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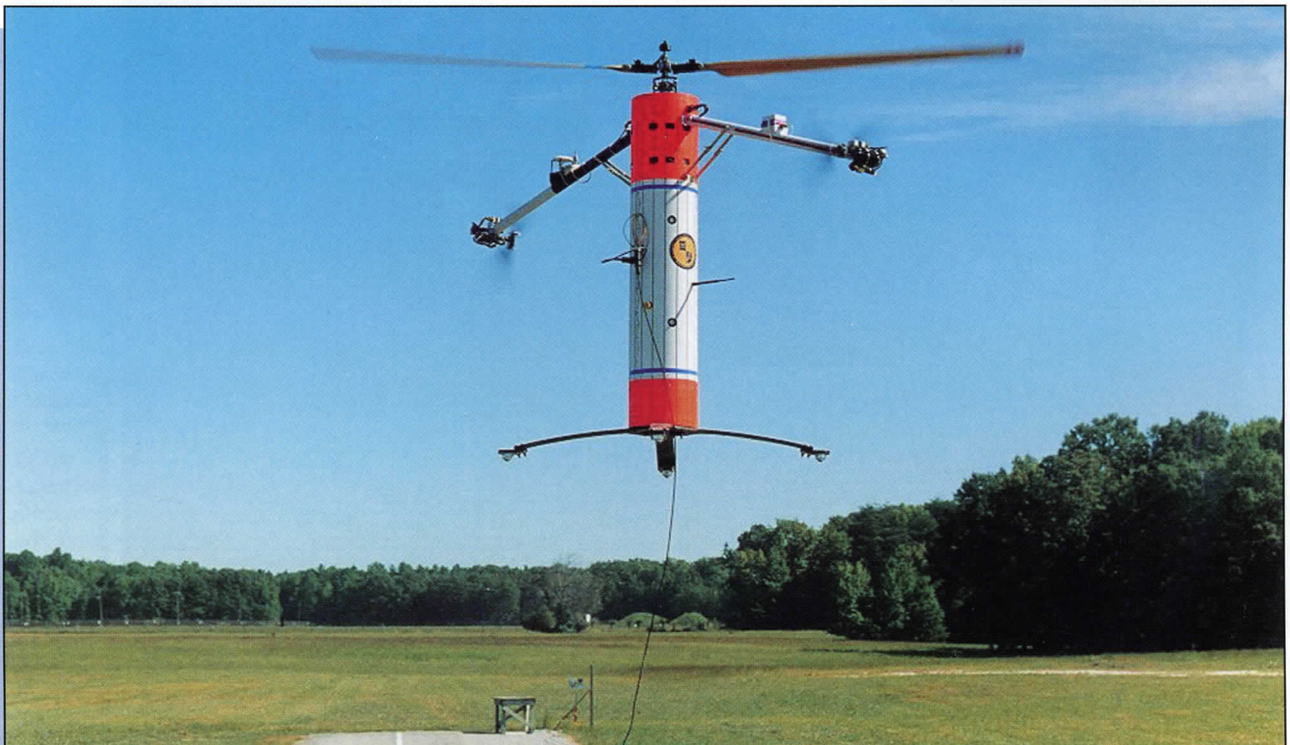
Maritime Engineering Journal

CANADA'S NAVAL TECHNICAL FORUM

Spring 2001

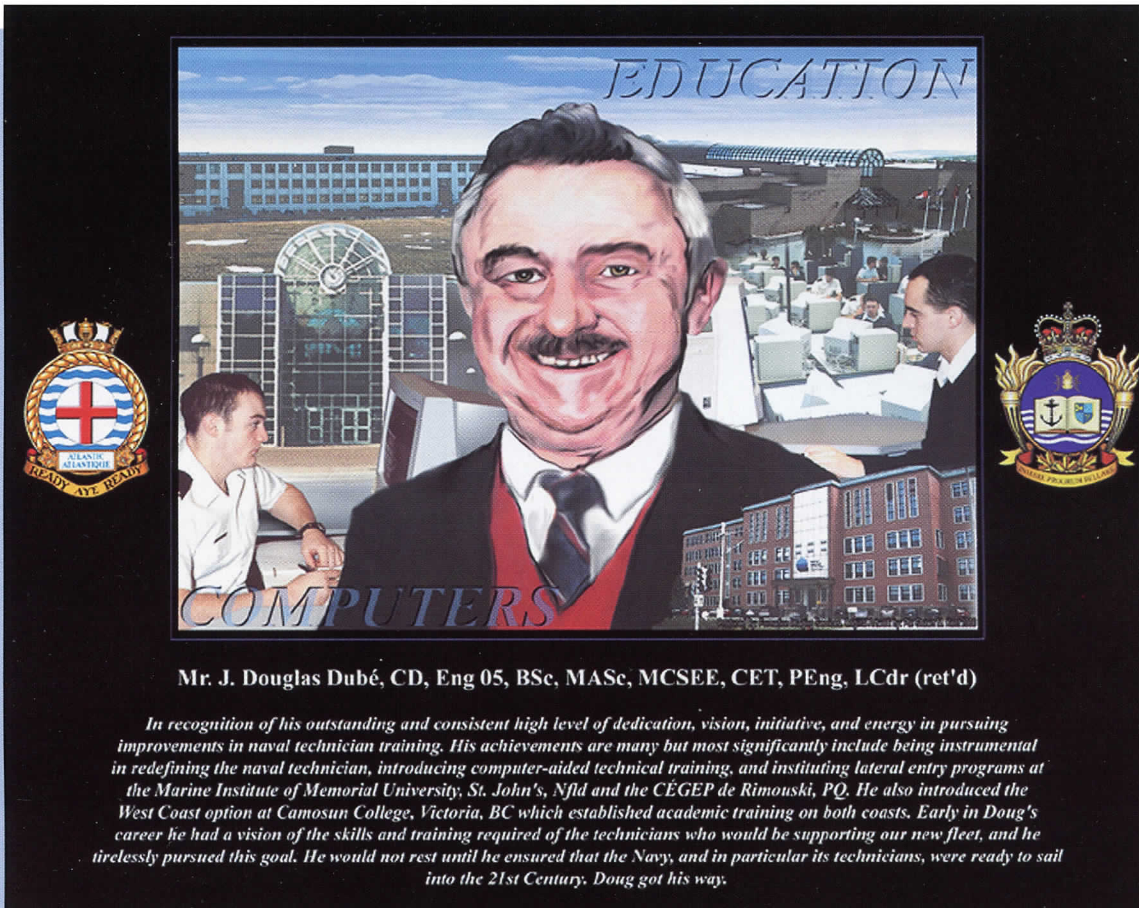


New Technology:
A Potential Unmanned Aerial Vehicle for Naval Electronic Warfare

Also in this Issue:

Canada

“Dubé’s Way”



DND photo courtesy of CFNES

The Canadian Forces Naval Engineering School in Halifax honoured one of its own last February by designating the 2nd deck of the engineering school (Bldg. S-37) as “Dubé’s Way.” The tribute was made in memory of former Engineering and Technology Division Commander Douglas Dubé who died in 1999. Mr. Dubé, who had been with the school since 1980, was honoured for his outstanding vision and dedication in pursuing improvements in naval technician training.

Maritime Engineering Journal

SPRING 2001

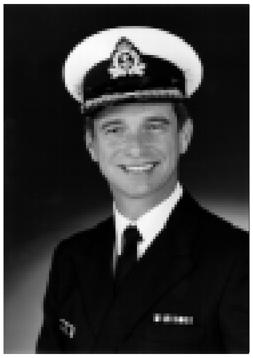
Vol. 20, No. 1 *(Established 1982)*

DEPARTMENTS

FEATURES

Cover:
The US Naval Research Laboratory's 50-kg tethered unmanned aerial vehicle, "Eager." *(Image courtesy USNRL)*

The *Maritime Engineering Journal* (ISSN 0713-0058) is an unofficial publication of the Maritime Engineers of the Canadian Forces, produced three times a year by the Director General Maritime Equipment Program Management. Views expressed are those of the writers and do not necessarily reflect official opinion or policy. Mail can be sent to: **The Editor, Maritime Engineering Journal, DMMS (6 LSTL), NDHQ, 101 Colonel By Drive, Ottawa, Ontario Canada K1A 0K2**. The editor reserves the right to reject or edit any editorial material. While every effort is made to return artwork and photos in good condition, the *Journal* assumes no responsibility for this. Unless otherwise stated, *Journal* articles may be reprinted with proper credit. A courtesy copy of the reprinted article would be appreciated.



Editor's Notes

The Navy Says Farewell to NETE's Dr. George Xistris

By Captain(N) David Hurl
Director of Maritime Management and Support

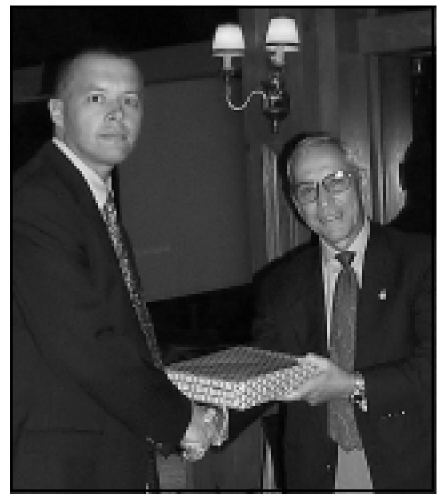
It's hard to think of the Naval Engineering Test Establishment without calling Dr. George D. Xistris to mind. For more than 30 years — since 1968, in fact — he has played a pivotal role in the development and success of the Department's premier naval engineering test facility. When he retired as Director of NETE earlier this year, he left behind a fully refurbished, smoothly running facility that is well-equipped to meet the navy's engineering challenges over the next several decades.

Dr. Xistris graduated from McGill University in 1959 with a bachelor's degree in mechanical engineering, and a Master of Engineering degree in 1967. He also enjoyed a long and distinguished professional association with the Faculty of Engineering of Concordia University from 1965 right up until 1995. In 1978 he was honoured with the title, "Docteur ès Sciences appliquées" from the Université de Montréal.

During his career with NETE and Peacock, George investigated the application of computational methods to statistical vibration studies, the intricacies of machinery vibration, shock and noise instrumentation, and the application of vibration measurements to machinery health monitoring. He published numerous technical papers and made more than 40 technical presentations at conferences. Ever the academic, when he became Director of Engineering in 1986 he encouraged NETE's engineers and technicians to share their findings with the *Maritime Engineering Journal*.

During the last nine years as director, George Xistris oversaw a major facilities upgrade at NETE, including the construction of a new office complex. He also directed the delicate and challenging task of setting NETE's administrative course for the future. These huge achievements proved to be a fitting cap to what was an outstanding career.

As George moves on to retirement and begins to take up the slack with his two favourite hobbies of golf and bridge (he is a master bridge player), he carries with him the best wishes and well-earned thanks of Canada's naval technical support community. To the irrepressible "Dr. X," we can only say "Bravo Zulu" for a job very well done. Farewell to a fine friend of the navy.



Dr. George Xistris (right) with NETE's new site manager, Michel (Butch) Bouchard. *(Photo courtesy of NETE)*

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.

Commodore's Corner

MARE Branch Restructuring

By Commodore J.R. Sylvester, CD
Director General Maritime Equipment Program Management

The naval technical community has been discussing the news that the MARE branch will soon be moving to a three-occupation (or suboccupation) structure. MAREs will be recruited as Marine Systems Engineers or Combat Systems Engineers, and remain under their separate Military Occupation Codes until they come together in a single, generic MARE group for Cdrs and Capts(N). Requirements for naval architecture and constructor specialties will be met via Occupation Specialty Qualifications rather than by separate sub-MOCs.

Most MAREs accept that benefits will accrue from this change. Where some people have expressed doubt is with a possible future step: consolidating into a single, generic MARE MOC for all ranks, without separate MS and CS designations.

Why would we do such a thing? Isn't our front-end training time already too long? Could a generalist have the depth of knowledge necessary to give a ship's CO credible service? What would it mean for the engineering trades?

I should emphasize that the MARE Council did not just dream up this idea to provoke you. Individual Council members have noted sufficient interest in a single MARE MOC from within the branch to warrant its serious consideration. Even so, rest assured that a single MARE MOC is not a foregone conclusion. The risks will be thoroughly analyzed and consultation will be held before a final decision is made. Let me share with you, though, the rationale behind the proposal.

