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Maritime Engineering Journal

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October 1998

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The *Maritime Engineering Journal* salutes the men and women of the Naval Reserve of Canada on the occasion of the Naval Reserve's 75th anniversary.

Maritime Engineering Journal

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Maritime Equipment Program Management
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OCTOBER 1998

Our Cover:
The *Upholder*-class submarines — The project manager of the Submarine Capability Life Extension Project introduces the Type 2400 boats, beginning on page 10. *(Photo copyright VSEL Barrow-in-Furness)*

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Editor's Notes

The Navy must use MCDV Procurement "Lessons Learned" Wisely

By Captain(N) Roger Westwood, CD
Director of Maritime Management and Support — Editor

On Saturday, the 26th of September 1998, the twelfth maritime coastal defence vessel (MCDV), HMCS *Summerside*, was launched at Halifax Shipyard Limited. As the former project manager of the MCDV Project for nigh on six years, and the senior naval representative for the laying of *Summerside*'s keel, this event had a very special significance for me. Not only has the final vessel in the program been safely launched and named, it is well on its way to completion.

Like most major crown projects, the MCDV Project is unique and has broken considerable new ground. The success of the project to date and the lessons that we continue to learn through the project are important to the future of our navy. In my opinion, the most important MCDV related initiatives, aside from the Naval Reserve crewing of an operational vessel, are the utilization of commercial standards and specifications for design and construction, and the use of a commercial contract to provide the vast majority of in-service support. (There were other initiatives, but these are probably the ones with the greatest consequence.) I would like to consider these two initiatives and discuss them in a little further detail.

As most of you are aware, the MCDVs have been designed and constructed largely to commercial standards and specifications. In fact, MCDV is the navy's bellwether for DND procurement policy which was announced in conjunction with Budget '94 and reinforced in the 1994 white paper on Defence. The policy indicates that we will procure more commercial off-the-shelf (COTS) systems and only use full military specifications where absolutely essential. Although it is too early to assess whether or not the MCDV systems will stand up to the rigours of naval service and remain cost-effective over the ship's life, we do know today that we have acquired considerable capability at a relatively low cost.

We have also gained considerable experience and learned some important lessons in the application of this new procurement policy. We must now use these lessons wisely in our approach to upcoming requirements and projects. For example, the MCDVs were designed, built and certified under Lloyd's Registry of Ships (LRS) rules. As a result of the contractual construct under which LRS became a subcontractor to the shipyard, interaction between the Crown and the LRS offices responsible for the application of the rules and subsequent certification of the vessels was minimal. In hindsight, I believe that more interface between the Crown and the LRS offices might have eliminated some of the problems encountered during the transition to in-service. If we continue to design, build and certify naval ships to a classification society's rules, we need to consider a contractual construct that allows more interface between the Crown and the classification society, without defeating the primary objective of reducing acquisition and life-cycle costs.

The second major initiative, the MCDV In-Service Support Contract (ISSC), was put into effect immediately following the delivery of HMCS *Kingston* in December 1995. The contract is meant to provide the total second- and third-line support to the MCDVs and their payload systems (with the exception of certain government-supplied material such as the 40mm Bofors gun and the communication crypto gear). To date, the contractor has provided the required support and the operational authorities are relatively happy with the support the MCDVs are receiving.

With the impending delivery of HMCS *Summerside*, we are well into the MCDV in-service phase. Although the ISSC appears to have been effective so far, it will soon have to function in a different environment. MCDV technical expertise that was readily available from the project office and the acquisition contractors will now have to come from the ISSC and the navy's in-service offices. A proper assessment of this changing environment requires us to answer some fundamental questions:

- Is the ISSC construct currently meeting all of the navy's needs?
- How great a role should LCMMs and Formation technical authorities play in the provision of MCDV support?
- Is there a greater role for FMFs in the provision of MCDV support?
- Will the ISSC construct meet the navy's future needs?

The ISSC is not due for renewal until December 2000, but the lengthy competitive contract renewal process dictates that we address and resolve the issues now. We need to acquire a universal understanding of the MCDV support philosophy and then put in place the optimum vehicle for delivering the required support.

The degree of success that we ultimately experience with these initiatives, and others of their ilk, will largely determine whether we can indeed "do more with less." The key is to discover that which is good and that which is bad about them, and then wherever possible and sensible, adapt the concepts to better meet our needs.

Commodore's Corner

Changes in the "Collective"— Moving on in DGMEPM

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

Many readers will have learned by now that the function of Branch Adviser for MARE and naval technical MOCs has moved from DGMEPM to the Maritime Staff, specifically to Capt(N) D.G. (Doug) Dubowski, DMMPD. CMS is the naval personnel managing authority and also employs the larger portion of MARE officers and technical NCMs. Now that the Maritime Staff has been located in Ottawa, this permits a consolidation under one roof of all naval branch advisory arms reporting to ADM(Per).

Naturally, we in the Division regret the loss of this role. Nevertheless, we will continue to support CMS on Branch issues and will work closely with Capt(N) Dubowski. CMS will continue to seek our counsel via the Branch Adviser and the MARE Council. As it happens, this change occurs at a juncture when the MARE Council requires a renewal of purpose — I will advise you of developments.

On the subject of change, I declared in my first "Corner" as DGMEPM that I had "neither a new broom nor a reluctance to change," and I also acknowledged the frustration that reengineering and downsizing could bring. In this context I would like to explain the rather dramatic shuffle of DGMEPM directors and section heads I recently directed. For those who have not yet heard, yes, among other changes, a *CSE* commander now leads the Propulsion, Electrical and Machinery Control section, an MSE commander, conversely, heads the Command, Control and Communications section, and a Nav. Arch. commander has assumed responsibility for the Acquisition section.

Foremost, I must reemphasize the importance of our "collective" knowledge and experience in providing naval materiel support within a project management framework. The naval "design authority" is still delivered from within this construct. However, following the organizational downsizing, reengineering and delayering, we can no longer afford the luxury of each DGMEPM specialist section being managed by a commander-equivalent expert in this specialty. Our smaller population and the expanded scope of the consolidated directorates and sections simply no longer permit it.

There were two other factors, though. First, at the section head and director level, expertise in materiel and project management has become increasingly important. The recent move should increase the focus of directors and section heads on these areas, and cause advisers at the subsection head level to be relied upon more heavily for expert advice. Second, given the increasing experience in rank/category, this move was designed to provide MARE commanders and their civilian counterparts with additional opportunities to broaden their experience and to offer additional challenge.

While I acknowledge that my action has caused a certain amount of surprise and consternation, there is nothing really new here. As additional responsibilities have been placed on a smaller division, the level-shifting of responsibilities which has already occurred at the Capt(N)/EX-01 level has simply been continued at the next level down. The message should be clear enough: if you wish to be employed in purely specialist capacities, your sights should be set at no higher than LCdr or equivalent civilian level.

I should mention that no section head or director has actually departed the Division as a direct result of this change, and so our "collective" expertise remains available to us all as required. I have assured ADM(Mat) and CMS that the quality of our output will not suffer.

* * * *

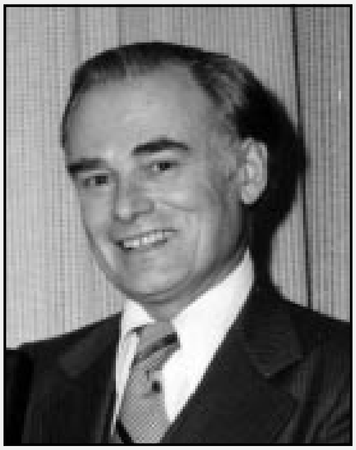
In the last issue, I mentioned that MAREs are part of a larger "collective" which includes engineering, technical, procurement, logistic and other specialists. Sadly, this past summer we lost two important members of this collective: D.K. (Don) Nicholson and Ken Tang. Neither spent much, if any, time in uniform, yet each made an immense contribution to the navy. I urge everyone to read the obituary articles on these gentlemen beginning on page 4. They were not merely part of our heritage, nor even just fine examples of the civilian contribution to the maritime engineering team. Their work, dedication and selflessness should be an inspiration for us all.

The *Journal* welcomes **unclassified** submissions, in English or French. To avoid duplication of effort and to ensure suitability of subject matter, prospective contributors are strongly advised to contact **The Editor, Maritime Engineering Journal, DMMS, National Defence Headquarters, Ottawa, Ontario, K1A 0K2, Tel. (819) 997-9355**, before submitting material. Final selection of articles for publication is made by the *Journal*'s editorial committee. Letters of any length are always welcome, but only signed correspondence will be considered for publication.

If you would like to change the number of copies of the *Journal* we ship to your unit or institution, please fax us your up-to-date requirements so that we can continue to provide you and your staff with the best possible service. Faxes may be sent to: **The Editor, Maritime Engineering Journal, DMMS (819) 994-8709.**

In Memoriam

Donald Keith Nicholson



In Ottawa this past August, four retired engineering flag officers, several naval captains and a host of other serving and retired navy and DND personnel attended the funeral of Donald Keith Nicholson, a civilian marine engineer who had retired from DND ten years earlier.

What kind of man was Don Nicholson to elicit such response and merit this level of respect? Between 1953 and 1987, he was very well known to Canadian naval marine engineers. He was "Mr. Gearing," later "Mr. Propulsion," an icon of Canadian naval marine engineering. He was the fount of knowledge on the main propulsion plants of the *St. Laurent* and associated steamer classes and the DDH-280 class, and was intimately involved in the *Halifax*-class propulsion specification and design as well. Naval officers came, left and returned to DGMEM, in ranks from lieutenant to commodore during this time. Don was always there, as a section head, quietly providing sound solutions and expert technical advice — truly an engineer's engineer. Long after his 1987 retirement, in fact as late as last year, his detailed knowledge and opinion on gearing issues were being informally sought.

Don was born in England, and received his engineering education and training at Woolwich Polytechnic, and as a student engineering apprentice at the Royal Arsenal, Woolwich. From 1945 to 1947 he served as an engineer officer with the Royal Navy in Ceylon and Singapore. In 1947 he joined the Yarrow English Electric team (the forerunner of Y-ARD) to investigate advanced steam power for naval construction. This led to the Y-100 steam propulsion plant, which was adopted by the RN, the RCN and many other navies. He came to Canada and joined the Engineer-in-Chief department of the RCN in 1953 to form a power transmission section, and became heavily involved with the manufacture of Y-100 equipment in Canada. He was a firm believer in building and supporting the Canadian industrial base.

Naval gearing was Don's specialty. Through his guidance, persistence and effort, the RCN became a world leader, at the technological cutting edge of hardened and ground naval gearing with the *St. Laurent* class. Similarly, the three-input, cross-connect *Halifax*-class gearbox design owes its existence in large part to Don. His gearing expertise was recognized and respected throughout the naval world, and he worked closely at a detailed level with MAAG and other manufacturers. His paper on the 1969 *Kootenay* gearbox explosion illustrates both his knowledge and his tenacity in discovering the root cause of that tragedy. Don regarded his work on the *Kootenay* investigation as the most challenging accomplishment of his career.

Those who were fortunate enough to serve with Don remember him also as a real gentleman — invariably friendly, calm, self-effacing and consummately polite. His thoroughness and attention to detail are legendary. To his credit, though at times to the dismay of project managers, he was very reluctant to compromise in his efforts to maintain the highest standards, whether of the navy's propulsion systems or the Queen's English!

The world, and certainly DGMEPM have changed since D.K. Nicholson's days. The Transmissions section was absorbed into a Propulsion Systems section, itself now merged with controls and electrical systems under a single section head. Our pursuit of cost-reduction has forced us to rely on Industry for most of our in-depth engineering expertise, and so it is unlikely that we will ever again see a senior, in-house specialist engineer of Don Nicholson's stature. As one DGMEPM engineer said on hearing of Don's passing, "It's the end of an era."**— Bob Weaver, DGMEPM SPO**

Ken Tang

With the passing of Ken Tang on August 18th, another link back to the glory days of leading-edge engineering conducted in DGMEM has been severed. Ken eventually succumbed to the cancer he had fought so bravely. He is survived by his wife Anna, and sons Marlon and Matthew.

Ken was a long-time member of DGMEPM, but is probably best remembered by us all as the developer of the original Shipboard Integrated Communication (SHINCOM) concept. His guiding hand can be traced back through its research, development, proving and production phases. And we all know the result — Canada has one of the best internal communication systems at sea today, and other navies may soon follow suit, with real benefits to Canadian industry. Ken was also the architect behind the transfer of intellectual property and production know-how from the bankrupt Leigh Electronics to the current manufacturer, DRS Technologies (ex-Spar). Through his latest efforts on the SHINCOM II research and development project, the navy has been provided with the opportunity for state-of-the-art, multimedia (voice, video and secure data) integration.

As pervasive as his influence in SHINCOM was, Ken was involved in leading-edge projects in other disciplines as well, including navigation systems and local area networks. Again, the systems which have been subsequently fielded have not only brought added measures of safety and efficiency to

Canadian naval operations, but have pushed the limits of the available technology, leaving the various manufacturers and system integrators with internationally recognized profiles in their respective market niches.

Ken Tang contributed more than just his engineering insight and management skills. He was a leader and a mentor to an entire generation of engineers who now share his sense of selfless service and excellence in engineering.

Underlying Ken's quiet and modest exterior was the iron will and love of life that permitted his valiant and protracted battle with the cancer that eventually overcame him. Despite the evident pain that he endured over the past two years, Ken continued to spend time in the office, and with the contractors, to the very limit of his strength; even remaining available for consultation when his health had deteriorated to the point of his being unable to actually come to the office. This is as much a testament to his commitment to public service as it is to his personal fortitude. We who worked with him will always remain inspired by his selfless spirit.

We will all miss you, Ken – for your mentorship, your engineering brilliance and your quiet strength.— **Cdr Mark Eldridge, DMSS 3**

For those wishing to make a more demonstrative indication of their respect for Ken, the family has advised that donations to the Terry Fox Foundation would be appreciated. Individual donations may be forwarded to the following address:

The Terry Fox Foundation
353, rue St. Nicolas
Bureau 313
Montreal, Quebec
H2Y 2P1

The Foundation will send a letter to Ken's family, informing them that donations have been received in his memory.

