National Defence / Défense nationale

Maritime Engineering Journal

February 1995

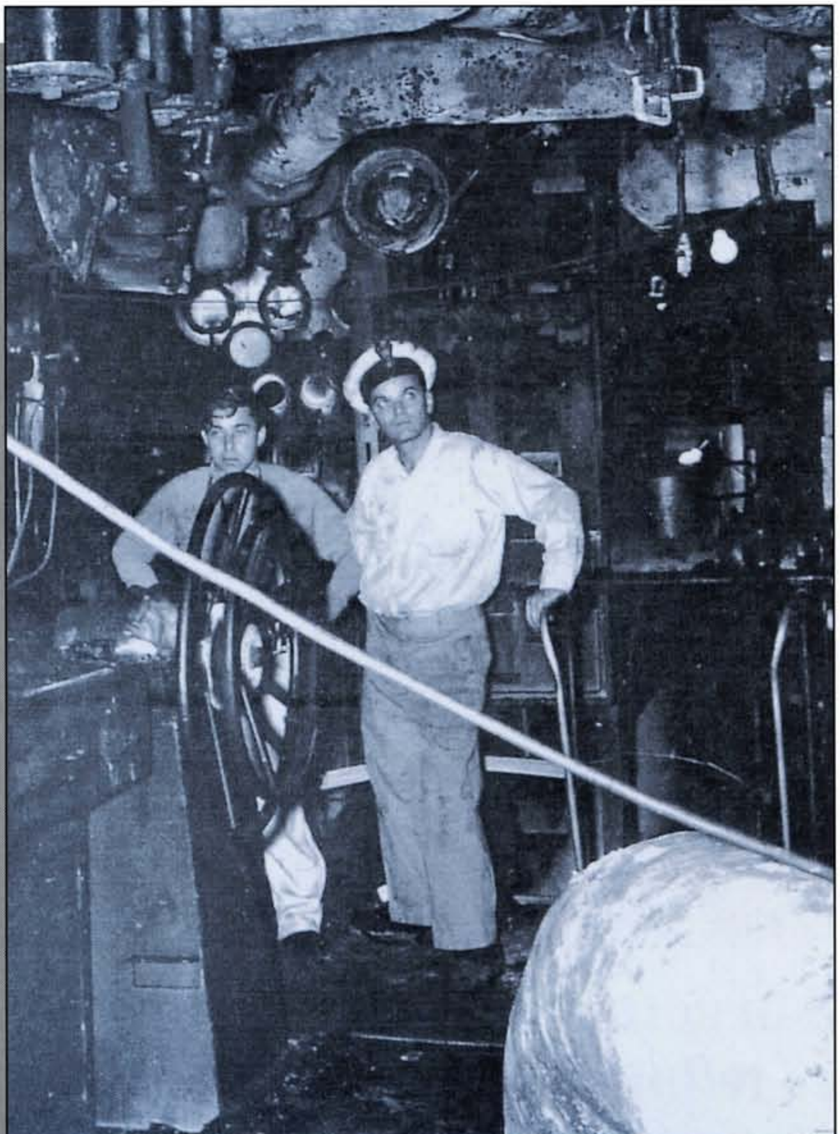
Cambodia — The Forgotten Mission… Two MARE officers tell their story

Also:

- *A CO's Expectations of the MARE Department Heads*
- *Looking Back at the 1969* **Kootenay** *Gearbox Explosion*

Canada

Oct. 23, 1969: Looking Back at a black day in Canadian naval history…see page 25



Maritime Engineering Journal

Established 1982

Director General
Maritime Engineering and
Maintenance
Commodore F.W. Gibson

Editor
Captain(N) Sherm Embree
Director of Marine and Electrical Engineering (DMEE)

Production Editor
Brian McCullough
Tel.(819) 997-9355
Fax (819) 994-9929

Technical Editors
LCdr Keith Dewar (Marine Systems)
LCdr Doug Brown (Combat Systems)
Simon Igici (Combat Systems)
LCdr Ken Holt (Naval Architecture)

Journal Representatives
Cdr Bill Miles (MARPAC)
(604) 363-2406
CPO1 Jim Dean (NCMs)
(819) 997-9610

Graphic Design
Ivor Pontiroli, DPGS 7-2

Translation Services by
Public Works and Government Services
Translation Bureau
Mme. Josette Pelletier, Director

FEBRUARY 1995

DEPARTMENTS

Editor's Notes 2
Letters 3
Commodore's Corner
by Commodore F.W. Gibson 4

FORUM

• A Mouse in the Navy: Does it Belong?
by Barbara Ford 5

FEATURES

Special: Cambodia — The Forgotten Mission

Part 1: Apocalypse II
by LCdr Ted Dochau 6
Part 2: The CSE as a Military Engineer
by Lt(N) Rob Mack 11
A Commanding Officer's Expectations of the MARE Department Heads
by Cdr D.J. Kyle 13
The Effect of Multipath Propagation in Missile Engagements
by Lt(N) M. Fitzmaurice 17
Alternative Posting Opportunities for MAREs
by LCdr Derek W. Davis 20

GREENSPACE:

Land-based Oily Wastewater Treatment...
Oil and water — they do mix!
by Lt(N) Mike McCall 22

LOOKING BACK:

HMCS *Kootenay* Gearbox Explosion and Fire
by Lt(N) David Sisley 25
NEWS BRIEFS 28

OUR COVER

Hearts and Minds: UN peacekeepers in Cambodia waged their own campaign on the local population with first-aid clinics and other community service. *(Photo by Lt(N) Rob Mack)*

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

In Praise of Engineering

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

Since the last issue of this *Journal*, the Maritime Engineering community has seen profound change in its personnel situation. The retirement option offered by the Force Reduction Program has been accepted by a significant percentage of highly trained, competent and experienced naval engineers from the rank of officer cadet to captain. Since the initial round of offers, the number of retirees has risen to include another captain and none other than our Branch Adviser, Commodore Robbie Preston, who retired in mid-December.

Although these engineers will be sorely missed, naval engineering will survive. As has happened in the past, we will depend on a resilience developed through an excellent education and training system, access to superb equipment and systems, and an industry capable of complementing our own skills and abilities. Still, the "can-do" attitude discussed in my June 1994 editorial and in Captain R.L. Donaldson's letter in this issue will be sorely tested.

Canada's corps of naval engineers is a vital part of a much wider navy/DND team. Where once the fighting trim of a vessel was determined solely by the efforts of the seaman branch, the engineers are now as much in the driver's seat in determining platform performance as the seaman branch is in skilfully fighting the vessel. Together we contribute to the fulfilment of the navy's assigned role.

Engineers are also a vital part of society as well. According to the essay "In Praise of Engineering," published in *The Royal Bank Letter* (Vol. 67, No.5, Sept./Oct. 1986), "The world we live in has largely been created by engineers, who have delivered blessings to mankind since the dawn of history." Engineers, the author states, are meant to take ideas and make them work. "From the beginning, Canada was an engineer's country. Today as never before Canadian engineers are spreading their skills around the world, helping to make life better for people in other countries." An engineer's guiding interest, the essayist maintains, must be "concern for the fate of man."

Despite the loss of so many of our skilled and experienced engineers, I am certain they will continue to contribute, as we will in the navy, to the betterment of Canada. We wish them well.

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 3.5" 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

Can do: naval structure requires capacity for flexibility

Dear Sir,

I am responding to your note about the "can do" attitude, as over the last few years I have had the experience of implementing projects that required such an approach.

The SUBTASS project, with a mandate to provide towed array sonar systems for the *Oberon*-class submarines, is a good example of the "can do" approach. The project is providing three off-the-shelf towed array systems with a total budget of $9.6 million. Successful installation of the first SUBTASS system in HMCS *Okanagan* during her last refit would not have been possible had it not been for the flexible and co-operative approach taken by the matrix members and the coastal organizations such as SM1, NEUA, SRUA and Base Supply.

Of course, flexibility requires resources, but as resources dwindle as they have over the last few years this kind of approach becomes much more difficult to pursue. And yet, we will continue to be faced with circumstances that require innovative and timely solutions that cannot be achieved through the pursuit of a regular course of action — such as was the case with SUBTASS. It is therefore essential that any new naval structure being considered under ongoing reorganization efforts possess the capacity for flexibility.

After all, our business is to serve Canada, under any circumstances. Can do indeed. — **Simon Igici, Directorate of Maritime Combat Systems, NDHQ**.

Can "dos and don'ts"

Dear Captain Embree,

Your provocative editorial in the June number prompts these thoughts on "The can do attitude - blessing or curse?" The RCN inherited a full set of splendid traditions in 1910. Many of them we could not have developed in the few decades of our existence. Some we haven't used yet: we shall never leave the Army in the lurch, for example, because a tradition tells us for certain what is expected of us. One, though, we have not only practised, but embellished: that when the country calls, the fleet will sail.

HMCS *Rainbow* started it by sailing on 1 August 1914 to search for the *Leipzig; Fraser* and *St. Laurent*, at four hours' notice in Vancouver, sailed in two and a half for the East Coast on 31 August 1939; when North Korea invaded the South on 25 June 1950, it took only until 5 July for the navy to sail a three-ship destroyer division to support the hastily-established UN command. As to the navy's response to the invasion of Kuwait, your readers will be more aware of the accomplishment than those of almost any other publication. Arguably, I believe, all hands concerned were inspired by this tradition.

I enclose, however, a copy of a paper recently published in the Defence Association's National Network News. The point it labours to make is that, while sailors did their part, all too often politicians left the navy ill-equipped for the job they sent it to do — and at the risk of sailors' lives.

My answer to your question, therefore, is this: the can-do attitude is a magnificent tradition, but a dangerously inadequate basis for planning.

On a more pedestrian note, may I recruit you into my campaign for some sanity in the deployment of "(N)" after certain ranks? It occurs to me, first, that it is only a written (and formal) form of address so that, while the envelope describes you as Captain(N) SB Embree CD CF, my salutation is merely Captain Embree: by extension, the body of an article need not continue such cumbersome usage once the individual has been identified. Secondly, the purpose of the suffix is to distinguish these naval ranks from homonymous military ranks — a requirement peculiar to the CF, since the letters RN, RNLN, RAN (and, of course, RCN), etc., after a name eliminate ambiguity. One must wonder, therefore, why poor Capt Baller RN has to submit to the indignity on page 19. I believe one reason is the more frequent omission of the service identifier after the name: a caption on page 21 correctly refers to Capt(E) Flameling RNLN, but RAdm Walmsley gets his RN in brackets on page 20, as does Flameling's colleague Osseweyer on page 21. Ah, the privilege of being an editor!

Please forgive any criticism you may think is implied. The Journal reflects a gratifying ability of the modern MARE officer to communicate clearly, it has better writing than most Service publications and I greatly enjoy reading it. Yours aye — **R.L. Donaldson, Captain, RCN (Ret.), 2848 Dewdney Ave., Victoria, BC V8R 3M6.**

Dear Sir,

Oh well, I suppose it had to happen sometime! I see the *Maritime Engineering Journal* has succumbed to the disease prevalent in other Canadian Forces publications of applying unique (and, in my opinion, unnecessary) Canadian rank designations to members of other navies. I refer to the picture on page 19 of the June 1994 edition in which Capt. Tony Baller RN is incorrectly labelled as a Capt(N). I must say that this practice smacks somewhat of a mixture of arrogance, ignorance and insensitivity on our part. Yours aye — **P.D.C. Barnhouse, Directorate of Research and Development Maritime, NDHQ.**

Commodore's Corner

Everything old is new again

By Commodore F.W. Gibson, DGMEM

In my last Commodore's Corner a year ago, I talked about the change and challenge facing Canada, the navy and the Maritime Engineering community. Not surprisingly, now that we are one year farther down the road, both the change and the challenge are taking shape — at least as much as they ever do in a dynamic situation. The renewed fleet has had its first operational assignments in the midst of the new world conflicts, while on the home front the reality of our fiscal situation is increasingly strident. Perhaps it is now time to comment on the factors and realities that I believe will shape our future.

The first and most important factor is that the need for fleet support is and will continue to be the cornerstone upon which Maritime Engineering activity is based. This should not be surprising; rather, it should be a source of comfort. Our raison d'être is understood and is the same as it has always been. The anchor that we have always relied upon will remain.

The second is that our focus will shift from acquisition engineering and procurement to in-service support as the fleet renewal projects wind down. Increasing emphasis will have to be placed on our appreciation of the "new" technology and the strategies that will have been put in place to operate and maintain it. How best to refine it over time to ensure maximum operational effectiveness will also be addressed. This shift should not be viewed as any lessening of opportunity to practice our trade or profession, but rather simply as a change in focus.

The third reality will be that fleet support will likely involve more contractor support than it has in the past. Contractors have always been involved in designing and producing systems, equipment and software and will continue to be involved in this area to the extent that the capital replacement program allows. It is suggested, however, that contractors will play an increasing part in fleet support, given the imperative to downsize the military and public service and the belief by some that contractors can provide support at less cost. How much will be involved or in what areas is not clear. Should this cause us alarm? I would suggest not. Clearly, if it makes sense to execute some or more of our business in this fashion, then so be it. The overriding criterion must be that fleet support be offered as efficiently and expediently as we can make it.

The final reality is that the engineering support community is going to be smaller, what with the major capital projects winding down, fiscal reality being what it is, and the sense that cuts should be taken in the "support tail" instead of the "sharp end." What impact this will have on how we do our business and how we will train ourselves is not yet clear, but if we are going to continue to do our job we will have to answer these questions and more.

What will the organizational framework be in which this engineering support is provided? The short answer is that we don't know yet, since the entire system (in effect, the life-cycle material management system) is being examined within the Materiel Group in NDHQ and within Maritime Command. It is safe to conclude, however, that there will remain a shipboard technical organization, a command technical organization and a headquarters technical organization, simply because our ships float and Ottawa is where the money is. What we are left to sort out is the wiring diagram that offers the most for the least.

I confessed in my last Commodore's Corner to not having a crystal ball. You will probably agree that I still don't have one, but I would observe that it doesn't take a rocket scientist, a software guru or a commodore to read the past. The challenges will remain everpresent; we will overcome them. Change is our reason for being — everything old is new again. The challenge to cope will be immense. Are you prepared to rise to it?

Readership Survey

Reader response to the survey we enclosed with our October 1994 issue has been tremendous. So far the comments have been constructive and, at times, imaginative. We want to hear from as many readers as possible. If you have already sent in a completed questionnaire, we thank you. If not, there is still just time to get your comments in to us if you act quickly. A full survey report will appear in the June issue.

A Mouse in the Navy: does it belong?

Article by Barbara Ford

There is some resistance to allowing a mouse into the navy. There is concern that the computer pointing and selecting device known as the mouse is inappropriate for use at sea. For example, the computers in the operations rooms of the fleet use trackballs, touch pads, joysticks and even light pens — anything but a mouse — for pointing and selecting.

The purpose of this article is to propose the suitability of the mouse for ops room computers. Perhaps by stimulating thought and discussion about the usefulness of a mouse at sea there can be more respect for, and reconsideration of, its benefits.

In my work with the Canadian Naval Electronic Warfare System I have watched ESM operators struggle with inaccurate joysticks and awkward trackballs. Lightpens present their own problems because of the amount of time an operator's arm must be suspended uncomfortably in mid-air while selecting screen functions. Although these devices are effective in some applications, in industry it is the mouse that is most often the pointing and selecting device of choice. Known for its fast, accurate capability, as well as its ease and comfort of use, the mouse enables the cursor to be moved quickly to a selected point on the screen and held there. When the mouse is used at a proper work height, the operator's arm is never fatigued since the arm and heel of the hand are comfortably supported.

