx \frac{f(x,y,x,t+\Delta t)-f(x,y,z,t)}{\Delta t} \qquad (3)$$

f(x,y,z,t) is a general function of space and time. The approximation becomes increasingly accurate as Δt approaches zero. By substituting the approximation for each partial differential operator that occurs in the expansion of **(1)** and **(2)**, discrete linear equations result. These equations, coupled with equations which dictate the boundary conditions, can then be programmed into the computer.

Yee's main contribution was to apply a well-known approximation, **(3)**, to Maxwell's equations. Unfortunately for researchers of Yee's generation, most of the available computers were just not powerful enough for practical use with FDTD applications. Only the few people who had access to expensive and powerful mainframe computers could do any meaningful work with FDTD. The rest had to limit their studies to small, simple applications which had little relevance beyond the research community.

What can FDTD be used for?

Today, it's a different story. Researchers now have access to increasingly capable computers and are able to use FDTD to analyze their EM problems. In the not-too-distant future FDTD (or another of the many numerical techniques) may be used to solve problems that were once too complex for this type of analysis. Electromagnetic compatibility and interference problems on board navy ships are a case in point. FDTD could find applications in radiation pattern prediction of various feedhorn or antenna constructions, or could be used to predict EM field intensity for radiation hazard studies. FDTD could also be used to investigate the radar cross-section of various structures and materials.

The applicability of the method is still restricted by the computer that runs the program. Despite all the advances of recent years, modern computers still have finite

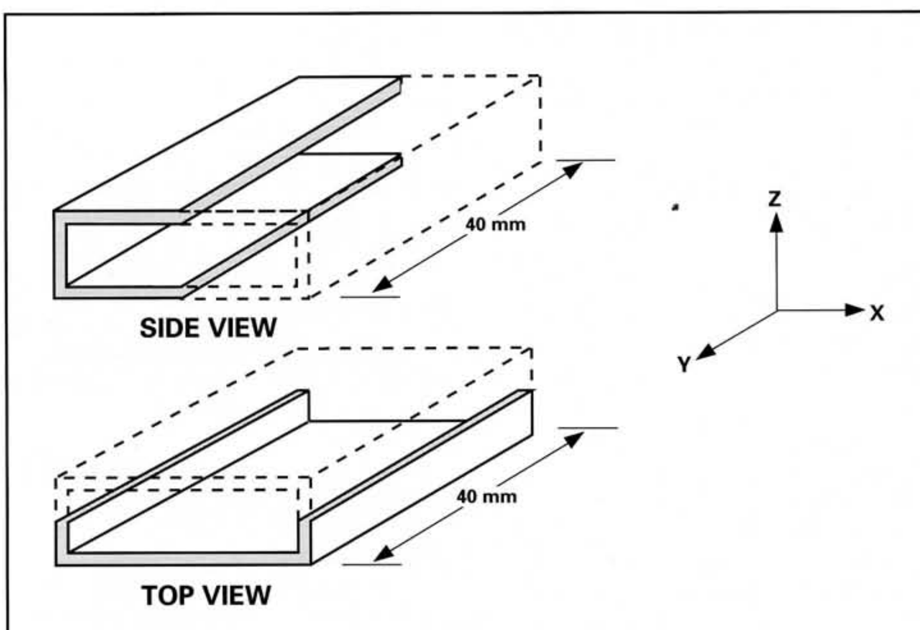


Fig. 1. Waveguide structure to be simulated

memories and can only perform so many calculations per second. There are obvious advantages to being able to simulate structures in great detail, but it makes little sense to attempt to analyze a structure so large (detailed) it outstrips available memory or requires six months of CPU time.

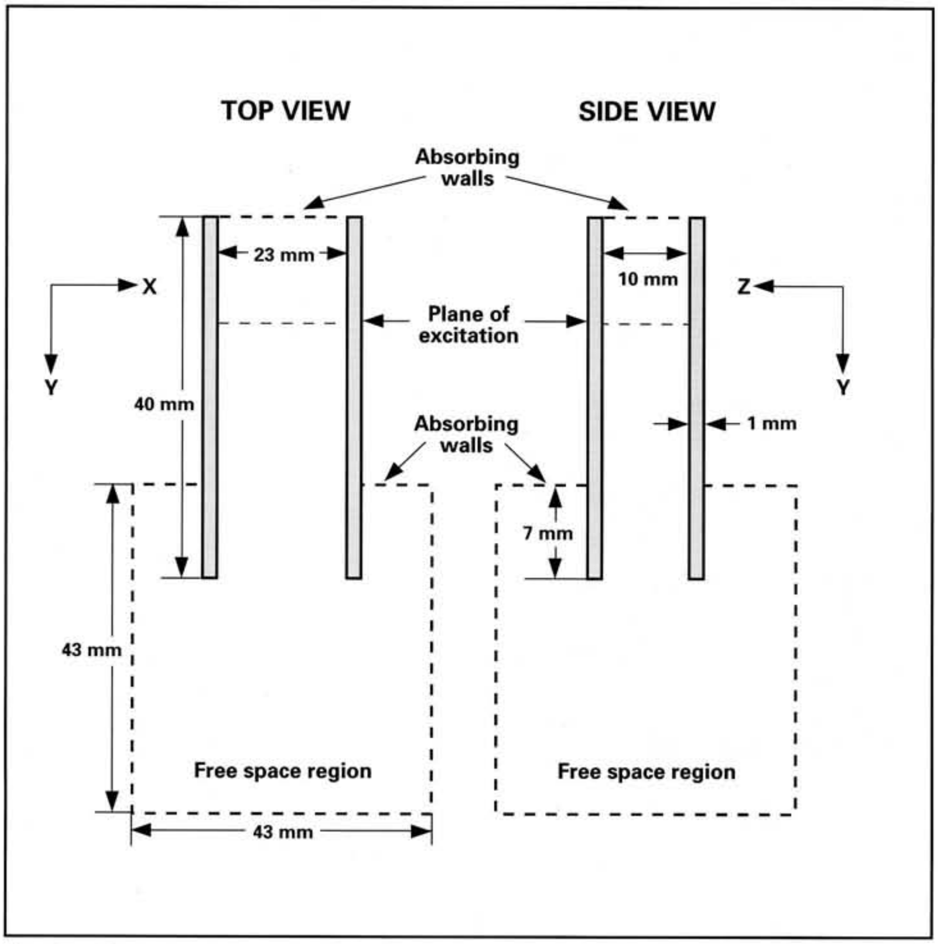


Fig. 2. Top and side perspectives

An example: the FDTD method applied to a waveguide structure

As an example, consider the waveguide section shown in *Fig. 1*. It is a piece of X-band waveguide 40 millimetres long with internal dimensions of 10 x 23 mm, and a wall thickness of one millimetre. Electromagnetic field propagation and distribution in this structure have been simulated using the FDTD method.

For orientation, *Fig. 1* shows the cutting planes which split the structure in half along the x and z axes to reveal top and side views (*Fig. 2*). While one end of the guide is closed off by an energy absorbing wall, the other end (the aperture) opens onto a region which simulates free space. Energy excited in the guide will travel down and go through the aperture and propagate and diffract into the free-space region.