Forum

P1 Cert Fours Need Meaningful Employment

Article by CPO2 Barry Getson

The task of matching the appropriate rank with meaningful jobs within the Mar Eng community, while at the same time attempting to retain our best people, must surely be one of the most challenging roles in the navy today. I believe that one of the trade's greatest concerns at the moment is how to best employ the growing number of petty officer first class Certificate Four Mar Engs with challenging and rewarding employment.

At a recent MOC meeting this issue surfaced and generated considerable debate. To no one's surprise, the results of these discussions were that insufficient data currently exists to properly determine the full extent of the matter. However, that a potential problem does exist, was clearly evident, if only from a morale viewpoint.

Briefly stated, it would appear that the Mar Eng community has created a greater number of Cert Four holders than it can realistically expect to promote to chief petty officer second class and employ as CERA in the foreseeable future. This situation begs the question, "How do we provide meaningful employment for those personnel who have made such a large effort to achieve certification, without forcing them to fill job positions that they believe themselves to have become overqualified to do?" I believe that continuing to employ the PO1 Cert Four in the same type of employment, at the same level of responsibility and skill as prior to Cert Four completion, without the benefit of either promotion or pay increase is a "demotivator" for the individual to exert the tremendous effort required to achieve this qualification.

One obvious example of this situation is the PO1 Cert Four who is at sea, watchkeeping as a Cert Three and attempting to motivate and train another PO1 to complete a Cert Four. I ask the question, "What is the motivation for the trainee to complete his training?" Surely we cannot say to the trainee, "Look how achieving a Cert Four has benefited your teacher." Regardless of which direction it is viewed from, there appears to be little reason, other than continuing to have a job, for the candidate to progress his Cert Four training package.

If we are to motivate these young engineers to achieve this qualification, then I believe we should allow them the opportunity to fill satisfying roles that are challenging, rewarding and above all, reflect the accomplishment they have achieved. The possibility of meaningful employment for these people may exist within the new MCDV fleet and the CMS organization. Perhaps some of the positions currently filled by young officers could be equally well served by the PO1 Cert Four. Whatever the solution, I believe the efforts of our best Mar Engs should be rewarded with something more satisfying than the opportunity to continue to fill those same jobs as before certification.

CPO2 Getson is the LCMM for black and greywater systems, DMSS 4-8-5-2.

Share Your Snaps!

The *Maritime Engineering Journal* is always on the lookout for good quality photos (with captions) to use as stand-alone items and illustrations for articles appearing in the magazine. Please keep us in mind as an outlet for your photographic efforts.

An Open Letter to DGMEPM*:

Engineering Recognition — A Personal Concern

During the Junior Officers' Symposium on Oct. 7, 1997, a sub-lieutenant MARE raised an issue to the attending senior officers. He stated that he could leave the CF and obtain employment at a private company and be paid a salary which is considerably more than what he receives, or expects to receive, within the CF. He then stated that he believes MAREs should be given more consideration with respect to pay for their services.

In response to these comments, I (a sub-lieutenant at the time) stated that he should pursue his ambitious plan outside of the CF, away from those of us who believe that service to country comes before personal gain. Having said that, I added that, yes, there should be some sort of professional recognition for engineer members of the CF who have attained certain trade qualifications — but that it should be something other than pay. I was subsequently invited by Capt(N) Delamere to write you this letter describing my comments.

There are various other MOCs within the CF that have been recognized, primarily through pay, as professional occupations, and are afforded the recognition they deserve. Military doctors, dentists, pharmacists, nurses, pilots, lawyers — even our technicians — are recognized for their qualifications through specialization pay. Why has the military engineer been excluded from any professional privilege? I realize that specialization pay may serve more to drive MAREs away from their MARS brethren, and should therefore not be entertained in the interest of maintaining harmonious relations in the Naval Operations team, but other avenues of recognition must be investigated.

Outside agencies have already begun recognizing the qualifications that CF engineers possess. The Association of Professional Engineers of Nova Scotia has set aside a program that specifically recognizes the training and development of MARE CS personnel and automatically grants two years of engineering apprenticeship time for attaining the 44C qualification (four years are required for professional engineering status). Why do military engineers have to resort to outside agencies to attain any professional recognition pertaining to their engineering skills? Can the CF not make a concerted effort to convince outside professional engineering associations to recognize other engineering MOCs such as MILE, CELE, AERE, LEME and EME?

I would suggest that a HOD-qualified (or equivalent) engineer could qualify as a professional engineer outside the CF, and I believe the Forces should aggressively pursue this avenue of establishing recognized professional engineers within its ranks. To accomplish this, there must be more opportunity to prove our engineering skills in design and development, not just in project management or participation within an analysis team. MAREs fulfilling "purple" jobs are not conducting the professional engineering required by the professional engineering associations, as are MAREs in the "hard engineering" positions. Consequently, I believe that these "purple" jobs are diluting our engineering credibility.

I myself now enjoy employment as a divisional officer within CFNES, leading over 160 NET and NWT students and staff from ordinary seaman to chief petty officer second class, a responsibility that is a general function of a naval officer and not specifically that of a naval engineer. Although I greatly enjoy this position and fully understand its importance, I must admit that my engineering skills are not being used to their fullest potential. Perhaps a working group should be developed to keep lines of communication open between the various provincial professional engineering organizations and the Canadian Forces. This would support those engineers occupying "purple" jobs in their pursuit of professional engineering status.

Rest assured that the junior MAREs understand and agree that their professional priorities are to be a professional naval officer, naval engineer and CSE/MSE, in that order. However, these priorities should not be used as an excuse to ignore the special qualifications attained by engineers. Being a professional naval officer does not preclude being a professional engineer. We can perform with professional recognition, as we have without, and subsequently will not lose sight of our priorities upon its receipt. With these priorities in mind, the Naval Operations team will still function as one. MAREs will still retain the higher honour of being naval officers before accepting any professional engineering recognition, but I believe we can do both. **— Lt(N) M.D. Wood, CSE Divisional Officer, CF Naval Engineering School, Halifax**

[Both the letter and the response have been edited for format and style. – Editor]*

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.

A Response by Commodore J.R. Sylvester, CD

Dear Lt(N) Wood:

Thank you very much for your letter. It has been reviewed with great interest by the MARE Branch Adviser and Combat Systems Co-Advisers, and has been the subject of much discussion at all levels. I would now like to provide a consolidation of these discussion points, and add my own thoughts regarding the questions and issues you have raised.

First, I would like to commend you for your response to the sub-lieutenant at the Junior Officers' Symposium. Whether civilian or military, the issue of "public service" is indeed important to the continued welfare of this country. By definition, this service must be placed before self-interest if we are to retain the quality of public service for which we are rightly recognized around the world (but sadly, perhaps not here at home). This being said, there is nothing wrong in raising the issue of self-interest in relation to the public interest as part of the complex equation of charting our own individual destiny. Equally, as you pointed out to the sub-lieutenant, if the individual calculation tips in favour of self-interest, then the recourse is indeed to pursue it outside of public service institutions and beyond any conflict of interest between the two.

Now, to the principal question you have asked: "Why has the military engineer been excluded from any professional privilege [unlike various other MOCs within the CF]?" In short, you have answered the question yourself in that you recognize the MARE officer is considered a professional naval officer. However, unlike military doctors and lawyers, the MARE officer is employed as a professional military officer — period.

If you have completed OPDP 7, "War and the Military Profession," you will have read an extract from "*The Soldier and the State*" by Samuel Huntington. In discussing the military profession, Mr Huntington states that "...a distinct sphere of military competence does exist which is common to all, or almost all, officers and which distinguishes them from all, or almost all, civilians....The direction, operation and control of a human organization whose primary function is the application of violence is the peculiar skill of the (military) officer." To paraphrase the words of a former Commander of Maritime Command, VAdm (ret.) Lynn Mason, MARE officers are members of the Naval Operations Branch and, together with their MARS and SEA LOG colleagues, will continue to provide leadership at sea and ashore essential to the application and regeneration of combat capable naval forces. There is, therefore, no doubt in my mind that MAREs are deemed to be military professionals, and merit any and all "professional privileges" afforded by our Service.

In the case of our doctors, lawyers, etc., who are recognized and paid as military specialist officers, they are required to exercise their professional specialty in uniform with civilian professional accreditation. In this regard, I also note that they do not fall within the general definition articulated by Huntington. While they are clearly military officers who might very well have to pay dearly for serving in uniform, they are professional *practitioners*, not professional managers in the application of violence. I would submit to you that the operational job of MAREs is to apply combat capability as an integral part of the shipboard team, and as such, fulfills Huntington's definition. Ashore, as an extension of the shipboard team, the MARE officer fills an essential role in, among other things, translating operational requirements into materiel support in both the sustaining and the regenerative aspects. This does not mean the MARE is working as a professional engineer (this is not a requirement), yet neither does it ignore or preclude engineering proficiency or professional certification. It does, however, directly imply that engineering, as a profession or background, is not sufficient to qualify a MARE as a professional naval officer, well versed in naval materiel operations, support and acquisition.

"...unlike military doctors... the MARE officer is employed as a professional military officer — period."

I would hasten to add that, as a member of the community of "professional officership," this entitles the member to a broader range of employment possibilities than naval materiel support. There is, of course, CF materiel support, but beyond this, other equally demanding assignments are offered that rely on the basis of the profession of arms and/or the technical background of the MARE. These employment opportunities are therefore encouraged as career development opportunities. They demonstrate that the individual, and indeed the classification, is capable of a broad contribution within the broad definition of the professional officer corps, and not just within the more narrow confines of the specialist officer or professional engineer corps.

External to the Canadian Forces, MAREs are able, and indeed, encouraged to apply for professional engineer status. Outside recognition is valuable to our credibility as an engineering community. However, whether or not we are professionally certified in the private sector, we are military professionals, and the CF recognizes us as such.

Let me turn now to some of your specific points. You have asked whether the CF can make a concerted effort to convince outside professional engineering associations to recognize other engineering MOCs as well. These other engineers are also able to apply for professional engineering status. We cannot dictate the entrance requirements to the professional associations, nor should we. However, we do maintain liaison with them to ensure they understand the unique engineering skills obtained and practised within the navy and other environments of the CF.

Given my preamble to you, I obviously agree that specialist pay would prove a thorny issue, not only within the naval officer community, but in the General Service Officer community at large. Quite frankly, as long as we remain within the GSO ranks, I believe it is more appropriate to lessen singular recognition in favour of why we are similar (i.e., no special treatment as members of the team). Special recognition beyond that necessary for our GSO classification would tend to reinforce the "specialist" view which neither you nor I support.

(Cont'd)

(Cont'd from p. 7)

Regarding pay in general, it is not uncommon to hear the complaint that industry is willing to pay more for engineering expertise than the CF. However, when all compensation and benefits accruing to military personnel are calculated, the CF monetary reward system may be seen to be comparable to many equivalent systems in the private sector. For example, many firms make little or no provision for their employees' pensions, and in some cases provide only minimum medical benefits. These companies prefer to pay their employees a high enough salary for them to have their own pension and supplementary medical insurance plans. If, beyond this context, a real pay/job satisfaction issue does exist, then broadly the CF, and more narrowly the navy, would have to deal with the resulting net exodus of its technical officer corps. This could be dealt with generally via pay increases (this is currently happening, by the way) or by a reexamination of the engineering MOC structure.

If you sometimes feel that, as you say, your "engineering skills are not being utilized to their fullest potential," keep in mind that the design process is far broader and more complex than is often taught at universities or colleges. Contemporary thought on this subject recognizes that in order to be successful, the design of complex, sophisticated systems requires multidisciplined teams. In the navy's case, this means representation from a wide spectrum of expertise provided by research and development scientists, engineers from industry, the operational community, departmental civilian engineers and MARE officers.

In the navy, as well as in industry, the design process must begin with a solid appreciation of the application. Companies depend on their ability to understand the needs of the customer better than the competition. From the navy's perspective, the role of the MARE in the design and support process is critical. MAREs are trained and employed in a manner that develops a practitioner's appreciation of the naval environment and missions. They are then charged with the responsibility of translating operational performance requirements into ship/system/ equipment performance requirements and then, as necessary, contractual work requirements. This is a challenging and critical responsibility that calls for more than just a cursory knowledge of the requirement and a company's proposed solution.

Regarding non-engineering appointments, it is understandable that "purple jobs" may be seen as distractions from the "hard" engineering activities that MAREs perform. However, it is not fair to say that "purple jobs dilute our engineering credibility." Purple jobs help broaden an officer's perspective and skills to the benefit of both the individual and the Service. They are effective in testing a MARE's problem-solving skills and invaluable in allowing our Branch to have some influence in the way the CF and the navy operate and evolve. Also, these positions help to mature an officer's knowledge of how the needs of the organization and of the individual interact.

I hope these thoughts prove useful in helping to provide my perspective of the MARE occupation and its place within the navy, the CF and the Department. I do not presume to think that either of us is absolutely right or wrong with respect to any of the questions and issues raised in your letter. It is my hope that our dialogue can continue and expand to include ideas and comments from other members of the MARE community. I would ask you to remember that the MARE classification is a fairly recent construct in the context of Canadian naval history, and if the need develops to examine the MARE construct more closely yet again, I will definitely consider your offer of assistance.

Thank you again for taking the time to advise me of your thoughts and expectations. I encourage you to continue to do so.

The Misuse of Technology — a Further Rebuttal

Article by Vil Auns

I support LCdr Hughes in his rebuttal of Mr. Cyr's article, "The Misuse of Technology" (see the Forum section in the October 1997 and February 1998 issues of the *Maritime Engineering Journal*), however, I would modify the following sentence of his opening paragraph from, "We are only getting half of the story," to "We are only getting a small bit of the story!" Due to Mr. Cyr's explicit statements which imply that little thought went into the design of the combat system of the *Halifax* class, I further support LCdr Hughes' use of the word "irresponsible." It is a blatant and undeserved barb pointed against the intensive industrial and DND planning and design that went into the CPF Project.