This all works well in the lab or office. But what about at sea? Sailors, unlike scientists, must contend with cramped work areas and work surfaces not guaranteed always to be horizontal. Will the operators be able to manipulate their on-screen windows easily and without conscious effort?

Problems

The issue of having to operate a mouse within a cramped work area is actually no more difficult than the situation with the trackball and joystick. The space required to operate a mouse is typically 8 inches by 10 inches. Trackballs and joysticks, and their associated buttons, require almost that amount of space to allow the operator to effectively move his hand.

The navy's greatest concern, of course, is that a mouse will roll off the flat surface on which it is operated. Naturally, this would pose a serious inconvenience and could lead to damaged equipment. The mouse could always be restrained by a short tether, but let's take a closer look at the problem.

The nature of modern human/computer interfaces (HCIs) requires the operator's hand to be on the mouse most of the time. Only occasionally are functions performed that do not require a mouse: using the keyboard, using earphones alone, consulting database hardcopy listings, etc. In these situations the mouse must be stored in a standard, convenient place such as an open frame box or bag, slightly larger than the mouse, or hung on a handily located hook. There are precedents for such mouse accommodations. A frame box attached to the side of the monitor is used on the Modified Communications Emitter Locating System (MCELS) to store the mouse when not in use. Returning the mouse to its storage place, or retrieving it, must be effortless.

Perhaps the best solution for the naval environment would be to use a mechanical mouse (optical mice need a hard, slippery pad) and a neoprene pad with a rounded, slightly elevated border that would not interfere with the movement of the mouse or irritate the operator's hand. In addition to the mouse being corralled, the friction against the neoprene would help keep the mouse in place.

Would the navy need to ruggedize a mouse for use at sea? I believe it would be both too costly and unnecessary. A mechanical mouse costs less than $100 and at that price spares could be readily available.

Changing Attitudes

The idea of using a mouse in the ops room was introduced to ESM operators who came to the Defence Research Establishment Ottawa to test the HCI prototype for CANEWS 2. Most of the operators at first expressed concern over the use of a mouse on the prototype, saying it would be unacceptable for the final version. They were assured only a suitable pointing and selecting device would be fielded, which we all assumed would be a trackball. But after using the mouse for less than 15 minutes, the operators began to appreciate the ease of using the mouse and questioned why it could not be used on board ship. DREO in turn began to consider its possible use in the end-product and started researching methods of accommodating the request. Some of this process has been noted in this article.

In view of the amount of functionality available to shipboard ESM operators and the amount of manipulation of the human/computer interface required of them, the mouse is an excellent choice as a pointing and selecting device. It allows fast, accurate cursor movement and easy item selection by pressing the convenient button. In addition, even after extended use of the mouse on a work surface at a comfortable height, the arm of the operator is not fatigued. Considering the enthusiasm with which the mouse was received by ESM operators, and the methods determined for coping with the unique naval work environment, there is no reason why the mouse could not be welcomed in any warship's ops room.

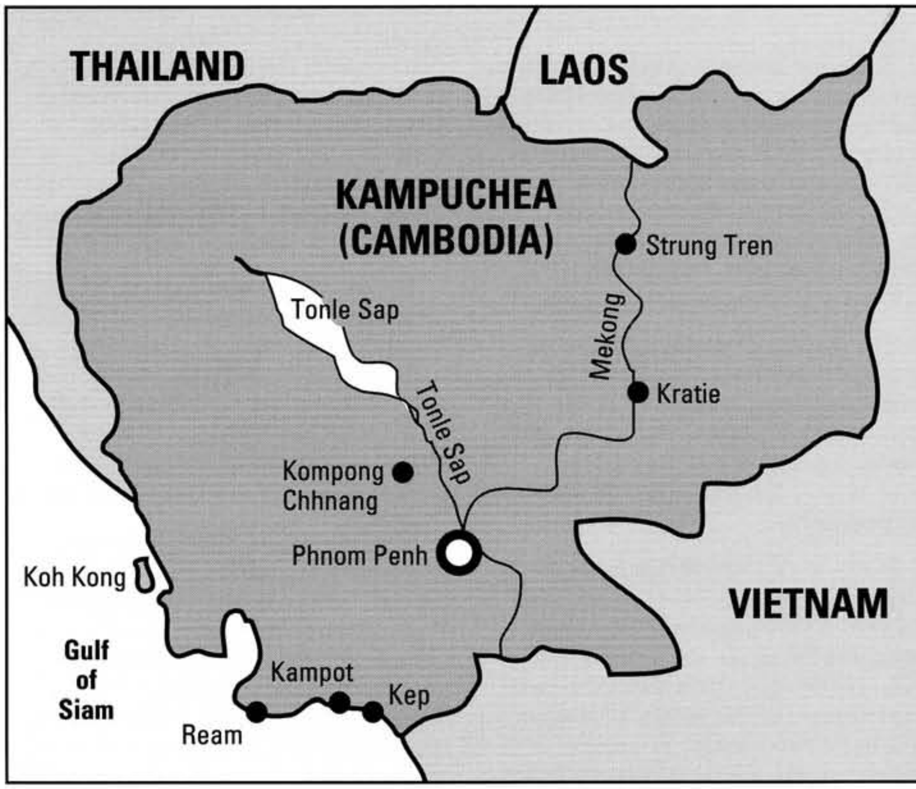
Barbara Ford is a defence scientist with the Electronic Warfare division of Defence Research Establishment Ottawa. Her article, "The Role of the End-user in the Design of Effective ESM Human/Computer Interfaces," appeared in the October 1994 issue.

Cambodia — The Forgotten Mission

Part 1: Apocalypse II

Article by LCdr Ted Dochau

On the 17th of April 1975, the Khmer Rouge (Communist guerilla forces in Cambodia) led by Pol Pot and backed by China and Russia, toppled the U.S.-backed Lon Nol government in a war of attrition. Upon taking the capital city, Phnom Penh, the Khmer Rouge implemented one of the most brutal restructurings of a society ever attempted;[1] their goal was to transform Cambodia into a Maoist, peasant-dominated agrarian co-operative. Within two weeks the populations of the capital and the provincial towns were force-marched into the countryside to perform slave labour. Disobedience of any sort often brought immediate execution.



Over the next four years at least one-sixth of Cambodia's population of six million people died as a direct result of the policies of the Khmer Rouge government. Between 1976 and 1978 Pol Pot's xenophobic government initiated a series of border clashes with Vietnam. Vietnam finally launched a "small-scale" invasion into Cambodia on December 25, 1978. The Khmer Rouge retreated at every encounter and within a few weeks the Vietnamese army entered Phnom Penh against only light resistance. The Khmer Rouge fled westward into Thailand while Vietnam installed a puppet government in Phnom Penh.

By 1989 Vietnam was suffering from a U.S. trade embargo and was eager to reduce its international isolation. In September Vietnam withdrew its troops from Cambodia, but in the vacuum created by their departure an ongoing civil war between government forces and rebel factions intensified. The international community soon came under pressure to restore stability to the region and to solve the problem of half a million Cambodian refugees in Southeast Asia.

In September 1990 a peace plan (the Paris Treaty) agreed to by the UN Security Council recognized a seven-member coalition, or Supreme National Council (SNC), representing the Phnom Penh government and the three resistance factions in Cambodia. The SNC, which was considered the embodiment of Cambodian sovereignty, conceded authority in foreign affairs, defence, internal security, finance and information to a United Nations Transitional Authority in Cambodia (UNTAC).

A Japanese career diplomat, Yasuski Akashi, was assigned to head UNTAC. (Japan was that eager to develop economic interests in Cambodia that they financed close to half the total UN mission costs there.) Akashi was given 5,000 civilians and 17,000 military peacekeepers to achieve his mandate of disarming the government and rebel factions equally and administering free and fair elections in 1993. Canada was invited to participate in what was then the most ambitious mission ever undertaken by the UN. Canada agreed to send a transport company of 220 officers and men, a half-dozen field engineers for mine clearance and 30 naval observers.

To understand the requirement for a naval component, one must first understand the country's geography and climate. Cambodia covers a land area of 181,035 square kilometres, about twice the size of New Brunswick. Cambodia's two dominant topographical features are Tonlé Sap Lake and the Mekong River. The Mekong, which is connected to the Tonlé lake and river system, is almost five kilometres wide in places, rising in Tibet and flowing more than 300 kilometres throughout Cambodia before continuing through southern Vietnam to the South China Sea. During the wet seasons most of the rivers overflow their banks, making highways and rural roads practically useless. Most fighting stops, with the exception of skirmishes on the rivers. At these times most transportation is by boat and the waterways become the primary communications routes for the country.

A government soldier armed with a rocket-propelled grenade guards the road leading to the UN vessels

Six naval officers (1 CSE, 1 MSE and 4 MARS) were selected to form a naval RECCE group in Cambodia. Our initial mission was to determine the size of the Canadian naval contingent that would be required and to report home on the status and mandate of the UN naval cell in Cambodia.

After one day of "jungle training" at CFB Valcartier and four days of briefings in Ottawa, we arrived in Phnom Penh on May 8 1992. In accordance with the Paris Treaty the Cambodian naval authorities were to turn over an initial 30 percent of their vessels to UNTAC. (The rest were scheduled to be handed over later.) The Cambodian admirals were reluctant to hand their ships over to the UN, but in the end they agreed to comply with our mandate. These vessels would be used by the UN naval component during the UNTAC mission.

I was immediately tasked to do a complete engineering evaluation of all the ships at the River Base in Phnom Penh and at Ream Naval Base on the coast. All told there were 27 Soviet-built patrol craft (including two 190-ton fast-attack hydrofoils), two U.S.-built patrol craft, eight landing craft (mostly U.S.-built) and to round out the fleet a Vietnamese-built ferry boat. Two U.S.-built floating docks, with lift capacities of 500 tonnes and 1,000 tonnes, also came under our charge. Eighty percent of these vessels had been non-operational for two years. I was told they only required fuel, oil and new batteries before they could be used, but found instead that the majority required dry-docking and major repairs. Many were beyond hope.

I was against repairing the Cambodian vessels from the start. For one thing, it would not be cost-effective. Replacement parts were not readily available, and those that could be acquired would cost us dearly. Moreover, as the vessels were still "owned and operated" by the government faction we would require Cambodian assistance in crewing the vessels, thereby contravening UN neutrality policy. (This created a number of dangerous incidents for us later in Khmer Rouge territories.) My recommendations to refit only the coastal vessels required by the UN and to purchase small, solid-hull outboard craft for the rivers were dismissed. (Later, when the ships were slow coming out of refit because of a lack of replacement parts, the naval command bought 50 rigid-hulled inflatable boats.)

Part of my task was to assess the feasibility of using a 170-tonne Soviet-built Stenka fast-attack craft to tow six smaller patrol vessels from the coastal base, through Vietnam's coastal and inland waters, to Phnom Penh. While evaluating the capabilities of the Stenka I had the opportunity to experience the thrill of manning the MCR in one of these 37-knot attack boats. Lt(N) Chuck Doma, the team's CSE, also enjoyed the unique challenge of evaluating the Soviet-built electronic systems. Unfortunately, the lengthy negotiations for passage through Vietnamese waters (during which I acted as the interpreter for our Uruguayan naval commander and the Vietnamese ambassador to Cambodia) proved fruitless. The Vietnamese government was demanding too high a transit fee, and so the vessels were never transferred to the Mekong river to supplement the inland fleet.

After completing the evaluation on the ships, I was tasked with setting up a repair infrastructure in Phnom Penh and given 125 Cambodian officers and men for the job. I set up four divisions — Engineering, Electrical, Hull and Floating Dock — under the command of a non-engineering Cambodian officer, Lt.-Cdr. Wandi. The section heads were chief petty officers, but to my bewilderment I learned that only a few men in each section had any technical training. The rest were either apprentices, or else had no technical skills or experience. By contrast, the officer corps was well-educated. The upper-deck officers had all attended naval college in Vietnam, while the engineers studied at engineering college in Russia.

The Cambodian sailors were only paid about 10-18 dollars a month, with paydays coming about four times a year. They also received rice from the government and about 2 dollars a month for a food allowance. The crews pooled their food money, which normally sufficed for

An American-made PCF-class fast patrol boat lies outboard of two Soviet-built 1204 Shmel-class river patrol craft at Ream naval base.

about 10 days. To get by they had to fish and sell some of the ship's fuel. Without a doubt they were the hardest-working, most ingenious crews I have ever encountered. With what little tools they did have, they were able to do wonders.

One of the first observations we made while working with the Cambodians was the non-existence of safety procedures. The work areas were littered with land mines, the floating fuel barge was being used as the main repair platform, bare wires were plugged straight into electrical sockets (ground wiring was never used), welders were using fake "Ray Ban" sunglasses in place of protective shades, ammunition was being packed into extremely hot lockers, there was no fire-fighting equipment on the vessels — the list goes on. It was a wonder no one was killed. We started teaching safety practices to the Cambodians as much for their safety as for ours.

Before we could start refitting the ships, we had to search the local markets for proper tools and services for the dockyard and ships. To refit the small, Soviet-built Kanos patrol craft (which required several weeks each to rebuild and paint white with UN letterings) the main engines had to be stripped and cleaned at the dockyard, crankshafts realigned at a local shop, injector and fuel pumps calibrated at another shop in the city, alternators rewound, and voltage regulators found in the markets. Wood had to be bought to replace rotten decks and frames. With no capability to weld aluminum, we had to use rivets or glue and fibreglass to repair small leaks. Electrical switches and contacts had to be found. Communication equipment such as VHF and HF radios had to be installed and liferafts, lifejackets and rescue flares had to be ordered.

If the Cambodian navy had any spares they weren't telling us about them. We knew as well as they did that parts would be extremely hard to replace once consumed, and so they were saving them for when they would need them most — fighting off aggressors after the UN left Cambodia. When a part couldn't be found we either rebuilt it or else put our heads together and redesigned a unit or system to make the ship run. Under the circumstances, resorting to unconventional acquisition and repair methods was the only way to get the vessels ready for the UN mission.

A month after my arrival in Cambodia, the remainder of the Canadian naval contingent, consisting of 24 personnel, arrived. At this time the UN naval strength had grown to about 230 officers and men from Canada, the Philippines, Chile, Uruguay, New Zealand and Britain. From our HQ in Phnom Penh, we expanded to 14 outstations throughout the country. Each station had 12 or more people and an allotment of various ships for patrols.

The author, showing the flag.

After two months of operations I set up a mobile repair team which travelled by ship, helo, airplane or automobile to the outstations. The problem was that when mechanical breakdowns occurred on the ships, the naval observers at the outstation involved couldn't relay the cause due to their limited technical backgrounds. Therefore the repair team couldn't take the proper replacement parts and time was wasted.

The shortage of engineers meant I was never offered a chance to be a team leader at the Thai or Vietnamese borders where my language abilities might have been an asset. (I am an ethnic Vietnamese and speak Thai, French and English in addition to my native Vietnamese.) While at River Base Phnom Penh, I went on patrols of the Mekong or Tonlé Sap rivers about twice a week. Our mission involved showing the UN flag, distributing UN pamphlets, boarding commercial ships to check for weapons and other contraband, contacting and establishing relations with rebel groups, collecting intelligence on government and rebel forces, conducting search and rescue operations, and investigating and closing down extortion operations.

My most memorable outing was a three-day river patrol into territory reportedly held by the Khmer Rouge. I was in the lead Zodiac with a petty officer from New Zealand and an ethnic Vietnamese interpreter. Because of the Khmer Rouge's active hatred of Vietnamese, I instructed the interpreter never to speak Vietnamese or reveal that we were ethnic Vietnamese. Two Filipino petty officers rode the second Zodiac about 100 metres astern. Each boat kept a flare ready so that, if ambushed, we could warn the other Zodiac to escape. This was the first encounter with the Khmer Rouge within their territory for the UN naval observers, and we didn't know how the guerrillas would react to our presence.