The free-space region, of course, is not entirely free, but is bounded by energy absorbing walls. These walls are complex mathematical boundaries which absorb incident energy without generating reflections. To an incident wave, they present a matched impedance. Energy absorbing walls are very handy because they allow the computational domain to be truncated to save memory. Even so, the structure here typically required 16 CPU hours to execute on an IBM RS/6000 fast desktop minicomputer.

Figure 2 shows the top and side view perspectives of the computational domain. Also shown is the plane of excitation, a surface in the xz plane from which the structure was excited. The excitation was a spatially distributed half-sinusoid for E_z and H_x field components whose time-dependent magnitudes were determined by a Gaussian pulse. The result of this type of excitation was to excite the dominant, or TE_{10}, mode of propagation in the waveguide. The excitation was such that most (but not all) of the energy travelled in the +y direction (i.e. toward the waveguide aperture).

To examine the propagation and distribution of electromagnetic energy in the waveguide structure as time passes, consider the field component E_z. (In a three-dimensional Cartesian co-ordinate system there exist six EM field components: three for the electrical field (E_x, E_y, E_z) and three for the magnetic field (H_x, H_y, H_z).) *Figure 3* shows black and white reproductions of colour photographs whose colours correspond to relative values of the E_z field intensity. Although colour could not be reproduced for this article, it is still possible to discern the intensity variation of the field by examining the contrasts.

Figure 3a shows the E_z field distribution from a top (x axis) and side (z axis) perspective at the fortieth time step, the point at which the excitation reaches its peak value. (Each time step, or iteration, represents 3.3333 picoseconds of "real" or elapsed time.) The top view shows the half-sinusoidal distribution of E_z along the x axis, while the side view reveals no variation in E_z along the z axis. Both of these characteristics are indicative of TE_{10} mode propagation in the guide.

Figure 3b shows the situation at iteration 74, at which time energy has reached the aperture. Some is reflected back into the guide and some propagates and diffracts into the free-space region. At iteration 111 (*Fig. 3c*) the energy quickly expands (or diffracts) in all directions from the aperture. The short, thin vertical grey lines visible in *3c* and *3d* represent the cross-section of the metallic walls of the portion of the waveguide that extends into the free-space region (see the 7-mm sections in *Fig. 2*).

By iteration 150 (*Fig. 3d*) energy is occupying the entire free-space region. Note there are no appreciable reflections from the energy absorbing walls. Although the oscillatory nature of the simulation is not shown in this article (a photo would be required for each iteration) the simulation did demonstrate that the oscillations are centred upon the aperture and plane of excitation, and die out after 500 to 600 iterations.

The figures show only the E_z field component from two different perspectives. Any one of the other five EM field vector components could have been selected and presented in a similar fashion. Naturally each is unique and behaves in its own peculiar fashion. Additionally, different cutting planes could have been used to present different perspectives. The quantity of information that could be derived from this three-dimensional simulation is staggering when one considers the permutations and combinations of various factors such as viewing perspective, EM field component and number of iterations.

Nice pictures...what's the point?

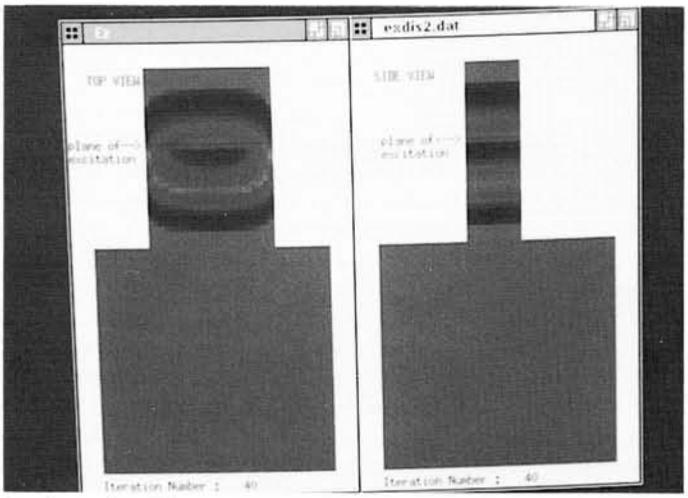
Certainly not everyone is interested in analyzing EM field propagation and distribution in small waveguide sections. For that matter, the example shown has very limited practical use. The point in writing this article is to show how an otherwise obscure research tool can, through the grace of modern technology, become an everyday microwave engineering tool.

Computer technology must advance further still before RF and microwave engineers can even hope to begin fully exploiting numerical methods such as FDTD. Just the same, it is important that we at least know what it can offer — full, three-dimensional simulations of real microwave structures. Numerical methods for EM field calculations, coupled with increasingly powerful computers, hold the promise of improved and more timely designs in the field of microwave and antenna engineering. It remains for us, as MAREs, to ponder how these methods might best be used to benefit our navy.

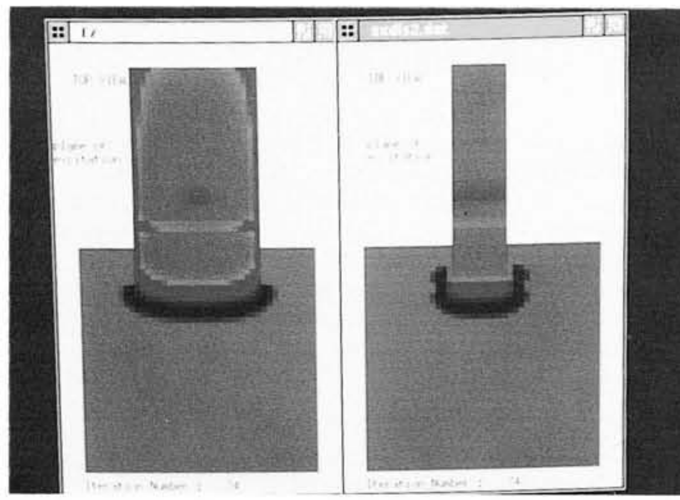
Reference

[1] K.S. Yee, "Numerical Solution of Initial Boundary Value Problems Involving Maxwell's Equations in Isotropic Media," *IEEE Transactions on Antennas and Propagation*, AP-14 (May 1966), 302-307.

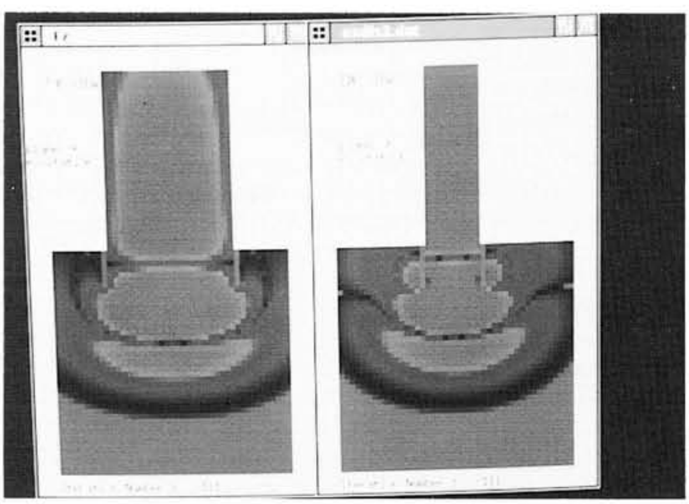
Lt(N) Fitzmaurice is a project engineer in DMCS 2.