The "archaic" methods of target tracking of previous combat systems, as put by Mr. Cyr, were in fact the best available at the time. The designers of the day did their best with the technology available to them. The methods of target tracking in UCS-257, Adlips, UCS-280, and CCS-280 command and control systems were equal to those found in any of the world's navies at the time of their implementation. For Mr. Cyr to state that "The opportunity to rethink naval operational processes and activities presented by the available technology was not seized," implies at best forgetfulness. As only a singular example, the design and strict specification of the automatic tracking systems in the SG-150HC and SPS-49(V5) radars were specifically implemented for the *Halifax* class, with the associated specification of minimal false alarm rates never previously achieved or implemented, even in the USN's Aegis Weapon System SPY-1 multifunction radar.

The short treatise on integrated systems is misleading, and in fact woefully simplistic. Naval integrated systems have to be operated safely and within established doctrine or under directed Rules of Engagement in either open ocean or littoral environments. These environments are multithreat in character and provide challenges to Command that are different during times of rising tension than during open hostilities. The ship's weapons are all differently targeted and controlled. This cannot be done by machine alone, nor by a singular person. It takes the experience of Command and the training and skills of various operators to operate a modern combat system. Hardware and software must be optimized to reduce repetitive tasks, leaving the human element to sort out situational uncertainties in the tactical picture. The design implemented into the *Halifax* class is a fully integrated CS/CCS that can be employed by the commanding officer in various modes of response, as required, to carry out his mission.

All newly detected dynamic tracks (which have not been classified friendly) entering the *Halifax* CCS are threat-evaluated and become part of its relative threat list (air, surface, subsurface). Such *air* tracks which also meet Command-approved quick-reaction (QR) criteria are tagged and qualify for quick-reaction processing (i.e. tracker/weapon assignment and engagement) according to the CCS QR mode authorized by the commanding officer. (QR modes range from manual, where operators do it all, to automatic, where all reactions are automatically controlled by the CCS— *including weapon release*. Command can, however, veto all weapons if it so desires. Intermediate modes provide varying operator participation.) In the case of similar *surface* and *subsurface* threats, all engagements are operator initiated due to the kinds of weapons and methods of targeting that are involved. The design of the *Halifax*-class combat system thus provides the commanding officer with full flexibility in resolving currently recognized situation/mission goals.

The "striking example of human failure" provided by Mr. Cyr (i.e. an unplanned second missile firing) could in fact be examined from a design perspective. As an aside, please remember that: "a loaded gun will fire if the trigger is pulled." Assuming the firing was not initiated by the STIR control console, for an operator to have "pressed the fire button twice" and actually have the second missile launch indicates:

• the firing switch on the standard display had been CCS enabled;

• (among other things) the target was being tracked by a STIR;

• the missile launch controller (MLC) considered the target to be engageable; and

• a VLSS missile was in "stand-by" and available for launch (i.e. all switches were in the correct position — the "gun" was loaded).

The pure fact that an operator action (the second press of the button) resulted in another missile launch indicates, by design, that either:

• the CCS was in QR automatic mode and had correctly launched the first missile; a second stand-by missile was available and a target was being tracked by a STIR and was MLC engageable — hence the operator's "press" launched that second missile (think loaded gun); or

• the CCS was in QR auto-assign mode; the first missile was launched after the firing switch was toggled after it was enabled by the CCS according to the conditions mentioned previously; and the second was launched by a second toggling of the firing switch (as per design for the same reasons — think loaded gun).

The system is designed this way to provide complete flexibility to the Command. Supervision, training, understanding each weapon system, and not loading the gun unless one needs to use it has been the formula for preventing unplanned weapon firings long before even the UYKs, the Pentiums and the SPARCs came into being.

With respect to the USS *Stark*, and personally not having the full facts, LCdr Hughes' ROE comments seem very germane. In littoral waters in the presence of neutral surface and air activity, and when NOT at war, keeping one's CCS in the QR auto mode and the CIWS in AAW auto (with the "Auto Desig Enable" pressed on the Remote Control Panel) could be described, at best, as imprudent for safety/political reasons (never mind the degradation to equipment being kept in a continual "standing-to" state).

Mr. Cyr's closing paragraph is further derogatory to the already mentioned planning, design, implementation, testing and trialing that went into the delivery of what is considered a world-class warship. The leading edge of technology was being stretched even at CPF Implementation contract signing in 1983 (with computer upgrades implemented halfway into the project). PMO CPF, Saint John Shipbuilding Ltd. and Lockheed Martin Canada (ex-Paramax/Unisys GSG) can be proud of that delivery.

Finally, as LCdr Hughes stated in a different but proper way, a major issue on the table is the accuracy and interpretation (or lack thereof) of the tactical picture — *not* the actual means of automatic weapon control. Situational awareness and identification of the true enemy to be engaged must be extracted from the CCS-derived tactical picture in accordance with the ROE that are in effect. Assisting in the identification of tracked targets through modification of current IFF auto-interrogation is an option that can be reviewed.

Resolution is on the way! The Directorate of Maritime Ship Support, the Defence Research Establishment Valcartier and Lockheed Martin Canada have been co-operatively conducting R&D into modern data fusion techniques to improve positional and identification accuracy. Through a process called multi-source data fusion, which draws on all available sources of information, all tracks (not just QR tracks) will be auto-interrogated to best identify them as friendly, hostile or neutral. The resultant local area picture from this data fusion process would be further refined through cluster processing, correlation of air tracks to commercial corridors, etc.

In closing, may it be known that further deep thought is going on by various folk in industry and DND with the aim of optimizing the warfighting capability of the *Halifax* class, using modern and predicted technology, for implementation during the *Halifax*-class mid-life refits. If the youth of Canada are to be asked to go to sea in harm's way in the near future, and are also expected to safely return, then this continued planning to optimize/improve the current combat system against perceived future threat is not desirable, but essential — as it was for those currently serving in the *Halifax* class.

Lockheed Martin Canada employee Vil Auns retired from the navy in 1995 with nearly 35 years of service. His last appointments included: PMO CPF Operational Requirements Manager (1988-94) and CPF CS Senior Trials Director (1991-94). Vil Auns implemented and conducted the CPF weapon certification program.

The Type 2400 *Upholder*-class Submarine — An Introduction

Article by Cdr Richard Payne

On April 6, 1998 the Minister of National Defence announced that Canada would be renewing its submarine capability through the lease-to-purchase of four Type 2400 *Upholder*-class submarines. This decision was welcome news to Canada's submariners, occurring "just in time" to allow for the uninterrupted transition from the venerable *Oberon*s, now well into life extension, to the almost new *Upholder*s, which, as the MND put it, are "hardly broken in." The decision reaffirmed the government's Defence policy, spelled out in the 1994 white paper, of maintaining multipurpose, combat capable forces; and it followed almost two decades of procurement effort to modernize the submarine arm of our navy.

The Type 2400 was designed in the early 1980s as the replacement solution to the RN's *Oberon*-class submarines. Twelve to sixteen platforms were planned. An order for the first batch was placed in 1983, and the lead boat was launched in 1986. This submarine was commissioned HMS *Upholder* in 1990, and was followed by her sisters *Unseen*, *Ursula* and *Unicorn* from 1991 to 1993. Three months after *Unicorn* entered service in 1993, the four submarines were decommissioned as a result of the U.K. government's "Options for Change" Defence review. The RN would thereafter operate nuclear-powered submarines only. The four *Upholder*s retired to the VSEL shipyard in Barrow-in-Furness, and were placed on the market for sale to "an acceptable recipient at an acceptable price." Following Canada's Defence review in 1993 and the Defence white paper in 1994, DND was directed to investigate this rather timely opportunity. Exploratory meetings evolved into a succession of on-again, off-again negotiations which, happily, culminated in a positive government decision earlier this year.

Welcome Aboard!

The Type 2400 meets the three essential Canadian requirements in a submarine: it is very quiet; it can be armed with our very capable arsenal of Mk 48 Mod 4 torpedoes; and its modern hull design will allow for the retrofitting of an air-independent (AIP) system at some future date. Also, with four submarines, the reestablishment of a West Coast submarine presence is again possible.

The Type 2400s will be renamed and recommissioned as Canadian submarines in the 2000-2001 time frame. ***(Photo copyright VSEL Barrow-in-Furness. Used with permission.)***

In many instances the *Upholder* has very similar, even identical, technology to the *Oberon*s. It is a diesel-electric boat in the traditional sense, with two main batteries (240 cells each), two mechanically supercharged diesel generators, and one DC propulsion motor coupled to one shaft/propeller. Its hull design, though, is a derivative of the SSN class, teardrop-shaped and highly manoeuvrable due to its oversized hydroplanes and rudders. Its indiscretion rate is in the same league as other modern SSKs, but it is well designed for stealth. Anti-detection tiles blanket the hull, and radar absorbent material covers the exposed portions of masts and periscopes. Damping treatments have been applied throughout the submarine. At the fighting end the Type 2400 will carry the same heavyweight torpedo currently deployed in the *Oberon*, although the weapon discharge system is radically improved, using air turbine pumps which ensure low discharge noise regardless of depth.

The Platform

The pressure hull is divided into three compartments. Back aft, the engine-room contains two mechanically supercharged diesel-generator sets, rated at 1.4 MW each under snort conditions. A dutch breech immediately above the Paxman diesels allows for the maintenance-by-exchange of these major components. A single DC propulsion motor designed to operate at shaft speeds of up to 170 r.p.m. ahead and astern is conservatively rated at 4 MW. Forward of the engine-room, the submarine has two deck levels and a "basement." The midsection upper level is the control room, with access to and from the remainder of the submarine provided by a ladder at the after end, and access to the conning tower located at the forward boundary of the control room. Therefore, the control room is not a thoroughfare. The CO's cabin is in the forward port side of the control room.

The fore end upper level is the weapon stowage compartment, incorporating the weapon handling and discharge system.

OBERON	CHARACTERISTIC	UPHOLDER
2030 tons	Displacement (Surfaced)	2168 tons
2410 tons	Displacement (Dived)	2455 tons
295 ft / 90 m	Length	231 ft / 70 m
> 500 ft / 150 m	Diving Depth	> 650 ft / 200 m
12 knots	Speed (Surfaced)	12 knots
17 knots	Speed (Dived)	20 knots
9000 nm @ 12 knots	Range	8000 nm @ 8 knots
2 diesels/ 2 motors/ 2 shafts	Propulsion	2 diesels/ 1 motor/ 1 shaft
65	Complement	49
6 forward	Torpedo Tubes	6 forward
20	Torpedoes	18

Submarine Characteristics

The space is capable of carrying 18 full-length, heavyweight torpedoes. Accommodation, messes, galley and provision stores are grouped in the middle level, forward and amidships. Main batteries and stores are situated in the lower level. The conning tower features a five-person divers' chamber, with ample room in the casing for the stowage of diving gear. The bulkhead forward of the control room is rated to deep diving test pressure, effectively dividing the submarine into two escape compartments, each fitted with the standard complement of escape and rescue equipment, and each featuring a single escape tower and a certified seating for a deep-submergence rescue vehicle (DSRV).

The Combat System

Sonar cover is provided by a variety of acoustic arrays found in the 2046(BS2) towed and flank array sonar, the 2041 micropuff array, and the 2040 active/passive bow sonar. There is a 2008 underwater telephone as well as a 183 emergency underwater telephone system. Search and attack periscopes/optronics are power assisted, and include thermal imaging, remote TV, still photography and communication capabilities. Navigation includes satnav, gyro, radar and echo sounders. External comms include satcom for line of sight, VLF receivers, fixed and buoyant wire antennas, and MF/HF radios.

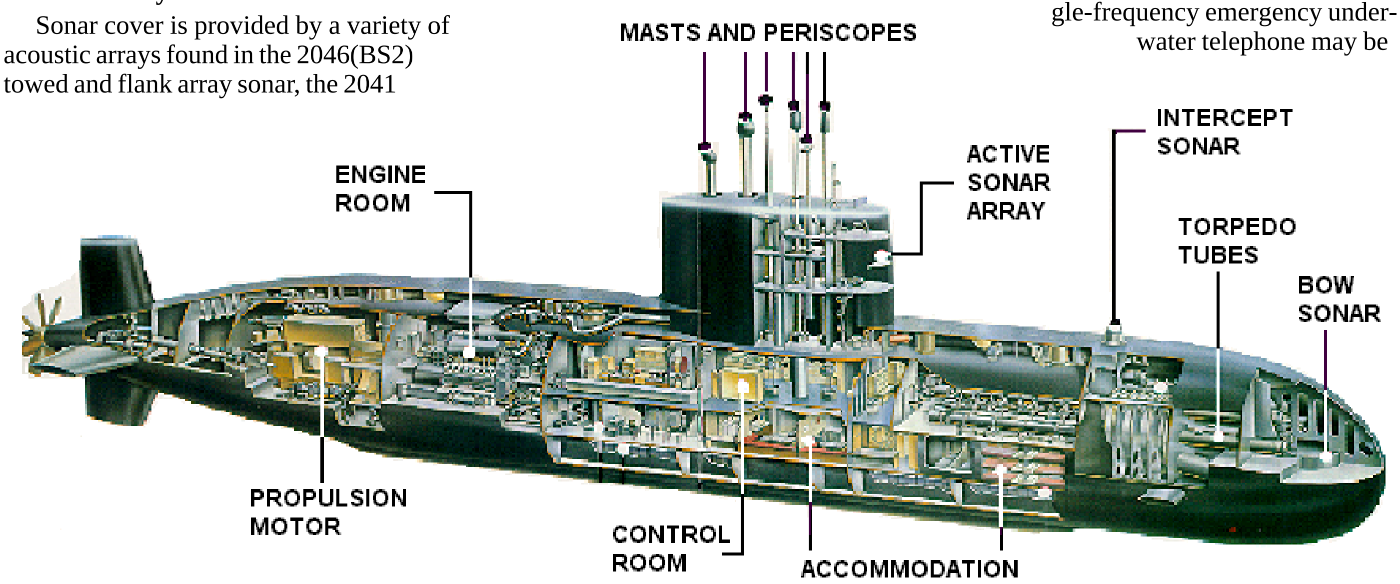
The weapon handling and discharge system is a vast improvement over that of the *Oberon*s. Six tubes are fitted with two air turbine pumps, each of which controls three tubes (port/stbd). Each discharge is controlled for optimum energy input, enabling the weapon to be discharged to deep diving depth with very low noise signature. The system was also designed for semi-automatic weapon embarkation and handling. The submarine can be fully ammunitioned or deammunitioned in about half a working day with minimal crew.