Two kilometres into the river we came around a bend and literally collided with a nine-man Khmer Rouge patrol in three row boats. They were more surprised than we were, but once they confirmed we weren't carrying weapons, and therefore were not a threat to them, they took us to see their commander. He preferred not to show himself, but we knew he would be among the men watching our moves. We left the area after being allowed to visit a village that was under their control. I told them I would be back in a week to see their commander and also that I had to go farther up the river. The following week another patrol tasked to continue where we left off came under fire from the unpredictable Khmer Rouge.

After seven months at River Base, I received a six-month tour extension and was redeployed to Ream Naval Base as the deputy engineer. The organization in Ream was much different from the one I had set up at River Base. Each ship's engineering department was on its own and had no support from other ships. (Just before I arrived the base's technical support unit had been disbanded due to lack of utilization.) In most cases the crews relied on the UN for assistance.

National election results posted in the streets of Phnom Penh. When the in cumbent government refused to concede a narrow defeat, a coalition was eventually formed with the winning opposition party.

The problems at Ream were similar to those at River Base. The tools for the base and for individual ships were inadequate. Twice at sea I had breakdowns, but no tools suitable for minor repairs. Due to the complexity of repairing the Soviet-built vessels, the UN obtained the services of five Russian naval engineers (all senior to me) who would work as technicians.

The navy's tasks at Ream were quite similar to those at the River Base — patrolling the coastal areas, countering the smuggling, checking for illegal fishing, search and rescue, resupplying coastal stations, and supporting electoral staffs. We also played a significant part in the UN's evacuation plan.

As the country approached the UN-controlled national elections, various factions began intimidation programs that caused us to increase security precautions during our patrols. Flak jackets and helmets became mandatory, we carried field packs with three days' emergency rations, and a 10 p.m. curfew was established for all UN personnel. During my time in Cambodia about a dozen UN personnel were killed and several dozen wounded as a result of military actions. (Twice that many were injured or lost their lives to accidents and illness.) One group of naval observers was taken and held hostage by the Khmer Rouge for four days.

True to the surveys, in May 1993 one of the opposition parties won the election by a small margin. The government, denied a recount by the UN, refused to give up power. Eventually a coalition government was formed between the two parties. At last report, the newly formed coalition government's armed forces were fighting the Khmer Rouge in the jungles and Thailand border areas, much like the situation from 1969 to 1975, and from 1979 to 1990.

The degree of success of the UNTAC mission is a debated point. The UN did achieve some success in unifying three of the four warring factions, in establishing a recognized, legitimized government and in creating economic stimulus in the region. At the same time, bearing in mind UNTAC's mandate, there were some failures: the demobilization phase failed (due to the non-participation of the Khmer Rouge), the government refused to relinquish power after losing the election, and Cambodia remains in a state of civil war.

From my own observation of the UN's organization, operation and control of the mission, I feel it could have been more effective. With the aim of improving future missions, I offer the following suggestions:

a. Mission definitions should be appropriate to the situation, i.e. peacekeeping shouldn't be applied in the absence of an effective ceasefire;

b. Effective control and enforcement of the mission plan is essential, particularly during critical phases;

c. Key personnel assignments in the mission's organization should be closely scrutinized by the UN.

Two U.S.-built patrol craft are refloated after their refit.

These policemen were persuaded to return the money they had extorted from boaters passing through their checkpoint.

Qualifications, merit, experience and capabilities should be the only selection criteria;

d. The UN should ensure that all participating countries have adequately prepared their personnel for the mission. Training should cover standard organization and procedures of UN missions;

e. A program is required to ensure appropriate leadership, supervision and control of all UN personnel. The program should ensure all peacekeepers are fully cognizant of and accountable for their tasks and responsibilities, and maintain the respect of the local population through due regard to the sensitivities of the local culture;

f. The UN must not hesitate to apply effective measures to prevent outside countries from hindering an established peace process;

g. Effective follow-up programs are required after completion of a mission to provide positive guidance and administrative support to the local government and to help prevent corruption and the devaluation of human rights.

Furthermore, for the UN to get the maximum performance out of Canadian peacekeepers we must do the following:

a. Ensure units are in a position to allow all interested personnel to volunteer for a UN mission;

b. Install a review board to set up a thorough screening process for potential UN candidates;

c. Establish an intensive training program geared to peacekeepers.

The government and senior military officers should support and encourage maximum Canadian participation in all UN missions. In time of peace, UN missions offer valuable training and experience for our forces. The small group of Canadian naval observers in Cambodia made a large impact on the country and its naval establishment. The friendships and influences they made are certain to be beneficial to Canadian foreign affairs.

The Canadian naval contingent was small compared to those of other countries, but I am convinced it was by far the most effective. I believe this was based in the Canadian military's strong foundation of professionalism. When post-UNTAC plans called for a country to provide naval advisers to guide the Cambodian Navy into the future, the Cambodian Chief of Naval Engineering expressed a desire for Canada to provide this service. This may have been an ideal opportunity for Canada to get a return on its peacekeeping investment by establishing lasting political and economic ties with Cambodia and greater Southeast Asia. In the end France was the only country to volunteer its services, albeit in the face of lukewarm Cambodian acceptance because of still-bitter memories of the era of French colonization in Indochina.

For most naval observers the Cambodian experience meant enduring the stress and danger of minefields, mortar bombardments, warning shots (or otherwise), personal threats and maladies ranging from diarrhoea to malaria. Still, I am grateful for having had the opportunity to go to Cambodia as a naval observer. The experience I gained through my naval career at FMG, SRU and as MSEO on board HMCS *Skeena* prepared me well for my tasks.

Acknowledgment

I would like to mention my appreciation to the following engineering personnel with whom I enjoyed a close working relationship while in Cambodia: Lt(N) Chuck Doma CSE, C2ER George Robertson, C2ET George Cormier, C2ER Brian Smith, P2ET Ron Hudson and MSER Mike Harrod.

Reference

[1] Lonely Planet Publications. Vietnam, Laos & Cambodia — A Travel Survival Kit. Colorcraft Ltd., HK. 1991.

LCdr Ted Dochau is an engineer in DSE 9.

The author *(left)* with Lt(N) Chuck Doma.

Cambodia — The Forgotten Mission

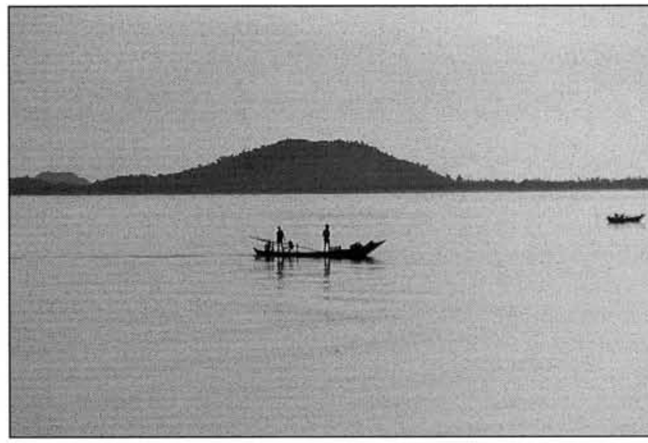
Part 2: The CSE as a Military Engineer

Article by Lt(N) Rob Mack

Over the last few years a number of MARE officers have participated in various United Nations peacekeeping operations. The largest operation to date has been the United Nations Transitional Authority in Cambodia (UNTAC), which ran from March 1992 until November 1993. Canadian naval personnel assigned to UNTAC were tasked with conducting river and coastal patrols in company with military personnel from Uruguay, Chile, New Zealand, the United Kingdom and the Philippines.

Our mission was to report on troop movements, arms shipments, smuggling activities, truce violations and any other criminal or significant events. The vessels we used included a variety of ex-Cambodian navy patrol boats (largely rebuilt by MARE-MS LCdr Ted Dochau and his men during the first and second Canadian rotations to UNTAC), fishing vessels and a collection of inflatables and rigid-inflatables (RIBs).

River activities were based mainly out of Phnom Penh River Base, with outstations in such locations as Kampong Chanang, Kampong Cham, Tonlé Sap Lake, Stung Treng and Kratie. Coastal activities in the Gulf of Thailand were co-ordinated from the main naval base at Ream, with outstations at Koh Kong, Kampot, Siem Reap, Sere Amble and Kep. Each station was unique, with its own mission, activities and resources.



Danger was ever-present for the patrols. This small fishing boat had three AK-47s on board.

I was assigned to Kep, a southern coastal town 18 kilometres from the Vietnamese border. During the period of French influence in Indochina Kep was regarded as the "Riviera" of Southeast Asia. When the Khmer Rouge pushed into the area in 1975-76, the 500 or so landowners in Kep managed to flee the country. The remaining 2,500 townsfolk were not so lucky. They were shot by the Khmer Rouge and their bodies were dumped into the underground fuel tanks of a local gas station. (I soon learned that every town in Cambodia has it's own killing field of some description.) The buildings of the town were blown up, then booby-trapped to prevent their being rebuilt. The booby-traps are still in place today.

Kep Station H.Q. The building was constructed entirely of teak for less than $8,000. The compound was ringed by a ten-foot-high bamboo fence topped with barbed wire. The perimeter was floodlit and had trip wires and flares. There were 26 sandbagged bunkers inside the compound.

Our combined residence and operations centre was erected by UN observers on the site of the former police station. Twelve Filipino marines guarded us and our compound around the clock. With two regiments of Khmer Rouge based within seven kilometres of us, primarily in the hills to the north, and with government troops also in the area, patrols from both sides could be encountered at any time. During my first night in Kep a major firefight erupted between rival patrols right outside our compound. For an hour the night lit up with heavy machine-gun fire, small-arms fire and grenade explosions. Gunfire, we newcomers learned, was a daily occurrence in the area.

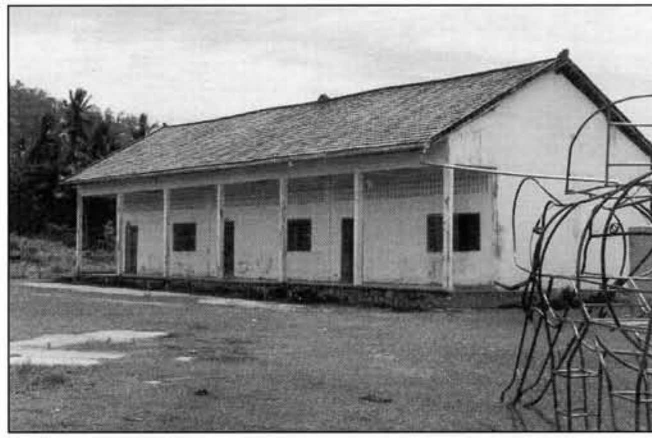
From Kep we conducted daily patrols on a 55-foot coastal fishing boat and two RIBs. Fishing boats were examined for contraband, sovereignty patrols were conducted along the border and we generally maintained a UN presence. Smuggling was very common in the area and payoffs to local officials were the accepted norm. I came under fire for the first time in July 1993 as a result of one of our coastal anti-smuggling operations. We had just chased off a smuggler, but unfortunately for us that meant the local government troops would miss their payoff and go unfed for that day. They expressed their displeasure by opening fire on us as we docked the RIBs. Let me tell you, there isn't a whole lot of cover in a rigid-inflatable boat.

Within two months of the government candidates being voted into office during the national elections in May, regional support swung almost entirely to the Khmer Rouge. This was because local government troops, having been left unpaid and unfed by the government, were setting up "toll stations" to extort money from the locals. For our part, the

UN observer units conducted a "hearts and minds" campaign, running first-aid clinics in many of the villages and performing other community assistance. Our own unit set up a number of first-aid clinics and rebuilt a bridge and four schools (reminiscent to me of hurricane relief operations a year earlier in Florida and the Bahamas while I was serving in HMCS *Protecteur*.)

In July a lack of land observers led to part of our unit being assigned responsibility for land patrols in the eastern third of Kampot province. The patrols, which we conducted by Land cruiser, cross-country motorcycle and on foot, could be extremely nerve-racking as we were never certain of how we would be received in a village. (Suddenly encountering 20 armed Khmer Rouge soldiers was always good for upping the heart rate.) During a firefight near the village of Lok one night, the police chief and two of his men accused of extorting money from local fishermen were kidnapped by the Khmer Rouge. Over the next two weeks our motorcycle patrols found scattered, grisly evidence of their fate.

We almost never drove at night because the vehicles tended to get shot up. Not long after the kidnapping and murder of the policemen, I found myself behind the wheel of an ambulance starting out on a night run to the local hospital with a Khmer who had been accidentally run over by one of our vehicles. As we left the compound we were confronted by 200 armed Cambodians who were convinced we were going to "dispose of our victim" in some remote place. I had three AKs pressed to the side of my head while the matter was sorted out.



One of the four schools reconstructed by UN peacekeepers in Kep.

Although my assignment in Cambodia was filled with remarkable episodes, the most memorable week for me came at the beginning of August during one of my visits to the Vietnamese border. (I travelled there every two weeks to discuss border concerns with the Vietnamese.) On the Monday, the "good" local Khmer regiment attacked a train by blowing up the tracks and then running alongside the stopped cars, throwing grenades in through the windows. The explosions in the enclosed spaces left 14 dead and 55 wounded. On Tuesday night the Vietnamese fishing fleet shot up the Cambodian fishing fleet in front of our station, and on Wednesday night the Cambodians retaliated by shooting up the Vietnamese fishermen. Thursday and Friday were spent dealing with the local Cambodian army colonel and 150 of his men who were attempting to land 54 cars being smuggled-in from Singapore. I was offered a new Honda (colour of my choice) to remove my men for 24 hours. The week was capped by a Cambodian soldier who aimed a rocket-propelled-grenade launcher at my truck during my trip back from the border.

Just what all well-equipped schools need. The author points to a 3-inch mortar bomb found in a school yard.

All in all, the Cambodia experience was fascinating. Admittedly there can be a steep learning curve for a naval officer being dropped into the jungle — land mines, gunfire (I was shot at on five occasions), diseases and other joys left an indelible impression on me — but I wouldn't have missed it for the world. Doing the leopard crawl through reeking jungle foliage with AK rounds rippling overhead may have put a chilling edge to my training from Chilliwack, but then conducting a first-aid clinic with literally hundreds of Cambodians waiting for attention was incredibly gratifying.

If there were a lesson to be learned from the UNTAC operation it would be that naval personnel can perform peacekeeping duties as effectively as personnel from the other services. In a letter from our Australian UN force commander, General John Sanderson, the naval contingent was complimented on turning in the most timely, detailed and accurate reports of all his observers. Almost all trades are suitable for these missions, but in the end it is the suitability of the individual that is the key. On that point, it can be safely left to the mission commander to make the final selection of volunteers.

Lt(N) W.R. Mack is the Maintenance Officer of the Naval Engineering School in Halifax. A Combat Systems Engineer, he participated in hurricane relief operations in Miami and the Bahamas while CSEO of HMCS Protecteur.

A Commanding Officer's Expectations of the MARE Department Heads

Article by Commander D.J. Kyle

Opening Salvoes

When I was asked to address the West Coast MARE Seminar on this subject in 1993, I was forced to re-visit some concerns which had occupied my attention in the early months of command of HMCS *Kootenay*. During the seemingly interminable period of refit, and at the outset of the trials program, I found myself asking questions such as: "What kind of support should the engineering department heads be providing me? Am I asking them the right questions? How do we reinforce one another's activities to maximize *Kootenay*'s technical readiness? How will I do the MSEO and CSEO justice when it comes time to assess their performance?"