The materiel community is much smaller now than when the current construct was established, and pressure to downsize continues. Demographic realities will make recruiting and retaining quality skill-sets increasingly difficult, and at some point the arbitrary separation of MARE MS and CS may become impractical. Are we at that point yet? That remains to be determined, but even now I often find myself wishing for more flexibility in MARE personnel management.

Evolving shipboard technology is also blurring the MS/CS distinction, with electronic controls, software, heavy electrics and hydraulics firmly part of both arms. There are a few instances where a major technology skill remains the purview of just one group (e.g. the MS officer's responsibility for combustion prime movers); nevertheless, the alignment of generic MS and CS functions is compelling. If any delineation remains appropriate, perhaps it should be between system and equipment rather than between systems themselves.

Whether or not we go to a generic MARE MOC we must be very conscious of our training load. This means rethinking what MARE officers really need to know. MAREs, NCMs, DND civilians and industry together share the burden of materiel cognizance, but the niche of the MARE officer lies in systems management and the technical interpretation of operational requirements. Technical depth can be provided by others. Commanding officers today should expect their MARE department heads to lead, to manage and to analyze unusual technical problems — not to be equipment-specific experts. Engineers have many resources upon which they can draw for specific technical expertise. We would, of course, have to rely heavily on the skill and expertise of our senior NCMs, and would review their training with this in mind. Note also, though, that systems and equipment are generally more reliable now than in the past, and that repair-by-replacement maintenance has reduced the need to get into the detail.

If the move to a single MARE MOC happens at all, it will be years from now. This gives you plenty of time to consider the idea and voice any concerns. I sincerely encourage you to do so because, if it becomes a reality, it will be on your watch.

Letters

Chief of the Maritime Staff — Chef d'état-major des forces maritimes

As I prepare to relinquish my duties as the Commander, Maritime Command, permit me to thank the editorial staff of the *Maritime Engineering Journal*, as well as its many contributors over the past four years, for their efforts in furthering the professional interests of the maritime engineering community.

I am a devoted reader of the *Maritime Engineering Journal*. The quality of thesis and rebuttal I find there is, of course, not only of fundamental importance to the professional naval materiel community, but, more importantly, signals that this community is intellectually "in good nick."

I depend absolutely on a well-informed community of MARE officers and NCMs, engineers and technologists to sort hard reality from fantasy, to match cost-effective capability to requirement, and to keep it all working in operational service. Simply put, I need them to keep their eyes both "on the dials" and scanning the horizon, and few professional vehicles do this as well as the *Maritime Engineering Journal*.

Once again, many thanks and BRAVO ZULU.

Sincerely,

G.R. Maddison, Vice-Admiral

Reduced manning may affect missions

I am currently deployed on board HMCS *Vancouver* in the Asia/Pacific region. I sailed on board the 280s (*Iroquois* class) prior to this posting, and am looking forward to the day when I can sail (hopefully as Sensor Weapons Controller) on the newest command and control platform.

I read with interest LCdr Gray's article in the *Maritime Engineering Journal* regarding the CADRE project and the reduced manning potential offered by early planning (*"Manning the CADRE Ships — Let's get it right," Maritime Engineering Journal, Fall 2000 / Winter 2001 issue*). I agree that newer technology does offer the potential to reduce the number of sailors required to stand a steaming watch, but I would like to submit the following thoughts on how reduced manning may impact a ship's effectiveness in carrying out other missions:

• A large part of our mission as a deployed unit involves public relations. Examples of this are daysails in support of civilian and local governments, and serving as a "backdrop" for official functions (i.e. cocktail parties). Manning for these large events is supplied by all departments on board ship;

• During maritime interdiction operations such as those being conducted by our ships in the Persian Gulf, large numbers of personnel are often employed as boarding party. Manning for this duty is supplied by all departments;

• Following the USS *Cole* incident, ships have been forced to adopt a larger foreign port duty watch, which entails extra sentries and roving patrols. Having sufficient manning to ensure a good duty watch rotation and adequate shore leave is very important to the sailor on deployment;

• HMC ships often find themselves carrying "riders." These may consist of Sea Training staff; FMF personnel brought on board to test a new piece of equipment; range and trials staff for missile firing events; as well as extra command staff, to name a few. If we reduce the manning levels of the ship, we should not necessarily reduce the number of bunks available. I have often seen sailors "hot-bunking," or sleeping on cots.

To effectively carry out our missions, we often require the assistance of all hands. It is my belief that when we propose manning levels for our new ships we should take into account *all* the duties of our sailors, and not just multiply the number of consoles by the watch rotation (e.g. 1-in-2, 1-in-3, 1-in-4) to arrive at our manning numbers. **— PO2 Keith Macfarlane, NESOP, Regulating Petty Officer, HMCS *Vancouver*.**

MARE Amalgamation: Vision or Illusion?

Article by Lt(N) Louis Saucier

During the Maritime Engineering (MARE) "town hall" meeting held in Halifax last November, MARE Branch Adviser Capt(N) Mark Eldridge discussed the finer points of the recent consolidation of Naval Architects and Constructor Officers under the Marine Systems Engineering suboccupation. At the end of the meeting, he left us to think about a long-term vision of the Branch that could include consolidating the two remaining MARE suboccupations — Combat Systems Engineering and Marine Systems Engineering — into one generic MARE occupation.

In this vision, one engineering officer would be responsible to the captain for all technical support on board ship. The engineer would likely be a CSE with basic understanding of diesel engines. Although far from any implementation stage, this vision seems to be supported within the naval community as it has kept coming up, under various forms, at MARE town hall meetings and other forums in recent years. Of course, the vision of a single MARE occupation presents advantages for the navy, such as downsizing the crew required on board, simplifying the management of the occupation and significantly enlarging the technical fields of competency of MARE officers. However, such a vision carries with it important pitfalls that have, so far, been ignored by the MARE community.

The aim of this paper is to highlight the inevitable downside of such an amalgamation, a move which would contribute to undermining the credibility and efficiency of the MARE community. Specifically, the following points will be discussed: the 50-percent reduction of Head of Department (HOD) positions at sea; the significant increase in the waiting period before employment in a HOD position at sea; and the introduction of general engineering practice.

50-percent reduction of HOD positions at sea

Clearly, the vision of amalgamating the MARE suboccupations would cut by half the number of HOD employment opportunities currently available at sea for MARE officers. Although the number of deputies and assistants can be predicted to increase to properly assist the new engineering officers with their enhanced duties, the number of people fully benefitting from the experience of being employed in a HOD position would nonetheless be reduced by half. With so few HOD billets available at sea, the rich experience of direct and intense interaction with a captain, executive officer, other HODs and members of the engineering department would be out of reach to most MARE officers. This in turn would impair the operational perspective of MARE officers, thus significantly impacting their ability to perform effectively as Maritime Engineers in technical support roles ashore.

Increased waiting period before HOD employment at sea

Whether it were due to the requirement for longer technical training, or the straight 50-percent cut of the few available positions, MAREs would face much longer waits before being employed in HOD positions at sea. Career progression delays and the accrued responsibilities of the new engineering officer would probably mean that HOD positions would become LCdr billets, meaning that the professional development opportunities normally associated with HOD positions, which were once available to junior officers, would now be strictly limited to senior officers. The issue of long waits for HOD positions is already very sensitive among junior MAREs. A vision of amalgamation that promises only longer delays must inevitably lead to a lessening of responsibilities for junior MAREs, a phenomenon that goes against current tendencies in the civilian world. This would badly affect the credibility, profes-

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sionalism and morale of junior MARE officers, making them less effective in performing their important role within the technical support team based ashore.

Introduction of general engineering practice

Due to the constantly rising level of complexity of combat and marine systems on board ship, the engineering officer envisioned by the amalgamation would cease to be seen as a subject-matter expert in any of his fields of expertise unless his education and training were significantly enhanced. This is by all means possible; just picture Marc Garneau's level of knowledge and responsibilities during his space shuttle missions. But are the navy and the MARE community willing to put forth the necessary time and money? Whether we decide to train our MARE officers equally in all engineering fields, or focus on one speciality more than the other as suggested in the vision presented by Capt(N) Eldridge, the introduction of general engineering practice is inevitable.

How can we expect tomorrow's engineering officer to remain efficient, credible and, in particular, competent in all engineering fields? Looking at an operational scenario, the engineer (from his position in HQ1, the bridge, or the operations room) would be the one to come up with a consolidated intervention plan to keep the ship floating, moving and fighting in accordance with the situation and with command's priorities. On the other end, in a ship acquisition project scenario, that same engineer would be making decisions on specifications for everything from fuel transfer systems to inertial navigation systems. Without the proper education and training, no doubt similar to that which Scotty in *Star Trek* received, the scope of the task seems enormous, if attainable at all. In essence, engineering officers will become managers, or the single point of contact between command's needs and the solutions brought forth by the senior technicians. They, as best they can, will pick up the slack left from this dilution of competency in MARE officers. As long as competent engineering practice remains a fundamental principle of leadership, tomorrow's engineering officer will experience important difficulties in gaining respect from his team. The lack of in-depth knowledge associated with general engineering practice will undermine the credibility of MARE officers in the eyes of their subordinates, their colleagues and the command team.

Conclusion and recommendations

Although the vision of amalgamating the two current MARE suboccupations into one has some advantages, such a move would invariably water down our occupation. The available number of challenging, operational HOD employment opportunities would be cut by half, and would come much too late in one's career. The HOD positions themselves would even likely be designated as LCdr positions, invariably diminishing the professionalism, competence and morale of junior MAREs. It will become undeniably harder for engineering officers to reach the minimum level of competency in their fields of expertise, in essence making them nothing more than general engineering practitioners or technical service managers. Their credibility and ability to lead would be at risk.

This vision of amalgamation will only get the MARE occupation closer to the day when, for the sake of efficiency, the navy's commander will hand over charge of the engineering department to the Maritime Surface (MARS) officers. Tomorrow's "engineering officer" might very well be an operationally focused MARS officer trained to only a basic level of understanding of combat and marine systems engineering.

The only vision that will allow MARE officers to properly serve the navy at sea and ashore is one that exposes them to the deepest levels of their respective fields of expertise. This means giving them adequate training both ashore and on board operational ships, and offering them, early enough in their careers, as many employment opportunities as a HOD at sea as possible. Anything less, and the vision becomes nothing more than illusion.

Lt(N) Saucier is a former MSEO of HMCS Ville de Québec, and most recently Control Systems Officer in the Marine Systems Engineering Division of Canadian Forces Naval Engineering School Halifax. He is now attending postgraduate studies in industrial engineering at Rutgers University in New Jersey.

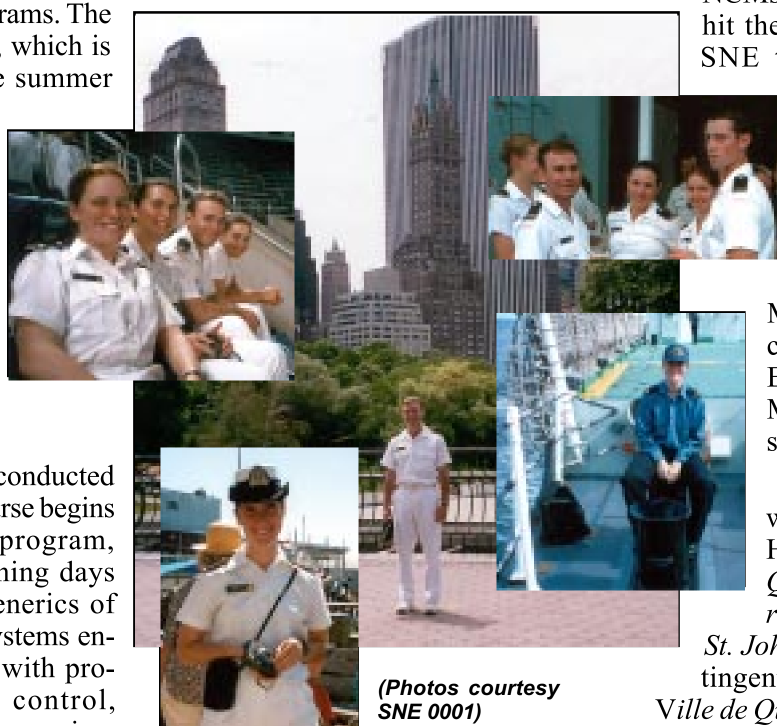
Support to Naval Engineering — A New Way of Training MAREs

Article by Lt(N) Chris Smith

During the summer of 2000, I had the pleasure of being the course training officer for a class of junior officers undergoing Support to Naval Engineering (SNE) training. For those unfamiliar with this training phase, Support to Naval Engineering was introduced five years ago to replace the old MARE Phase III and Phase IV training programs. The resulting SNE course, which is conducted during the summer between the third and fourth years of Royal Military College for Regular Officer Training Plan cadets, and in the late fall for some other entry plans, qualifies trainees to the MARE 44A common level upon commissioning.