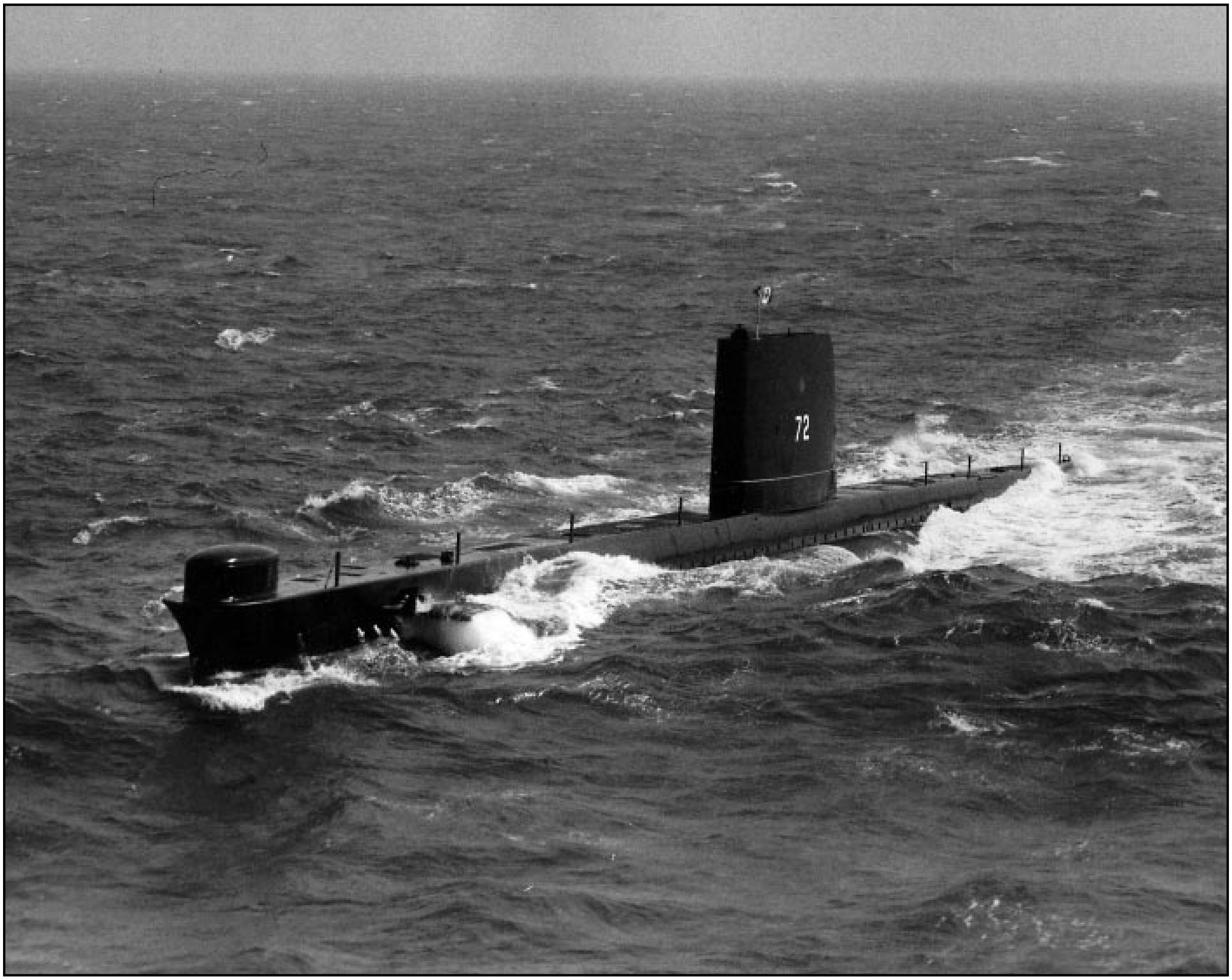
Canadian Modifications

The *Upholder*s were equipped in RN service with Mk 24 torpedoes. In Canada they will operate using our current inventory of Mk 48 torpedoes. To allow this to happen, the boats' fore-ends will require slight modification, particularly to the tubes proper. This work, which is dock dependent, will be completed during each submarine's reactivation in Barrow prior to acceptance. The major part of the modification, which will occur as the submarines arrive in Canada, involves stripping out the existing DCC fire-control system and replacing it with the Submarine Fire Control System (SFCS) currently in use in our *Oberon*s, but with new and improved COTS-design consoles.

The RACAL ESM equipment that was fitted in the *Upholder*s was removed for re-use in their SSNs. The submarines therefore do not yet have an electronic warfare capability. Several options are currently under consideration by the requirements staff in NDHQ; once a solution is found, the project will manage its implementation.

There will be other changes to the submarines once they arrive in Canada. For example, the communications suite will be modified to accommodate Canadian interoperability requirements. The towed array wet-end interface will also be modified to accept our arrays, and the 183 single-frequency emergency underwater telephone may be





During their three decades of service with Canada's naval fleet, the *Oberon*-class submarines *Okanagan*, *Ojibwa* (shown here) and *Onondaga* have established an exemplary standard of service that is expected to continue with the yet-to-be-renamed *Upholder*s. *(DND Photo)*

upgraded to the 2073 multifrequency system. *Upholder* herself will be fitted with a 1007 (vice 1006) nav radar to make her identical to her sister subs.

Maintenance Profile

These submarines will require a lesser amount of maintenance than what we have been used to with the *Oberon*s. Their modern design allows for a significant amount of maintenance by exchange, as is the case in most new ships such as the CPFs. The submarine was designed for two commissions, with a midlife refit/update in between. Within each commission there is a six-month docking scheduled at the mid-point (7½ years) for safe-to-dive recertification, and a shorter three-month docking at 3½-year intervals on each side of the extended docking. Within each 3½- year period between these dockings, the vessel operates on a repetitive 17-week cycle, four weeks of which constitute a short work period (SWP) alongside for planned and corrective maintenance. In summary, these newer submarines will be "operationally" available approximately eighty percent of the time, compared to the *Oberon*'s fifty percent availability.

Dolphin Code 38*

The Type 2400s will be renamed and recommissioned as Canadian submarines in the 2000-2001 time frame. There is no doubt that the Canadian navy will operate these cost-effective assets to their fullest capability and life span — 36 years on average for Canadian warships! Over the years, affordable and innovative ways of modernizing and improving this already very capable warship will be found to keep it at the leading edge of warfare technology. Thanks to years of tireless effort by a multitude of staffs both inside and outside of the Department of National Defence, Canada's submarine capability is now reborn. The best submariners in the world can now continue to hone their hunting skills in these new and improved submarines. Skimmers beware!

(* Diesel Boats Forever!)

Cdr Payne is the Project Manager of the Submarine Capability Life Extension Project.

HMCS *St. John's*: Port LM2500 Gas Generator Change-out in Toulon, France

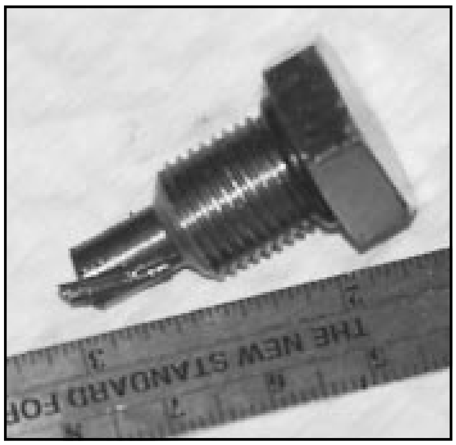
Article by Lt(N) Roger Heimpel

HMCS *St. John's* (FFH-340) sailed from Halifax, N.S. on Aug. 5, 1997 to join the Standing Naval Force Atlantic (SNFL) squadron in Norfolk, Va. When the squadron subsequently sailed for Bermuda on Aug.18, *St. John's* had no defects in her main propulsion system. Our propulsion troubles began on Sept. 2 when a salt-water pump failure put the propulsion diesel engine (PDE) out of commission. Unfortunately, repairs could not be effected prior to our departure from Bermuda on Sept. 7. Although the loss of the PDE was hammering our fuel budget, we left Bermuda early to evade Hurricane Erica, with only the two LM2500 gas turbines (GTs) available for propulsion.

Sunday, Sept. 14, 1997

St. John's was proceeding at 16 knots on the starboard gas turbine in cross-connect mode (SGT XCON), when a drive mode changeover was ordered to PGT XCON to allow water washing of the starboard LM2500. The port GT came to idle and ramped up to assume power. All PGT parameters were normal, including positive lube oil pressure. As the PGT assumed power, its scavenge filter went into high differential alarm. Since a stop signal had not yet been sent to the starboard GT, SGT XCON drive mode was quickly reselected. Concurrently, the duplex scavenge filter was switched over to the other filter and again the filter indicated a high differential pressure of 1.20 bar. As the port engine came down to idle speed, a 0.68-bar differential pressure was observed. There was no abnormal vibration detected. The port LM2500 was tripped after the starboard GT assumed power. At shutdown, the port engine scavenge pressure was 0.01 bar, indicating that the sensor was in fact "ranging." After a 15-minute cool-down, the scavenge screens and magnetic chip detectors were removed from all sumps. The screens were all clear and all the chip detectors were clean with the exception of the C sump. It was holding a metallic shard approximately 1/2" (1.27 cm) long, 3/32" (.24 cm) wide, 1/32" (.08 cm) thick.

The scavenge filters were removed and the one which initially came into alarm contained a small amount of metallic material. The bottom of the filter housing also contained a small amount of debris. An oil sample drawn off the lube oil storage and conditioning assembly did not contain any metallic debris. We suspected that a bearing had failed. The seriousness of losing the PGT was compounded by the previous loss of the PDE.



Metal found on "C" sump magnetic chip detector

Monday, Sept. 15, 1997

The options facing *St. John's* were very few. With only one serviceable propulsion engine, we broke away from the SNFL force to effect repairs in Toulon, France. *St. John's* and the Fleet Maintenance Facility *Cape Scott* technical staff reached a consensus that a field service representative should come to Toulon with a 6R midframe bearing. The container of tools needed to change out the bearing would be shipped to France. As well, three members of the FMF *Cape Scott* Gas Turbine Handling Facility would fly over with the tool container to assist replacing the bearing in situ. It was suspected that either the #6R or #5R bearing had begun to fail, but only the 6R bearing could be replaced in situ. Any other failed bearing would require an engine replacement.

Wednesday, Sept. 17, 1997

St. John's pulled into Toulon late in the afternoon of Sept. 17. Despite having requested a jetty with suitable crane facilities, the ship was berthed at a tiny jetty without cranes. As an added bonus, the jetty was just about as far away from the main gate as you could possibly get in the French dockyard. The FSR was to have met the ship on arrival, but miscommunication prevented his finding us. The three members of *Cape Scott*'s GTHF arrived by Hercules early the next day, along with the container of GT removal tools. The intention was to separate the gas generator and propulsion turbine and replace #6R bearing in situ.

Thursday, Sept. 18, 1997

When the FSR was finally able to boroscope the engine, we discovered damage to a large number of second-stage HP turbine blade tips. The recommendation was made to replace the gas generator. As expected, this caused a tremendous amount of high-level discussion between *St. John's*, MARLANT and COMSNFL. While this discussion ensued, the propulsion turbine was inspected to confirm the damage was limited to the HP turbine blading (which it was). From an engineering perspective, many questions remained: What was the condition of the 5R and 6R bearings? Was the blade damage a result of a bearing failure? What caused the initial failure?

From an operational perspective these questions were overshadowed by the need for a decision on when the generator would be replaced. We could change it out either in Toulon, or in El Farrel, Spain (*St. John's* had a work period slated for Spain in late October), or leave the ship restricted to a single gas turbine for the remainder of the NATO deployment. MARLANT presented two options to COMSNFL — *St. John's* could sail on time and remain without a PGT for the remainder of the deployment, or the ship could sail two days behind the force and rejoin fully operational. Late in the evening of Sept. 18 an immediate message arrived from COMSNFL telling us to replace the gas generator in Toulon. Unfortunately, the team had neither a complete set of removal tools, nor a new gas generator. The support team at FMF, MARLANT and Base Supply commenced preparations for delivery of the new generator and the required tools.

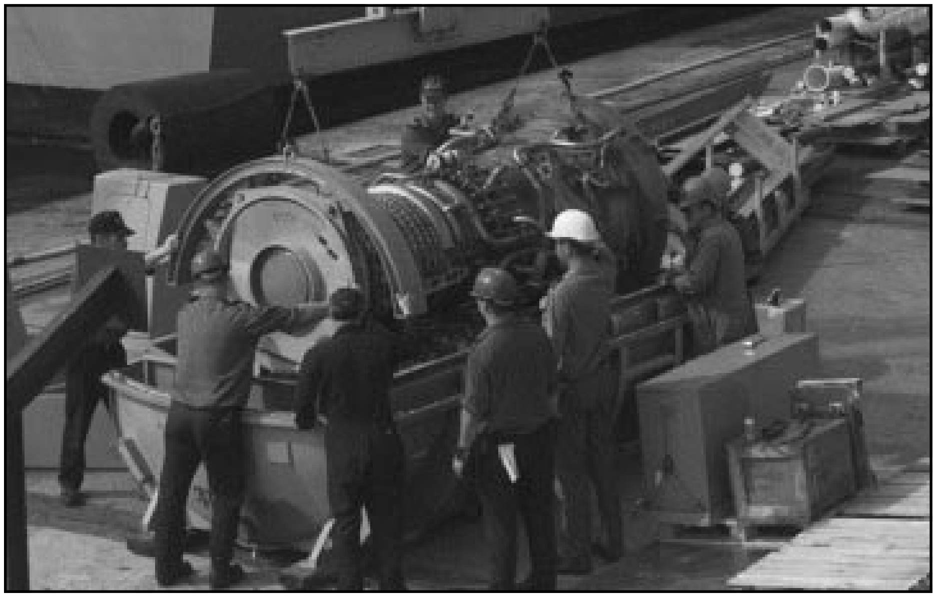
Friday, Sept. 19, 1997

At 0800 the on-site team began removing the old generator by disconnecting all IMCS connections, artery piping (lube oil, fuel and hydraulic start lines) and disconnecting the shroud between the generator and the turbine. As well, the plan was to remove the soft patch above the intake plenum and begin removing the intake splitters. However, as *St. John's* was berthed at a tiny jetty without cranes and with only limited access for a mobile crane, and the dockyard had serious concerns about the weight of the equipment we wished to place on that jetty, we hastily began making arrangements with the French liaison officer to have *St. John's* cold-moved to a jetty with suitable crane service.