Once the sailing program commenced, philosophical musings were displaced by more pointed engineering questions such as, "Why can't I get hot water or cable TV in my cabin?" and "Does the upper-deck stoker have a religious or political rationale for maintaining our permanent list to starboard?"

The reason for my early pondering is obvious. Commanding officers acquire only passing familiarity with the duties of the MSEO and CSEO during the eight to ten years of sea time most of us accumulate en route to command. Moreover, as will become clear in a few moments, the command development process contains a bare minimum of engineering content. Much the same statements may be made of the CO's relationship with the supply officer. In that case, however, useful guidance has been issued in the form of a document called *The CO's Guide to Sea Logistics*, which contains explanations and advice sufficient for the captain to effectively monitor the activities of the Supply department.

A much greater gap exists in the operator/engineer interface. Despite the navy's best intentions over the years to recruit MARS officers with technically oriented academic qualifications, we have in fact attracted only a fraction with post-secondary math, science or engineering education; until very recently, less than half of our annual production of MARS 71A officers held university degrees of any sort.

To widen the cultural gap even further the navy has seen to it that the training accumulated by MARS officers between entry and command touches only briefly upon engineering subjects (and, at that, only during the early career stages). The first and last formal coursing on marine systems occurs at *Venture*; combat systems are revisited as senior lieutenants during the Operations Room Officers Course, and those who attend Staff College in Toronto will acquire some insight into the black art of the naval architect via a two-day ship design exercise.

Further development of engineering familiarity (knowledge is too strong a term) occurs as a result of self-study for the Engineering and Power command exam (one of 12 which precede the command board). Interestingly enough, combat systems are not considered worthy of examination. The command board itself may, but does not always, present a "command-perspective" engineering problem for consideration. The command qualification, once earned, is in perpetuity, and the CO/XO Refresher Course which precedes command at sea contains no engineering content (although considerable guidance was provided in past years for dealing with overweight stokers).

In summary, captains and engineers today are in most cases attempting to communicate without the advantage of a common vocabulary. This situation is rooted in our Royal Navy heritage, whereby the engineering and executive branches remained as distinct as church and state. In the U.S. Navy, on the other hand, the career path to command originates in much more intensive and continuous technological exposure, and progresses for many (but not all) through alternating engineering and operational duties at sea. Without opening up a debate on the respective merits of these systems, I would simply emphasize that for years MARS officers in our navy have been reduced to dealing with engineering officers in the most generalized terms.

"Why can't I get cable in my cabin?"

Indeed, I have been advised by many captains past and present that it is redundant to know more about engineering than to ask two questions: "What's broken?" and "How long will it take to fix?"

The introduction of CPF/TRUMP technology, and with it the opportunity (indeed the requirement) for a fresh training start, may see this command perspective on its way out, but lack of technical depth will remain a fact within the MARS community for the foreseeable future. Therefore, as a department head the MARE must learn to advise the captain without:

a. patronizing him; and

b. overwhelming him with incomprehensible jargon.

At the risk of completely undermining the pedestal upon which the captain has stood for generations of engineers, the foregoing has attempted to sketch out the systemic barriers which exist in the typical CO/MSEO/CSEO relationships. I propose, therefore, to offer an admittedly personal recipe for successful performance as a department head at sea, and, subsequently, expand upon some factors pertinent to the MARE HODs in particular.

Department Head Posting

Seagoing department head experience forms an essential element of the MARE career profile. While all CS and MS officers will eventually get their chance to go to sea as HODs, the best and the brightest should strive (and should be encouraged) to go after the job early in their careers. It is appropriate to explain why experience gained at sea is so vital to our overall well-being as a naval fraternity.

There is nothing quite so intensive in the job inventory as a department head tour, particularly for the MARE. At a comparatively early career point simultaneous development as both officer and engineer will be demanded in a "real-time" setting where the results of one's professional judgement and decisions bear fruit in the near term, if not immediately. At sea one gains the true worms-eye view of "the system" and how it works — or doesn't. Appreciating the realities, exigencies and limitations of the shipboard environment takes more time than the basic sub-occupation qualification (i.e. 44B/C) allows. Consequently, design and acquisition "faux pas" are much less likely when decisions at the headquarters level are grounded in a sure knowledge of what it takes to make equipment or systems both functional at sea and "sailor-proof." Finally, I would like to offer reassurance that in spite of a lot of bar talk which purports the navy is no longer fun, life at sea continues to provide the traditional mix of hard work and play. These days there is also the added excitement of introducing a fleet of state-of-the-art ships into service. There is nothing ashore to match the camaraderie, stimuli and sense of purpose which pervade a seagoing ship.

There are no unrated performance or attribute lines on a department head's PER. The job offers full scope to demonstrate the ability and characteristics the navy needs in its future senior and flag officers. Whereas the HOD tour is an excellent opportunity to make one's mark upon the navy at an early stage, there is, admittedly, equal risk of doing oneself in by failing to succeed in such a visible billet. Careerism — i.e. preoccupation with the impact of day-to-day decisions on one's future prospects — is a phenomenon which is alive and well in the navy, patently obvious to superiors and generally counter-productive. The only important job is the one at hand.

Recognizing that the size of the MARE establishment in relation to the fleet means not all officers will get their crack at the HOD's job as soon as they might want, I offer my condolences to the desk-bound. For those who are serving or who are about to serve as department heads, I submit the following generic expectations.

Technical Knowledge

Although understood to be short on experience at the outset, I take it on faith that my department heads are technically proficient and current until proven otherwise. In practice, there will be almost daily opportunities to expose gaps in one's knowledge of systems, procedures or general philosophical and doctrinal shifts (rampant today with the fleet in transition). An enormous burden of trust is placed upon the department head by command (and the navy-at-large) to accurately guide the ship through departmental shoal waters. The days when the captain exercised his authority by virtue of having performed every job on board are in the distant past, and the consequences of advising the CO from a dated or inadequate level of expertise are unforgiving to combat officer and engineer alike.

Captains and engineers are communicating without a common vocabulary.

Workload

Having put your career on the line by seeking a HOD position, you must be ready to accept the unrelenting workload imposed by departmental duty. Good looks and charm don't go far when forced to grapple well into the evening and over many weekends with an imposing administrative backlog, pressure arising from the operational program and the failure of both equipment and personnel to function with 100-percent reliability. Moreover, few captains reward or even note overtime put in by ship's officers, especially the department heads. It goes with the territory and, considering the national investment represented by one of HMC ships, the CO is not unreasonable in measuring output in terms of results rather than effort.

Qualities

A few critical qualities come to mind when assessing HOD performance. Above all, the HOD must be well-organized. The sheer volume of information and direction that has to be sorted through should never overwhelm the ability to correctly prioritize departmental activity and initiate action on several fronts at once. The well-organized department head is easily distinguished by the long- and short-term plans which govern departmental preparations for activities at sea. The truly exceptional HOD is one who asks the "What if?" questions, indicative of the cross-over from reactive to anticipatory management.

The best-run department does not function in isolation, however, and thus considerable co-ordinating effort must occur among all departments on board. Failure of HODs and command to communicate frequently and without misunderstanding is the number one source of disjointed ship's programs, which in turn create disgruntled ship's companies.

In my experience, much of that could be avoided if department heads took the simple precaution of arming themselves with a notepad when calling upon the captain. CO/HOD discussions frequently range off onto tangents, and these invariably result in command expectations of follow-up action. "It slipped my mind," is not something a CO will react to lightly.

Leadership

The real reward of an officer's service at sea is the degree of respect he or she wins from subordinates. It would be pretentious of me to pontificate on a formula for leadership, but several years spent observing HODs at sea leads me to rate "visibility" as a constant which prevails across the spectrum of successful leadership styles. At all costs one must avoid the "laptop leadership" syndrome evidenced by the symbiotic relationship many officers form with their computers. "Face time" is what counts, especially among junior personnel, so one must make the sacrifice of setting aside discretionary paperwork to "non-working hours," get into departmental spaces and learn the art of asking the right questions. After all, you will never:

a. see the bottom of your in-basket;

b. be remembered for the excellence of your memoranda and records.

You will, however, be followed to the gates of hell by demonstrating genuine concern for the training and well-being of your people.

This emphasis on personal leadership should not obscure the importance of the HOD's capacity and willingness to provide technical leadership as well. Despite the years of experience and training vested in our senior NCMs, there are occasions when all eyes turn to the guy with seven years of university and naval coursing. Functioning as a "voice-pipe" for the senior operator or technician is an outright failure of officership.

Training

Training isn't just something that goes on at the fleet school. Training is fundamental to readiness, and all HODs should be aware from the start that operational readiness will be the captain's overriding command priority. HODs are thus accountable for a wide range of training activities — OJT, refresher, ship-wide — which are too important to remain a transparent function of departmental training petty officers. A common misunderstanding I have observed among HODs of all stripes is a belief that the XO drives training objectives on board. In a properly functioning ship, command will be under continual pressure from the departments themselves to fit their competing training requirements into the ship's program, at sea and alongside.

Administration

My warning of the perils of "laptop leadership" should not be construed as an invitation to let administration slide. In the old days the saying went: "A ship is known by her boats." Today a ship is known by her paperwork, and thus attention to detailed, timely and well-written correspondence are key indicators of departmental efficiency and attitude. All too often, mishandling of administration by loosely supervised junior divisional officers results in either embarrassment to the ship or the creation of unnecessary divisional problems.

On a final note, I should mention that I'm a great believer in the freedom of manoeuvre inherent in Periodic Engineering Letters. I hope drafters appreciate their letters are read closely by the CO's of similar-class ships, and that an element of the ship's reputation thus rides on the quality of these letters.

Dealing with the Captain

There are a number of unique dimensions to the captain's relationship with the engineering department heads. As discussed earlier, a large burden of trust has been placed upon comparatively inexperienced MSEOs and CSEOs. While the CO is thus heavily dependent upon the education and training of his MARE department heads, I should emphasize he doesn't come to the banquet empty-handed (or empty-headed). The captain's contribution to the resolution of shipboard technical problems is three-fold:

a. he has the benefit of several years at sea, with its consequent accumulation of numerous data points on the engineering learning curve. As a department head and as an XO the captain will have witnessed the resolution of a wide variety of shipboard technical issues;

b. a healthy dose of common sense is an absolute requirement for any seaman officer who ascends the career path to command at sea. The captain should have a keen appreciation of what is "do-able" in the real-time context of your problem;

"Laptop leadership"

c. he will have acquired reasonable insight into the workings of the "system" through preceding appointments ashore and at sea. Specifically, he will know the pressure points, and more importantly the personalities in the shore organization which provoke action. Your sacred cows and his are probably not the same, which means you can often work a problem together from different directions.

Risk

Your advice to command must always make clear the difference between recommended restrictions (i.e. playing it safe) and absolute maximum limitations imposed on the plant or combat systems. Risk-management is the CO's responsibility. The MSEO/CSEO must never subject equipment or personnel to risks without the captain's knowledge just to convey a "can-do" approach.

Defects

The engineering HOD must avoid the tendency to function as a messenger in relating technical problems to the CO. Unless you want to play "Twenty Questions" every time you enter his cabin, make a practice of pushing your techs for as much background as possible once the initial report has been made to command. Make all of those years of academic and technical training work for you and get in the habit of explaining problems in terms of equipment/system history (design and actual MTBF), redundancy, single points of failure, degraded modes, spares status (allowed and actual), investigation plan, etc.

"Unexplainable faults" are always explainable in the end. If the trouble-shooting agency is dead in the water, push harder and elsewhere for answers — keep going up the technical chain for advice and results. Don't automatically accept the bean-counter's perspective on how many man-hours and dollars are worth spending on your problem. What is best for the navy in the long run may be achieved by the engineer sticking to his guns and making the case for repair or alteration *now*.

Once the OPDEF has gone out there is a tendency to sit back and wait for shore support to clutch in. Not in *Kootenay*! With the MSEO or CSEO encouraging, advising and directing as required, our techs were relentless in pressing their investigations. At times this perseverance paid off in fault rectification. More often, though, it was a matter of maintaining professional pride and credibility by continuing the investigative effort, and there were spin-off benefits of increased system knowledge and technical confidence. I realize the new support philosophies of maintenance-by-exchange and repair-by-replacement will make this approach seem dated and potentially counter-productive. I defer to those with expertise in this area, but as a commanding officer I witness with mixed regret and skepticism the transformation such policies will engender in the attitude of our technicians.

The extra effort my MSEO and CSEO went to in bringing offending, unserviceable components up to my cabin for me to inspect personally was laudable, and successful in keeping explanations short if the broken part was leaking quantities of oil or seawater.

Loyalty

It is not a motherhood statement to assert that the MARE HOD's first loyalty must be to his captain and ship, and *not* to the engineering fraternity. Don't underestimate the dilemma facing the MSEO and CSEO. Time at sea is a brief and, in many cases, a one-time experience in the long run of a career. Pressure will be felt occasionally to avoid running afoul of the MARE hierarchy in advocating the ship's interests, but you will find it impossible to serve two masters. For this reason there is a push from the moment a MARE enters the doors at *Venture* to embrace the philosophy "Naval officer first, engineer second." If nothing else one should hope to avoid being defined solely as an engineer, bearing in mind Mark Twain's conclusion:

"Just because a man is an engineer doesn't mean he knows all there is to know about engineering. It simply means he knows very little about anything else."

I would go further and point out that the MARE HOD who doesn't challenge the system to produce results for the ship will get rolled over by the captain. Alarm bells should start ringing if you discover your CO working the technical hierarchy for you. When you spot him hosting senior MAREs to lunch it's probably time to man the liferafts.

Explanations

Keeping in mind COs like me who believed for years that Fast Fourier was a hockey player, I would make a strong case for explanations of faults to be accompanied by diagrams or sketches. Without insulting the captain's intelligence you must provide clear, simple explanations to ensure he grasps the problem sufficiently to advise and obtain the support of higher authority. The extra effort my MSEO and CSEO went to in bringing offending, unserviceable components up to my cabin for me to inspect personally was laudable, and successful in keeping explanations short if the broken part was leaking quantities of oil or seawater.

Operational Focus

It is essential that the MSEO and CSEO share the CO's mission-oriented approach to life. They must know what the ship's mission is at all times — not just the big picture (eg. Exercise MARCOT), but in detail. The ship's employment changes frequently and sometimes unexpectedly. In the course of one 10-day exercise *Kootenay's* employment alternated between Orange Raider, ASW escort, maritime intercept and support to other government departments. How do these role changes affect the engineering departments? Trust me, they do. Among other considerations the ship's tasks will determine operating area (inshore ops have obvious environmental implications), system availability requirements and access to replenishment and logistic support. A constant effort is required by the MARE HODs to stay tuned into operations via frequent visits to the bridge and ops room. Planning meetings at sea are infrequent and tend to look ahead to the long-term since they cannot hope to keep up with day-to-day and hour-by-hour program changes.

Finally, the engineering officer must strive to develop a combat-ready approach to his responsibilities. It is very difficult to convince technicians that "primacy of operations" is not an empty phrase and to motivate them to overcome our peacetime, Exercise Make-believe mindset. With a succession of real-world operations behind us in recent years, and the parallel introduction of modern ships, it is considerably easier these days to maintain an operational focus across departmental boundaries. The corollary to that sentiment is the requirement for all departments to take a "We are as One" (*Kootenay's* motto, by the way) approach. There are no victors in departmental "turf wars" in HMC ships, and if you let narrow-minded subordinates hold sway in the hope of developing departmental cohesion, you will be judged to have abrogated your higher responsibility to command.