The SNE course is conducted in two phases. The course begins with a shore-based program, consisting of 15 training days spent learning the generics of marine and combat systems engineering associated with propulsion, machinery control, power generation, radar, navigation and communications. General engineering concepts such as signature reduction, equipment health monitoring and noise control are also covered. Most trainees have never been to sea in a warship prior to SNE, so do not yet have a complete appreciation of the operation, capabilities and limitations of naval shipboard systems.

The afloat phase, which is completed in 35 training days on board a warship, bridges the theory to the practical in providing the candidates a first-hand view of a ship in operation. Devoted to the application of the students' theoretical knowledge to the actual systems fitted in HMC warships, the at-sea portion of the course provides most of the students with their first real sense of naval adventure. At the end of the training phase, the trainees must still successfully challenge an oral qualification board, chaired by a MARE lieutenant-commander, to be awarded their 44A qualification.



(Photos courtesy SNE 0001)

Conducting the training in this manner has effectively shortened the overall training profile of the MARE, and it gives the trainees a better appreciation of the MARE occupation before they finish their university education and carry on with further coursing. For the SNE 0001 candidates, most of whom were sailing on board a warship for the first time, the experience of deploying to ports on the Great Lakes and along the eastern seaboard was unforgettable.

The 32 students who arrived at CFNES Halifax to commence the shore phase of SNE 0001 on May 29, 2000 were a diverse mix of third-year RMC cadets, Direct Entry Officers and University Training Plan NCMs. And they were eager to hit the books. In the past, the SNE trainees were divided among East and West Coast ships for the afloat phase of their training, which created certain management and fiscal challenges. However, joint MARS and MARE training is now completed solely on the East Coast, a priority in MARLANT's operational schedule each year.

The SNE 0001 trainees were accommodated in HMC ships *Ville de Québec*, *Montréal*, *Toronto*, *Charlottetown* and *St. John's*, with the largest contingent (13 trainees) sailing in V*ille de Québec* with a course training officer. The navy hasn't seen this many trainees on board one ship since the "glory days" of the West Coast Training Squadron. To the delight of the junior officers under training, they got the chance to show the flag in US as well as Canadian ports. While trainees in HMCS *Toronto* visited a number of ports in the Great Lakes, those in *Ville de Québec* and *Montréal* visited Newport, Rhode Island, New York City and Boston. After a brief break in Halifax, *Ville de Québec* headed for Charlottetown, PEI with an additional six trainees embarked, while *Montréal* sailed for St. John's, NF. *Charlottetown* and *St. John's* conducted training alongside for those trainees who could not be accommodated in *Ville de Québec* and *Montréal*.

From the start, the ships' companies were quick to integrate the trainees into their daily routines. One engineering officer told me that, initially, there was some trepidation on the part of the Marine Systems and Combat Systems departments when they were told that a large number of SNE trainees would be joining them. However, once they saw the attitude of the trainees toward their training and how eager they were to learn the systems, the apprehension evaporated and departmental personnel made every effort to show them everything there was to know about their systems. The trainees certainly appreciated this effort, as is confirmed by their comments in their course critiques. Many of the trainees noted that it was one of the best summers they had spent since joining the Forces and that they had definitely made the right decision in selecting the Naval Operations Branch as a career choice.

Although some problem areas were encountered regarding co-ordination and employment priorities, lessons were learned which will be incorporated into future training serials. Overall, the Support to Naval Engineering training was highly successful, due in no small part to the attitude of the trainees and the ships' companies. The chance for the trainees to conduct training on ships sailing to foreign and Canadian ports was of considerable benefit.

In closing, I would like to thank all members of the ships' companies of HMC ships *Ville de Québec*, *Montréal*, *Toronto*, *Charlottetown* and *St. John's* for their tremendous assistance to the SNE trainees. As one naval cadet noted, "The generosity of these ships to accommodate trainees demonstrates the strength and cohesiveness of the Navy." Finally, I would like to congratulate the candidates of SNE 0001 for their effort in completing an intense period of training. For me, it was pleasant and satisfying to act as a training officer for such a motivated group of young engineers, and I thank them for allowing me to use their comments in this article. I wish them well with the rest of their careers as MAREs, and earnestly hope they find it a rewarding experience.

Lt(N) Smith is the Assistant MARE 44A Course Officer at the Canadian Forces Naval Engineering School in Halifax.

Leadership and the Non-commissioned Member*

Article by MS Bettina McCulloch

Perspectives on leadership are as varied as the leadership styles employed by Canadian Forces members in the performance of their duties. In essence, though, leadership involves interacting with people and influencing them to do willingly what is required to achieve an aim or goal.

Although the media and the public look first to our officers for examples of leadership, leadership is not restricted to the wardroom. Throughout Canada's military history there are examples of NCMs taking on responsibility, making timely decisions and becoming a positive example to others. Some of these individuals have even received the Victoria Cross for their actions in the face of the enemy. But what is it that these people had in common with each other, and with the leaders of today?

Usually when we speak of leadership we think in terms of people having (or not having) such qualities and attributes as good communication skills, integrity, honesty, a sense of responsibility, energy, confidence, initiative and the ability to make timely decisions. Of course, these are just a few of the attributes an effective leader can possess. The Canadian Forces "Principles of Leadership" found in CFP 131(1) offers guidance to CF members, regardless of rank, who wish to become effective leaders. What follows is one interpretation of those principles.

Achieve professional competence and pursue self-improvement

No one wants to take direction from someone who cannot demonstrate a sound knowledge of his or her trade. Nor will anyone want to follow someone who lacks the skills necessary to accomplish a task. A lack of knowledge on the part of a leader will actually diminish his effectiveness by undermining the confidence others have in him.

NCMs can achieve professional competence through trade courses, through experience gained working in their trade (i.e. participating fully in exercises and operations), by seeking a mentor for professional guidance, and by engaging in individual study on a specific area of interest. None of this comes without a price. Effective leaders know that nothing is gained from taking short-cuts; something worthwhile is rarely achieved without a lot of hard work.

Appreciate your own strengths and limitations

Leaders are not perfect. Like everyone else they have their limitations as well as their strengths. Effective leaders are not afraid of change. They admit when they make mistakes, strive to learn from their mistakes, and develop strategies to overcome their own limitations. As they build on their personal strengths, leaders strive to stretch their limits while remaining an effective part of the team environment.

Seek and accept responsibility

One of the ways an NCM can develop leadership skills (e.g. the ability to organize and execute a task) is by seeking and accepting additional responsibility. Opportunities to develop leadership skills through volunteering are available for the asking. Serving on your mess executive, assisting with the organization of a unit event, or volunteering with a local cadet group are only a few of the opportunities you can take advantage of.

Lead by example

You are on parade and the inspecting NCM who has just picked you up for a minor dress infraction appears to be guilty of the same offence. While this may seem insignificant, it serves to illustrate the point that anyone wishing to influence the behaviour of others must be the first one to exhibit the desired behaviour. In many ways, actions speak louder than words.

Communicate your intentions, and lead others in accomplishing the mission

The ability to communicate your ideas or instructions for a task in a clear, concise, complete and accurate manner is essential to becoming an effective leader. You must be able to delegate. However, while it is necessary for a leader to delegate tasks, the leader is still responsible for providing the team with the focus and direction it needs to accomplish the mission in a timely and effective manner. Minimal supervision, follow-up and meaningful feedback are tools a leader can use to keep a team on track.

Train your soldiers as a team and employ them up to their capabilities

Teamwork is essential in any organization for completing complex tasks because no one person has all the knowledge or skills that are required. Without the input of everyone on the team, tasks become harder to accomplish and group morale begins to suffer. Effective leaders strive to maximize the effectiveness of their teams by assigning meaningful tasks that fully utilize and develop the abilities and skills of the people who are working for them.

Know your people and promote their welfare

Always set aside time for your people. Although time constraints make this difficult, it is vitally important that you know who your people are and what is going on in their professional and private lives. What kind of activities are they involved in outside of work? Is anything happening at home that may be affecting their performance on the job? Which individuals are ready for more challenges, and which need more practice at a particular skill? Once you know the people who are working for you, you will be better able to employ them in the overall effort and to go to bat for them when the occasion arises.

Develop the leadership potential of subordinates

Eventually you will need to find someone to fill a leadership role (e.g. training co-ordinator). To promote growth within your organization, it is necessary to develop the abilities and skills of each individual — from the most junior, to the most senior. As leaders we need to provide our people with opportunities to take charge of a group, express their ideas for change, take the initiative, plan an evolution, etc.

Make sound decisions, and keep your subordinates informed

People need to know that their leaders are making sound decisions based on all the available knowledge. They also need to know that these decisions are timely. As a leader, it sometimes just isn't possible to gather more information before you need to take action. When this happens, get on with it! There is nothing more you can do.

And just as a leader needs information to make sound decisions, those who follow need some information in return. Subordinates need to know how they are progressing, how a specific task affects the "big picture," and what factors will have an impact on the task at hand. Keep your people informed.

Conclusion

Influencing others to willingly do what is required to achieve a goal is an art that can be learned by anyone. It is the art of leadership. All that is needed is opportunity to develop the abilities and embody the principles that support it.

**MS Bettina McCulloch is the editor-in-chief of* The Prop Wash*, the newsletter of Ottawa's naval reserve division, HMCS* Carleton*. Her article, first presented at a junior ranks professional development conference held at* Carleton *in November 1999, was condensed for publication in the Winter 2000/2001 issue of* The Prop Wash*. It has been edited and reprinted here with permission.*

New Technology:

A Potential Unmanned Aerial Vehicle for Canadian Navy Electronic Warfare

A developmental US Navy tethered UAV could be just what the Canadian navy needs for extended horizon electronic surveillance and countermeasures

Article by Barbara Ford, Tom Ollevier and Alvin Cross

Unmanned aerial vehicles have a history stretching back to the Kettering Bug designed toward the end of the First World War. After a preset distance of flight, the wings of this pilotless biplane would fold back and the Bug, along with its 300-lb bomb load, would drop onto its target. Serious interest in UAVs, however, dates from the 1960s and 70s when Teledyne Ryan's Lightning Bug (ALQ-34L) was observed playing a key role in aerial photo reconnaissance during the Vietnam War. Years later, an arsenal of sophisticated UAVs would show their effectiveness in a broad range of roles during the Gulf War and in the Bosnian conflict. Equipped with TV, forward looking infrared, radar, and an array of other specialized electronics, the UAVs were just as much at home playing "eye in the sky" as they were decoying Iraqi missiles or acquiring targets for manned missions.