To expedite the removal job, two splitters were lifted from their retaining slots using rigging attached to the deckhead of the intake plenum, and were left secured inside the plenum. This opened up a gap in the intake path, enabling us to lower the tools and horizontal rails into the enclosure. The FOD (foreign object damage) screen and firewall were removed from the front of the engine, along with the bellmouth and bullet nose. By 1300 *St. John's* was prepared for a cold move to the face of two jetties forming the sides of a drydock. We were to be berthed in front of the drydock gate which had three cranes fitted on the jetties. Only after we arrived did we realize that we should have specified a jetty with *serviceable* cranes. None of the available cranes was operable. A floating crane arrived at 1530 hours and confirmed it could reach the port LM2500 removal route. Although we anticipated removing the soft patch, splitters and FOD screen right then, the floating crane departed, assuring us it would return the next day at 1100. The maintenance repair party proceeded with the installation of the horizontal rails.

Saturday, Sept. 20, 1997

Anticipating the arrival of the floating crane at 1100 as promised, the team continued installing the horizontal rails inside the enclosure. The liaison officer informed us that the crane would not be available until 1315 due to higher priorities in the dockyard. From our new berth we were able to observe the crane sitting idle at 1315. When we finally went over and queried the delay, we were informed that the crane operators were available but, alas, all the pilots were occupied with berthing the SNFL fleet now entering harbour. The FSR kept the team occupied with activities normally performed after the interference items were removed.



The new gas generator is hoisted out of its shipping "coffin."

The crane finally arrived at 1600, and the soft patch, splitters and FOD screen were removed. We also used the crane to remove the sections of the firewall. The wind had risen by this time and there were a few tense moments as the splitters drifted close to the HF whip antennas. For future jobs of this nature, it should be noted that we rested the soft patch on top of the pyro lockers on the flag deck, and stacked the splitters on the starboard side, top part of ship. This concluded the activities for the day.

We were alerted by the national authorities that the Hercules flight carrying our gas generator and additional removal tools was scheduled to land at the local airport at 0100 on Mon., Sept. 22. Unfortunately, the local airport closed at 2300, but special permission was sought and granted for the Herc's arrival at the later hour. Of course, no sooner had we gained this approval, but the Herc pushed its arrival time back to 0430 local. This adjustment, in addition to the difficulty acquiring transport from the airport to the dockyard only heightened tensions on board *St. John's.* The reason we experienced tremendous difficulty with transportation was the communication breakdown. When we had first discovered the damage necessitating the replacement of the engine, we never thought we would get it done in Toulon. The first thought was the return of the removal tools to Canada and as such we had instructed the aircraft not to unload the container. Meanwhile we had already contracted a truck to deliver the container to the dockyard. When we finally had the decision to change the gas generator in Toulon, the driver had to be dispatched again to retrieve our container. The French were more than slightly disturbed by our seeming inability to decide on exactly what we required.

Sunday, Sept. 21, 1997

The removal route through the intakes was now free of obstruction, but we had no vertical rails to complete the removal rail system. The team worked to ensure all possible action had been taken and went so far as to move the gas generator forward on the horizontal rails. Without more equipment, or a gas generator, the team had worked itself right out of a job. Fortunately for the MSEO, he was able to stay occupied by being OOD! No rest for the wicked.

Monday, Sept. 22, 1997

At 0200 we received a call that the Herc flight was delayed 20 minutes. To ensure the airport staff and driver stayed to receive the flight, the ship's liaison officer and the assistant EO left for the airport. All went well and the engine container and associated removal gear arrived at the dockyard just before Colours.

The team sprang into action. Using the port side deck crane, we installed the rails in the intakes and, shortly after lunch, were prepared to remove the old engine. When the floating crane arrived in the late afternoon, the first step was to remove the lid from the gas generator container. The lifting harness was attached to the new engine, and the engine dollies were placed on the floating crane. This would allow the new engine and old engines to both be on the floating crane at the same time, thereby allowing the most expeditious transfer.

The floating crane was moved to the starboard side of *St. John's* and the old engine was plucked from the bowels of the forward engine-room without mishap. While the team transferred the rollers to the new engine, a plan was formulated to have the new engine in place prior to securing for the day. Unfortunately, we were told that the crane would not be available to complete the job until at least 1600 the next day due to other priorities in the dockyard. In the end, however, we were given the option of keeping the crane until 0630 the next morning. The team was by this time exhausted from all the activity of the previous few days, but the decision was made to complete the crane work.

The new engine was placed into the forward engine-room quite handily on the rail system. The crane was put on hold while the vertical rail system was disassembled and the new engine was safely secured in place. The factory service rep and maintenance repair party carried on with their activities on the new engine, while ship's staff removed the rails, rigged out all available tools and rails and commenced returning the intake system to its original configuration. The firewall sections and FOD screens were lowered into place, and the crane was reactivated to replace the splitters. All work progressed smoothly and by 0130 on Sept. 23 the splitters were in place. The soft patch hole was cleaned up and new gasket applied to the structure. Once the gasket epoxy cured, the soft patch was finally set back on. The bolts were replaced and the team finally secured at 0400. Twenty-four hours of activity had accomplished a phenomenal amount of work.

Tues., Sept. 23, 1997

SNFL sailed on schedule without *St. John's.* The team began the arduous task of reconnecting the piping and IMCS connections to the new engine, refilling the synthetic lube oil system and preparing the engineering spaces for sea. The team also had to fit modifications to the engine to ensure it was kitted-out the same as the old engine had been. These tasks were completed late that evening, and the engine was ready for the basin trial slated for the next morning.

Wed., Sept. 24, 1997

The Engineering Department conducted a successful basin trial and at 1500, after having had the new engine put through its paces pawl freed, the port gas turbine turned shafts. Special sea dutymen closed up at 1530 and, after a hasty goodbye to the factory service rep and the maintenance repair party, *St. John's* sailed from Toulon at 1615. The Engineering Department commenced an MMPT immediately upon clearing the harbour approaches. Some minor oil leaks were encountered and rectified on the PGT, and at 0230 on Sept. 25, the OPDEF (operational deficiency) was rectified.

A side note to all this focus on the first foreign port change-out of an LM2500 from a *Halifax*-class warship was that we had lost our propulsion diesel engine to a saltwater pump failure prior to the loss of the PGT. The pump was changed out concurrent with the GT change-out, with assistance from the SEMT reps, and *St. John's* sailed with all three propulsion engines.

In summation, we completed a gas generator change-out in a foreign port within 10 days of the failure. The supporting cast for this evolution was extensive and has set a strong benchmark for future jobs of this magnitude. As well, this level of support from the national authorities left a very good impression with the other nations and our SNFL commander about Canada's commitment to NATO.

Lt(N) Heimpel is the Marine Systems Engineering Officer in HMCS Fredericton.

Lessons Learned

Lesson 1: The change-out schedule for HMCS *St. John's* was driven by two factors — the logistic arrival of the replacement generator, and the availability of the French dockyard's crane services. Crane availability usually plays great importance in this type of work (as was shown by our change-out and by HMCS *Charlottetown*'s PGT change-out in Halifax). If at all possible, immediately consider contracting a mobile crane of sufficient size, complete with an operator, when conducting this evolution in a foreign port. This will prevent foreign priorities from hampering your work schedule. Our crew also maximized the use of the deck crane to work around floating crane availability.

Lesson 2: Phone lines may be a premium commodity in a foreign port. Ensure your Engineering Department has a dedicated phone line to allow free-flowing communication between the ship and any external agencies, including the fleet technical authority. Good communications allow flexibility to adapt to the inevitable snags which accompany a major repair in a foreign port.

Lesson 3: In the same way that crane availability affects a work schedule, the transportation aspect must be given maximum attention. Only when our aircraft arrived did we consider the need for a specialized vehicle (a "K" loader) to off-load the container from the aircraft. We also had difficulty securing the use of a transport of sufficient size and a crane on our end to unload the transport. Do not rely on the aircraft crew to assist in these tasks, and the national authorities are too far removed from the scene to be able to provide this level of support. Proper communication and a good working relationship with your ship's supply officer is vital.

Lesson 4: As per any tightly scheduled task, expect the unexpected and make every attempt to be proactive.

The Influence of Sea Water and Atmospheric Corrosion on Wood-Polymer Composites*

Article by **Leslaw Kyziol**, Akademia Marynarki Wojennej, Gdynia, and **Stanislaw Szpak-Szpakowski**, Centrum Techniki Okrêtowej, Gdañsk

[*Condensed from the authors' original paper entitled, "*The Influence of Sea Water and Atmospheric Corrosion on Specific Properties of Wood-polymer Composites*," available from the *Maritime Engineering Journal.* This paper, which contains a complete discussion of results, was originally produced in Polish and translated into French for the *Journal* while Lt. Cdr. Kyziol was attending the Canadian Forces Language School at St-Jean. The assistance of the school's course co-ordinating officer, Lt(N) P. Cameron, in liaising between the author and the *Journal* is gratefully acknowledged by the editor.]

There appears to be renewed interest in using wood as a construction material in naval engineering. Its reappearance in shipbuilding has been made possible due to the elimination of its shortcomings and the enhancement of its qualities — advances realized through the development of wood-polymer composite materials (known as *lignomers*). The authors present the results of tests conducted on samples of wood-polymer composites immersed in sea water. The influence of atmospheric corrosion on the shock resistance of material placed in contact with ordinary steel was also determined.

General

Wood, one of the oldest materials used in construction, not only possesses many positive qualities which stem from its highly sophisticated structure, it also has a number of shortcomings. Its tendency to change size under the influence of the environment, its hygrometric qualities, and its weak mechanical properties in an orientation perpendicular to the alignment of the fibres cause major technical problems.

A great deal of research has been done on deriving the maximum benefit from the natural qualities of this material. Most of the methods that have been developed involve first breaking down the wood, then reconstructing it following the addition of a variety of ingredients. The process by which wood is modified first by impregnating it with monomers and then by conducting a series of polymerizations appears to have a great deal of promise.

One method for producing wood-polymer composites uses thermal energy to polymerize the monomers introduced into the wood. A polymerization catalyst is initially added to the monomer, and then heat is transmitted into the wood impregnated with the monomer and the catalyst either through contact or convection.

The most effective process involves combining the monomer with at least two polymerization catalysts that break down at different temperatures. Polymerization occurs when the material is in liquid form and under extremely high pressure. During the initial phase of the heat treatment, the catalyst with the lower degradation temperature disintegrates, increasing the number of polymer particles and the viscosity of the substances introduced into the wood; the heat produced when the catalyst degrades and triggers polymerization is used partially to initiate the disintegration of the next catalyst, which has a higher temperature of degradation.

Testing and General Results

Tests were conducted involving alder and birch wood composites, which led to the preparation of test specimens which could be used to determine their different characteristics. Polymerization was conducted using a heat method developed by M. Lawniczak.

The test specimens were prepared from polymerized alder wood having identical concentrations of monomers and polymers, and from birch wood with differing concentrations of monomers and polymers. The samples removed followed the longitudinal direction of the fibres. All the samples were weighed, and their weight and dimensions determined, before and after immersion in sea water.

The samples were placed in a perforated receptacle and then immersed in the sea at a depth of three metres. The temperature of the water was 5°C, pH = 7.8. The samples were tested for resistance to static tension, absorption of water and swelling. Four cycles were planned:

Initial State (Cycle 0)
Cycle I – 10 days
Cycle II – 20 days
Cycle III – 30 days
Cycle IV – 60 days

At the end of each cycle (I-IV) the specimens were removed, their surfaces were dried and we immediately began testing.

The tests aimed at determining the effects of atmospheric corrosion on natural wood showed that, in contact with steel, the destruction of wood tissue accelerates, there is deterioration of mechanical characteristics and of shock resistance, and there is increased creep and reduced overlap. Hence it is critical, both from a technical and economic standpoint, that we become familiar with the behaviour of modified wood in contact with ordinary steel. The length of time that construction components assembled using intermediate steel parts such as nails, screws, bolts, etc., are able to remain in service depends on it.

In light of this fact, we decided to carry out testing to determine the influence of accelerated atmospheric corrosion of steel on the shock resistance of modified wood. The tests involved beech and alder wood both in their natural state and in the form of lignomers. The samples of wood in both a natural and modified state were separated into two groups. The first group was subjected to accelerated ageing in contact with a bar of ordinary steel; the second had no contact with steel.

The samples prepared in this manner were subjected to accelerated atmospheric corrosion. Each cycle lasted 48 hrs and involved the immersion in water, freezing, thawing and drying of samples. The samples were subjected to 24 cycles of simulated atmospheric conditions. To observe the influence of atmospheric corrosion on elasticity we conducted tests at the end of 0, 3, 6, 11 and 24 cycles. Resistance to shock was gauged using the Charpy method, which involved activating a pendulum in line with the length of the wood fibres in soaked samples.