Closing Thoughts

This article and the presentation upon which it is based were prepared at the request of the West Coast MARE community. In causing me to consider a topic which has thus far escaped inclusion in the MARE training curriculum I think they have done both branches of the navy useful service. Certainly, it was beneficial for me to focus my thoughts on the engineer/captain relationship at an early stage in command, and as I completed my tour of two years I reflected upon the excellent support provided by my two MARE HODs with great satisfaction and pride. Establishing the ground-rules early as a side-benefit of this effort greatly facilitated our collective effort to keep *Kootenay* at the peak of technical readiness.

Our 35-year-old ship went on to enforce UN sanctions off Haiti, having steamed over 42,000 miles since refit in 1993. If the navy decides to keep her steaming for several years to come she will be up to the challenge. Her remarkable condition today is a ringing endorsement of the professionalism and dedication of several generations of Canadian naval engineers. I hope this article captures the ingredients of our successful team effort in operating these ships, and recommend that as we adapt to future challenges the gurus of change do not distract us from the solid engineering practices upon which this record was built.

Cdr Kyle commanded HMCS Kootenay *from 1992 to 1994. He is currently pursuing a Master's Degree in Business Administration at the University of Western Ontario.*

The Effect of Multipath Propagation in Missile Engagements

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

This article discusses an electromagnetic effect which is present during any missile engagement and which can, given the right set of circumstances, cause a missile to miss even the least challenging of targets. The effect is commonly referred to as multipath propagation (MP) and occurs because shipborne fire-control radars operate close to the sea surface. Although multipath propagation afflicts search radars as well, this paper will focus on its effect upon fire-control (FC) and tracking radars during a missile engagement.

To understand multipath propagation it is helpful to understand what is meant by the term *multipath*. A good explanation is as follows:

> "...multipath refers to the existence of more than one ray path by which electromagnetic waves can travel from the radar to the target, and vice versa."[1]

Multipath propagation occurs when radio frequency energy propagates over and reflects from the sea's surface. The energy combines constructively and destructively to create alternating regions where radio frequency energy is returned strongly and weakly from a target. Consider the idealized scenario shown in *Fig. 1*: an omnidirectional radar transceiver, a target and a flat, perfectly conducting, infinite plate. RF energy from the ship's radar (A) will arrive at and be reflected from the target (B) via a direct path (AB-BA), or by the multipaths ACB-BCA, AB-BCA and ACB-BA. The amount of RF energy that follows these paths depends on the radiation pattern of the transceiver antenna (in the vertical plane) and the scattering properties of the target (i.e. how much incident RF energy the target reradiates and in which directions).

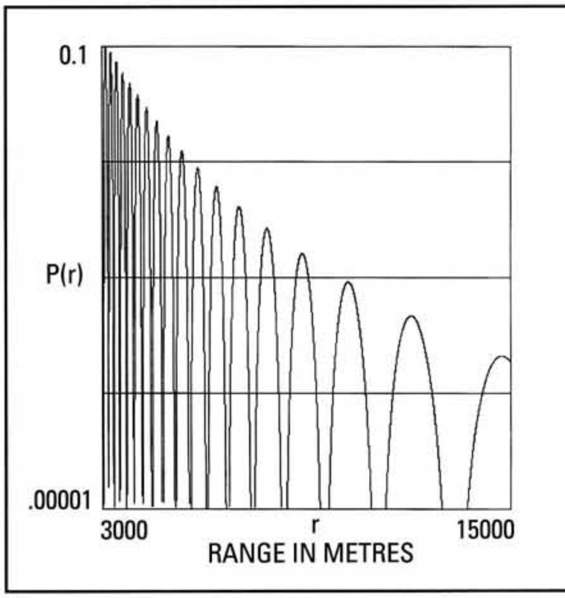


Fig. 2.

The sinusoidal nature of the MP phenomenon as a function of the range, wavelength and height (of target and radar) is plotted in *Fig. 2* as a function of range only. *Figure 2* is the idealized mathematical representation of the cyclical nature of the MP pattern due to the presence of the flat conducting plate. Of course this exact pattern is never observed in the real world, but it helps in our understanding of the MP phenomenon. Since realistic fire-control and tracking radars have antennas with radiation patterns that exhibit maximum gain along the direct path, minima in a diagram like *Fig. 2* become "filled in" and never actually reach a zero value.

A significant factor affecting the MP pattern is the reflection coefficient (ρ). When dealing with RF reflection from sea water, ρ is a complex quantity and therefore has magnitude and phase. ρ is a function of grazing angle, frequency and polarization. For low grazing angles (i.e. 1° to 5°), horizontal polarization and

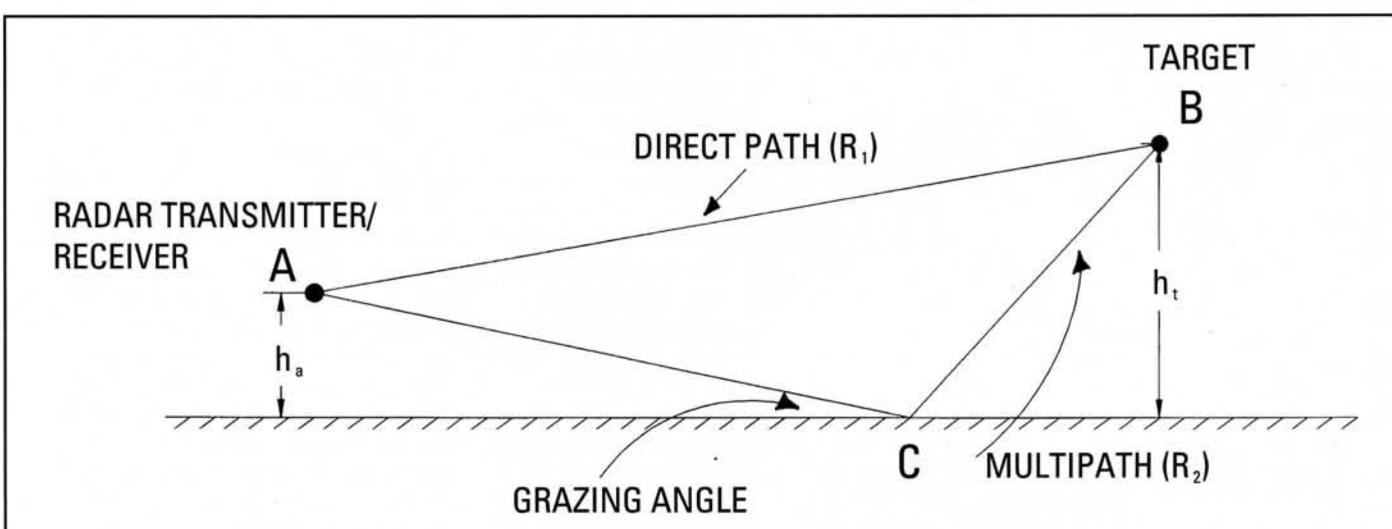


Fig. 1.

frequencies common for FC radars (i.e. 8-12 GHz), the magnitude of ρ is close to unity and its phase is 180°. However, in a similar situation except with vertical polarization, the magnitude of ρ is significantly reduced and a 60° to 120° phase shift occurs.[2] These variations in the magnitude and phase of ρ can significantly reduce the maxima and shift the location of the minima from the idealized MP pattern shown in *Fig. 2*. *Figure 2* also assumes specular, or mirror-like, reflection which is rarely observed at sea. It is generally accepted by the research community that the roughness of the sea will dominate over such electrical characteristics as frequency and polarization, etc., in determining whether reflection is specular or not. Therefore, the sea state figures prominently when measuring the actual reflection coefficient in practical situations.[3]

The most important factors in determining the MP pattern are range, wavelength and height (of target and radar). Together, they conspire to determine the location and spacing of the minima. Environmental and physical parameters such as the curvature of the earth, evaporation and surface-based duct heights must also be accounted for in order that the MP pattern of *Fig. 2* be made useful for practical situations. Finally radar parameters such as gain, transmitted power, frequency, etc., must also be accounted for.

A computer program that combines these factors (and more) to generate a more representative MP pattern is called PROPR and is part of the Engineers' Refractive Effects Prediction System (EREPS) developed by the Naval Ocean Systems Center in San Diego, CA.[4] *Figure 3* is a plot generated by the PROPR program and shows the predicted propagation loss diagram given various environmental and radar parameters. Propagation loss is the amount of power lost as a function of range. It is a one-way loss, i.e. the dB value of the propagation loss must be doubled to obtain the amount of power returned to the radar receiver (assuming a target radar cross-section of unity for all aspects and frequencies of interest). The dashed line in *Fig. 3* represents the free-space propagation loss that would be observed if the earth's surface were not present (or, equally, if MP were not considered).

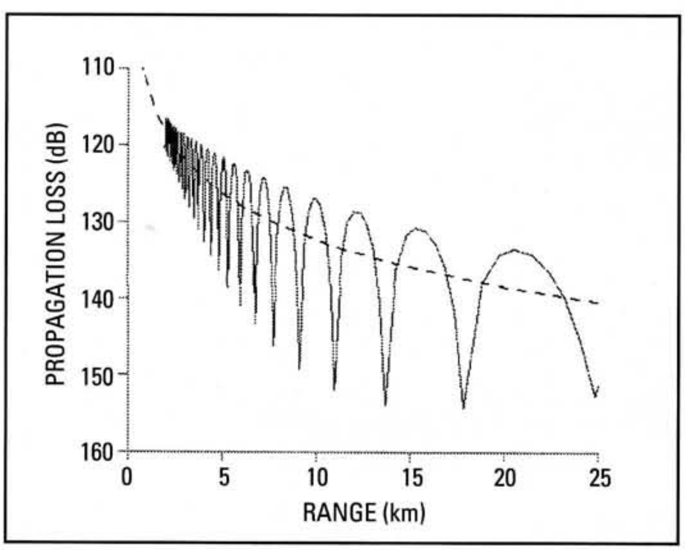


Fig. 3.

Operational Implications

Now that the MP phenomenon has been examined and its origin explained, let us investigate how it can affect a warship in an operational situation. Consider a ship that detects a subsonic sea-skimming, in-bound anti-ship missile. Given the ship has enough data to determine that this target is threatening, it will attempt to designate a fire-control radar to track it. The radar will provide the ship's command and control system (CCS) with data which (in our scenario) will confirm the target's hostile intentions and contribute to threat evaluation and engageability calculations. The objective of the engageability calculations is to determine when the ship's weapons can be brought to bear with maximum effectiveness given the known weapon parameters and target data.

As the target closes the ship, the radar and environmental parameters will combine to generate a multipath propagation pattern (similar to *Fig. 3*) which will be unique to the situation. In this scenario, let us assume that the MP pattern is indeed that described by *Fig. 3*. As the target closes the ship, the returned power will fluctuate because of MP. If the power returned to the radar while the target is in an MP pattern minimum is less than the radar's minimum discernable signal, the radar might report no target present; or, if tracking, that it has been lost. The critical unknown here is whether the fluctuation will be severe enough and last long enough to cause the fire-control radar to "think" the target is no longer present, or at least be uncertain as to its location.

As the target continues to close the ship it leaves a minimum, enters a maximum, and significant power is again returned. This represents another problem: Will the radar or CCS be able to correlate this most recent track data with what it had before, or will this be seen as a new track? The likelihood of this occurring increases greatly if the ship is unfortunate enough to be up against a manoeuvring target which (knowingly or not) executes its manoeuvre when it is in an MP minimum. All of this results in uncertainties about the target which can play havoc with software algorithms designed to calculate how and when to best deploy weapons against targets. Such vacillation by the FC radar and/or CCS could result in aborted missile launches by the ship and needless recalculation and re-positioning, all of which consumes precious seconds.

Now consider the same scenario in a broader sense: the ship manages to launch a missile against the target as shown in *Fig. 4*. Most naval missile systems require a signal from the ship's FC radar to the missile (while in-flight) for rear-reference and/or to up-link target data. Missiles used by our navy also require that targets be "illuminated" with RF energy from the FC radar. While in-flight, the missile can look for the reflections and guide itself onto the target. We now have RF radiating from the ship's FC radar for three purposes: (1) to the outbound missile for rear-reference (the dotted lines in *Fig. 4*); this is a one-way path; (2) to the target for tracking (dash and dot line); this is a two-way path since this energy is reflected off the target and returned to the ship; and (3) to illuminate the target; the RF is reradiated (or reflected) by the target and detected by the missile's seeker-head (line with dash and two dots); this is a one-way path. In each of these three cases, RF propagation will be affected by multipath propagation as described in the previous paragraph. What is certain is that MP will be present. What is uncertain is how severe the effect will be. It easily has the potential to degrade overall system performance, resulting in the ship failing to defend itself.

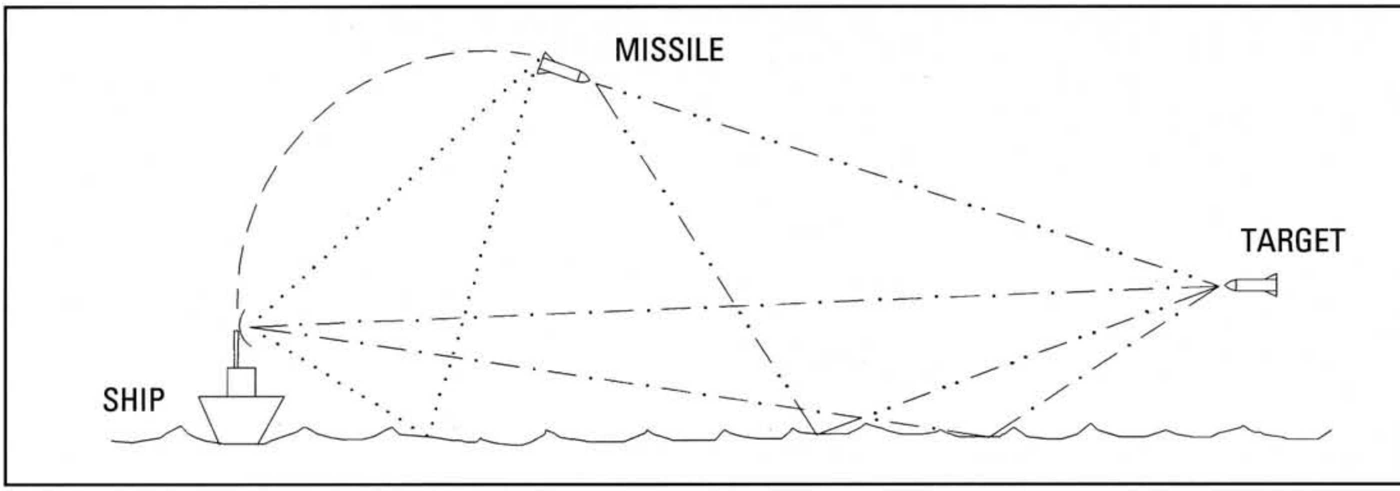


Fig. 4.

Practical Limitations

What can be done to improve the ship's ability to defeat a missile threat (and the CSE's chances for promotion) in the scenario described above? The microwave engineers that work for manufacturers of FC radars are well aware of MP and how it affects the performance of their radars. They have incorporated various techniques in the radar's design to mitigate MP's effect. Examples of some of these are as follows: enhanced signal processing so that the system can identify unreasonable target behaviour; frequency diversity (i.e. operating the radar over a range of frequencies); and the use of electro-optical devices (i.e. TV or IR) in conjunction with the radar.