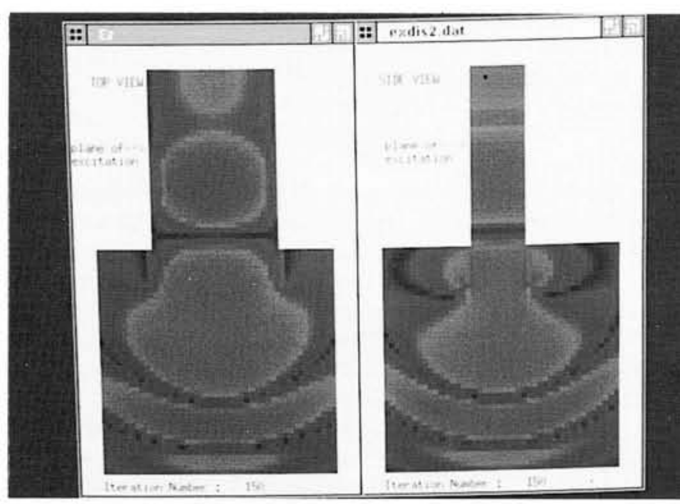
3a. Iteration 40



3b. Iteration 74



3c. Iteration 111



3d. Iteration 150

Fig. 3. E_z field distribution from top and side perspectives (iterations 40 through 150). The path of the energy can be followed as it travels down the waveguide and enters the free-space region to eventually fill it. The extremely complex energy absorbing walls bounding the free-space region allow the simulation's computational domain to be truncated to save memory.

The Assistant Deputy Minister *(Engineering and Maintenance)*

ADM(EM) heads a branch of nearly 4,000 military and civilian personnel within the ADM(Materiel) Group at National Defence Headquarters in Ottawa. Four environmental divisions — maritime, air, land and communications electronics — and one central staff division report to ADM(EM). Included in these numbers are almost 1,100 temporary project personnel who manage the Department's nearly 300 capital projects, and eight field units comprising 1,500 personnel which report to the E&M divisions.

By Rear-Admiral M.T. Saker

7:00 a.m. — My working day begins as I climb into the car and listen to the CBC news on my drive in to the office from my home in Ottawa's east end. I confess to clogging up the streets with perhaps unnecessary traffic (we have very good bus service in the morning), but my end of days are so unpredictable that I have little choice but to take the car.

7:30 a.m. — By the time I arrive in my 11th-floor office at NDHQ, the staff has cranked up the computer terminal and everything is set to go so that I can check my calendar and E-mail over a cup of coffee. Today's schedule seems fairly typical — meetings all day! I've just got time to read the press clippings before heading to the Senior ADM(Mat)'s 30-minute "O" Group meeting at eight o'clock. This meeting is attended by the other Materiel Group branch heads (Supply, Infrastructure & Environment, R&D and Logistics Operations) and Ray Sturgeon, the Senior ADM(Mat). We go over the day's agenda for the Materiel Group and come up to speed on any late-breaking news of interest. Mr. Sturgeon also uses the meeting as a preparatory session for the daily executive meeting (called by the Deputy Minister and Chief of the Defence Staff) that he and other Group Principals will attend at eight-thirty.

8:30 a.m. — On this day, as the Sr ADM(Mat) leaves for his meeting, I head across to my own conference room for the weekly Engineering and Maintenance Management Committee meeting with my directors-general. This week's agenda features a report on the findings of a study we conducted into the E&M Branch's eight field units, which include the Naval Engineering Test Establishment and the CF Maritime and Experimental Test Ranges. The study's main aim was to consider how we might equitably distribute the 19% personnel reductions we are facing in the Materiel Group over the next five years. (Not surprisingly, the study found no magic solution, but I think it did allow the units to better understand each other's operations and lessen the finger-pointing and second guessing.) The EMMC covers a number of other items of mutual interest and then the DGs report on any significant issues going on in their areas. As usual, the two-hour meeting has delivered a few surprises that will require some follow-up co-ordination.

10:30 a.m. — Immediately following the EMMC meeting BGen Harley Ranson (DGAEM) and I meet with Pierre Lagueux (ADM Supply) and a few staff to discuss an aircraft repair situation with which we've been having difficulty. The problem concerns contractor scheduling and pricing on a contracted depot-level inspection and repair program (refit, to you naval types) for one of our aircraft fleets. Inside of an hour we have agreed on a course of action to resolve the situation, and I return to my office to clear the urgent correspondence and return (or at least try to return) three phone calls.

12:00 noon — At noon, it's off to an executive luncheon for a company's presentation on "Why Some Companies Receive Better Payback from their Information Technology Investment." If there is any subject around NDHQ that can incite emotion it is information technology — and why we don't have enough of it. While I accept that the technology is a good thing, I think there is a limit to how much we should have. It does not come cheaply. Payback on investment may be rather easy to measure for industry, but not so for government bureaucracies. The presentation tends to support my concerns (or am I only seeing things that support my views?).

2:00 p.m. — Back to 101 Colonel By Drive to chair an interdepartmental Senior Project Advisory Committee meeting on the army's Light Armoured Vehicle Project. The SPAC's members from the Department of Supply and Services, the Department of Industry, Science and Technology, the Treasury Board and regional agencies are meeting to discuss the project's procurement of 203 vehicles from the General Motors Diesel Division of London, Ont. This has been a real Canadian success story, with GM sales of more than 2,700 various types of light armoured vehicles. Our meeting reveals good co-operation and reasonable progress; our biggest problem is getting GM's undivided attention to our needs. (Great to be popular; hell to be the rage!)

3:00 p.m. — Capt(N) Roger Westwood drops by for half an hour to fill me in on the latest developments with the Maritime Coastal Defence Vessel project. The first year of a project is often the most difficult, and I find it useful to keep tabs on things.

4:00 p.m. — I'm off to Sr ADM(Mat)'s office for an informal meeting with him and ADM Supply to discuss a number of current issues and concerns. An hour and a half later we finish, having covered a dozen issues, been interrupted a few times by incoming urgent calls and a few calls of our own. Then it's back to my office where I finally get a chance to sort through some outstanding calls and separate the mail into that which must be done here and that which can be taken home.

6:45 p.m. — At last, we shut down the office and head for home. With any luck the traffic will be light, a nice meal awaits me at home, and the Blue Jays will be on TV while I complete tonight's homework.

Notwithstanding the erratic schedule I keep as ADM(EM), it is an interesting job, filled with new and exciting challenges. One of the things I like most about this job is the chance I get to work with competent, professional and very interesting people. At the end of the day, however, our value needs to be felt at the sharp end in the form of good equipment and support. That's our ultimate challenge.

Greenspace: Maritime Environmental Protection

Adventures in Black Water
Confessions of a Project Officer

Story by Lt(N) Doug McDonald
Cartoon illustrations by Brian McDonald

When I was first posted to DMEE 5 in 1991 it took me a while to come to terms with people's general attitude toward my new field of responsibility. For some reason they just didn't share my enthusiasm for blackwater systems management. Even at home, my wife laughingly boiled it down to one thing — her husband was installing toilets in warships.