Generally, we found that:

- The lignomer immersed in sea water exhibited significant resistance to the action of sea water.
- Increasing monomer and polymer concentrations reduced loss of resistance, diminished permeability and enhanced the stability of modified wood in terms of both size and shape.
- The influence of sea water on the lignomer was greatest during the first cycle. Following this period, we observed only a slight deterioration in the characteristics we examined.
- Modified wood displayed excellent resistance to atmospheric corrosion in contact with a bar of ordinary steel.

Summary

The process of modifying wood by merging it with synthetic polymers has made possible the creation of composite materials boasting outstanding practical qualities. The use of polymers not only eliminates wood's shortcomings, it enhances its natural properties. Moreover, the structure of wood reinforces the plastic material even more effectively than do synthetic fibres. By modifying wood, new composite materials are obtained whose properties vary depending on the raw materials used in their manufacture. Tests have shown that polystyrene-based composite materials employing birch, poplar and alder wood may be used in any situation where extreme stability of size and form, and great precision in shaping is required.

For the tests described in this paper, the wood of the birch, poplar, aspen and alder — species that mature quickly (i.e. 40-60 years) — were used as source material. In many countries, including some European countries, action has been taken to make more judicious use of existing reserves of renewable raw materials and intensify the growth of the biomass through the introduction of energy forests characterized by short exploitation cycles of five to ten years.

The appealing characteristics of lignomers have yielded certain commercial opportunities in various sectors of the economy. Experiments are currently being conducted, designed to develop a modified wood that can meet the requirements imposed on material used in shipbuilding.

Lt. Cdr. L. Kyziol

Fleet Obesity a Growing Trend

The "Fleet Body Mass Index" has reached the "Obese" level. Our mighty fighting machines continue to gain tonnes around the waterline.

As with all of us who carry a few extra pounds, we fatigue sooner. Cracks are starting to appear under the strain and a remedial fitness program is required.

The *Iroquois* class is being given a "slimming" patch in the form of a load line mark (*see News Briefs*). The *Halifax* class has been told to lay off the extra fuel, or it won't be able to have any cosmetic surgery at mid-life. Even the *Kingston* class will need to pull its boot-topping up in order to hide the signs of early weight gains.

For the sake of combat fitness, we must learn to live with a few less pounds. **— Lt. Cdr. A.R. Graham, RCNC, DMSS 2-2.**

Submission Formats

As a general rule, article submissions should not exceed 12 double-spaced pages of text. The preferred format is MS Word, or WordPerfect, on 3.5" diskette, accompanied by one copy of the typescript. The author's name, title, address and telephone number should appear on the first page. The last page should contain complete figure captions for all photographs and illustrations accompanying the article.

Photos and other artwork should not be incorporated with the typescript, but should be protected and inserted loose in the mailing envelope. If at all possible, electronic photographs and drawings should be in TIFF or JPEG format. A photograph of the author would be appreciated.

Naval Engineering Test Establishment:

A Motor Current Signature Based Equipment Health Monitoring Prototype

Article by John W.M. Cheng and Céline Paré

Abstract

NETE was tasked by DMSS 5-2 to develop a prototype that would monitor motor current signatures (MCS) of shipboard equipment in order to assist in early detection of motor failures. The prototype was used to collect current signatures on the *Iroquois* (IRO) class main fire pumps in both plant and field trials. It was established that certain current signatures, such as the current waveform with the 60 Hz component removed, possess unique characteristics which can be used to identify even minor defects. Neural network technology was then applied to help differentiate the normal and abnormal signature patterns automatically. The diagnostic results from the neural nets were also shown to be accurate, suggesting that the prototype and associated technology developed in this project can be an effective tool for continuous equipment monitoring use.

Motor current signatures (MCS) are based on a simple concept, i.e. the motor itself is an *implicit transducer* built into motor-driven equipment where the electrical current behaviour reflects the “state” of the motor and the load it is driving. Since the current can be monitored non-intrusively and remotely, MCS becomes a legitimate and attractive means for equipment health monitoring purposes[1].

Introduction

NETE was tasked by DMSS 5-2 in 1996 to begin construction of an MCS-based prototype to build up the capability and expertise of implementing such technology for naval use. With its continuous monitoring capability, an MCS-based monitoring device can identify potential problems earlier so that remedial action can be initiated before catastrophic failure occurs. As a result, the equipment availability can be improved and the overall maintenance costs reduced. The experience gained in this project will then be used to decide whether to implement similar devices into a long-term EHM program.

Objectives

There were four main objectives for this project:

• Design and implement a self-contained MCS-based health monitoring device for shipboard motor-driven equipment use;

• Develop necessary hardware and software tools to extract appropriate current signatures and use them for health monitoring purposes;

• Collect and analyze current signatures under normal and simulated defective conditions;

• Evaluate the capability and performance of the prototype and provide recommendations for any further development.

Prototype System Description

The prototype consisted of three main parts, namely the sensors, a data acquisition front-end and a laptop PC. *Figure 1* shows the prototype at completion.

Sensors: The sensors were the clamp-on current probes which provide a measuring range from 0.05-1000 A AC with an accuracy up to 1% of reading from 30-20k Hz.

Data Acquisition front-end (DAQ): The DAQ was used to sample, digitize and then transfer the sampled data to the laptop PC. This DAQ was configured to operate with eight differential channels for this application, but can be expanded up to 16 single-ended channels. The DAQ also supported a maximum sampling rate of 100k Hz for one channel (or 12k Hz/channel for eight

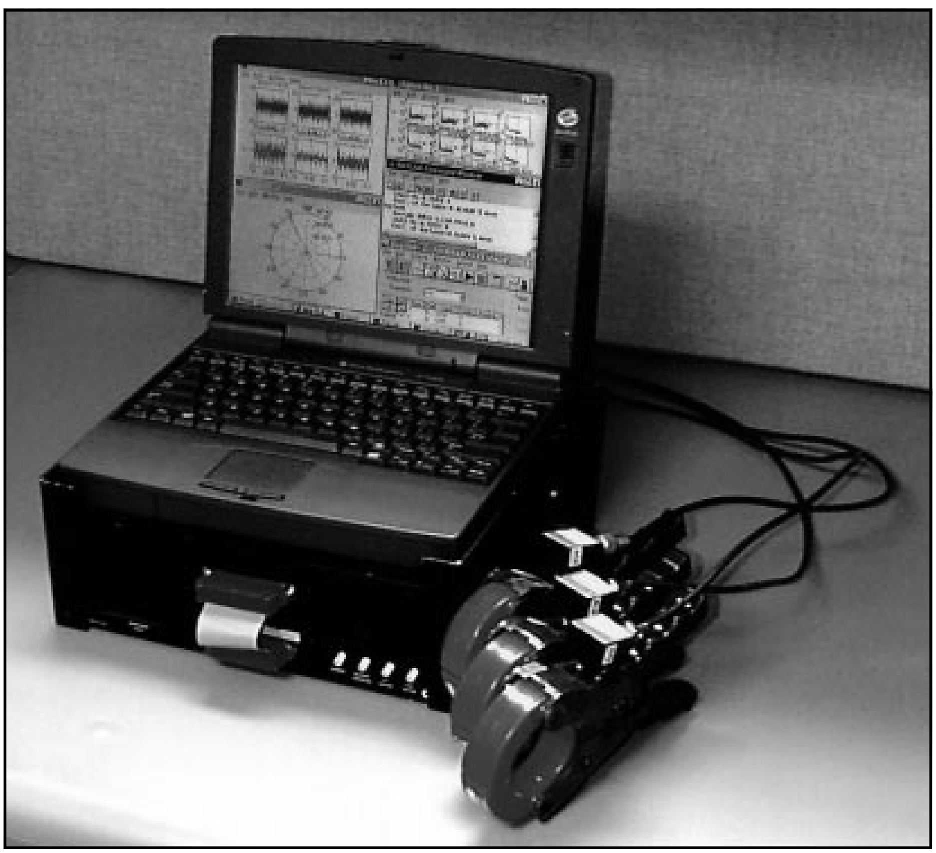


Figure 1: Physical Layout of the MCS-based Prototype

channels) and a 16-bit analogue-to-digital converter. In this case, a sampling rate of 5k Hz/channel was used.

Laptop PC: The laptop PC was the "brain" of the system, controlling the data acquisition front-end, extracting and displaying the current signatures, performing the analyses and finally storing the data for trending purposes. The PC used in this prototype was a standard laptop PC with a 120-MHz Pentium processor, 16-Mbyte RAM and 810-Mbyte hard disk storage.

Motor Current Signatures

Two types of current signatures were identified and studied in this investigation, namely the scalar signatures and vector signatures.

Scalar Signatures

A scalar signature indicates that a *single* value is used to describe a "state" of a system. For example, each of the following measurements can be considered as scalar signatures, namely: peak value; root-mean-square (rms) value; total harmonic distortion (thd) value; and statistical measurements such as the mean or standard deviation of the three-phase values.

Vector Signatures

A vector signature indicates that *a series* of values is used to describe a "state" of a system. For example, each of the following measurements can be considered as a vector signature, namely:

Symmetrical components: The symmetrical components method converts an imbalanced three-phase system into three balanced and symmetrical subsystems called the positive, negative and zero sequence components. In the present context, all of these components become a form of signature [2].

Frequency spectra: The current waveform can be converted into a series of frequency components using Fourier Transform. The resulting frequency spectra can then be treated as another form of signature.

Current waveform without the fundamental component (CWWF): This is actually a reconstructed current waveform in the time domain after the fundamental component (60 Hz) has been removed. The advantages for removing the fundamental are as follows:

• The presence of the fundamental frequency usually dominates the current signal such that any abnormal current behaviour on top of the fundamental is very hard to detect. By removing the fundamental frequency, smaller current fluctuations can be detected much more easily;

• Abnormal current activities are rarely concentrated on a specific frequency range or related to a particular frequency. Instead, abnormal currents may have frequency components distributed throughout a wide area. As a result, the amplitudes of the frequency spectra corresponding to the abnormality may be low and scattered. Hence, it may be hard to compare them with their healthy counterparts. Therefore, if the fundamental (60 Hz) component in the frequency domain is removed from the original signal and the remaining frequency components reassembled and converted back to the time domain, the resulting current waveform will possess the *accumulative* effects of *all* the frequency components. As a result, the reconstructed waveform may be easier to be compared and analyzed.

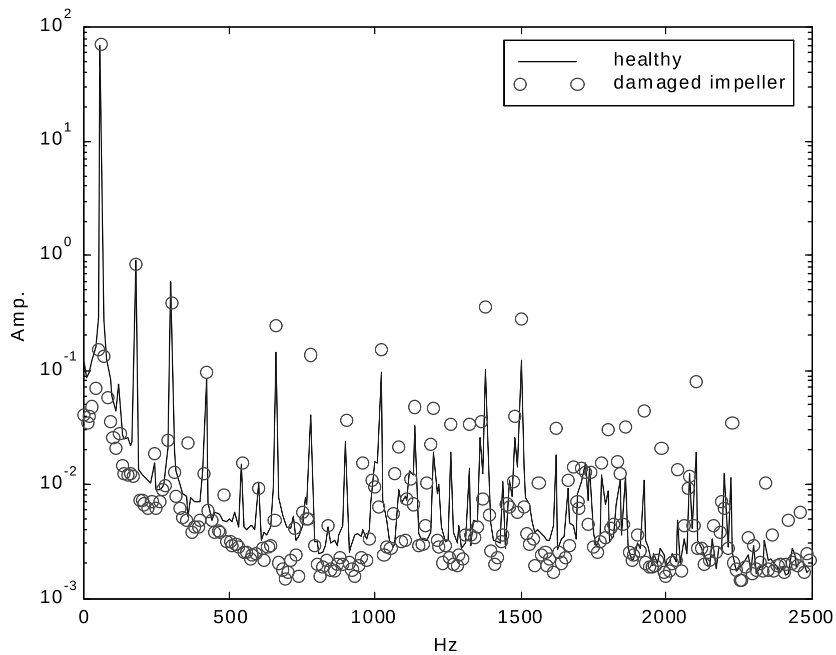


Figure 2: Comparison of Frequency Spectra

Selection of Test Subject — The IRO-class Main Fire Pump

The IRO-class main fire pump was selected as the test subject used in this investigation, based on its size, historical failure rate and the number of units installed on each ship [3]. The rating of the motor is: 37.3 kW (50 hp), 440 V, 3-phase, 60 Hz, 3535 rpm and 50°C.

Plant Trials

Original (Healthy) Signatures

A recently overhauled and certified IRO-class main fire pump was first installed at NETE's test bay. Using the prototype, three different loadings, namely minimum (30 A), medium (40 A) and maximum (50 A), were set up and the corresponding current data recorded.

Used Impeller Signatures

A "used" impeller from a previously failed unit was retrieved from the disposal stock. Without any modification, this "used" impeller was then installed on the healthy pump and tested. The intention was to observe any abnormality that might be detected. Three sets of loadings (30, 40 and 50 A) were repeated and the current data recorded.

Damaged Impeller Signatures

To simulate a more pronounced effect of a defective impeller, a notch was cut into one of the vanes of the "used" impeller. This notch was expected to generate severe imbalance and water turbulence. The same three loading levels were again repeated and the corresponding current data recorded.

Damaged Bearing Signatures

After the impeller trials, the motor-pump was completely disassembled and the drive-end bearing was removed from the motor shaft. A damaged drive-end bearing was then installed. The damage was carefully situated on the rolling elements and outer race such that the level of damage was easily distinguishable with a bearing analyzer (e.g. 3-4 times above normal) but not too severe to cause any catastrophic failure during test. The "original" healthy impeller was used so that the only known defect was the drive-end bearing. The same three sets of loading levels were then repeated and the current data recorded.

Field Trials

Two IRO-class ships were visited to carry out the field trials. In the first ship, HMCS *Iroquois* based in Halifax, the current behaviour on all three main fire pumps on board was surveyed. For the second ship, HMCS *Huron* in Victoria, only two main fire pumps were surveyed as the third one was out on maintenance.

Comparison and Analysis of Signatures

Table 1 shows a typical comparison of the scalar signatures extracted from the trial detailed above. It appears that there is no significant difference in these measurements that can be used to differentiate between the healthy and the defective equipment.