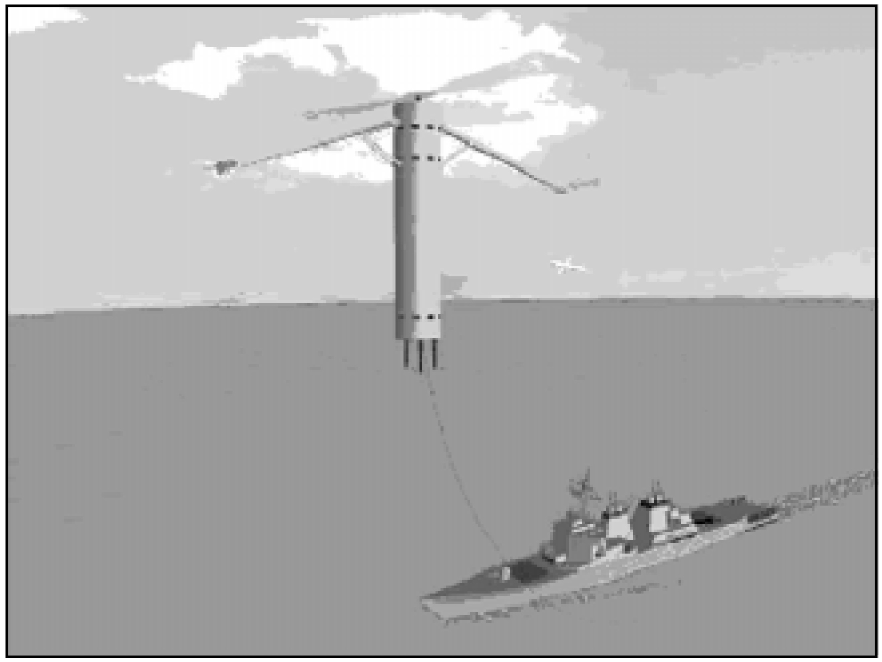


Fig. 1: Concept diagram of the Eager unmanned aerial vehicle tethered to a naval vessel. *(Images courtesy US Naval Research Laboratory)*

Today, fixed- and rotary-wing UAVs are available for a seemingly endless variety of purposes and payloads. They range in size from the "micro-UAVs" measured in centimetres to the much larger vehicles having wing spans of more than 30 metres. Some UAVs have airborne endurances of up to 50 hours. Around the world, budget conscious nations are exploring the use of these vehicles as less costly ways of performing specific military tasks such as electronic surveillance and countermeasures, photo reconnaissance, target acquisition and weapon delivery. UAVs may prove especially useful to the Canadian navy in extended littoral operations, such as those undertaken in support of UN embargo operations, and in multinational peace enforcement initiatives in which Canadian maritime forces are exposed to surface warfare threats.

The "Eager"

Unmanned aerial vehicles are broadly categorized as either *reconnaissance* air vehicles, which are generally high-altitude vehicles with limited manoeuvrability, or as weapon delivery *combat* air vehicles that can operate over a range of altitudes, speeds and attack profiles. Of particular interest in this paper are the reconnaissance UAVs designed to carry electronic warfare (EW) payloads for electronic support measures and countermeasures (ESM/ECM). One such vehicle is the "Eager" (*Fig. 1*).

Developed by the US Naval Research Laboratory in Washington, DC, the Eager could address certain Canadian navy EW needs for extended horizon ESM/ECM. The 50-kg, recoverable rotary wing vehicle was initially intended as an ECM decoy, but the Naval Research Laboratory is now considering it as an ESM platform as well. According to Jane's *Navy International*, the United States Navy is considering introducing the Eager as an EW platform during Increment II of its Advanced

Integrated Electronic Warfare System project.[1]

The Eager was developed to assist ships in coping with the extremely short engagement time lines and detection ranges typically associated with anti-ship missile attacks in littoral warfare. The vehicle can be deployed repeatedly without pyrotechnics, and receives its electrical power and fibre-optic communications via a tether from the ship. The Eager has the advantages of long endurance, reusability, and relatively low cost (although, as it is a research vehicle, it is difficult to compare specific costs with fielded UAVs). It was not designed to replace longer range UAVs.

The Eager and ESM/ECM

Electronic support measures are used by the Canadian navy (and others) for surveillance, self-protection and for specialized functions such as anti-submarine warfare. A ship's ESM system searches for, intercepts, identifies and tracks sources of radiated electromagnetic energy. To optimize these functions, ESM receivers need over-the-horizon detection capability without interference from a ship's own antennas or other sensors. An unmanned aerial vehicle such as the Eager could rise above all this to provide an unobstructed, over-the-horizon field-of-view.

The Eager would require a lightweight auxiliary ESM receiver, or perhaps a horizontal interferometric receiver array for high-accuracy direction-finding (although fitting a horizontal array in the Eager would take some consideration). The Eager has a payload capacity of just 11.5 kg (*Fig. 2*), so to save weight it would be preferable to carry just the ESM receiver on board the UAV, and locate the associated processing system on board the ship. An ESM receiver carried on board the Eager could be used in conjunction with a ship's masthead ESM receiver to triangulate targets through passive geolocation. A phase-difference algorithm would be used to give accurate lines of bearing. (It remains to be determined whether there is enough bandwidth for adequate data transfer in a reasonably lightweight fibre-optic cable.)

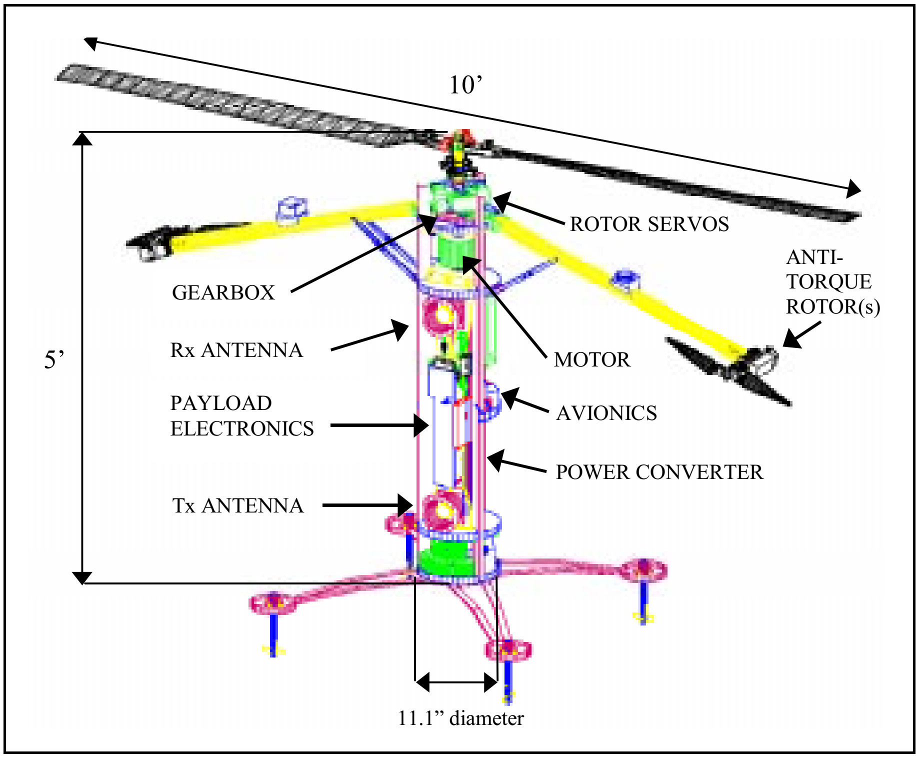


Fig. 2. General Arrangement of the Eager

The Eager aerial platform could also satisfy part of the navy's requirements for electronic countermeasures by offering long-endurance offboard jamming. This capability would be in addition to the existing Shield chaff and flare systems in the major ship classes, the *Halifax* class's Ramses onboard jammer, and the Nulka active missile decoy system being installed in the *Iroquois* class.

Consider the usefulness of a long-endurance ESM/ECM aerial vehicle during missions abroad. Extended operations in littoral environments can leave ships exposed to the threat of shore-launched anti-ship missiles. Even simulated missile launches made by a hostile state can force a ship to maintain a constant high state of readiness. While simulated launches may not actually push the rules of engagement far enough to solicit an armed response, a ship might be forced to launch expensive chaff or decoys. An Eager system equipped with an EW payload could counter this threat by keeping to the air for long periods of time, ready to react instantly to most ASM scenarios through early warning and short-range jammer defence.

As with the Nulka, the Eager has the advantage of a self-propulsion system that offers some immunity to environmental conditions. With other offboard systems such as chaff, the ship is dependent on a combination of local wind conditions and its own movement to achieve proper placement of the chaff for optimum performance. With the Eager system, the aerial vehicle can be precisely positioned through its onboard navigation and propulsion systems. Naturally, a ship's helicopter operations would have to be managed carefully when the Eager was deployed. Depending on the UAV's tether position, it might be difficult to launch or recover a helicopter.

Conclusions

A tethered UAV such as the US Naval Research Laboratory's Eager might be well worth considering for augmenting current and future shipboard electronic warfare systems. The challenge may lie in integrating both an ESM receiver and an EW payload into a single Eager platform. Because the largest constraints are the payload's weight and power requirements, as much of the required equipment as possible would have to be located on board the ship.

Nonetheless, the Eager system has the potential to provide a high level of availability through relatively low unit cost and extended operational life. Both the vehicle and the payload are recoverable, which translates into savings over the one-time use of expendable assets such as decoys. The affordability of the vehicles means several spares could easily be carried to ensure long-term coverage.

Properly deployed, the Eager could significantly extend a ship's ESM over-the-horizon detection capability with little or no interference from own-ship radars. This would provide the navy with a cost-effective option for long-range early warning, and for short-range EW defence against anti-ship missiles over extended periods.

Purposes	Payloads
• Surveillance • Target acquisition • Reconnaissance • Damage assessment • Artillery support • Photographic	• Synthetic aperture radar • Forward-looking infrared sensor • Laser designators • Electro-optical camera
• Electronic warfare	• ESM • ECM • Direction finding • Communications jammer • Signals intelligence
• Communications/data relay	• Data links
• Atmospheric research	• Nuclear Biological Chemical detectors • Agent dispensing
• Weapon delivery • Anti-radar attack	• Weapons

UAVs are available for a wide range of applications

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Barbara Ford and Tom Ollevier are defence scientists, specializing in electronic warfare systems at Defence Research Establishment Ottawa.

Alvin Cross is a senior aerospace engineer with the Tactical Electronic Warfare Division of the US Naval Research Laboratory in Washington, DC.

Postgraduate Education:

Educating a Marine Engineer — The UCL Experience!

Article by LCdr Pierre Demers, CD, B.Eng., M.Sc.,
LCdr Kirby McBurney, CD, B.Eng., M.Sc.,
LCdr Derek Hughes, CD, B.Eng., M.Sc., C.Eng., MIMarE and
Lt(N) Dan Riis, B.Eng., M.Sc.

In the academic years of 1998 and 1999, four of us — Marine Systems Engineers all — each began an incredible year of postgraduate study in the Master of Science program in Marine Engineering at University College London (UCL). Our experience on what the RN still calls the "Dagger" course was not limited to academics, although that was the primary thrust. The simple experience of living in a city with the historic and trend-setting appeal of London, England was worthy on its own, as was the opportunity to study alongside individuals from navies from around the world. Without a doubt, it was this collective experience that contributed to making our M.Sc. year so worthwhile.

University College London was founded in 1826 as the University of London, and is the third-oldest university in England. It is also an ideal PG learning centre for marine engineering, offering three complementary programs applicable to the naval engineering world: an M.Sc. in Marine Engineering (Mechanical or Electrical option) which we were undertaking; an M.Sc. in Naval Architecture; and an M.Sc. in Defence Systems (Project Management). As with most masters-level programs in the U.K., our program was compressed into one full year, with two weeks' vacation at Christmas and Easter. The program was divided into a six-month academic phase, a three-month ship design exercise, and a three-month individual research project.

Academic Phase

The academic phase, which began in September, was the most challenging and intense period of the program. Having completed our engineering undergraduate degrees at Royal Military College some years prior, we faced a steep learning curve in dealing with the gruelling multi-course approach and substantial number of research assignments. A two-week math refresher organized for the Canadian contingent was helpful in reminding us about such useful tools as derivatives, integrals, Laplace Transforms and the Fourier series, and served to make the constant onslaught of program information more comprehensible. Inevitably, between classes and the odd visit to the pub, we spent an ENORMOUS amount of time buried in the books to bring ourselves back up to speed.

The academics were broken down into six broad areas, each consisting of from three to six different course topics. As well, there were four broad areas of study that everyone in the M.Sc. program undertook: Applied Thermodynamics & Turbomachinery, Power Transmission & Auxiliary Machinery Systems, Vibration, Acoustics & Control, and Advanced Computer Applications in Engineering. Finally, there were the more specific subjects: the Mechanical option students studied Materials & Fatigue, and Heat Transfer & Heat Systems, while the Electrical students investigated Electrical Motors & Power Electronics, and Electrical Propulsion & Distribution Networks.

In general, each course included a demanding research assignment — a mini-project, really — that required a significant amount of work. Somehow, they all seemed to come due during a two-month "hell" stretch from January to February, which played havoc with our Christmas holidays and "compressed" the time we had available to prepare for March exams.