This was all quite an ego deflator, but the setback proved to be only temporary. In time I regained my love for blackwater systems, drawing much of my strength from the wisdom of author James Gorman who wrote, "If you consider the contribution of plumbing to human life, the other sciences fade into insignificance."[1]

One interesting blackwater project that required a great deal of effort was the installation of an interim Gravity Collection, Holding and Transfer (GCHT) system in the recently TRUMP-refitted HMCS *Algonquin*. The experience of managing this effort gave me a real appreciation for the multitude of co-ordinated actions that are necessary for the successful completion of a high-priority, short-deadline project.

The roots of the project go back to 1988 when, as part of the Shipboard Pollution Abatement Project, a decision was made to fit the *Iroquois* class with blackwater Vacuum Collection, Holding and Transfer (VCHT) systems at the earliest opportunity. It took two years to come up with a basic design that would meet the weight and stability restrictions imposed on the *Iroquois* class. (Twenty tonnes of the anticipated TRUMP growth envelope had been reserved for a blackwater installation.) Delays in finalizing the basic design and the lead time required to develop the specifications left insufficient time and funds to have the systems installed as arisings during the TRUMP refits.

In August 1991 Maritime Command directed that *Algonquin* be fitted with some type of blackwater collection system for her March 1993 deployment as command ship to the Standing Naval Force Atlantic (SNFL). The navy had little choice but to turn to an interim fit of a simpler, gravity-based GCHT design (*see box*). It was a good compromise. The ship could be fitted

"If you consider the contribution of plumbing to human life, the other sciences fade into insignificance."

with a limited collection capability in the short time available, and since the system was based on the VCHT system tank design it would be easy to upgrade to a full VCHT system during the next scheduled refit. Work began on the GCHT specifications shortly after I arrived in DMEE 5 and my education in project management truly began.

Design and Installation Planning

The GCHT specifications were developed by the Ottawa office of MIL Systems under the auspices of the Maritime Design and Drawing Office (MDDO) contract. For the uninitiated, the first experience with MIL can be a bit daunting. Early on in the contract MIL requested that co-worker Lt(N) Brad Anguish and I visit their office to discuss some of the finer design points. When we arrived for the meeting we were led to a conference room and seated on one side of a large table. (We had been expecting a little chat with the MIL project manager and perhaps one of his engineers.) In marched *seven* engineers who proceeded to grill us for the next hour and a half. The Spanish Inquisition had nothing on these guys. There must have been at least 150 years' worth of Clydeside marine engineering experience sitting on the other side of that table — interrogating two navy lieutenants who hadn't even served in the class of vessel we were discussing!

Relationships with MIL improved considerably after I had an opportunity to visit *Algonquin* and become familiar with the affected compartments. It completely changed my perspective. I was more comfortable with the design team now that I had knowledge I could bring to the table, but I was growing markedly more restless with the rapidly approaching deadlines. It was now December 1991 and the only installation window for *Algonquin* was opening up in June 1992. Simple time-line estimates based on my basic understanding of the Engineering Change Proposal (ECP) process made me realize I was going to have to "bend" a few of the ECP rules to get this system installed in time for SNFL.

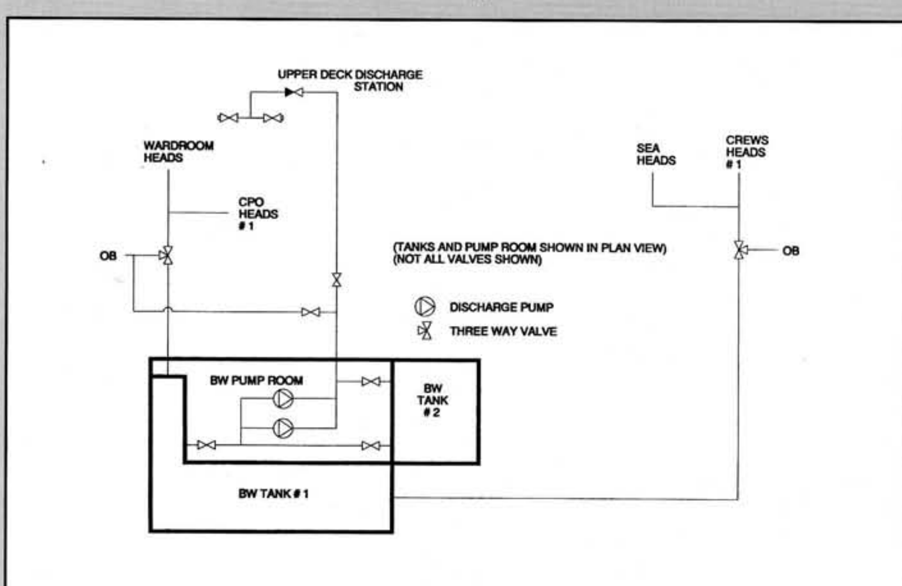
The most laborious and ship-disruptive portion of the installation was going to be the construction of the two blackwater holding tanks and the blackwater pump-room in the after portion of No. 3 saltwater ballast (SWB) tank. By mid-January 1992 I had preliminary drawings and specifications for the installation of the tank package only. My first bent ECP rule was to involve Ship Repair Unit Atlantic (SRUA) at this early stage of the project. I sent the drawings and specs to their estimators and planners for a rough work estimate and, more importantly, an opinion on whether or not we could get this system installed in time. Not surprisingly, their initial reactions ranged from detached amusement to laughing disbelief. It took an additional planning meeting in February, where the complete preliminary GCHT specifications were reviewed, for SRUA to settle on cautious optimism and a 10,000-person hour estimate for the full GCHT installation.

Procurement

The second bent ECP rule was to begin the procurement of equipment and materials for the complete system well before the specifications had obtained final approval. I wouldn't recommend this approach to anyone, but in this case it was absolutely essential because of the large number of long-lead items and the rapidly approaching installation window. After pleading our case to Naval Mod Review Board Secretary LCdr Peter Ross, the ECP was secretarially granted approval in principle in February 1992.

A copy of the preliminary Consolidated Material List (CML) was passed immediately to Base Supply in Halifax to begin the assembly of our pack-up. Although Planned Requirements Reservation Clerk Cindy Gallant and supervisor Heather Wincey were a bit suspicious when they received this preliminary CML from a lowly lieutenant from NDHQ, they did a fantastic job of sorting through the materials and ensuring that all items would be available for the installation.

Algonquin's Interim GCHT System



The interim Gravity Collection, Holding and Transfer (GCHT) system is designed to collect and hold black water from 16 of the ship's toilets while the ship is in restricted waters or alongside. The principal components are the two blackwater (BW) holding tanks (11,700 litres and 9,300 litres) and two discharge pumps. Piping interconnections and automatic start/stop switching arrangements allow the pumps to draw suction from either or both tanks, transfer black water between tanks, and discharge it overboard while in unrestricted waters or to the upper-deck discharge station while alongside a blackwater reception facility. The estimated daily blackwater production in *Algonquin* is 19,600 litres, giving the GCHT system a holding capacity of approximately one day.