The astute reader may argue that, with careful use of PROPR, the naval tactician can have prior knowledge of the nature of the MP pattern in a given environment and plan a missile engagement so as to avoid its adverse effects. Combining this with the FC radar's inherent abilities to limit MP's adverse effects, the argument would go, reduces the potential for MP-related problems and makes it less of a concern. The most difficult aspect of this problem is that it is dynamic. Two critical pieces of data that significantly affect the nature of the MP pattern are the heights of the transmitter and receiver. Recall that the missile in *Fig. 4* receives RF reflected from the target. In this case, the missile is the receiver and the target is the transmitter. As the missile flies out, its altitude changes continuously as it attempts to intercept the target. This causes the MP pattern to change continuously as well. The same situation applies between the missile and the ship except that the missile is now the receiver and the ship (i.e. the ship's FC radar) is the transmitter. The situation between the target and the ship is more stable but it is not likely that the tactician will know the target's altitude in advance so as to generate a reliable MP pattern (though a range of target altitudes could be considered and hence be of some use). All this assumes that the necessary radar cross-sections are known at the radar's frequency and that environmental factors are known and accounted for.

Although computer simulations like PROPR greatly help our understanding of the MP effect, they are of limited use in an operational scenario; there are just too many variables present, all changing too quickly, to accurately and reliably predict (and therefore counter) the effect of MP in a specific scenario. More advanced computer models which account for target and missile dynamics are required to completely defeat the MP problem.

As can be seen from *Fig. 3*, MP at times actually helps by extending the FC radar's detection range beyond what would be expected in a free-space environment. This is a result of the constructive interference that occurs as RF energy reflects off the earth's surface. Regrettably, for the reasons discussed, it is inconsistent and therefore difficult to predict accurately.

For brevity, this paper has deliberately avoided discussing an effect related to MP commonly known as the "false target." An FC radar tracking a low-altitude target above the sea can track onto a false or image target, which is nothing more than the target's electrical reflection in the sea. This false target can severely affect the FC radar's elevation tracking of the real target.

Conclusion

The purpose of this paper was to inform the MARE community of the existence of MP and how it can affect missile engagements. Although substantial progress has been made in understanding MP and mitigating its effects, we have not yet "engineered" MP out of the missile engagement. As such, we must expect a percentage of missiles to miss their targets in what, upon initial inspection, would appear to be target geometries well within the missile's capabilities.

References

[1] L.V. Blake, *Radar Range-Performance Analysis* (Lexington, Mass: D.C. Heath and Company, 1988), p. 237.

[2] Ibid, pp. 261-263.

[3] M. Skolnik, *Introduction to Radar Systems*, 2nd ed. (New York: McGraw-Hill Book Company, 1980), p. 444.

[4] W. Patterson et al., *Engineer's Refractive Effects Prediction System (EREPS)*, Rev. 2.0, Technical Document 1342, Naval Ocean Systems Center, February 1990.

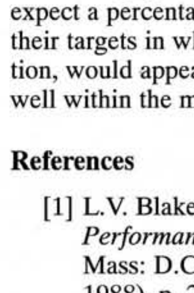


PHOTO COURTESY TRACY FITZMAURICE

Lt(N) Mike Fitzmaurice was a project engineer in the DMCS 2 Surface and Air Warfare section of DGMEM until last summer. He is now the A/CSEO on board HMCS Winnipeg.

Alternative Posting Opportunities for MAREs

By LCdr Derek W. Davis, *Personnel Careers Officer (MARE)*

Many MAREs seem to be unaware of the out-of-mainstream postings that are available to them. (Probably because we are so focused on the day-to-day problems of our particular engineering areas.) Still, take a moment to review these tables. One or more of the alternative posting opportunities summarized here might pique your interest.

Postings outside Ottawa and the Coasts

TYPE OF JOB	RANK	LOCATION
Recruiting	Lt(N)	Calgary, Hamilton, Trois Rivières, Montréal
Area Cadet Officer	Lt(N)	Winnipeg, Edmonton, Gagetown
CFOCS Platoon Commander	Lt(N)	Chilliwack
Detachment Commander Training Detachments	Lt(N)	Cornwall, Rimouski, St. John's
Training System Associated Positions	LCdr, Lt(N)	St-Jean, Trenton (moving to Borden)
Military Faculty RMC	Lt(N)	Kingston
CFALL Instructor	Lt(N)	Borden

Non-engineering jobs in the Ottawa area

ORGANIZATION	RANK	JOB
DCDS Group Coordination	Lt(N)	Language Quality Assessor
Senior ADM(Mat)	LCdr	Research Officer, Director Logistics Analysis
DG Corporate Management Services	LCdr, Lt(N)	(Minister's office) Corporate Inquiries and Correspondence Secretariat, inquiries and correspondence related work
DG Intelligence	LCdr, Lt(N)	Analysts, Technical and other Intelligence
Bilingual Technical Documentation Project	LCdr	Maritime Publications Officer
DG Internat'l & Industrial Programs	LCdr	Staff Officer Director International Armaments Cooperation
DG Maritime Development	Lt(N)	Policy and Doctrine, Base Closure Force Structure, Maritime Force Development
DG Force Development	LCdr	Mobilization Plans, Models/Guidance
DG Manpower Utilization	LCdr, Lt(N)	Military Occupational Structure Control Implementation Officers, Occupational Analysts
D Attaches	Lt(N)	Foreign Liaison Accreditation and Policy, Asia and Middle East
DG R&D Operations	LCdr	Director Research and Development Maritime, Marine Engineering
DGPEM	LCdr	Project Management Secretariat
DG Aerospace Eng. & Maint.	Lt(N)	Project Officers, Simulators and Trainers

MARE out-of-country positions *(subject to change)*

JOB	RANK	SPECIAL CONDITIONS	LOCATION
NATO Sea Sparrow Project Office, Canadian Project Officer	LCdr	CSE	Washington, DC
TRUMP Detachment Commander	LCdr	CSE	Washington, DC
Staff Officer CDLS(W)	LCdr	Any MARE	Washington, DC
Ship Superintendent	LCdr	MSE	Philadelphia, Pa. (to be moved?)
Instructor, U.S. Naval Academy	LCdr	Any MARE, must be able to teach electrical engineering	Annapolis, Md.
Project Officer, Ship R&D Center	LCdr	Nav. Arch.	Carderock, Md.
Trials Officer, Weapons Acceptance	LCdr	CSE	Portsmouth, UK
Lecturer, Royal Naval Engineering College	LCdr	MSE with Postgrad Training	Plymouth, UK (likely moving to Portsmouth area in 1995-96)
Asst. Constructor, Structures Section	LCdr	Nav. Arch.	Bath, UK
Inspector Officer, Diesels Section	LCdr	MSE with Postgrad Training	Bath, UK
Afloat Maintenance Officer, HMAS *Platypus*	Lt	Submarine Qualified	Sydney, Australia

Land-based Oily Wastewater Treatment
Oil and water — they do mix!

Article by Lt(N) Mike McCall

Oily waste water is a normal by-product of day-to-day operations in the marine environment. CFB Esquimalt alone receives some 20 million litres of oily waste and compensating water annually from naval ships and shore-based establishments. With federal, provincial and regional environmental regulations becoming increasingly stringent in recent years, disposal of this water has become a major concern for MARPAC.

A parallel plate separation system has been employed as the primary treatment system in Esquimalt dockyard for many years. As with all mechanical/gravity-type separators the system is based on the Stokes Law principle that oil and water do not mix (although in reality this does not always seem to be the case). While this system is capable of separating free oil from an oily water waste stream, it is less effective against oils held in chemical suspension and the toxic elements common to oily waste water.

These chemical emulsions are difficult to avoid as surfactants such as soaps and hand cleaners find their way into ships' bilges. Because surfactants hold oil in suspension in such small droplets that gravity separation becomes ineffective, there remains (as in the case of CFB Esquimalt) a large store of untreatable waste water.

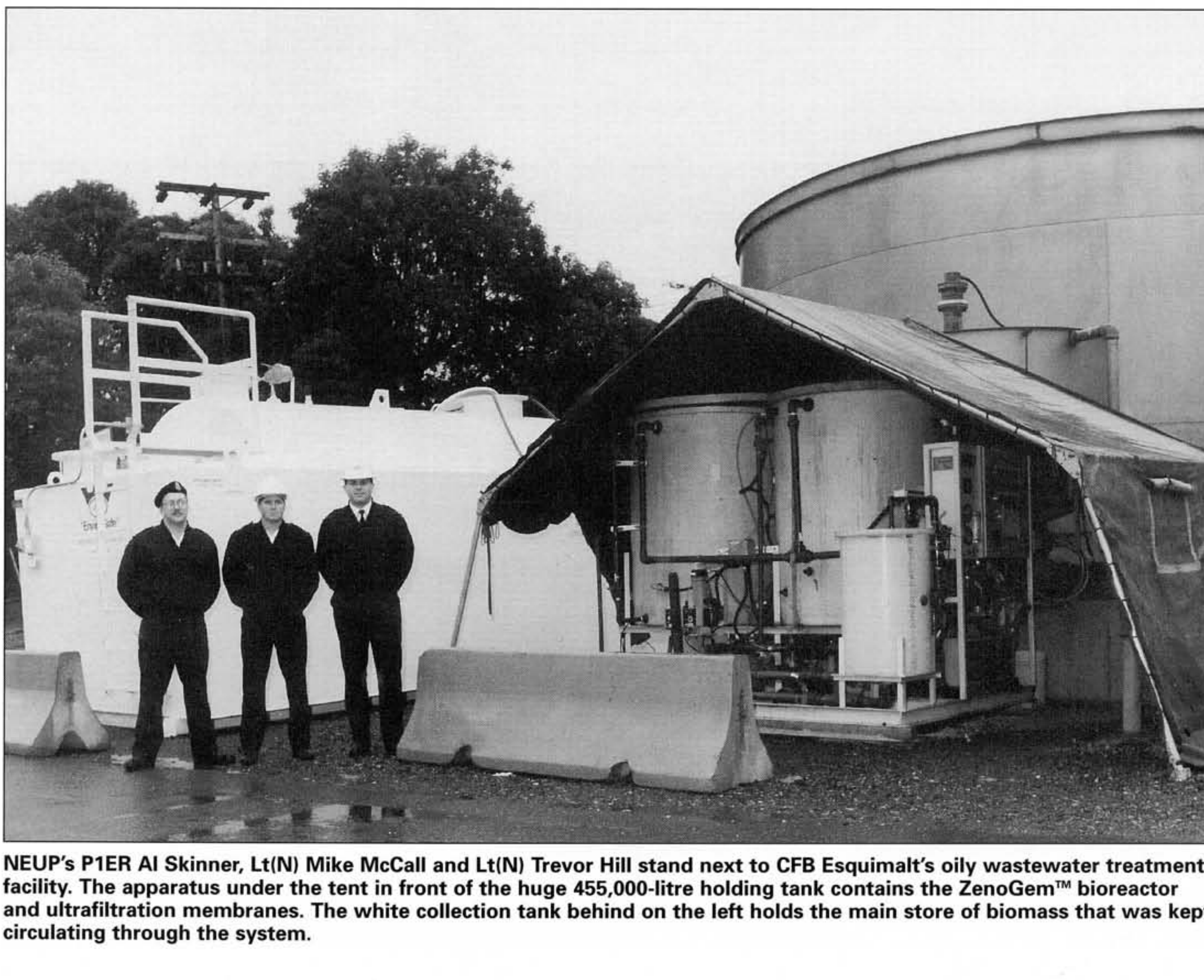


PHOTO BY BASE PHOTO ESQUIMALT

NEUP's P1ER Al Skinner, Lt(N) Mike McCall and Lt(N) Trevor Hill stand next to CFB Esquimalt's oily wastewater treatment facility. The apparatus under the tent in front of the huge 455,000-litre holding tank contains the ZenoGem™ bioreactor and ultrafiltration membranes. The white collection tank behind on the left holds the main store of biomass that was kept circulating through the system.

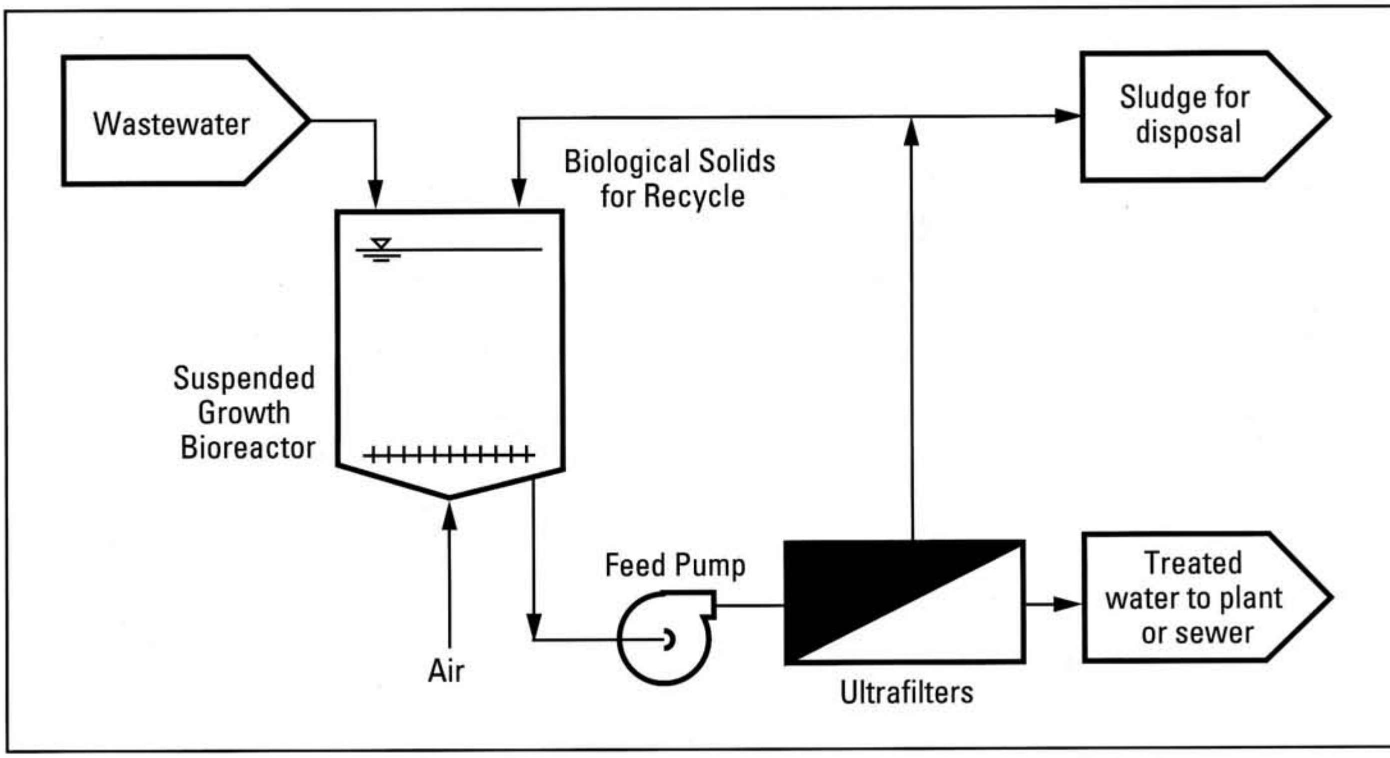


Fig. 1. ZenoGem™ Flow Schematic

In 1993 Naval Engineering Unit Pacific (NEUP) initiated a study to effectively address this problem. The objective was to find a workable, cost-effective solution to the present and future concerns over oily waste water in HMC Dockyard, Esquimalt.

Treatment Methods

Many oily wastewater treatment options have been investigated, with two of the most effective being a physical/chemical (physchem) process and a biological treatment. The physical portion of a physchem process is usually some form of mechanical/gravity separator. Since, as mentioned, this technique is ineffective in removing oil suspended in a chemically emulsified state, rigorous control over the influent must be exercised.

The chemical portion of a physchem process is typically characterized by flocculants and clarifying agents used to precipitate solids out of the waste stream, and by chemicals to neutralize and stabilize the effluent. Toxins and inorganics are usually removed through filters and strainers, and through the use of activated carbon. These systems are unstable and produce a great deal of sludge.