After a very challenging six months, we all successfully "met the grade" during the exam session, and were given a two-week reprieve over Easter. (An intelligent conversation regarding finite element analysis, computational fluid dynamics, Matlab programming, power plant performance, power electronic devices, and marine propulsion motors is now within our abilities!)

Ship Design Phase

The three-month ship design exercise gave us an opportunity to apply the knowledge we had gained during the previous six months. Teams of design engineers were formed, generally putting together a Mechanical option engineer, an Electrical option engineer, and an individual completing a masters in the Naval Architecture program at UCL. Each team was given a Statement of Operational Requirements outlining the type of ship it was to design, along with certain parameters. The team was then left to design a ship, with each member contributing according to his area of study.

Although we looked forward to the ship design exercise as a break from the intensity of the academic phase, we soon found that our anticipation was misplaced. A full progress presentation was required every two weeks, which involved an extensive defence of our design calculations and plant selection.

The exercise involved many late nights arguing the finer points of ship design within our groups, and calculating powers and sizes. From the marine engineering perspective, the challenge was to provide the naval architects with a propulsion plant that was able to meet the power requirements of the hull, while still fitting within the imposed size limits and endurance requirements. Of course, cost was as always the overriding concern. Options were tossed back and forth — gas turbines or diesels, electrical propulsion, podded propulsion, controllable reversible pitch propellers, etc. — and we sometimes made choices that altered the power curves, which meant reworking the entire plant from scratch!

In the meantime, we still needed to make decisions on everything else necessary for ship operation. We had to sort out the power generation distribution system, the heating, ventilation and air-conditioning, the freshwater, blackwater and greywater systems, etc., with countless calculations to determine the sizes and powers necessary. On top of that, we needed to research the unknown world of the dreaded Combat Systems so as to provide our vessel with suitable communications, defences and armament for its role. Finally, developing the ship's operational philosophy required an "all-ship" perspective on how we will man our future combatants. Working to match targets such as the USN's goal of a 95-person establishment for their future destroyers involved some very difficult decisions on the makeup of the Watch and Station Bill assignments (e.g. Emergency Stations).

After an extremely challenging and rewarding three months, each team had to prepare and present its design proposal to a review panel comprising members of Industry, the Classification Society, the Royal Navy and UCL professors. Justification and trade-off analysis had to be realistic and well researched. Having gone through the design loop several times we fully appreciated the principles underlying good ship design, and understood the difficulties involved in balancing design against a set of requirements and constraints. As a learning tool and a means of applying what we had learned, this exercise was second to none.*

[*In 1998 and 1999 the UCL prize for best overall ship design was awarded to a team that included a Canadian MARE. — Ed.]

University College London PG experience: "Well worth the long hours of study." ***(Images courtesy UCL)***

Individual Research Project

The final phase of our masters program was a research project, which for all intents and purposes was a mini-thesis. A number of research topics were offered by various professors, but students could also recommend topics of their own choosing for approval. Three months were allocated for this project, during which we were left to conduct the research, experimentation and programming necessary to reach worthy conclusions and recommendations. These findings were presented to a marking panel consisting of senior Royal Navy personnel, industrial representatives and faculty members who were all too willing to test a presenter's resolve. We were privileged to have Cmdre J.R. Sylvester (DGMEPM) and Mr. Bob Spittall (DMSS) as members of our project review panel.

Summary

The University College London postgraduate experience was an exceptional one, well worth the long hours of study. We gained an enhanced level of technical knowledge, increased understanding of developments in our field, and confidence in our ability to deal with complex project management issues and time constraints. The Canadian Forces can only benefit by sending its officers on programs such as this, as the rewards will continue to show for years afterward. We heartily encourage our fellow MAREs to apply for and complete PG programs of their own.

LCdr Demers is Marine Systems Manager for the Afloat Logistics and Sealift Capability Project in Ottawa.

LCdr McBurney is Senior Staff Officer for the Naval Engineering & Maintenance Management System under the MARLANT Fleet Technical Authority.

LCdr Hughes is on exchange as Diesel Development Officer in the propulsion section of the RN Ship Support Agency at Foxhill in Bath.

Lt(N) Riis is Special Projects Officer and Equipment Health Monitoring subsection head in the MSE section of Fleet Maintenance Facility Cape Breton.

Risk Management:

Risk Management of Safety Hazards

Article by LCdr David Peer

Safety management is a key activity involving all levels of the Canadian Forces. A proactive goal-setting approach to safety management and how it could apply to Canada's ships and submarines was discussed in the Summer 2000 issue of the *Maritime Engineering Journal.* The approach uses a safety case to demonstrate safety levels to a regulator.

The safety case relies on setting appropriate targets for safety risk, and demonstrating that these targets are met. Setting targets is not always easy, and poor public understanding of safety risks makes infrequent catastrophic hazards less acceptable than more frequent non-catastrophic ones.

Definitions

Hazard – Something with the potential to cause harm.

Risk – A property that measures the chance and effect of something adverse happening.

Risk Analysis – The systematic use of available information to identify hazards and estimate risk.

Risk Assessment – An evaluation of the results of a risk analysis against risk criteria.

Risk Reduction – Management, engineering or operational techniques to reduce hazard probability or mitigate hazard severity.

Safety Case – Detailed documentation showing how safety has been incorporated into the design or modification of a system or equipment.

Risk assessment is a critical component of a safety case because of the way it levels the playing field. We can compare an infrequent event having catastrophic consequences with a frequent event having less severe effects.

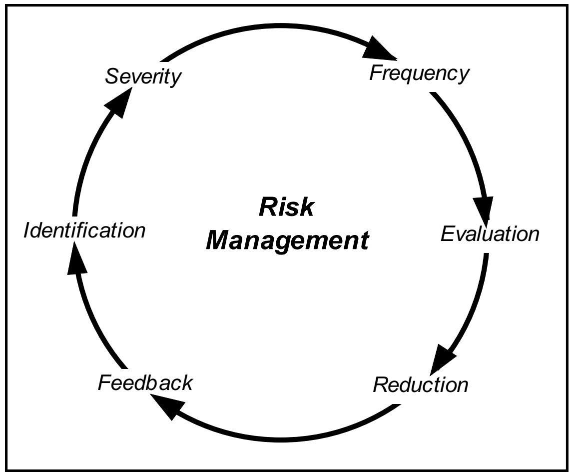

Fig. 1. The Risk Management Cycle

Elements of Risk Management

Risk management means different things to different people. Free association of the idea may bring to mind images of complexity, high cost, major accidents, secretive experts and meaningless jargon. The truth may be a bit disappointing. Risk management is a structured technical process that answers five simple questions. Systematic application of these questions will analyze, evaluate and control risk. The questions are presented here with a corresponding technical description:

What can go wrong? [Hazard Identification]

How bad can it get? [Hazard Severity]

How often will it happen? [Hazard Frequency]

So what? [Risk Evaluation]

What do we need to do about it? [Risk Reduction]

Hazard identification identifies what can go wrong. It is the first and crucial part of risk management, because if hazards aren't identified the risk cannot be assessed, eliminated, controlled or managed.

Consequence models predict how bad it can get. Estimates of hazard severity can be qualitative or quantitative, and can be as simple as engineering judgment on a graduated scale, or as complex as a computer model or event tree.

Frequency estimation determines how often a hazard will occur. As for consequence predictions, the estimate can be qualitative or quantitative. Qualitative techniques use various methods to place frequency on a scale. Historical records and fault trees are two common methods of quantitative analysis.

The answer to the first three questions forms the *risk analysis* portion of the risk management cycle (*Fig. 1*), where hazards are identified and risk is calculated. Next, the risk estimate needs to be evaluated against risk targets or acceptance criteria to determine if it is acceptable. Within the UK Ministry of Defence, when a risk analysis is evaluated against criteria it is called *risk assessment.* Risk assessment includes all steps from hazard identification to risk evaluation

When a risk is unacceptable, *risk reduction* is necessary. Reduction measures may include methods

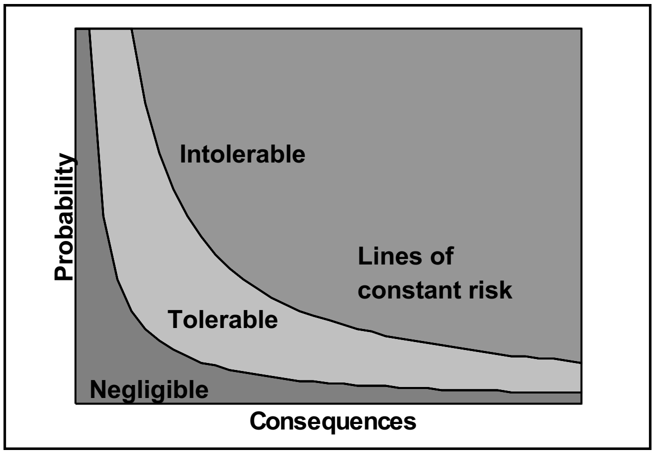

Fig. 2. Risk Levels

based on management, engineering, or operations. Management can apply appropriate resources, for example to training. Good engineering design can eliminate hazards and ensure proper safety systems are available. Operators can devise appropriate procedures and training. All these methods control risk by either reducing the frequency of hazard occurrence or mitigating hazard severity.

Feedback is essential to the risk management process. Without feedback, control is impossible. Once the risk is assessed and a risk reduction solution is implemented, then management must ensure that periodic measurement and review occur.

In the rest of the paper we will look more closely at risk assessment, from hazard identification to risk evaluation. In particular, we will look at how to calculate risk and how to determine whether risk is acceptable.

Risk Calculation

Risk is a property of a hazard that measures the level of acceptance or tolerability. Risk is the product of the probability of the hazard occurring, P, and the seriousness of the consequences, C. It is expressed mathematically in a risk relation — R.

$$R = P^n \times C$$

Setting n = 1 results in a common risk equation.

We unconsciously assess situations for risk against a constant risk level. As the likelihood of an adverse outcome increases, our tolerance of the consequences decreases. If risk levels are too high, the solution is to either reduce the hazard probability or mitigate the hazard severity.

Risk level provides a neat theoretical way to rank risks, but it is notoriously difficult to determine precisely because of subjectivity in the assessment of probability and consequence.

In many circumstances available data will only support a qualitative assessment of risk; however, the risk relation is applied similarly.

Risk Assessment

Risk assessment compares the calculated risk level against criteria. The aim of risk assessment is to establish the risk of a hazard within three broad regions: *intolerable*, *tolerable* and *negligible*. For example, *Fig. 2* graphically illustrates risk levels using the risk relation of n=1, where the boundaries of the tolerable region are the risk criteria.

Qualitative risk assessments represent this mathematical relationship with a matrix. *Figure 3* shows an example risk classification scheme. The risk matrix combines hazard probability and severity of consequences to interpret risk levels. Risk class A (risk classes are interpreted in *Fig. 3*) is intolerable; risk classes B, C, and D all fall within the tolerable region. Hazards deemed as a negligible risk fall outside the risk matrix.

The probability component varies from frequent to incredible and describes probability ranging from "continuously experienced" to "extremely unlikely," for example. The severity component also varies, with a range encompassing "multiple deaths or loss of ship" to "minor injury or occupational illness." During an actual qualitative risk assessment, the risk matrix components receive serious consideration. A more complete description of this method is available in MoD Defence Standard 00-56.

		Severity of Consequences			
		Catastrophic	*Critical*	*Marginal*	*Negligible*
Hazard Probability	*Frequent*	A	A	A	B
	Probable	A	A	B	C
	Occasional	B	B	C	C
	Remote	C	C	C	D
	Improbable	C	C	D	D
	Incredible	D	D	D	D

Risk Class Interpretation

A *Intolerable*
B *Undesirable. Only accepted when risk reduction is impractical.*
C *Tolerable with endorsement of senior project committee.*
D *Tolerable with endorsement of normal line management.*

Fig. 3. Risk Classification

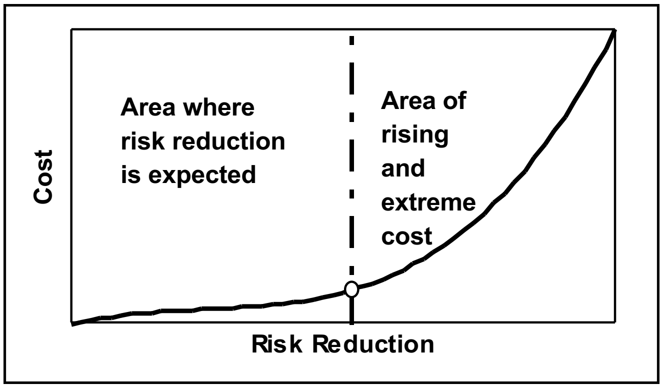

Fig. 4. The ALARP Principle

The ALARP Principle

When a risk level is negligible, the hazard warrants no further consideration. However, when risk assessment identifies an intolerable risk, corrective action is required. All risk must be reduced to the tolerable region as a minimum. Remedial action for tolerable risks depends on the ALARP (as low as reasonably practicable) principle. Tolerable risks are reduced to ALARP with a cost-benefit trade-off. Risk reduction in the tolerable risk region should continue as long as the benefit is not disproportionate to the effort in cost or time. This is easiest to explain visually.