A minor crisis occurred in early May 1992 after all reviews of the specifications had been completed. I had taken receipt of our final version of the specifications, when to my horror I discovered that some of the minor modifications we had recommended for the specifications had caused a renumbering of the 540 items on the CML. Since item numbers are used to label the box, carton or bag each item comes in, the potential for confusion was immense. SRU personnel (working from the final specifications) could open a box expecting to find an electrical relay, and instead find a valve. To make matters worse, Heather Wincey had agreed to use the preliminary CML only after I promised there would be no problems with it. If I ever wanted to show my face in Halifax again, I was going to have to do something about it — fast. It took six hours of furious work to prepare an old-to-new item numbering table. Fortunately, materials had only just begun to trickle in, so Cindy Gallant was able to enter the new numbers into her computer in time to catch most of the incoming materials.

By mid-May the project was really starting to heat up. Work was scheduled to begin on May 25, with approximately 200 CML items still outstanding. SRUA was all set to go, but the pivotal question remained: Was DMEE 5 confident enough in the promised delivery dates of all outstanding items to recommend the ECP be granted approval to implement? By this point I was on a first-name basis with the suppliers of the crucial items. Placing my trust in them, and remembering MARCOM's directive that *Algonquin* be blackwater capable for SNFL, I swallowed hard and said, "We can make it." Thus, a third ECP rule was bent. Without having assembled all of the necessary equipment in our pack-up, approval to implement was granted on May 15, 1992.

Installation and Set-to-Work

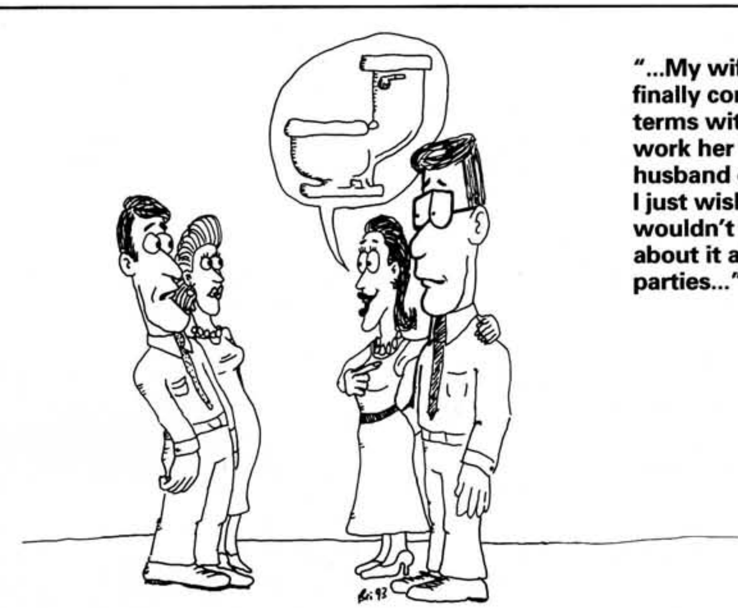
The installation began on schedule with the docking of *Algonquin* on the synchrolift. Priority was given to the plate shop for the construction of the blackwater tanks and the blackwater pump-room. Where there was no interference, the pipe shop proceeded with work on the soil lines, overboard discharge valves and the blackwater vent line. The tank installation went smoothly, but the pipe work was frustrating since the majority of crucial outstanding items were those required by the pipe shop. Pipe shop chargehand Mike Fitzgerald was most co-operative and kept me advised as to which items required priority to keep the job on schedule. I, in turn, would "nudge" the appropriate supplier, then pass the shipping details on to Mike so he could collect the item as soon as it arrived at the Willow Park Supply Depot. It was "just-in-time inventory control" at its very best.

Over the course of the installation I gained a new appreciation for the creative talents of the pipe shop. They understood this was a short-fuse installation and had accepted that the specifications and drawings would be in an unrefined state (since they were based on *Iroquois* class drawings). Faced with the reality of *Algonquin*'s particular compartmental configuration, they freely interpreted, simplified and improved upon sections of the piping runs and a number of valve positions. In all cases where the modifications were considered significant, Mike Fitzgerald made his recommendations to me and I faxed back instructions based on consultation with the MIL engineers.

Overall, the installation progressed well. The bulk of the work was completed during the June 1992 installation window, but interference with TRUMP trials and the sailing program delayed the completion of the GCHT installation until September. There was no time to sit back. The momentary lull gave me a chance to go back and properly register and provide spares for the system, as well as prepare set-to-work instructions, a manual and a preventive maintenance schedule (all of which *should* have been done prior to approval to implement).

With time running out, a set-to-work of the system was conducted in late October 1992. It was up to Lt(N) Brad Anguish (now the A/MSEO in *Algonquin* — poetic justice?), Andy O'May (the MIL FSR) and me to prove the system functional and instruct the crew in its correct operation. Optimistically the trial was scheduled for two days, but it proved to be a classic case of Murphy's Law. Every time we got the trial going, small but significant faults would derail us until we could effect the necessary repairs. Flange leaks and teething problems with valves, pumps and float switches turned our two days into four, but we finally got to the point of knowing what the faults were and what had to be done to get the system up and running. Lt(N) Anguish worked through the faults as time permitted and had the system fully functional well before the ship's deployment to SNFL.

I count myself fortunate to have been involved with this project from design through set-to-work. Under normal circumstances a project like this should have



"...My wife has finally come to terms with the work her husband does. I just wish she wouldn't boast about it at parties..."

taken at least three years to complete. But with its high priority and the tacitly approved leeway to "bend" our ECP rules, we were able to complete the project in less than a year. It was rushed and it was hectic, but it was an education every step of the way.

I discovered early on that I had to know the ECP process inside out and backwards. Otherwise, I wouldn't have been able to tell when the project was coming off the rails. Also, since there was no room for schedule slippage, it was essential that I adopt a proactive approach to my job. I had to go looking for problems that had the potential to trip up our progress and confirm the achievement of each important milestone in the development of the project. Probably the most important lesson I was able to hoist in was that the work goes much more easily if you know your important contacts well, especially when it comes time to work through the sticky problems that jump up in your path.

After two years of patiently listening to my blackwater exploits, my wife has finally come to terms with the work her husband does. I just wish she wouldn't boast about it at parties. It still makes me uncomfortable when everyone around us takes one step back.

Acknowledgments

Although I've only mentioned a few people by name, there were many who were involved in the *Algonquin* blackwater GCHT project. I express my gratitude to them all for the significant roles they played in making the project a success. My experiences over the last two years have reinforced my belief that the greatest resource this organization has is the people who keep it running so smoothly.

Reference

[1] James Gorman, *The Man with No Endorphins: And Other Reflections on Science* (New York: Viking Penguin, 1989).

Lt(N) McDonald, now A/EO in HMCS Toronto, served as an environmental protection project officer in DMEE 5 from 1991 to 1993.

Looking Back

Passive Protection for the Fleet
The Fergusons Cove Influence Range

By Lt(N) P.D. Smithers, P.Eng.
Historical photos courtesy of June Creelman

The navy's long involvement with ship passive protection began a new chapter last April when Naval Engineering Unit Atlantic officially opened its new influence range building at Fergusons Cove, NS. Named in honour of William MacKay (Mack) Creelman, a Canadian pioneer in naval passive protection research (*see box*), the modern facility represents an important step forward in the passive protection of the navy's ships and submarines.