On the other hand, the vector signatures in general show a more appreciable difference from one condition to the other. For example, *Table 2* shows a typical comparison of the symmetrical components obtained from different trials. If these values are normalized by the amplitude of the positive sequence, the negative sequence of the defective impeller increased by 44% and the defective bearing by 103% when compared to the healthy unit. *Figure 2* shows a typical comparison of the frequency spectra between the healthy pump and the one with a defective impeller. The differences are quite noticeable, especially beyond the 500-Hz level.

Furthermore, the most interesting finding is illustrated in *Figures 3-6*. These are the typical CWWF signatures obtained during the plant trials where it is clearly shown that there is a distinct signature pattern within each particular case. For example, the healthy motor shows a smooth pattern while the damaged impeller shows a highly fluctuating CWWF waveform. For the defective bearing, the fluctuations are somewhat less violent but still distinguishable from the healthy one as demonstrated in the figures.

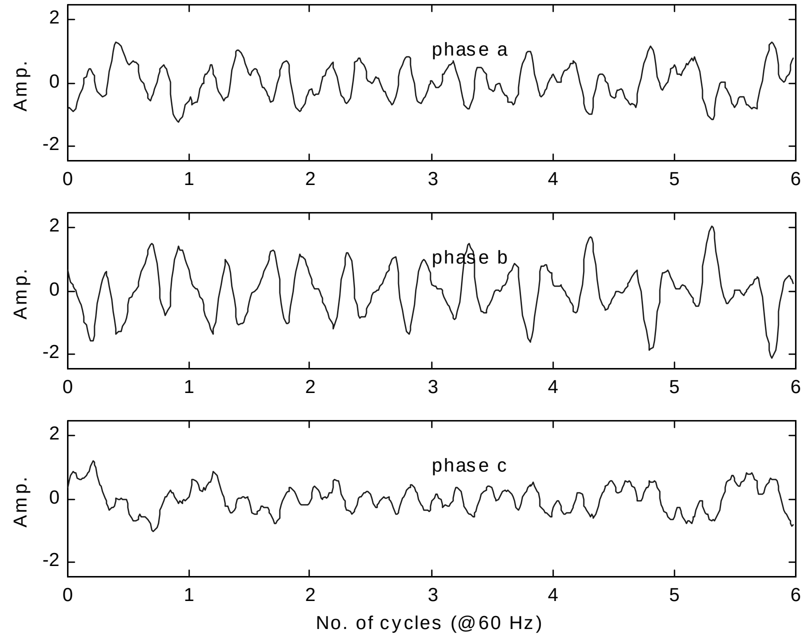


Figure 3: CWWF Signature of Healthy Pump

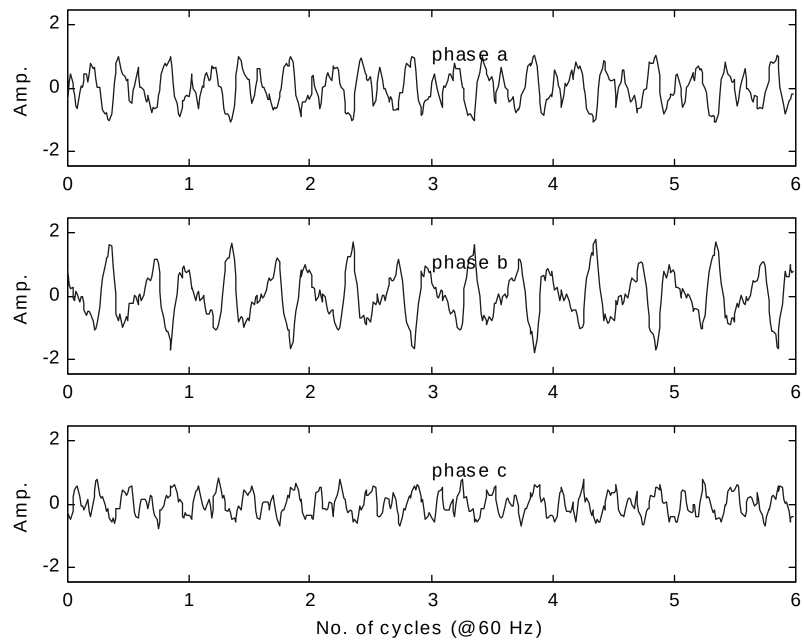


Figure 4: CWWF Signature of Used Impeller

	HEALTHY	USED IMPELLER	DAMAGED IMPELLER	DEFECTIVE BEARING	HMCS IROQUOIS M1	HMCS IROQUOIS M3	HMCS IROQUOIS M5	HMCS HURON M3	HMCS HURON M5
peak (A)	69.83	70.49	70.55	69.43	77.74	82.79	81.6	64.47	73.81
rms (A)	49.38	49.84	49.89	49.1	54.97	58.54	57.7	45.6	52.21
thd (%)	1.39	1.19	1.32	1.21	0.91	1.06	0.99	1.74	2.35

Table 1: Comparison of some Scalar Signatures from Different Trials

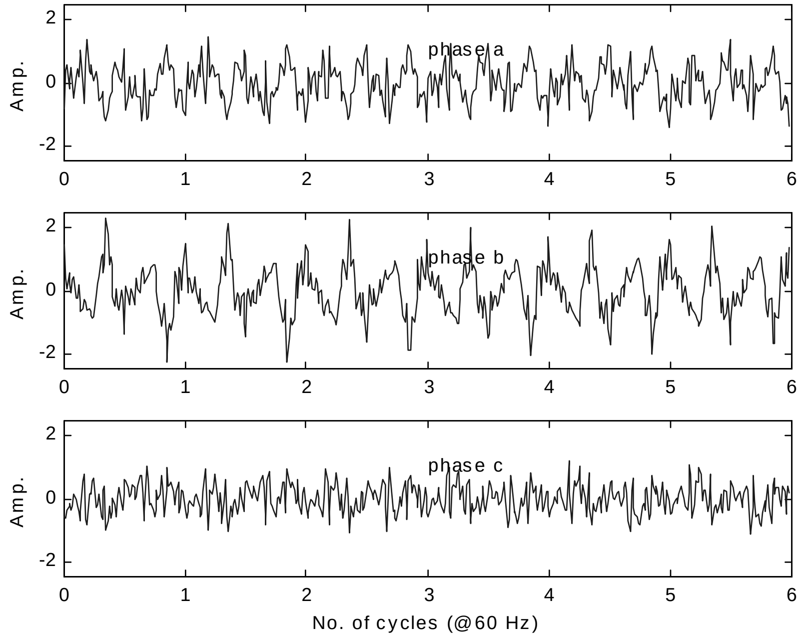


Figure 5: CWWF Signature of Damaged Impeller

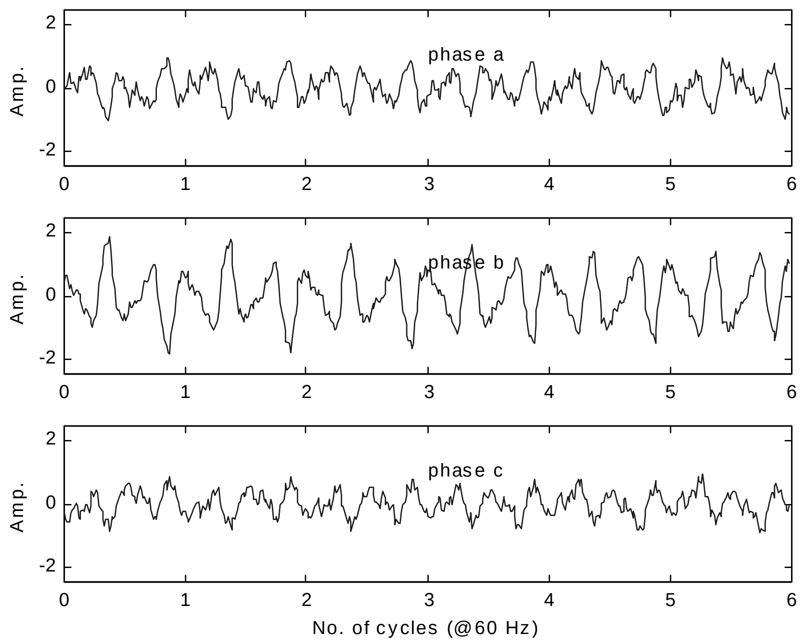


Figure 6: CWWF Signature of Defective Bearing

The field data obtained from HMCS *Iroquois* are generally comparable to the healthy signatures observed in the plant trials and no abnormality is detected. However, it is noted that the signatures from the two main fire pumps on HMCS *Huron* have relatively high 5th and 7th harmonic contents, i.e. 2% and 1% of fundamental respectively. Since these harmonics are detected on both motors and their proportion to the fundamental component is similar on both pumps, it is concluded that the cause of this abnormality is more of a power supply quality problem rather than defects originating from the pumps.

Using Neural Networks for Diagnostics

The signatures from different plant trials were used to train neural networks in order to gain some experience and insight as to whether this technology can be applied for diagnostic purposes. Two types of neural networks, namely the PERCEPTRON and BACKPROPOGATION nets [4], were studied. PERCEPTRON is the most primitive form of neural nets and the simplest in terms of computational requirements. BACKPROPOGATION is the most popular type of neural nets used today, but more demanding on computational power. The CWWF signatures from the plant trials were used as inputs to the neural nets because these signatures are the most distinguishable even with the naked eye. The output was simply a diagnostic pattern to identify whether the pump is healthy or defective (e.g. impeller defective, or bearing defective).

After training, the neural nets were applied to a set of backup recordings saved from each trial. (Note: These backup recordings were not used in the training part.) Since the status of each backup recording is already known, the results of the neural net diagnoses can be used to verify the accuracy and capability of the trained nets. It was observed that

	HEALTHY	USED IMPELLER	DAMAGED IMPELLER	DEFECTIVE BEARING	HMCS IROQUOIS M1	HMCS IROQUOIS M3	HMCS IROQUOIS M5	HMCS HURON M3	HMCS HURON M5
zero (A)	0.27	0.36	0.35	0.35	0.29	0.22	0.21	0.15	0.19
positive (A)	69.8	70.5	70.5	69.4	77.77	82.7	81.6	64.5	73.7
negative (A)	0.41	0.87	0.59	0.81	4.42	4.79	3.76	1.77	3.72

Table 2: Comparison of Symmetrical Components from Different Trials

the PERCEPTRON achieved 63% accuracy and the BACKPROPOGATION achieved 68% accuracy. In other words, both methods can identify defective equipment over and above 63% of the time. Furthermore, both neural nets achieved a 100% accuracy if the pumps were at full load (e.g. normal operating condition).

Conclusions

The prototype revealed that there are indeed different signatures within the motor current which can be used for equipment health monitoring and diagnostic purposes. One of the most significant signatures is the current waveform with the fundamental 60-Hz component removed. The capability to harness this information has been established in this project. The experience gained and the results observed support further development and serious consideration of implementing similar devices as a long-term EHM program.

References:

[1] Farag et. al., "An Integrated On-Line Motor Protection System," IEEE Industry Applications magazine, April 1996, pp. 21-26.

[2] Kliman et. al., "Sensorless, Online Motor Diagnostics," IEEE Computer Applications in Power magazine, April 1997, pp. 39-43.

[3] Cheng, "Cost Benefit Analysis of Using Motor Current Signature Methods as a Health Monitoring Tool for Shipboard Motor-Driven Equipment," NETE Project IT1292 Final Report 14/96, June 1996.

[4] Matlab Neural Network Toolbox User's Manual.

John Cheng and Céline Paré are project engineers in the Combat and Control Systems section of the Naval Engineering Test Establishment in LaSalle, Quebec.

"The Navy at Work and Play"

Maritime Engineering Journal Photo Competition

Deadline for Entries: April 30, 1999

Give us your best shot...and help us restock our photo library! The *Maritime Engineering Journal* is looking for **unclassified** photographs to use in illustrating articles and news items. To this end, we are announcing a photo competition, complete with cash prizes!

In keeping with our theme of **"The Navy at Work and Play,"** we are looking for new and old photographs of everything and anything that depicts the people, ships and equipment of Canada's naval community at work and play. Ever mindful of our navy's illustrious historical past, the photos need not be recent.

Prizes:
Main prizes will be awarded as follows:
Best overall photo:

1st Place — $150
2nd Place — $75
3rd Place — $25

A $25 prize will also be awarded for deserving entries in each of the following categories:

Ship/Vessel
People
Equipment (with or without people in the picture)

Contest Rules:

The competition is open to everyone, with the exception of members of the *Maritime Engineering Journal* editorial committee and their immediate families.

Original photo entries may be submitted as colour or black & white prints of any size, or as 35-mm transparencies. DO NOT SEND NEGATIVES. Digital images in TIFF or JPEG format are also eligible, but please don't send us digital scans of your photos (in other words, send us *original* digital shots, or *original* photos where available). No more than one prize will be awarded for any individual photo.

Entries must identify the subject of the photo, any people who are prominent in the shot (if possible), along with the photographer's name, and the date (as near as possible) that the picture was taken. For example:

"Flying operations on board HMCS *Regina* in heavy weather off Oahu. Photo by Lt(N) Liz Shutterbug, May 1995."

"Late-night pump repairs in *Preserver*. Photo by P2ER John Focus, CARIBOPS '78."

"FMF *Cape Breton*'s entry in the 1998 Nanaimo-to-Vancouver bathtub race (driven by Joe Castonguay) capsizes in the Georgia Strait. Photo by Bob Effstop."

Don't forget to include your address and telephone number so that we can get in touch with you.

Entries must be received by the *Maritime Engineering Journal* no later than April 30, 1999. Package your entry carefully, and send it to:

The Editor
Maritime Engineering Journal
c/o DMMS (6 LSTL)
National Defence Headquarters
101 Colonel By Dr., Ottawa, Ontario,
Canada K1A 0K2

The judges reserve the right to declare no winner in any category. Winning photographs, along with photos of the contest winners, will appear in the June 1999 issue of the *Journal*.