Figure 4 only considers risk in the tolerable region. It illustrates the point in a cost-benefit relation where the rising cost in time and effort makes further risk reduction unwarranted. Hazards with risk levels in the area of rising and extreme cost are ALARP. Outside of this area risk reduction is expected. Risk reduction must continue until the risk becomes negligible or where risk becomes ALARP. The ALARP region for each hazard depends on the factors influencing the cost-benefit relationship.

Risk Reduction

The preferred methods of risk reduction minimize the human factors in the hazard, and use engineering or management techniques. Operational techniques such as training or operating procedures are a last resort when the other techniques cannot reduce risk to an acceptable level. Resorting to operational techniques is an admission that human error is the most likely cause of an accident. The measures adopted to reduce risk should follow in order of preference:

1. Respecification or redesign;
2. Safety features or systems (e.g. redundancy);
3. Warning devices;
4. Operating and training procedures; and
5. Warning notices and signs.

The last three methods do not remove the chance of human error. Since human error is the most difficult failure to predict and control, it is far better to design the chance of error out of the system.

Conclusion

Risk management concepts are natural; we all have an in-born ability to assess our own tolerance to risk. Whether you are preparing a safety case for a regulator or trying to convince your spouse to go white-water rafting, the same principles apply. Introducing structure into safety management decisions demonstrates a commitment to prove to operators and the public that the risk of all hazards is negligible, or that further risk reduction is not cost-effective. Risk management levels the playing field, it improves our understanding of safety risks, and it provides a cost-effective method to manage safety against acceptance criteria.

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LCdr Peer has just reported in to DGMEPM, having completed an exchange posting with the Royal Navy in the Submarine Naval Architecture section of the Defence Procurement Agency.

Submission Formats

As a rule of thumb, major article submissions should not exceed about 1,800 words. The preferred format is MS Word, accompanied by a hard copy of the typescript. The author's name, title, address and telephone number should appear on the first page.

Please submit photos and illustrations as separate pieces of artwork, or as individual *high-resolution* electronic files, and remember to include complete caption information.

A Green Ship — The Afloat Logistics and Sealift Capability Project

Article by Mike Gardner

In the Summer 2000 issue of the *Maritime Engineering Journal*, LCdr Mark Tinney described some of the work being done to establish a green ship standard for North America. Although the ALSC Project is in its early stages, the project management office has begun to address environmental issues. This article describes some of the action already taken, or about to be taken, to ensure that the ALSC complies with such a green ship standard.

The ALSC Project includes the acquisition and through-life support of three or four ships for task group support and sealift roles, and potentially a number of landing craft for ferrying cargo and vehicles between the ALSC ship and the shore to support a "logistics over the shore (LOTS)" role. The Statement of Operational Requirements for the ALSC states:

> To prevent being denied access to any coastal waters or ports, the ALSC ship will comply with all national and international pollution prevention regulations either currently in force or anticipated by 2015.

This forward thinking is consistent with national and international initiatives of the type described in LCdr Tinney's article, and is reflected in the actions and intent of international regulatory bodies and classification societies. So far, PMO ALSC has drafted an environmental assessment and established an informal environmental working group to ensure the legislative and regulatory requirements are met and reflected in equipment specification and selection. In parallel with this effort, MARCORD G18 (Shipboard Environmental Management, Part I – General Policy and Directives) is being updated. The draft environmental assessment addresses the effect ALSC ships and associated landing craft might have on:

- the aquatic habitat and animals, commercial fisheries, tourism and other socio-economic matters;
- commercial and marine telecommunications; and
- inshore waters, beaches, shorelines, reefs, etc.

The environmental impact of the proposed acquisition of ALSC ships has been assessed in accordance with relevant government guidelines, and many of the identified environmental issues can be satisfactorily addressed by the environmental programs and procedures currently practised by Canadian industry and the navy. Based on this, the overall environmental rating for an ALSC ship is expected to be Code 1 (i.e. "Effects not likely significant with the implementation of appropriate mitigation measures.").

The ALSC ships will comply fully with all existing *and anticipated* relevant national and international regulations and protocols, including the Canada Shipping Act and MARPOL 73/78. They will also employ the ISO 14000 Environmental Management System currently in use by the *Halifax* and *Iroquois* classes. The ships will therefore be equipped with:

- domestic garbage and plastic waste disposal systems;
- black- and greywater handling, treatment and stowage systems (sufficient for operating in the Great Lakes and St. Lawrence Seaway);
- fittings to allow discharge of black and grey water to shore facilities;
- oily water separators and monitors; and
- bilgewater handling systems to provide storage, treatment, monitoring and discharge cut-off if oil content exceeds allowable limits.

The ALSC ships will not contain ozone-depleting substances (e.g. Halon 1301 and CFC-12) which are regulated under the Canadian Environmental Protection Act. The freon used in the refrigeration systems will be HCFC-134a, or an acceptable alternative. Environmentally friendly, fixed high-pressure waterfog systems are being considered for firefighting in machinery spaces, combat system equipment rooms, vehicle decks, accommodation areas and storerooms. Although there is concern that aqueous film-forming foam (AFFF) and CO_2 may be banned in the future, PMO ALSC expects that the ships will be delivered with firefighting systems using these substances while the search for alternatives continues.

Emissions from machinery, including incinerators, will also comply fully with all relevant regulations, protocols and IMO certification requirements. No hazardous materials will be incinerated. The machinery for the ALSC ships will be selected for energy efficiency so as to minimize any contribution to the greenhouse effect.

Operational Considerations

Since a major role of ALSC is replenishment at sea, the ships will be double-hulled as required by regulations to reduce the risk and extent of spills in the event of collision or grounding. They will also follow procedures similar to those in use today with the AORs to prevent and control the accidental loss into the sea of cargo fuel, ammunition and stores. The ships themselves will be coated with approved, high-durability, long-lasting anti-corrosive and anti-fouling paints. The use of paints, thinners and other volatile organic compounds by ship's staff will be kept to a minimum commensurate with necessary care and preservation.

Because of the ALSC ship's "constant displacement" concept of operations and the likely presence of a floodable "well dock" at the stern for launching and recovering landing craft, the ships will be fitted with an elaborate ballasting system capable of taking on and discharging large volumes of ballast water. This naturally carries the risk of introducing foreign species or pathogens into territorial waters, so the ships will adhere to a ballast water management plan in accordance with IMO protocols.

Also, because vehicles and other military cargo being sealifted can carry contaminants from one country to another, ALSC ships will have portable pressure-washers for cleaning and decontaminating vehicles and cargo as necessary prior to embarkation. Agriculture Canada will inspect everything from an overseas sealift before it is allowed onto Canadian soil. To minimize the impact on the environment from any fuel or oil leaking from transported vehicles, the ALSC ships will be provided with drip trays, sorbents and cleaning materials. Drains will carry any contaminated water to holding tanks.

As much as possible, logistics over the shore trials and exercises will be conducted in areas and at times chosen to minimize the effects on commercial fisheries and aquaculture industries. Environmental assessments will be prepared for each LOTS trial and exercise area.

A principal role of the ALSC ship is to support a containerized field hospital. A medical waste handling system will therefore be fitted to gather, treat, store and dispose of biohazardous infectious waste in accordance with MARCORD G-18 and applicable health regulations.

Construction and Maintenance

Environmental issues relating to the construction, outfitting, test and trial of ALSC ships and associated landing craft will be similar to those for commercial vessels. The contractor, subcontractors and suppliers will be contractually bound to conduct environmental assessments, and to develop and follow "best management practices" for safeguarding the environment during construction. Contractual restrictions will even be placed on materials used in construction and outfitting. Guidance to contractors in this regard is contained in PMO ALSC's draft environmental assessment.

Environmental concerns associated with the repair, overhaul and maintenance of the vessels will be similar to those for the AORs and other HMC ships. More modern and reliable equipment, and a greater emphasis on reliability centred maintenance should reduce the amount of maintenance required on the ALSC ships compared to their predecessors. And since modern paints and concepts of preservation are expected to reduce the frequency of docking work periods over the life of the ships, a reduced environmental impact is expected. Environmental assessments will be made as required for maintenance and docking work periods.

The method for disposing the ALSC ships has yet to be determined, but it is likely they will be dismantled for scrap. Whatever the method, though, contractual restrictions on the use of environmentally detrimental materials during construction will reduce the environmental impact of the ALSC ships when they are eventually retired from service and sent for disposal. And even this, the final phase in the life of the ship, will be the subject of its own environmental assessment.

The navy and the Department of National Defence have made a commitment to comply with all national and international environmental legislation and regulations. The ALSC will address potential environmental impacts earlier in the project cycle and more comprehensively than any previous naval project.

Mike Gardner is a project engineer with PMO ALSC in Ottawa.

Mobile Dockyard at Famagusta

In the autumn of 1955, a young naval engineer faced the challenge of establishing a mobile dockyard in the tumultuous environment that was post-war Cyprus.

Article by Cmdre Peter Charlton, RCN (Ret.), CD, P.Eng.

When I was due to leave the Royal Naval Engineering College at Manadon at the end of my training there in 1954, the Admiralty commander in charge of junior officer appointments came down to see us, supposedly to find out where we wanted to be sent for our first real working jobs. He probably just wanted a couple of days out of the Admiralty, but in any event our term mustered in one of the classrooms and he began asking each of us our name and where we wanted to go. With a home in London, I naturally wanted to go to the nearby naval air station at Ford which had jet fighters. By the time it was my turn, though, half the class had already requested Ford, so I knew that was a waste of time. I popped up and said, "Charlton, sir. I'll go anywhere." The commander looked up from his notebook. "Who said that?" (which showed how much attention he was paying). So I repeated my name and he asked me, "Anywhere?" and I repeated, "Yes, sir, anywhere." He sort of grunted, and that was that. As it turned out, no one went to Ford, but I was the only one to get a really interesting appointment, abroad — as the Assistant Air Engineer Officer (AEO) of 728 Squadron at Hal Far on Malta. Lucky me!

Two Royal Navy patrol boats alongside the mobile dockyard at Famagusta, Cyprus in 1955. ***(Photos courtesy the author)***

Hal Far was properly known as HMS *Falcon*, Royal Naval Air Station, Hal Far, Malta GC (the GC is for the George Cross that was awarded to the people of Malta by King George VI in recognition of their heroism during the war). Seven-two-eight was a second-line fleet requirements squadron that did all sorts of odd jobs. Our major task was to tow aircraft targets and track jet aircraft for fleet gunnery practice, but we also carried out search and rescue, delivered mail around the Mediterranean, and did anything else that was needed.

What the squadron really didn't need was an assistant AEO. It already had a very capable lieutenant-commander as AEO, and he was hardly overworked even though we did have about 28 or 30 aircraft of six different types. I was fortunate in being a "spare wheel" in 728, because I was able to spend time in the maintenance shops, and travel around to various places in the Mediterranean on aircraft salvage or other technical tasks. The most interesting of these visits was one that I made to Cyprus in the fall of 1955.