Naval warfare has come a long way since the days when signature reduction meant little more than camouflaging a ship's profile with a clever paint scheme and degaussing (neutralizing) its magnetic field with electric coils. Ships today are vulnerable to attack on a host of fronts, thanks to their acoustic, magnetic, electromagnetic, hydrodynamic and infra-red

(PHOTO: CFB HALIFAX BASE PHOTO)

The *William MacKay Creelman* building at the Fergusons Cove Influence Range

signatures. During Operation Friction, for instance, magnetic influence mines, acoustic influence mines and infra-red guided missiles were considered significant threats to our ships in the Persian Gulf.

The Gulf War is chiefly responsible for a renewed emphasis on signature reduction in the fleet today. Ships of all classes have been making extensive use of the influence range at Fergusons Cove. From its site overlooking the approaches to Halifax Harbour, the new range facility actually uses the same water space as the old McNabs Island influence range across the channel. At the moment it is equipped as a sound range only, but a new degaussing system is being installed to provide a much-needed deep-draught capability for AORs and merchant ships. A laser range-finding system will accurately records ships' positions on the range.

Plans also call for a hydrodynamic pressure-sensing system to be installed to analyze ships' wakes and water flow around the hull. Such data would be useful in improving ships' designs for seakeeping and hull speed, and for improving their defences against hydrodynamically triggered mines and wake-homing torpedoes. A capability for measuring extremely low-frequency electric emissions is also being developed. Although not a permanent feature of the range, infra-red signature analysis of warships has already been conducted using equipment provided by the Naval Engineering Test Establishment.

William MacKay (Mack) Creelman, 1918 - 1985

Mack Creelman was born in Pictou, Nova Scotia to a family whose roots in that province extended back to the 1770s. He completed high school at the Halifax Academy in 1936 and went on to study math and physics at Dalhousie University, completing his BSc in 1940 and his MSc in 1942. He was a member of the Association of Professional Engineers of Nova Scotia (APENS) and a member of the Engineering Institute of Canada.

After graduating from Dalhousie in 1942, Creelman joined the Naval Group of the National Research Council in Halifax as a junior research physicist. This group became the Naval Research Establishment for the RCN a year later. About this time Creelman took a commission in the Navy and by 1945 was responsible for all electrical mine countermeasures in the Atlantic Command. He retired from the Navy as a lieutenant-commander in 1946, but continued his work in the Public Service as Electrical Anti-Mining Officer at HMC Dockyard Halifax until 1955.

Through his work at the Naval Research Establishment, Creelman had met Nancy Littlejohns. They married in 1954 and had three children — June, David and William. When Nancy died of cancer in 1963, Creelman assumed the responsibility of raising his three young children on his own. Despite his demanding career, he was a devoted father and never missed a significant event in his children's lives. A neighbour once even referred to him as "the best mom on the block."

In 1955 Creelman became head of the degaussing section at Naval Service Headquarters in Ottawa, and four years later was named head of the passive protection section in the Directorate of Maritime Facilities and Resources. Up until the time of his retirement in 1983 after 40 years of naval and civilian service, Creelman had his hand in virtually every passive protection project the navy had on the go. Notably, he was heavily involved with the design, procurement and set-to-work of the McNabs Island acoustics range.

Mack Creelman was good at what he did and was widely respected as an expert in the passive protection of ships. Promotion was his for the asking, yet it was a measure of his character that he refused all offers beyond section head. He was a scientist, he insisted, not a manager.

William MacKay Creelman on his commissioning into the RCN as a sub-lieutenant in 1943.

The old facility on McNabs Island

RCN Influence Range History

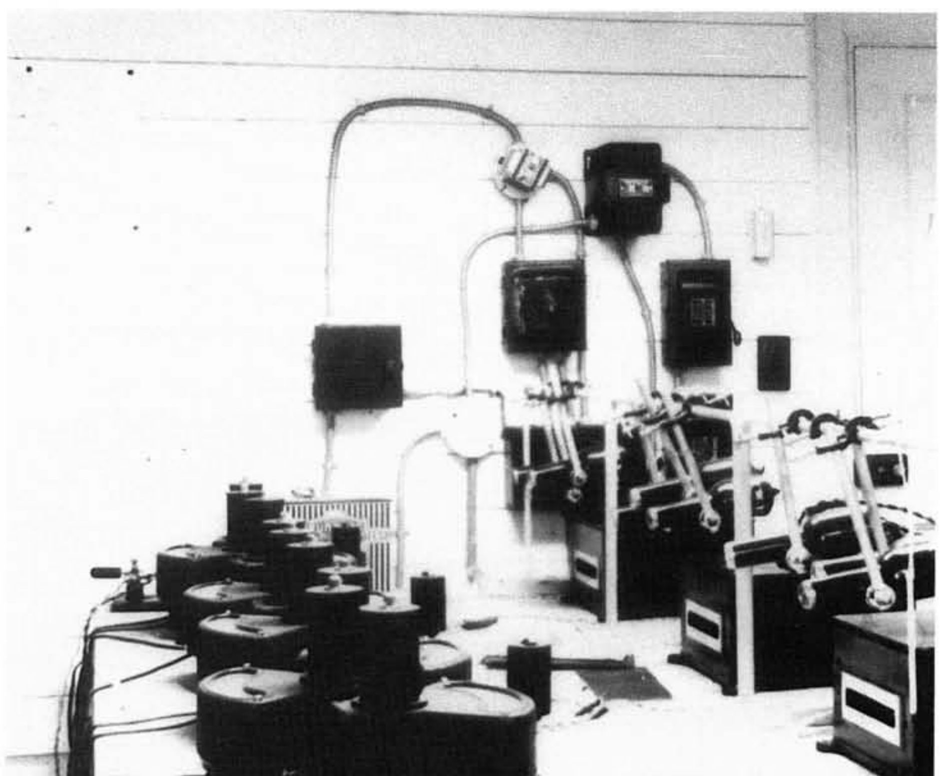
The Royal Canadian Navy's first serious attempt at degaussing came with the establishment of a degaussing range at McNabs Island in 1942. The range operated for 30 years until equipment deterioration caused its closure in 1972. From 1943 to 1946 the Navy also operated an acoustic range at McNabs Island. Acoustic ranging was resurrected in the late 1950s with the installation of the RCN 720 sound-range equipment, a derivative of a British vacuum-tube based design capable only of octave-band analysis.

In 1969 the system was redesigned to computerize the output from the 720 system. A subsequent change during the 1970s incorporated solid state electronics and implemented a Fast Fourier Transform (FFT) algorithm for discrete signal analysis. A separate digital FFT processor was added later. (By comparison, the system now in place at Fergusons Cove is a modern microcomputer-based network with FFT boards installed in the individual microcomputers themselves.) Throughout these modifications, the "wet end" hardware remained largely unchanged from its 1940s configuration.

In the late 1980s the navy set about improving its capability for measuring ship signatures and providing better passive protection to the fleet. The opening of the Fergusons Cove Influence Range was the first major element of this process. After 50 years of service to the fleet, the McNabs Island facility finally closed its doors in 1992. Today, with the new range facility at Fergusons Cove, NEUA's passive protection section is in a much better position to "lend an ear" to the fleet.

Lt(N) Smithers is the underwater weapons project officer (mechanical) at the CSE Division of Naval Engineering Unit Atlantic.