Biological treatment of black water has proven effective. Virtually all municipal sewage treatment plants employ some form of biological treatment process whereby the organic components of the waste stream are biodegraded and consumed through aerobic metabolism. Oily waste can be effectively treated through biological degradation in a manner very similar to black water or sewage treatment. Oils, greases and fuels are made up of long-chain hydrocarbon molecules and are consumable by the biological organisms found in conventional sewage treatment facilities.

Current shipboard mechanical/gravity separators have proven to be ineffective in the treatment of highly concentrated oily waste water and chemically created oil-water emulsions. This has limited ships to discharging considerably less than 100 percent of their accumulated wastewater while at sea. Until technology supplies a shipboard system that can consistently treat oily waste water to the current and proposed legislation, the requirement for an effective shore-based treatment system will continue to exist.

The parameters concerning effluent discharge to sewer, storm drain or surface waters are governed by different legislative bodies, depending on the nature of the discharge activity and the classification of the waste. In the Victoria area two agencies are leading the way in mandating discharge criteria for land-based systems: the Capital Regional District for sewer discharge and Environment Canada for surface-water discharge.

Having defined the problems, NEUP began to scrutinize systems in operation worldwide. General Motors was found to have many industrial centres that treat volumes exceeding fifty times that produced in CFB Esquimalt. The constituents of the waste stream from these plants are very similar to those found at CFB Esquimalt — a high percentage of lubricating oil, combined with a low percentage of fuel, emulsified with water and solvents. GM's plants are using a proprietary Canadian treatment concept known as ZenoGem™ which was funded by GM and developed by Zenon Environmental Systems Inc. of Burlington, Ontario.

System Description

ZenoGem™ is a biological/membrane-based system where microbiological organisms (i.e. bugs) work in parallel with a bank of semipermeable ultrafiltration membranes (*Fig. 1*). The waste stream and bug mixture — the biomass — is concentrated in a bioreactor and mixed with air, in which, not unlike a conventional sewage treatment plant, the bugs consume the slurry of oil, fuel, solvents, surfactants and chemicals. The bugs produce primarily carbon dioxide and water as byproducts through aerobic metabolism.

The long-chain hydrocarbons are consumed by the organisms, after which the biomass is discharged through the membranes, allowing the "pure" water to be permeated out. Any molecule larger than 1/100th of a micron will not pass through the membrane walls, but will continue back to the bioreactor for further degradation and consumption. The process is continual, with the system running 24 hours a day, requiring only a small Urea injection for the bugs' nutrition and a chemical injection for Ph control. The biochemical organisms can acclimate to the changes in the waste stream and survive through a wide range of conditions.

Since there was no conclusive evidence of the effects of salt on the bioreactor (specifically on the micro-organisms) at the GM facilities, NEUP decided to run a pilot study of the ZenoGem™ process on the CFB Esquimalt waste stream. In conjunction with the base Construction Engineering organization and Zenon Environmental Systems, a two-phase plan was developed under the MARCOM Environmental Program to test the feasibility of the ZenoGem™ system on the waste water common to CFB Esquimalt.

System Trials
Phase I

During the ten-week-long first phase, controlled batches of bilge waste were processed weekly at a rate of one litre per minute. NEUP was eventually able to introduce very high concentrations of common contaminants into the plant. The plant was tested with pure bilge water, bilge water containing fuels, lube oils and synthetic lube oils, bilge water containing cleaners, solvents and detergents, compensating water, metals and Aqueous Film-Forming Foam (AFFF).

The bioreactor was started with organisms from the Saanich Municipal Waste Station which acclimated very well. A similar strain of organism was known to degrade both sewage and hydrocarbon-based compounds, but how quickly it would adapt was not known. By the end of the second week the organisms were completely acclimated to their new environment and remained healthy despite our efforts to test their endurance.

During the initial phase of the trial the plant performed very well. Despite the rapidly changing constituents in the feed stream, the permeate (discharge) was constant in nature. The total oil and grease readings fell to a level consistently below 10 ppm and the toxin levels within the permeate were always well within standards. The system also proved extremely effective in treating compensating water, being able to operate at a higher flow rate than for oily waste.

Phase II

The second phase of the trial got under way in mid-January 1994 to demonstrate that the ZenoGem™ plant could meet or exceed the demands of the dockyard and the environmental legislation. An upgraded plant featuring a new membrane module and a larger pump and blower assembly was operated at an output rate of 15 litres per minute. The plant operated for two months, treating bilge water that had accumulated in the dockyard tanks, with the effluent being certified for discharge directly to sewer. The vast majority of the contaminants, separated from more than 4,000,000 litres of contaminated feed, were removed and biodegraded, leaving only carbon-dioxide and water.

NEUP developed both trial agendas to meet the discharge criteria of the Capital Regional District, the B.C. Ministry of the Environment and Environment Canada. Analytical data were compared against these criteria to examine the technology's ability to effectively treat all possible waste streams.

Results

The system proved to be practical in operation, economical and non-real-estate intensive. The results of the trials demonstrated the ability of this technology to remove oil and grease, hydrocarbons, toxic elements and surfactants well enough to meet all environmental discharge criteria. The sludge accumulated during the entire trial amounted to 200 litres of landfill waste from four million litres of oily waste water. At the end of February 1994, the Capital Regional District granted the system a Sewer Discharge Permit.

The system had proved its ability to meet all current and proposed discharge criteria for oily waste water. The biological/ultrafiltration-type treatment system offers a solution to a problem that has plagued the marine sector since the introduction of legislation governing the discharge of wastes of this kind.

References

[1] Davis/Cornwell, *Introduction to Environmental Engineering*, 2nd ed. McGraw Hill series in Waste Water Resources in Environmental Engineering, (New York: McGraw Hill, 1991).

[2] *Pilot Scale Demonstration of Membrane for Treatment of Bilge Water at CFB Esquimalt*, Zenon Environmental Inc., March 15, 1994.

[3] *Advanced Membrane Based Oily Waste-Water Treatment System Final Report*, Naval Engineering Unit Pacific, April 28, 1994.

[4] Capital Regional District Special Waste Management Act, August 1994.

Lt(N) Mike McCall is the Halifax *class officer at Naval Engineering Unit Pacific.*

HMCS *Kootenay* Gearbox Explosion and Fire

On October 23, 1969 an explosion and fire erupted on board HMCS *Kootenay*, killing nine crewmembers and injuring 53. The navy learned, or tragically relearned, some tough lessons in damage control on that fateful day. Twenty-five years later, do we remember the lessons of *Kootenay*?

Article by Lt(N) David Sisley

The navy has had its share of shipboard fires over the years, but none in recent memory carries the same degree of infamy as the "*Kootenay* fire." By 1969 a certain amount of complacency had crept into the navy's maintenance and damage control practices, and it took the deaths of nine people and injuries to 53 more to wake us up to it. Today, Canadian warships still carry visible, sobering reminders of the lessons learned from the *Kootenay* disaster.

HMCS *Kootenay* in an early 1960s photo.

HMCS *Kootenay* (DDE-258) was launched in 1954 and is still in service today, although somewhat modified from the way she appeared in 1969 with her after 3"50 mount in place of the ASROC. The 2,600-tonne ship has a Y-100 steam propulsion plant, consisting of twin boilers, turbines, gearboxes and propellers, and a top speed in excess of 28 knots.

On the morning of October 23, 1969 *Kootenay* was part of a nine-ship Canadian task force proceeding westward out of the English Channel. At 6 a.m. she was detached to conduct a full-power trial. By habit, the ship was steaming with the forward boiler-room and after engine-room hatches open. Ten engineering personnel were stationed in the engine-room for the trial.

At 8:10 a.m. the full-power trial commenced. As the ship picked up speed, heavy oil vapour began issuing from the gearbox vents, blown forward by the air stream in the space. This was not unusual in *Kootenay*. Engineers on the plates had complained on earlier occasions about the vapour being blown into their faces.

Explosion!

At 8:21 a.m. lube oil mist in the starboard gearbox ignited. Subsequent investigation revealed that bearing shells had been installed back-to-front during a refit five years beforehand. The misassembly completely blocked the oil supply and caused the affected bearing to overheat. The real wonder was the catastrophe hadn't happened during earlier full-power trials.

The temperature and pressure inside the gearbox casing quickly rose and forced their way out the vent, producing a 15-to-20-second "organ note." There was a pause, then a hissing noise as material began to escape through a split in the gearbox cover. The cover finally burst, spraying oil mist and liquid into the engine-room to mix with the existing oil vapour. The lethal mixture ignited, engulfing the space in flames, intense heat and dense, black smoke.

The explosion sent a fireball bursting up through the open after engine-room hatch, filling No. 3 deck (i.e. "Burma Road," the damage control deck) with hot gases and smoke. The fireball left a trail of burning paint, fittings and wiring in its wake. Moving at "gale force speed" the smoke filled the interior of the ship within a minute. Personnel in the cafeterias above the engine-room made their escape as best they could through pantry and galley hatches.

Survivors in the engine-room managed to close the main-engine throttles enough to slow the ship by two or three knots, and send off two rings of a six-ring emergency signal to the wheelhouse. Their garbled telephone message to the bridge could not be understood. Four men (one of whom was the engineer officer) of the original ten in the engine-room managed to escape through the forward hatch, but only three survived. The badly injured EO fought his way through the smoke-filled ship to the bridge, and prior to collapsing told people of the need to pull the oil and steam emergency shut-offs.

In the boiler room the men on watch felt the concussion and noticed smoke entering through the open forward boiler-room hatch. The safety valves on the starboard boiler had lifted and the fires were extinguished, but were relit. Lacking orders, and with no communication possible with the Command, the boiler-room maintained steam pressure. The ship steamed in excess of 20 knots for the next 40 minutes. Unfortunately, this fed the engine-room fire by pumping lubricating oil to the exposed gearing. At 9 a.m. the boiler-room crew decided to shut off steam to the main engines by closing the main stops and the ship stopped.

Damage Control

The damage control organization was decimated. Most of the key members had been involved in the full-power trial and were either dead or injured. With communications virtually non-existent, officers and men took charge wherever they happened to be. Fire teams were formed, but their initial efforts were hampered by a lack of Chemox breathing apparatus.

The six Chemox sets carried in the ship that day (the allowance had recently been raised to 21) were beyond reach below decks. The chief hull technician had an "extra" set stored up forward, and this was used to rescue three other Chemox sets. In a daring move early in the emergency, the Diving Officer donned his diving tanks and made his way along 3 deck to the emergency stops. His unfamiliarity with their operation left him unable to activate them and the ship steamed on. Following his example, the remaining divers donned their tanks and assisted with the rescue work.

The fire-fighting effort consisted of two teams. Foam was applied through the after engine-room foam tubes, and a fog spray was directed through the after engine-room hatch. The deck area around the open after hatch was glowing red-hot. Initially, it was impossible to close the forward and after engine-room hatches. Then, unlike today, hold-backs for the forward and after engine-room hatch-covers could only be released by reaching across potentially heat- and smoke-filled openings. An initial attempt by the chief hull tech to inspect the engine-room failed when his boot went through the melting deck-grating at the bottom of the ladder. He tried again at 10:15 and was beaten back by the intense heat, but not before discovering there was no sustained combustion except for a small fire in an electrical panel.

The fire team at the after engine-room hatch also suffered a setback shortly before 9 a.m. Spraying of the after 3"50 magazine was initiated by the two fire teams at work at the after engine-room hatch. Due to lack of communications and a DC organization, the command was unaware this was being done. Fearful of the condition of the magazine (immediately abaft the engine-room) the command ordered the magazine flooded. This was done without the knowledge of the fire teams. The resulting sudden drop in fire-main pressure forced the teams to retreat, allowing the fire to regain hold.

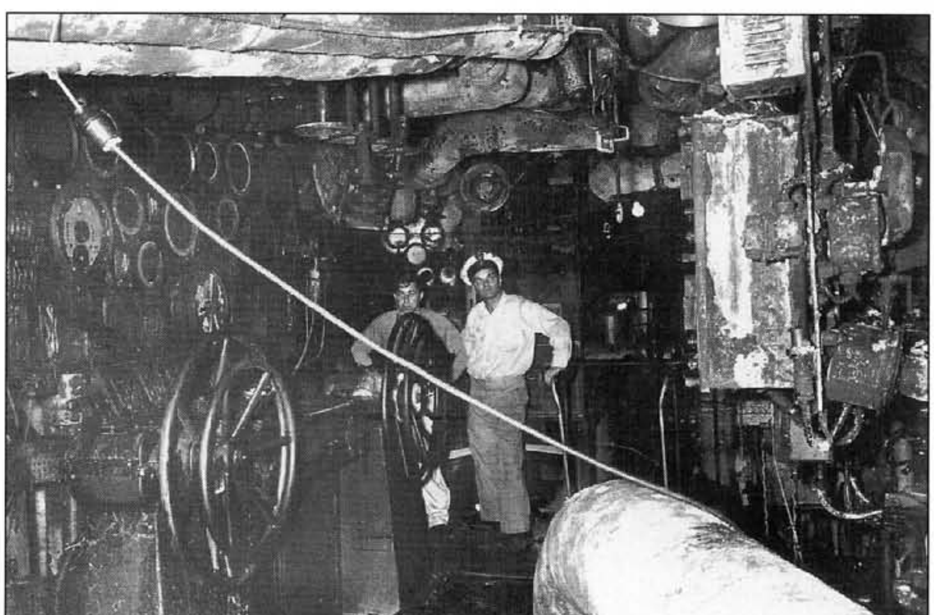
Pressure was eventually restored by bringing No. 3 hull-and-fire pump on line and discontinuing the magazine flooding.

By now the task group was aware of *Kootenay*'s plight. Shortly after 9:00 a.m. the first helicopters arrived with medical help and supplies of foam, blankets and Chemox gear. The fire blazed up periodically, but by 11:00 a.m. firefighters were finally able to occupy the engine-room. The ship was taken in tow shortly afterwards.

Lessons to be Learned — or Relearned

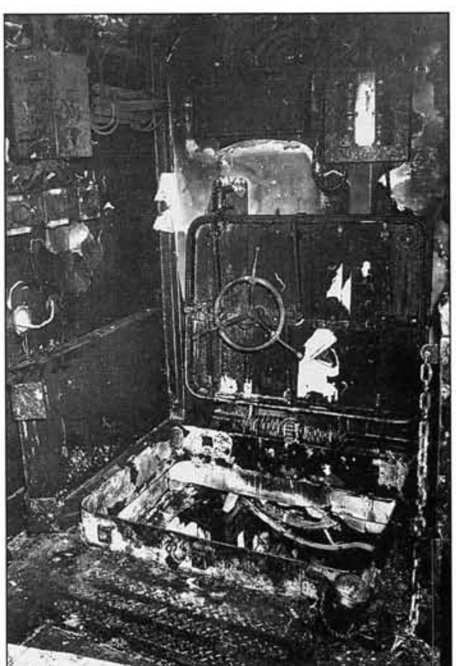
It is easy to critique other people's damage control actions from the safety of a desk without full regard for the circumstances and tremendous stresses the participants were under at the time. However, the following observations are made in the interest of underlining the lessons to be remembered. Although considerable local efforts were made to combat the fire, a damage control organization was never properly established:

- no HQ2 was set up; nor were section-base teams established;
- the boiler room was not successfully contacted to close the main stops and so stop the shafts;



Four of the ten men in the engine-room managed to escape through the forward hatch, but only three survived.