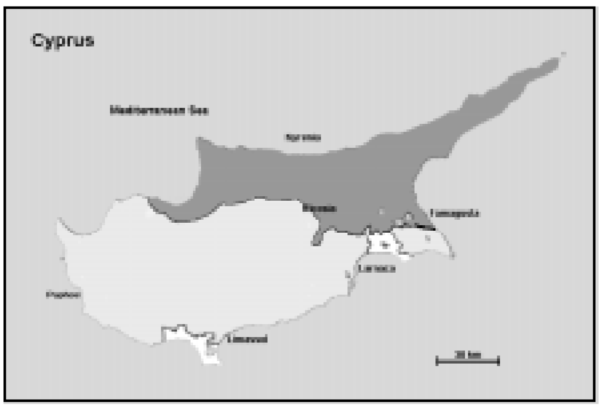
Orders for Cyprus

Early one Monday morning in October of 1955, I was called down to the chief of staff's office in the Valetta headquarters of Flag Officer Mediterranean and told to assemble a mobile dockyard at Famagusta, Cyprus. This was to maintain and support four Royal Navy minesweepers and four motor patrol boats that were based there for anti-gunrunning patrols. I was to load everything I needed aboard the tank landing ship HMS *Striker*, and be prepared to sail for Cyprus at noon on Wednesday, two days hence. I was given a copy of a Secret message sent by the admiral to anyone who mattered in the navy in Malta. It read:

"LIEUTENANT CHARLTON IS TO BE GIVEN EVERY, REPEAT EVERY, ASSISTANCE IN HIS MISSION."

This was virtually a blank cheque. I had a lot of help, of course, organized by the chief of staff, Cmdre Desmond Dreyer, one time gunnery officer in HMS *Duke of York* when my father served aboard her in Dreyer's department. The commodore said he remembered meeting me at a ship's Christmas party in Rosyth in 1941 when I was ten. (I put that one away in my memory book on leadership.)

I knew roughly what the Ton-class minesweepers were like. The patrol boats, I quickly found out, were 65-foot ex-RAF torpedo recovery boats with the stump derrick removed. They had been fitted out with a cabin and a couple of machine guns. I decided that I would need a lot of bits and pieces of wood, canvas, metal, screws, bolts, etc., some machine tools, and some kind of shelter for everything. I went to the main machine shop in the dockyard and met with the captain in charge, Captain H.G.H. Tracey, RN. He had been my training commander at



Manadon a few months previously. I asked for a lathe, a milling machine, drill press, power saw and a few other things. He looked at me with a straight face and asked if I thought they had spare ones lying around just waiting for someone to come in and pick up. I said that I did not think that, but would he please arrange to have some of those he did have unbolted from the shop floor and put aboard *Striker* in time to sail. Aware of what I was up to, he laughed at my serious demeanour and told me not to worry. He would arrange for all the tools and spares to be loaded. And he did.

I returned to Hal Far to make arrangements to pick up what was called a MONAB, or mobile naval air base. This was a collection of huts, really, designed as one-room offices, stores buildings and workshops. They would make ideal shelters on the dockside in Famagusta. I had a shipwright officer gather everything we would need for hull repairs, while another engineer collected all the mechanical odds and ends and the metal stock we would need to make things. It was then I realized that, while there was at least one highly skilled artificer in each of the minesweepers, the men in the patrol boats were stokers who were essentially engine operators, not engine repair men. Knowing the boats' engines were Perkins P6M diesels, with which I was quite familiar, I thought it might be wise to take along a decent tool kit which I could use myself to make engine repairs. But when I requested a chief aircraft artificer's tool kit, neither the supply chief nor the Lieutenant Commander(S) at Hal Far would co-operate. As far as they were concerned, officers were not entitled to a tool kit and, no, they didn't want to see my magic message. After a quick phone call to the Commander(S), who knew what I was doing, things changed very fast. I got my tool kit; and it was a good thing, too, as events proved.

Ironically, I received one thing I didn't particularly want — a .38 calibre revolver. I was told it must never leave my possession. I had to sleep with it, eat with it, carry it whether or not I was in uniform, etc., etc. Even in the hotel's communal toilet I was not permitted to hang the wretched thing on the back of the door, or set it down on the floor in case someone reached in, grabbed it and shot me! (Believe me, it is most inconvenient to sit on a toilet and hold a pistol, even if it is in a holster.) I was never so heartily sick of anything as I was of that revolver by the time I returned to Malta.

More Smoke than Horsepower

The Wednesday came, and off I went to Cyprus aboard HMS *Striker* with this great heap of crates and huts loaded on the tank deck. We arrived at Famagusta several days later, and headed in toward the jetty to offload. As the bow door was being lowered, a rotund little figure wearing a white uniform decorated with a lot of gold lace and medal ribbons bounced aboard. I saluted very smartly, for this was RAdm Anthony Miers, VC, DSO and Bar. He was Flag Officer Middle East, commanding everything east from Malta to about Ceylon in the Indian Ocean. He returned my salute, informed me I was his new Staff Officer Engineering, and told me to "Get the bloody patrol boats working!" This immediately gained my loyalty and made another point for my memory book on leadership. And off he went. I never saw him again, which was a good thing from my point of view because he was quite a character and one never quite knew what he might do next.

My first task, then, was to deal with the patrol boats. All four were alongside the wall in Famagusta, along with a very unhappy squadron commander. The situation looked grim. Each boat had three engines, and between the lot of them only one of the 12 was working…and even it was putting out more smoke than horsepower. That's where the tool kit proved its worth. I spent two days and the intervening night getting those engines working properly. It involved a lot of work stripping, honing and reassembling the Bosch fuel pumps, a job which I had forgotten to consider normally requires a proper clean room and a calibration rig operated by dockyard specialists. I don't think there were any spare fuel pumps in Malta either, since they were always in short supply. So I scraped away, blessing the training that had given me some idea of what to do when I got as far as the lead seal. Normally, when you got to a lead seal on a part, you stopped and sent it back to the factory. But a wise navy knew that sometimes this might not be an option and so spent quite a bit of time teaching us what our real options were in these cases. The end result was that all four boats resumed their patrols around the island, the squad boss was happy, and I had a few hours to set up my little dockyard.

The officers and men of our crew were set up in two hotels right on the waterfront, with a lovely beach right below the balcony where we had our breakfast. We officers lived in the very nice King George Hotel, and the men lived in a smaller hotel next door. All very comfortable, except that there was a 21:00 curfew. If you were caught out later than that in anything other than a military vehicle, you were very likely to be shot at by the army. One night after working late on one of the boats, a group of us actually did get fired upon as we returned to our hotel well past curfew. We were all armed to the teeth, but we didn't stop to see who was doing the shooting (turned out it wasn't the army). We drove as fast as we could back to the hotels, where we very nearly got shot by our own sailors. Hearing the firing, they thought their hotel was being attacked and turned out to repel boarders. They nearly started in on us before they recognized who we were.

"We were all armed to the teeth, but we didn't stop to see who was doing the shooting...."

Sabotage!

During my training I had seen a good many drydocks and slipways, but never a careenage until now. Across from the jetty where we had our huts set up, a careenage had been established on a flat earthen area that sloped gently up from the water. Here, boats could be hauled out of the water for hull cleaning, painting and other repairs. It was run by a man who could have been anywhere from about 60 to 120 years old, and a young boy. Numerous rings were attached to big rods driven into the ground around the careenage, while at the top of the slope a small hut housed an ancient steam engine driving a winch. A boat would drive up to the careenage until the bows gently grounded. The old man and the boy would then drag bits of timber down to the boat and begin building a cradle around the bows. Finishing that, they would pass a wire through some of the rings and pull the cradle and boat together up the slope a short distance. They continued this routine of building more sections of cradle and pulling the assembly up the slope bit by bit until they had the whole thing high and dry. It all looked a bit mickey mouse, but it worked. I watched over a couple of days as they hauled out a big Arab dhow that must have been close to 200 tons. Nary a mistake. I suppose it has been done this way for two thousand years, but with oxen instead of steam for the first nineteen hundred.

At one point we had to take one of our 65-foot patrol boats out of the water to change a shaft. So over to the careenage we went. The old man took a good look at what needed to be done, agreed to do the job, and started work. We were worried that he might damage our nice patrol boat, but since we couldn't help him we at least managed to stay out of his way. It took the man and the boy a long day, but at the end of it our boat was out of the water, all nice and steady on a not-too-bad-looking cradle. Now came the test. Could we get the shaft out, or had the boat hogged or sagged so much that it would be stuck? We disconnected the shaft inside the boat — and it slipped out as easily as you could ever wish. The replacement shaft went in just as easily. We were really impressed. The only problem was that we had to leave the boat at the careenage for a few days for some cleaning and painting. We decided to have one of the crew sleep in the boat so that no one would come aboard and steal things. The dockyard was supposed to be fairly secure, but it was not nearly secure enough as we discovered a few nights later.

During the night someone planted a bomb underneath our boat and blew a hole about four feet wide in the bottom. Fortunately, it didn't injure the petty officer sentry who was sleeping on board, but it did destroy his trousers which were folded neatly right over where the bomb went off. By the time we arrived after being awakened by the explosion, he was hopping mad. It seems his false teeth had been in one of his trouser pockets. Once we found out he was all right, we had to laugh. We then set-to to look for his teeth. They turned up a bit smoky, but otherwise undamaged (which cheered him up a bit). Our boat had to spend a few more days out of the water while we repaired the bomb damage. This time we posted armed guards around the clock, which we ought to have done from the outset. Luckily, the damage was not as extensive as it could have been. Had the bomb gone off a few feet farther forward under a main bulkhead, the boat's back would have been broken and it would have been a write-off. As it was, there were no leaks when it was put back in the water, and off it went on patrol.

A Wonderful Month

Apart from the terrorist activity, Cyprus was a lovely place. I sincerely hoped the navy would forget about me and leave me there for months or even years, but alas, all too soon, this marvellous job came to an end. The system had not forgotten me. Rather, it had remembered that this was a job for someone in Coastal Forces, and I wasn't part of Coastal Forces. A much more senior lieutenant was sent out from the Coastal Forces base at Hornet in Portsmouth, and I returned to Malta.

It had been a wonderful month while it lasted. As it turned out, the only dockyard items we needed which I hadn't brought from Malta were some really long coach bolts for attaching the ventilator cowls to the cabin roofs of the patrol boats. But, considering how self-sufficient we became with most everything else at our mini-dockyard in Famagusta, this hardly hindered our operations.

The author on the roof of the King George Hotel in 1955.

*Cmdre Charlton transferred to the RCN as a naval aviation engineer in 1958. He was Senior Technical Officer of VX-10, the navy's experimental squadron at Shearwater, NS, and is the author of "*Nobody Told Us It Couldn't Be Done — The VX 10 Story.*" He was responsible for the technical management of the development and trials of the Beartrap Helicopter Hauldown System, to which he contributed a great deal of original design work. Cmdre Charlton retired from the Canadian Forces in 1980, and works as an independent engineering consultant in Ottawa.*

News Briefs

Project Update: Protected Military Satellite Communications

All branches of Canada's military, including DND's heaviest user of military satellite communications — the navy — can look forward to having access to some sophisticated new communications gear later this decade. Two years ago, DND signed a memorandum of understanding with the US Department of Defense which provides assured access to a portion of the US Advanced Extremely High Frequency (AEHF) Protected Military Satellite Communications constellation. The system promises interoperability at relatively high bandwidths, with low probability of intercept and very good anti-jamming performance.

The AEHF space segment will provide global communication coverage (excluding the polar regions) through a combination of steerable spot beams and earth coverage beams. The satellite constellation also incorporates crosslinks between the satellites, which makes the entire system very flexible — much like having a communication switch in the sky. The AEHF MILSATCOM will provide an unparalleled capability for ships and submarines to com-

(Cont'd next page)

INNARE PROGREDI BELLARE

(To float, to move, to fight)

New Crest for CFNES Halifax

Canadian Forces Naval Engineering School Halifax has a new crest. On June 14, during the annual Maritime Engineering Mess Dinner, engineering school Commandant Cdr J.R. Murphy unveiled the new CFNES crest which was granted Royal Assent by Governor General Adrienne Clarkson, CC, CMM, CD.

The five wavy bars represent the five training divisions which sustain naval engineering. The ship's lantern symbolizes a naval version of the lamp of knowledge, with the rays referring to the spread of knowledge represented by the book on which is placed the classic naval symbol, the fouled anchor. The school's scope of expertise is highlighted by the symbols on the circles — marine systems (propeller), combat systems (signal trace), naval architecture (ship's hull forms), and naval construction (axe and hammer). ♣

Book Launch: Equal to the Challenge

In May, ADM(Mat) launched the book, "*Equal to the Challenge — An Anthology of Women's Experiences During World War II*." The 552-page book consists of 55 first-person accounts from women remembering their wartime service in the military, underground resistance, industry and civilian agencies.