A Flower-class corvette on the sound range, circa 1944



Acoustic range hardware of the 1940s

News Briefs

Calling all FHE-400 Bras d'Or *crew!*

The Musée maritime Bernier near Quebec City needs help completing its historical picture of HMCS *Bras d'Or*. The world-famous hydrofoil, which made history (and the *Guinness Book of World Records*) in the late sixties as the world's fastest warship, was retired in 1971 and has been part of the museum's collection since 1983.

Following a decade of research and preparation by museum staff, the 200-ton vessel was opened to visitors last June. The museum is particularly interested in acquiring photographs and anything else that can give visitors a better understanding of what life was like on board Canada's only anti-submarine hydrofoil.

During her brief heyday, *Bras d'Or* captured the imagination of the world with her state-of-the-art technology and foilborne performance.

"*Foilborne* was the proper terminology —" says retired **CPO2 Mike McQuillen**, a former P1ER engineer on board *Bras d'Or*. "We called it *flying*!" And fly she did, skimming the sea at speeds in excess of 60 knots.

McQuillen, now a DMEE 2 marine engineering specialist in gearing, shafting and propellers, served three years on the FHE-400 project. He remembers well the attention the ship drew from visitors from around the world. "I never saw so much brass in my life," he said. "It was a very high-profile project and there was a lot of pressure to succeed."

Bras d'Or became the subject of controversy in 1971 when she was laid up in reserve just two years after commissioning. At the time the navy was focusing its attention on a helicopter-ship partnership for the ASW role. As short-lived as the hydrofoil project was, its advancements in everything from sonars to machinery control pioneered the way for the DDH-280 Tribal-class destroyers. McQuillen recalls being "flabbergasted" at being able to sit at a console and fuel a ship by push-button control.

Yet as new and exciting as the technology was, it seems that some "modcons" were created less equal than others. McQuillen hinted that *Bras d'Or*'s small, aircraft style galley was designed more for rapid meal preparation than for customer satisfaction. His deliciously lurid description of a pale, greenish roast fresh out of the ship's newfangled microwave oven is enough to put any sailor's appetite on hold. "We didn't have all the proper microwavable cooking dishes," McQuillen explained. "The meat would be cooked, but it would look horrible."

Meals notwithstanding, McQuillen said he has fond memories of his service in *Bras d'Or*. "It was the zenith of my career as far as going to sea was concerned," he said. "We knew what was expected of us and we did it. There was a lot of esprit de corps."

Today, visitors to the Bernier museum can enjoy 30-minute guided tours of *Bras d'Or* from 1:00 p.m. to 5:00 p.m., seven days a week from late May until mid-October. (The museum building alone is open Tuesday to Friday during the off-season.) Admission to the museum and all ship exhibits is $7.00 for adults, $3.50 for children aged six to 16, and $15.75 for families. Group rates and a range of site-specific admission prices to the museum and major ship exhibits are also available.

The Musée maritime Bernier, which is celebrating its 25th anniversary this year, is situated on the south shore of the St. Lawrence River, 100 kilometres east of Quebec City, at **55 Chemin des Pionniers Est, L'Islet-sur-Mer, Québec G0R 2B0**. The museum's communications director, **Nicole Ménard**, can be reached by telephone at **(418) 247-5001**, and by fax at 247-5002.

PHOTO COURTESY MUSÉE MARITIME BERNIER

Visitors tour the "Flying 400" at her retirement berth at Quebec's Musée maritime Bernier. The navy's only hydrofoil once established a record as the fastest warship in the world.

HMCS Toronto!

CF PHOTO BY SGT DAVE SNASHALL, ISC-93-134

With the city of Toronto's skyline fading in the distance, the newly commissioned HMCS *Toronto* sails to join the Atlantic fleet. The commissioning ceremony, held in Toronto July 29, was surrounded by a week of activities, including tours of the 4,750-tonne ship, a traditional naval "gun run" demonstration at a Blue Jays game, and a live, on-board broadcast of Much Music. *Toronto* is the second Canadian patrol frigate to be commissioned.

Royal visit!

CF PHOTO BY SGT DAVE SNASHALL, ISC-93-134

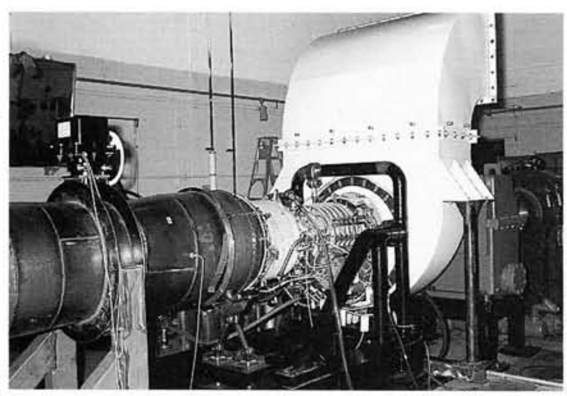
The Duke of York, Prince Andrew, inspects HMCS *Toronto*'s guard during a courtesy visit in September. The prince was on his way back to England after paying his first official visit to the Canadian Airborne Regiment as its colonel-in-chief. Prince Andrew commands a minesweeper in the Royal Navy.

Land-based test facility for TRUMP cruise engine

The engine test-cell at the Naval Engineering Test Establishment (NETE) in LaSalle, Quebec has a new boarder — the Allison 570K gas turbine TRUMP cruise engine. For the next year and a half DMEE 2 and NETE will duplicate and test certain key aspects of the Allison 570K shipboard installation. The first phase of testing — the engine-starting phase — is scheduled to be completed by the end of 1993.

The installation employs a low-speed dynamometer driven through a separate reduction gearbox to load the engine up to a maximum of 6,500 h.p. The test cell is fitted with support systems for starting, lubrication and fuel supply. Test-cell instrumentation and controls enable full-range operation using the shipboard engine controller. Sight glasses have been installed along the lube oil piping and exhaust ducting to permit visual monitoring of the respective flow streams.

In addition to its usefulness in developing engineering solutions to shipboard operational problems with the cruise engine, the multipurpose test rig provides a convenient platform for evaluating post-commissioning modifications. The test cell can also be used for assessing the condition of engines removed from service. — **by Ahmed Abdelrazik, NETE; with files from Peter Cheney, DMEE 2-2.**



NETE PHOTO: GEORGE CSUKLY

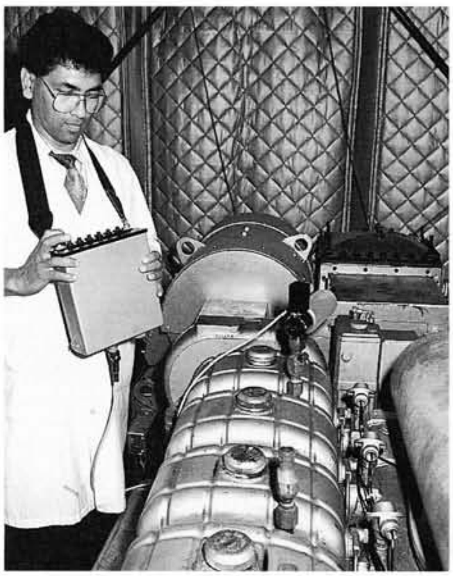
The Allison 570K gas turbine engine mounted on the test bed at NETE. The large white structure is the air intake, with the reduction gearbox and dynamometer beyond. At left, just above the support, is the exhaust back-pressure valve.