- many doors and hatches remained open during the entire incident, allowing smoke to swirl throughout the ship;
- engine-room steam smothering was not successfully employed;
- the amount of foam used on the engine-room bilge (i.e. all of the ship's immediately accessible supply, plus additional stocks flown in) far exceeded the requirements for the space size. After the initial application, the manpower, hoses and fire-main pressure could have been better used to attack the fire and ensure the security of the fire boundaries;
- flooding of the 3"50 magazine (which was already being sprayed), without bringing on additional fire pumps, led to a loss of fire-main pressure as a fire-fighting team was attacking the fire;
- no fire boundaries were set up, apart from spraying and flooding the magazine.



In 1969, unlike today, hold-backs for the forward and after engine-room hatch-covers could only be released by reaching across potentially heat- and smoke-filled openings.

Board of Inquiry Recommendations for Damage Control

The Board made 15 recommendations relating to damage control in Y-100 ships and other classes. Fourteen of these were actioned, including:

- fitting gearboxes with a continuous monitoring system;
- fitting gearbox vents with antiflash screens and redirecting them to vent outside the space;
- taking design action to prevent incorrect installation of bearings, etc;
- avoiding the use of thin-section light metal (eg. aluminum) catwalks, ladders, platforms and handrails in future machinery spaces;
- fitting additional escape hatches, particularly in cafeterias;
- Installing direct bridge-to-boiler-room communications;
- Reviewing policy of flooding magazines from the fire-main: magazine flood and spray capability from the fire-main were deemed necessary; to prevent drastic drop-offs in fire-main pressure the reliability of the fire-main pumps would be improved, the main would be sectioned off as required to avoid dragging down the overall pressure, and emphasis would be placed on fire-main management;
- Reassessing DC training with emphasis on use of breathing apparatus, fire-fighting and emergency organization and action, and "know your ship" drills;
- Installing smoke/flame-tight doors on No. 3 deck;
- Installing fitted fog sprays in all machinery spaces. Heat-activated sprays are now fitted above all ladders leading out of the engine- and boiler rooms.

Postscript

Twenty-five years later, have we remembered the lessons of *Kootenay*? In general, we have, but the battle against complacency in peacetime must continue. In the last five years at least two NATO navies have lost personnel to machinery space fireballs caused by poor maintenance practices compounded by steaming with open machinery space hatches. The Canadian navy can take some small comfort in that it has one of the best fire and fire-damage records of any navy in NATO. But this can only continue as long as we emphasize all aspects of damage control — careful ship design, preparation (i.e. realistic training), prevention, vigilance and attention to lessons learned.

This buckled, aluminum ladder at the after engine-room hatch was no match for the intense heat created by the fire.

References

[1] Report of the Board of Inquiry, HMCS *Kootenay*, November 7, 1969.

[2] Personal Recollections of Mr. Robert George (A/DMEE 4-3), the chief hull technician on board *Kootenay* at the time.

Lt(N) Sisley is a damage control project engineer in DMEE 4.

News Briefs

Microwave fibre-optic link for CANEWS 2

A collaborative development effort between DND and the National Research Council's (NRC) Institute for Information Technology (Photonics Group) has resulted in a tested prototype for a microwave fibre-optic link. Developed in less than a year, the technology will be used in the navy's second-generation naval electronic support measures system — CANEWS 2.

Part of the CANEWS 2 project consists of developing an auxiliary receiver to detect and measure faint signals from distant radars, despite interference from nearby radar emissions. The proposed receiver architecture consists of a frequency measurement subsystem that prompts or cues a direction-finding subsystem to characterize a radar. The cuing determines the specific frequency that should be analyzed by the amplitude-comparison, direction-finding subsystem.

A complicated design using only conventional microwave components had difficulty achieving this objective. The simpler fibre-optic design requires fewer electronic components and should improve equipment reliability, save weight, and reduce susceptibility to electromagnetic interference. The link will extend the range of radar frequencies that can be monitored by the auxiliary receiver.

The microwave fibre-optic link will connect the direction-finding receiver's "up-mast" and "below-decks" circuitry and delay or store signals to allow time for cuing. Since fibre-optic cables can carry signals for kilometres without significant losses, long delay times and wide separations between receiving antennas become practical. This potentially allows very precise bearing measurement of radar signals over a wide range of power and pulse width.

Other military applications of the link are possible. By using suitable optical couplers it can provide several microwave output signals with a variety of delays (depending on the cable length between couplers). Several receivers optimized for different functions could then process the signals independently for recording, special analysis, or to search for a specific radar signature. An accurate replica of the delayed signal could even be transmitted back to confuse or jam a target radar.

Unusual in most defence research, the real potential of microwave fibre-optic technology lies in the commercial sector. For example, the technology can combine high-speed digital communications with the transmission of extended frequency microwave signals over the same cable. By using separate lasers to transmit the two signals at different optical wavelengths, a link could simultaneously transmit the equivalent of 3,000 television channels and a computer communication data rate more than 10,000 times faster than current telephone modems. This link could be over a single line, ten kilometres long, without amplification relays. The capability should significantly contribute to the telecommunication network necessary for the "information highway."

The CANEWS 2 project has funded more than half the project costs for the microwave fibre-optic link, with the NRC contributing the rest of the investment and developing the technology. Defence Research Establishment Ottawa staff advised on the electronic warfare applications of the link. Work continues on a second, more capable, demonstration unit. — **by F.J. Harlow, DMCS 4-4-5.**

DGMEM Cox'n

C1NET(M) Craig Calvert (left) takes over as the new DGMEM Chief Petty Officer from C1ER Jim Dean. Appointed to the position by Cmdre Robert L. Preston (DGMEM) last December, Chief Calvert will act as the divisional coxswain, representing all NCMs in the Maritime Engineering division of NDHQ. Chief Dean, who held the appointment for 2½ years, retires from the navy during FRP '95. *(Canadian Forces photo)*

Canadian Forces Naval Engineering School

July 1, 1994 signalled the end of an era at CFB Halifax (Stadacona). On that day, Canadian Forces Fleet School Halifax officially stood down and two new, smaller schools came into existence. The former fleet school, commanded by a naval captain for all but the last year of its long history, was divided into the Canadian Forces Naval Engineering School (CFNES) and the Canadian Forces Naval Operations School (CFNOS). For each of the new schools, the position of commandant was established at the rank of commander.

Under the new structure, CFNES comprises the former Marine Systems Engineering, Combat Systems Engineering and Damage Control divisions. The CFNOS comprises the former Combat and Seamanship divisions.

The first commandant of the CFNES was Commander "J.C." Tremblay (MARE/CS), who held the position for one month prior to his retirement. He was relieved by Commander J.E. Jollymore (MARE/MS) who assumed command on July 28, 1994 after returning from a one-year posting to the French Joint Staff College in Paris.

The CFNES has an establishment of 48 officers, 254 NCMs and 60 civilians organized into five divisions:

- Combat Systems Engineering
- Marine Systems Engineering
- Engineering and Technology
- Tactical Software Training
- Damage Control

Career and occupation specialty training at the Naval Engineering School is conducted for the following personnel:

- Marine and Combat Systems Engineering officers;
- Naval Electronics Technicians (Acoustic, Communications and Tactical);
- Naval Weapons Technicians;
- Marine Engineering Mechanics, Technicians and Artificers;
- Marine Electrician and Electrical Technicians; and
- Hull Technicians.

Cdr Jim Jollymore signs the Change of Command certificate for the CF Naval Engineering School in Halifax. Looking on is outgoing commandant, Cdr "J.C." Tremblay. *(Canadian Forces photo)*

Courses range in length from a few days for refresher and specialty training, to more than one year for career courses. In a typical year some 10,000 students will receive training in one form or another, with the majority of them (about 8,500) attending to receive Damage Control refresher training. The CFNES conducts Damage Control training for all seagoing personnel from the naval and air occupations (regular and reserve); the Tactical Software Training Division also conducts training for selected officers and NCMs from both the naval and air environments.

In his first year as commandant Cdr Jollymore will face a variety of challenges, including taking over responsibility for CPF technical training from the CPF Training Detachment. The CF Naval Engineering School is expected to be a very busy unit over the next few years. Development and conduct of training, especially for the *Halifax* class, should keep the staff (and students) well occupied.— **LCdr Greg Harper, Chief Standards Officer, CFNES.**

Multimedia technology: solving the naval training gap

As technology develops, in particular computer technology, the number of complex systems that naval personnel use as part of their shipboard duties increases accordingly. Unfortunately, personnel changes on board ship mean it is not always convenient or even possible to adequately train everyone in the use of the various systems. This reality of the modern navy has created a "training gap" that grows with every new system added to Canadian naval ships.

The use of computers and multimedia technology has been identified as a possible solution to this growing problem; a solution which is practical, convenient and cost-effective. Multimedia technology uses graphics, animation, sound and interaction to make learning easier, more intuitive and better suited to individual needs. Instead of trying to train personnel on new systems using the traditional classroom approach, or expecting them to learn by "trial and error" during the course of their duties, multimedia training packages can be developed to allow individual users to train themselves at their own pace and at whatever time they find most convenient.

NETE is currently developing a prototype multimedia training package entitled "Introduction to Personal Computers," for use on the ICEMaN LAN. The package explains all of the basics of using the ICEMaN computers, including definitions, general and specific information on hardware and software, and the beginning concepts of computer networking.

For example, during a lesson on computer memory the screen is split into two to demonstrate the difference between the computer's RAM (Random Access) and ROM (Read Only) memory. While a voiceover describes the difference between the two types of memory, a pair of animated eyes moves onto the screen and "reads" data from both sides of the screen. The eyes are followed by a hand which is able to write on the RAM side, but is confronted by a stop sign when it tries to write on the ROM side. This demonstrates to the student in a graphic, memorable way that you cannot write to the computer's ROM memory. The system can later quiz the student by creating a ROM and RAM box on the screen, placing a "pencil" graphic on the screen, and asking the student to use the trackball to move the pencil to the type of memory to which the computer is able to write.

While this is a rather primitive example of the capabilities of this type of system, it's easy to see how multimedia training can provide easy-to-use and easy-to-remember instruction. Students can use the lessons to supplement their classroom training.

An early version of the "Introduction to Personal Computers" multimedia training course was recently demonstrated to naval personnel who were attending the classroom equivalent of the same course. The feedback was encouraging. The students were particularly interested in using this kind of system as a way to refresh their memory for tasks which they may find themselves performing only once every several months or years, especially if the multimedia system were designed to take them "step by step" through the various procedures.

If this prototype is successful in demonstrating the practicality of the technology, multimedia training packages could be used to enhance or even replace other training methods, and could perhaps help to close the training gap in the Canadian navy. — **by Andrew Gurudata, B.Comp.Sc., NETE.**

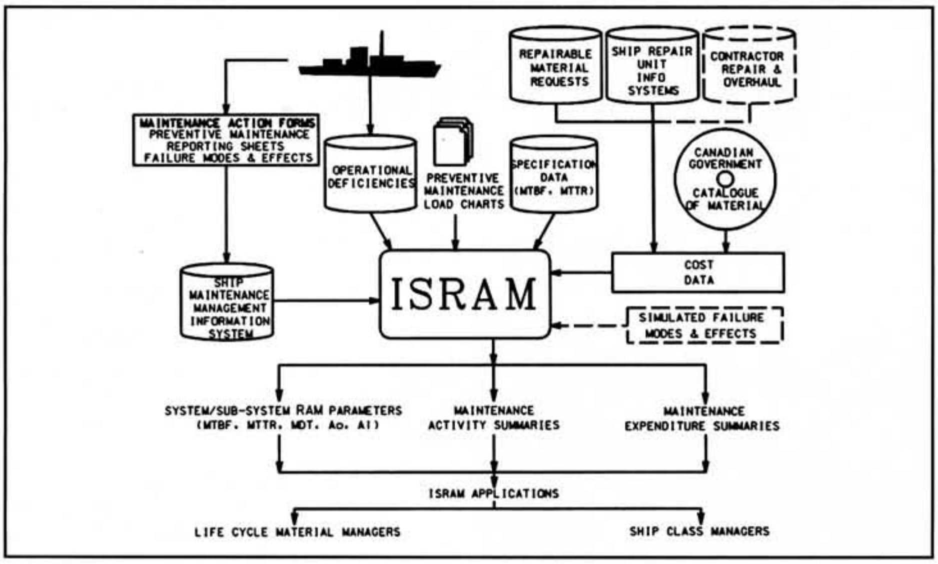
Badminton anyone?

Singles champion SLt François Letarte walked away with the spoils of victory at the Royal Navy badminton championships in Portsmouth a year ago in January. He and partner SLt Dan Riis, representing RNEC Manadon at the time, were also semifinalists in the Men's Doubles competition. Bravo Zulu to both officers who have just begun their MARE 44B sea phase training. *(Photo by SLt Dan Riis)*

ISRAM for the Canadian navy

An In-service reliability, availability and maintainability (ISRAM) operational evaluation (OPVAL) commenced on board HMC ships *Toronto* and *Vancouver* in January 1994. ISRAM is an initiative undertaken by DMES 6, in co-operation with the Naval Engineering Test Establishment, to help the navy realize the full potential of the Canadian patrol frigate (CPF) in terms of its designed operational availability. Furthermore, ISRAM is a reliability-centred-maintenance (RCM) tool designed to highlight reliability and maintenance problems at the subsystem, system and ship level.

The primary purpose of the two-year OPVAL is to gather, analyze and disseminate failure and repair cost data of 11 selected systems (i.e. six marine systems and five combat systems). The OPVAL will continue until early 1996 and will expand to cover more ships and systems.



The ISRAM project provides six types of periodic reports to the naval community. Three types are intended to assist in system analysis activities performed primarily by life-cycle materiel managers (LCMMs) and NEU personnel. The other three provide rolled-up figures of maintenance activities which can assist in-service class managers (ISCMs) in allocating resources. Together these reports can help commands, squadrons, and ship staffs assess the reliability and availability of their ships and systems.

Expected long-term benefits of ISRAM will include more effective PM routines, fewer failures, lower system down time, higher system and ship-level availability and more effective on-board sparing. As the ISRAM OPVAL progresses, it will improve operator and maintainer confidence in the equipment they manage. ISRAM will also assist LCMMs and ISCMs in the evolution toward the most cost-effective maintenance and support required to achieve mandated levels of operational availability. — **by Leo Pizzi, Project Engineer, NETE Maintenance & Signature Analysis Section, with files from Lt(N) Joël Parent, ISRAM Program Manager, DMES 6-2-4.**

New Branch Adviser takes over

The Maritime Engineering branch has a new Branch Adviser. In December, Commodore F.W. Gibson, OMM, CD, formerly the project manager of the Canadian Patrol Frigate project, was appointed Director General Maritime Engineering and Maintenance. Cmdre Gibson relieved Commodore Robert L. Preston, who retired with 37 years of naval service.

Cmdre Gibson joined the navy as a cadet in 1967, and went on to earn a baccalaureate degree in engineering physics and a master's degree in electrical engineering. Prior to his appointment as PM CPF he served as Base Commander, CFB Esquimalt, and as the Director of Maritime Combat Systems in DGMEM. Cmdre Gibson is a former CO of Naval Engineering Unit Pacific. He was awarded the Order of Military Merit in 1992.

Cmdre Preston closes out a distinguished career that includes service as commanding officer of Ship Repair Unit Pacific, Chief of Staff (Materiel) in Maritime Command H.Q., Marine Engineering Staff Officer to the naval attaché in Washington, and program manager for the Tribal-class Update and Modernization Project. He was appointed DGMEM in July 1992.

The farewell held at the HMCS *Bytown* Crowsnest in Ottawa for Cmdre Preston on Dec. 2 was extremely well-attended. The roast from Cmdre Gibson, along with the sentiments of several other naval friends, certainly conveyed the best wishes of the Maritime Engineering community to Cmdre Preston and his wife Maureen for a healthy and happy retirement.

CPF Construction: Experience Gained

Coming up in our June issue