Some of the stories are told by women who now have sons or daughters serving in DND. **Marcella Menard**, whose son Jamey is a DMSS 2 civilian engineer, actually began the war working in a munitions factory in Kitchener-Waterloo, Ontario before joining the Women's Royal Canadian Naval Service in 1943.

As a signals clerk in Halifax she remembers being tipped off by her friend Florie in the cipher department that the troopship *Queen Mary* was about to sail. The two Wrens made their way to the harbour to watch the great ship.

"We knew that she was loaded with troops headed for England," Mrs. Menard recalled. "We watched the *Queen Mary* until she was just a grey speck on the horizon."

The book project, produced by Lisa Banister, was funded by DND in recognition of the many women who served with distinction during the war. ♣

Marcella Menard (née Graff)

(Satellite Communications cont'd)

municate and be interoperable with all other services, the US DOD, and other allies equipped with AEHF terminals. Full operational capability is expected by late 2008.

In addition to the space segment, which is now in implementation, the Protected Military Satellite Communications (PMSC) Project includes the definition and acquisition of satellite terminals for all branches of the Canadian military. The navy will receive terminals for the *Halifax*- and *Iroquois*-class ships, *Victoria*-class submarines and ALSC vessels, along with the necessary training and support infrastructure. The shipboard terminals will consist of a modem, associated baseband interfaces and an antenna group consisting of two gimbal-mounted dish antennas with radomes. The antenna for the submarines could require its own mast.

The satellite terminal component of the project is currently in the definition phase and is working closely with DGMEPM and Directorate of Maritime Requirements (Sea) staffs to refine and validate the operational requirements. A joint-service working group had its first deliberations last January. A project web page will soon be published on the DND Intranet and updated regularly as work progresses. — **Simon Igici (Project Technical Office PMSC Navy Terminals Engineer), and Maj (US) Charlie Torok (PMSC Requirements Officer).** ♣

National Defence / Défense nationale

SPRING 2001

News

CANADIAN NAVAL TECHNICAL HISTORY ASSOCIATION

Special Edition: Focus on HMCS *Cape Breton*

Cape Breton to become World's Largest Artificial Reef

Inside this issue:

CNTHA News *Est. 1997*

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Gabrielle Nishiguchi

Directorate of History and Heritage Liaison
Michael Whitby

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Bob Spittall

Maritime Engineering Journal Liaison
Brian McCullough

Newsletter Editing and Production Services, Layout and Design
Brightstar Communications,
Kanata, Ont.

CNTHA News is the unofficial newsletter of the Canadian Naval Technical History Association. Please address all correspondence to the publisher, attention Michael Whitby, Chief of the Naval Team, Directorate of History and Heritage, NDHQ Ottawa, K1A 0K2. Tel. (613) 998-7045, fax 990-8579. Views expressed are those of the writers and do not necessarily reflect official DND opinion or policy. The editor reserves the right to edit or reject any editorial material.

The navy's old fleet maintenance and repair depot ship HMCS *Cape Breton* will soon become the world's largest artificial reef. The Artificial Reef Society of British Columbia together with the Nanaimo Dive Association is planning to sink the ship near Nanaimo, BC on Oct. 20. The ARSBC bought the former wartime Victory ship in 1999 for $20,000, five years after the ship was retired from naval service. *Cape Breton* will serve as an undersea marine habitat and diving attraction not far from artificial reef HMCS *Saskatchewan* which was placed on the bottom off Snake Island by the ARSBC in 1997.

In May, a section of the stern and the ship's triple-expansion steam engine were removed and donated to a new North Vancouver Maritime Interpretive Centre as part of a Victory Ship Memorial Project. The display will be a major focus of the waterfront museum planned for the old Versatile Pacific Shipyards/Burrard Dry Dock where *Cape Breton* was built in 1944-45.

Naval technical historians should be pleased. Preserving the complete ship was never a viable option, but thanks to the long-sighted efforts of some very dedicated people on the West Coast, many of them volunteers, an important part of Canada's naval technical history is being preserved for posterity above and below the surface of the sea.

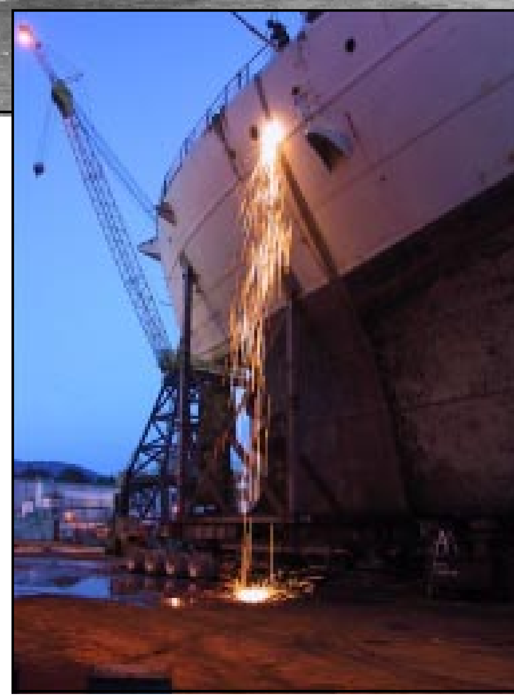
The Canadian Naval Technical History Association is therefore pleased to dedicate this edition of *CNTHA News* to the continuing story of HMCS *Cape Breton*. In so doing, we gratefully acknowledge the assistance of Howard Robins of the Artificial Reef Society of BC.

— RAdm (ret.) Mike Saker, Chairman CNTHA

HMCS *Cape Breton* — Fifty Years of History

Story courtesy the Artificial Reef Society of British Columbia

(DND Photo)



Stern separation final cuts, May 10, 2001. HMCS *Cape Breton* nears her final configuration. (*Photo by Lightstone Video Services*)

History at a Glance

Built at Burrard Dry Dock, Vancouver, BC

Keel laid June 1944

Launched October 7, 1944

Delivered as HMS *Flamborough Head* April 25, 1945

Participated in relief of Hong Kong August 1945

RN fleet maintenance and repair ship 1945-51

Transferred to RCN as HMCS *Cape Breton* 1951

Fleet repair and training ship for artificers (Halifax) 1951-58

Escort maintenance (Pacific fleet) 1958-64

Esquimalt base repair ship 1964

Fleet Maintenance Group (Pacific) base and accommodation vessel 1972

Retired 1994

Purchased by Artificial Reef Society of BC 1999

Ship prepared for museum display and artificial reef final voyage 2001

HMCS *Cape Breton* (originally named HMS *Flamborough Head*) is the only survivor of Canada's entire wartime construction of 402 merchant type vessels.

Flamborough Head was commissioned into the service of the Royal Navy in North Vancouver in 1945, and assisted with the relief of Hong Kong that August. After the war, she served as an escort maintenance ship for the Royal Navy, and in 1951 was finally commissioned into the Royal Canadian Navy as HMCS *Cape Breton*.

Cape Breton was based in Halifax as a repair depot and training vessel for technical apprentices up until 1958, then transferred to the West Coast for conversion to an escort maintenance ship. The ship served in that capacity until she was paid off into reserve as a base repair ship in 1964. From 1972 until her retirement from naval service in 1994, HMCS *Cape Breton* — or "*Building 100*" as she was affectionately known — served as a floating base for the navy's Fleet Maintenance Group (Pacific) and as an accommodation ship. Berthed semi-permanently alongside the old "C" Jetty in the Esquimalt naval dockyard, the ship was home to a great number of sailors and naval reservists who were temporarily billeted in her historic hull.

During the dockyard redevelopment of the late 1980s, *Cape Breton* was berthed across the harbour adjacent to the Public Works Graving Dock. With the completion of the

(Cont'd next page)

The Victory Ships

Accomplishing the technical and logistical problems of building hundreds of freighters in a very short period of time called for a standardized design. A "North Sands" design was chosen, based on a class of traditional freighter created at the North Sands Shipyard in Sunderland, England. The design was for a riveted, five-hold midship superstructure cargo ship, 441.5 feet (135.6 m) long, with a beam of 57 feet (20 m), and an average tonnage of 10,000 DWT. Propulsion was provided by a reliable low-maintenance triple-expansion steam engine. With minor physical differences and modified inboard spaces to meet changing requirements, Canadian yards built ships on the North Sands design that were variously known as "Fort," "Park" and "Victory" ships.

Shortly after the Canadian/British program started in 1942, the United States commissioned a similar plan for its own shipping requirements. The basic North Sands design was adopted for the American "Liberty" ships, but the superstructure was significantly different in appearance and layout. The most obvious technical change was the use of more extensive welding rather than riveting, which reduced construction time and cost. More than 2,700 Liberty ships were built.

After the war, many of these ships were dispersed to civilian shipping companies and reserve fleet status; others were scrapped. Of the entire North American production, only four vessels remain: the *SS Jeremiah O'Brien* and *SS John W. Brown* in the United States, HMS *Rame Head* in England, and HMCS *Cape Breton* in Canada. — ***Courtesy the Artificial Reef Society of British Columbia.***

Tech Specs: HMCS *Cape Breton*

Length: 135.6m (441.5 ft.)

Beam: 17.4m (57 ft.)

Draft: 8.5m (28 ft.)

Dead Weight: 11,270 tons

Speed: 11 knots

Range: 7,000 naut. miles

Propulsion:

One reciprocating, three-cylinder triple-expansion steam engine.

Steam generated by two oil-fired boilers.

(Cont'd from page 2)

dockyard redevelopment and the advent of superior shore-based facilities, *Cape Breton* was declared surplus in 1994 and assigned to the reserve fleet in Colwood. Attempts to return the ship to service or preserve it all failed.

In 1999, the Artificial Reef Society of British Columbia was able to step in, and so began the final chapter in the long history of this great ship.

The North Vancouver Museum is interested in receiving any memorabilia from *Cape Breton* (ex-*Flamborough Head*), or stories from those who served in the ship from her days in either the RN or RCN. Contributors are asked to contact Robin Inglis at (604) 987-5618, or via e-mail to inglis@northvan.museum.bc.ca

For the latest information on HMCS *Cape Breton*'s new role, see the Artificial Reef Society of British Columbia's web site: http://www.artificialreef.bc.ca

What's in an Engine?

Story courtesy the Artificial Reef Society of British Columbia

Engine liftout, May 9. HMCS *Cape Breton*'s three-cylinder, triple-expansion steam engine will become the working centrepiece of a new waterfront museum in North Vancouver. The huge engine weighs 120 tonnes and stands more than two storeys tall. (*Photo by Lightstone Video Services*)

One remarkable aspect of the intense shipbuilding achievement of the Victory ships and their kind was the story of the triple-expansion steam engine. Built in huge numbers, the engines were awe-inspiring, weighing 120 tonnes and measuring 6.5 metres in length and about the same in height. Capable of driving a ship at a speed of 11 knots, the half-metre-diameter pistons of these 2,500-IHP engines moved 1.2 metres up and down 76 times every minute.

Six engine shops, including one each in Ohio and Oregon, built engines for the Canadian ships. Most, however, were shipped across the country from Montreal, Toronto and Hamilton. Some Canadian-built engines even found their way into American Liberty ships, and in four years of feverish activity it is estimated that close to 3,300 of these giant triple-expansion engines were produced in North America.

Photo: Paul Hess © 2001

***On display!* The stern section of HMCS *Cape Breton* (ex HMS *Flamborough Head*) will be affixed to the front of the old Burrard Dry Dock machine shop, site of North Vancouver's new shipbuilding museum, and connected to the ship's engine inside. The museum is not expected to open before 2004. (*Photo courtesy North Vancouver Museum and Archives/International Marine Consultants Ltd.*)**

About the CNTHA

The Canadian Naval Technical History Association is a volunteer organization working in support of the Directorate of History and Heritage (DHH) effort to preserve our country's naval technical history. Interested persons may become members of the CNTHA by contacting DHH.

A prime purpose of the CNTHA is to make its information available to researchers and others. The Collection may be viewed at the Directorate of History and Heritage, 2429 Holly Lane (near the intersection of Heron and Walkley Roads) in Ottawa.

DHH is open to the public every Tuesday and Wednesday 8:30-4:30. Staff are on hand to retrieve the information you request and to help in any way. Photocopy facilities are available on a self-serve basis. Copies of the index to the Collection may be obtained by writing to DHH.