News Briefs

Reciprocating machinery analysis

The navy's diesel-engine maintainers could soon have a new equipment health monitoring technique in their toolboxes. Reciprocating machinery analysis (RMA), long used by the natural gas industry to measure cylinder pressures and vibration in internal combustion engines, is now being considered for use by the navy.

RMA measures engine pressure and vibration, and displays the two curves as a function of crankangle position. Cylinder horsepower and timing can be calculated from the pressure information, while the vibration signals can be used to determine the condition of individual engine components. Until recently, the instrumentation used in RMA was bulky and difficult to operate. But thanks to computers, systems today are smaller, easier to operate, and can generate complete reports automatically.



NETE PHOTO: GEORGE CSUKLY

NETE diesel technologist Intees Ishmael simulates a reciprocating machinery analysis of a 200-kW General Motors diesel.

Under the auspices of DMEE 2, the Naval Engineering Test Establishment has been evaluating reciprocating machinery analysis on marine diesel engines with some success. A project is now under way to determine the feasibility of incorporating the non-intrusive technique with the navy's Diesel Inspection Program. Diesel engines could be analyzed by RMA prior to their annual inspection, making it easier for inspectors to plan a more efficient inspection or justify deferring the internal phase of an inspection. RMA could also be used to assess post-maintenance performance.

Currently, one RMA analyzer owned by NETE is being used for testing on both Coasts. If the application of the technique proves successful, DMEE 2 intends to acquire three RMA units for the navy — one for each Coast and one spare. The units are manufactured by Beta Monitors and Controls of Calgary, Alberta. The same company supplies the Canadian navy with the Data Trap, the computer-based portable machinery vibration data collector used in the fleet vibration program. **— by Bob Bellini, NETE; with files from Lt(N) Greg Royston, DMEE 2-4-3.**

MARE occupational analysis

Last August, at DGMEM's request, the Directorate of Manpower Planning in NDHQ began a year-long analysis of the Maritime Engineering (MARE) occupation. The aim is to objectively examine the ability of regular and reserve MARE officers to meet their assigned roles in peace and war. The data gathered on MARE selection, training, employment and career development should indicate whether the MARE occupational specifications, last adjusted in 1989, need to be fine tuned.

"It's a snapshot of what the MARE occupation is doing," says **LCdr Dan Powell**. He and **LCdr Garth Taylor** form the MARE contingent on the analysis team led by DMP analyst **Capt Bob Babin**. According to Powell the team has already completed its scheduled interviews with a representative five percent of the MARE population, and early in 1994 will administer questionnaires to all qualified MARE officers.

The current analysis has roots going back to the late '70s and early '80s when unusually high attrition left the MARE occupation critically short of trained officers. Official reaction to the crisis brought about the 1983 MARE Study and the MARE Get Well Program. Occupational specifications were adjusted in 1983, and again in 1989 following the 1987 MARE Establishment Review.

The occupational analysis team is scheduled to table its final report and recommendations next July 15 before a senior MARE advisory group headed by **Cmdre Robert L. Preston** (DGMEM).

Gold medal for CSE

PHOTO COURTESY OF ROYAL MILITARY COLLEGE

Combat Systems Engineer Lt(N) Steve Morton receives the Governor General's Gold Medal for academic excellence from Royal Military College Commandant MGen J.E.J. Boyle. Morton, currently the DMCS 3 project engineer for the Arctic Subsurface Surveillance System, received the award last May on completion of his Master of Electrical Engineering program. The medal is awarded at Canadian universities to the student graduating with the highest academic standing in a graduate degree program. Bravo zulu!

NETE celebrates 40 years of operations

The Naval Engineering Test Establishment has celebrated its 40th anniversary as the navy's principal centre for naval test and evaluation. Established in 1953 to test the steam and auxiliary machinery of the navy's new destroyer escorts, NETE operates as a government-owned, contractor-operated (Peacock Inc.) field unit of the Materiel branch. Commanding Officer **LCdr Josef Frigan** oversees NETE's activities as the on-site DND inspecting and co-ordinating authority.

In its 40-year history NETE has experienced significant changes in meeting the ever-changing technological needs of the Canadian navy. From a unit of fewer than 60 civilian employees in 1953, the Establishment has grown to employ a staff of about 140, including those at detachments on each coast. Since 1991, NETE has acted as the in-service engineering agent for the Mk 48 guided missile vertical launch system, providing technical support to the Netherlands, Greece and Canada (*Maritime Engineering Journal*, June 1992, page 30). Recent renovations to the primary facility located in the Montreal suburb of LaSalle, Quebec include a new environmental chamber, replacement of the original steam-generating plant, and the modification of the gas turbine test cell to set up a land-based test site for the Allison 570K TRUMP cruise engine.

On Sept. 9, four of NETE's 16 former commanding officers — **LCdr (ret.) Charles McLauchlan** (1963-68), **LCdr (ret.) Bill Durnin** (1974-76), **LCdr Jacques Lavallée** (1984-88) and **LCdr Gilbert Moineau** (1988-91) — joined NETE personnel in commemorating the success and endurance of the Establishment. The occasion was also used to honour 58 employees with long-service awards. Earlier in the month NETE's Equipment Health Monitoring section head, **Fumio Motomura**, was recognized for his 25 years of dedicated service. — **Raeann Rose, Project Administrator, NETE.**

NETE PHOTO BY GEORGE CSUKLY

Happy 40th, NETE!

Best Wishes! Tom Speirs retires after 30 years with NETE

After a productive and rewarding 30-year career with the Naval Engineering Test Establishment, Tom Speirs has retired as head of the Combat Systems & Instrumentation section.

A native of Clydebank, Scotland, Speirs was educated at Paisley Technical College and emigrated to Canada with his wife Betty in 1954. After nine years with RCA Victor, he joined NETE as an instrumentation technician in May 1963. From a one-man operation providing instrumentation and measurement support to NETE engineers, he rose to head a section of 17 with a mandate to test and evaluate naval combat systems and equipment. He was also responsible for overseeing the NATO Seasparrow Mk 48 GMVLS in-service engineering agent (*Maritime Engineering Journal, June 1992, p. 30*) in Halifax.

During his 30 years at NETE, Speirs dealt with phenomenal advances in technology and successfully guided his staff in making the transition from analog to digital measurements. A dedicated professional, he never compromised on quality and always remained amiable and approachable.

His colleagues wish him a long and healthy retirement to enjoy his two children and four grandchildren. — **Rodney Kennett, Manager, Technical Support Services, NETE.**

Tom Speirs

HMCS Vancouver!

CF PHOTO: HSC 93-0505

HMCS *Vancouver*, seen departing Halifax, was commissioned in Vancouver Aug. 23. The City of Vancouver, represented by Mayor Gordon Campbell, presented the new patrol frigate with a ship's bell. *Vancouver* is the first CPF to be assigned to the Pacific fleet.

The AN/SQR-19 Towed Array

Coming up in our next issue

PHOTO: LT(N) STEVE MONKHOUSE

HMCS *Fraser*