Important: Please note that photographs and slides will not be returned. All submissions become the property of the *Maritime Engineering Journal* for possible eventual publication in the *Journal* and/or related publications, or as directed by the editorial committee in response to requests for photo support. In all cases, the photographer's name will appear alongside any published photos. It is suggested that photographers make a copy of their work before submitting it to the *Journal*.

Greenspace: Maritime Environmental Protection

Halifax-class Sewage Treatment Plant Evaluation

Article by Lt(N) A.W. Cook

In response to an increasing number of operational deficiency reports (OPDEFs) and unsatisfactory condition reports (UCRs) directed at the poor reliability and maintainability of the *Halifax*-class sewage treatment plant, PMO CPF provided funding in April 1997 to perform an evaluation (EVAL) of an upgraded version of the Omnipure® system. The objective of the EVAL was to improve the reliability and maintainability of the sewage treatment plant without compromising its ability to meet the effluent quality standards for which it was originally certified.

Approval to proceed with the EVAL was received from MARCOM in May 1997, HMCS *Halifax* being nominated to receive the new system. The installation phase was contracted to Halifax Shipyard Limited (HSL) and was to be followed by a five-day set-to-work performed by the equipment's manufacturer.

Principle of Operation

The *Halifax*-class sewage treatment plant consists of a main collection tank, level switches, macerator pumps, electrocatalytic cells, a quiet medium tank and discharge pumps (*Fig. 1*). Classed as a physical/chemical system, treatment of the sewage is accomplished primarily through maceration and disinfection.

Black and grey water are introduced to the collection tank by way of the vacuum collection system. A constant flow of salt water is also provided to facilitate the production of disinfectant within the electrocatalytic cells and to help keep the system clean during periods of reduced hydraulic loading. When set up in "auto," two level switches in the main collection tank control when the macerator pumps, electrocatalytic cells and discharge pumps cycle on and off. When energized, sewage and salt water from the collection tank are passed to the electrocatalytic cells via the macerator pumps. Within the cells, the salt water in the influent is broken down by electrolysis, thus oxidizing the bacteria in the sewage which is simultaneously treated by evolved sodium hypochlorite.

Having passed through the cells, the waste stream is directed to the quiet medium tank whose design ensures that adequate residence time is provided for further disinfection and settling of suspended solids. The volume of the quiet medium tank and the position of the level control switches ensure the waste stream is subjected to a minimum residence time of 30 minutes before being pumped overboard via the discharge pumps.

Problems with the Original Configuration

The reliability and maintainability problems experienced by *Halifax*-class vessels with the Omnipure® system have been well documented and have been supported through independent reports published by the RAN and USN. Common to all reports, the major problem areas have been:

a. **Electrocatalytic Cells Failure:** The design of the original cells promotes rapid clogging and heavy scale build-up. The clogging affects the flow rate through the cells (hence the contact time), while scale build-up reduces the cells' ability to produce hypochlorite and promotes severe overheating. In the absence of regular cleaning, the cumulative effect of the overheating causes the seals to breakdown and leak. Cell repair and cleaning is resource intensive and is required at an alarming frequency. The cells currently in service are used exclusively in *Halifax*-class vessels and are no longer in production. Although the manufacturer is providing support for these cells, the requirement to retool for each order has caused the price of the cells to increase dramatically. What had been envisioned as a lifetime supply of electrocatalytic cells was completely exhausted within seven years of the first system being commissioned;

b. **Macerator Pumps:** The macerator pumps serve the purpose of reducing the particle size in the waste stream such that the likelihood of clogging is reduced, while maximizing their surface area. The pumps currently in service are not bona fide macerator pumps. Rather, they are sewage transfer pumps which have been modified to accommodate a failure-prone cutting bar. As there is no way for operators to know that the cutting bar has failed, continued operation of the system results in severe clogging and premature cell failure;

c. **Orifice Plates:** For the treatment plant to work correctly the flow through the system must be maintained at the design rate such that adequate contact time occurs in the cells and that sufficient retention time is provided in the quiet medium tank for the settling of suspended solids. At present, the flow rate through the system is controlled by a single orifice plate which is being

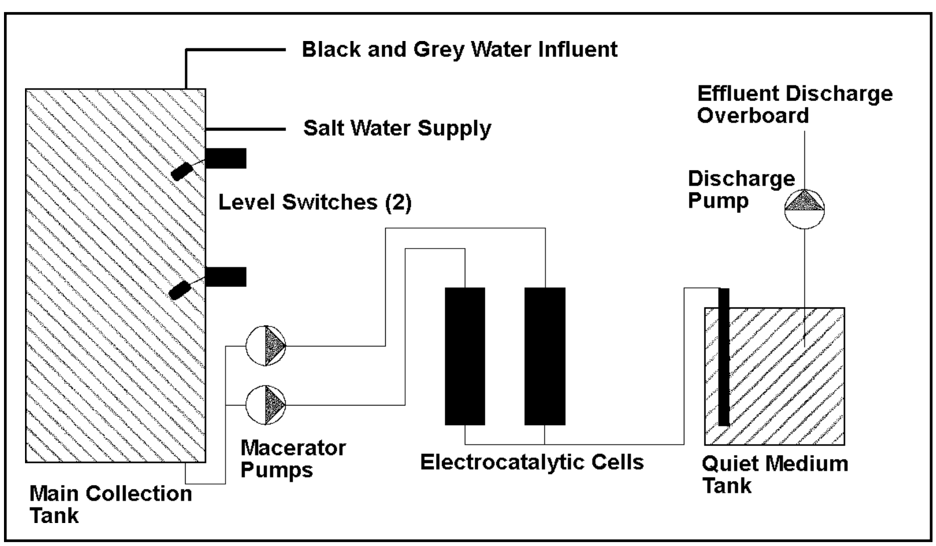


Figure 1: Sewage Treatment Plant Schematic

adversely affected by the varying sewage level in the main collection tank. When subjected to low flow rates, the cells experience heavy scale build-up, overheating and eventual failure. Abnormally high flow rates result in short contact time which manifests itself in a discharge that does not meet the effluent quality requirements.

The combined effect of these problems has required that considerable resources be directed toward keeping the systems operational. This, along with the nature of the waste stream being processed, has not done much to keep maintainers motivated. A thorough inspection of the systems in three vessels found them to be in varying states of disrepair, evidence that this condition has existed for quite some time.

The Omnipure® system

Equipment Upgrade

Following a number of meetings with the manufacturer's engineers and PMO CPF staff, approval was given to retrofit a single Omnipure® system with the manufacturer's newest components and conduct an EVAL. Although the principle of operation of the new system remained the same, the component upgrade had the potential to offer significant improvements in terms of reliability and maintainability.

Briefly, the key modifications made to the system were:

a. **Book-type cells.** The original "round-type" cells were replaced with the manufacturer's new "book-type" cells, as shown in *Fig. 2,* which are less prone to scale build-up and allow in-situ cleaning and repair. Except in extraordinary situations, the new cells can be completely rebuilt in-situ and should never need to be removed from the vessel. The previous design required that maintainers land the cells and have them immersed in an acid bath to remove the scale. On average, this labour-intensive procedure was required after as little as 400 hours of operation;

b. **Ruggedized macerator pumps.** Three new ruggedized macerator pumps were fitted to reliably reduce the particle size of the cell influent. By so doing, the likelihood of cell blockage was reduced, while increasing the disinfection efficiency of the system;

c. **Orifice plate modification.** An additional orifice plate was introduced to compensate for the changing static head in the black and greywater collection tank. Once calibrated, the new orifice plate combination helps ensure that optimum flow rates are maintained regardless of loading conditions;

d. **Tin dioxide-coated electrodes.** Available exclusively with "book-type" cells, tin dioxide coated electrodes are standard for all newly manufactured Omnipure® units. Although the manufacturer's test results show that the new coating offers an improvement in the cells' ability to reduce biochemical oxygen demand (BOD) and total suspended solid (TSS) levels, the main advantage will be evident in extending the life of the electrodes in the cells.

As a consequence of these changes, it was also possible to incorporate several other minor improvements which would enhance the reliability and maintainability of the system. These included an automated cell back-flushing capability and a saltwater flush feature designed to reduce the number of mechanical seal failures on the macerator and discharge pumps.

Confirmed Effluent Quality

As discussed previously, the EVAL's success was dependent upon the upgraded system's ability to meet the effluent quality requirements for which it was originally certified. So as to ensure the validity of the test results, a detailed sampling and testing protocol was developed based on U.S. Coast Guard and International Maritime Organization (IMO) requirements.

Forty effluent samples were taken by NETE personnel over a 10-day period and analyzed by an accredited laboratory. The ensuing results confirmed that modifications made to the treatment plants did not have an adverse effect on the system's ability to meet U.S. Coast Guard or IMO standards.

Improved Maintainability

The major selling point for the EVAL was the improvement the upgraded components would offer in terms of maintainability. To quantify this improvement, members of the ship's staff were asked to complete log books and write reports following each planned and corrective maintenance activity and to answer a brief survey. The bench mark for this portion of the EVAL was based on planned and corrective maintenance reports, and on the navy's maintenance information system (SMMIS) and discussions with personnel from the fleet maintenance facilities (FMFs).

Despite being in operation for only a relatively short time, the upgraded system demonstrated significant improvements in maintainability, offering a 20-hour reduction in the ship's monthly maintenance work load, and 36 hours in that of the FMFs. However, the most significant saving will occur when the FMFs are tasked to replace or acid clean the electrocatalytic cells. With the system's original configuration, this was an unpleasant and labour-intensive task which, on average, was required four times a year per ship. Except in extraordinary cases, the upgraded cells can be cleaned or completely rebuilt in situ at a saving of 108 hours per vessel — an annual saving of $311 thousand. It is likely that this figure is conservative as visual inspections of the cell electrodes found them to be more durable than those used in the original cells.

Improved Reliability

Although it had been hoped to use the reliability data contained in the failure modes and effects analysis (FMEA) as a bench mark, current data extracted from SMMIS, UCRs and OPDEFs raised considerable doubt as to the accuracy of this information. In an effort to preserve the validity of this analysis, failure rate data for the original system was based on current information rather than the system's FMEA.

At the conclusion of the EVAL, the system had accumulated in excess of 750 operating hours without failure. Unfortunately, the absence of failure rate data made it impossible to accurately define the extent by which the reliability of the upgraded system had increased. However, using the data which was available, the upgraded system's reliability was estimated to be an order of magnitude higher than that of the original system following six months of continuous operation.

The Way Ahead

The purpose of the EVAL was to confirm that the reliability and maintainability of the Omnipure® system could be enhanced by upgrading a number of its components. It was also necessary to prove that the modifications did not hamper the system's ability to meet the effluent quality requirements for which it was originally certified. All of these objectives were met and sufficient data was collected to deem the EVAL a success.

As a result of the EVAL, DGMEPM has authorized that the remaining *Halifax*-class vessels receive the upgrade. It is anticipated that this will occur prior to the end of this fiscal year.

Lt(N) A.W. Cook is the Project Manager for black and greywater collection and treatment systems in DMSS 4.

Book Review

The Canadian Naval Chronicle 1939-1945

Reviewed by Brian McCullough

"The Canadian Naval Chronicle 1939-1945," Fraser McKee and Robert Darlington, Vanwell Publishing Ltd., 1996, 272 pp., illustrated, tables, etc. (ISBN 1-55125-032-2, $39.95).

The Canadian Naval Chronicle sets out to record the story of "every ship lost and every success against enemy warships experienced by the Royal Canadian Navy in the Second World War." In so doing, the book's authors have succeeded in producing an attractive volume that will engage the interest of the general reader and naval historian alike.

The story of the dramatic and unexpected encounter between the frigate HMCS *New Glasgow* and *U 1003* on March 20, 1945 is typical of the book. The episode, which resulted in the RCN's last U-boat "kill" of the war, is told in a style familiar to anyone who has ever enjoyed a good yarn over a brew with his mates. The amusing circumstances surrounding *New Glasgow*'s being credited with the sinking ("by other means") and an odd footnote to the story combine to make for an enjoyable, informative read.

Similarly, the story of Canada's last naval loss of the war — the tragic sinking of the minesweeper HMCS *Esquimalt* in April 1945 — contains enough background material to effectively set the scene for the reader and bridge the time span of more than half a century.

Notably, *The Naval Chronicle* includes a full listing and brief histories of the 44 Canadian-owned and registered merchant vessels that were lost during the war. Naval history enthusiasts will appreciate some of the more unusual information contained in the book, such as the names of European ships taken over by Canada when their home countries were overrun, and a (complete?) list of Canadian fishing vessels sunk by enemy action. In the wealth of data, there is even a table summary of RCAF squadron successes against U-boats.

The information in the book is designed for "easy access," and includes specialized indexes of persons, ships and axis submarines, and an extensive bibliographical listing. *The Canadian Naval Chronicle* easily stands as a useful and entertaining reference to the stories of Canada's successes and losses during the war at sea.

As Cmdre Howard L. Quinn, DSC CD, RCN (Ret.) writes in the book's foreword, "The grey, rust-streaked, salt-encrusted ships from the hastily constructed navy are long gone. They live today only in fading photographs and in the memories of aging men...who cheerfully and bravely manned them across the storm-battered, war-torn North Atlantic."

And now their stories live on for all of us to share in the pages of *The Canadian Naval Chronicle 1939-1945*.

Brian McCullough is production editor of the Maritime Engineering Journal.

News Briefs

A "line in the sand"

Most *Journal* readers will recognize the name "Plimsoll" as having something to do with load marks on the side of commercial ships. The importance of this insignia is not apparent without a brief explanation of its origin.

Merchant shipping was the cornerstone of British commerce in the 1800s. Although the vessels themselves were privately owned, they were considered essential to the nation's growth and prosperity. Ship owners were typically wealthy, influential and politically well-connected, so that despite the fact that substantial numbers of vessels were lost at sea, Parliament was hesitant to interfere. Finally, in 1850, the public outcry over lost ships and crews resulted in the creation of a Marine Department of the Board of Trade. The mandate of this body was to enforce laws regarding the safe operation and manning of merchant vessels. For some twenty years the industry was monitored, but no effective regulation was imposed.

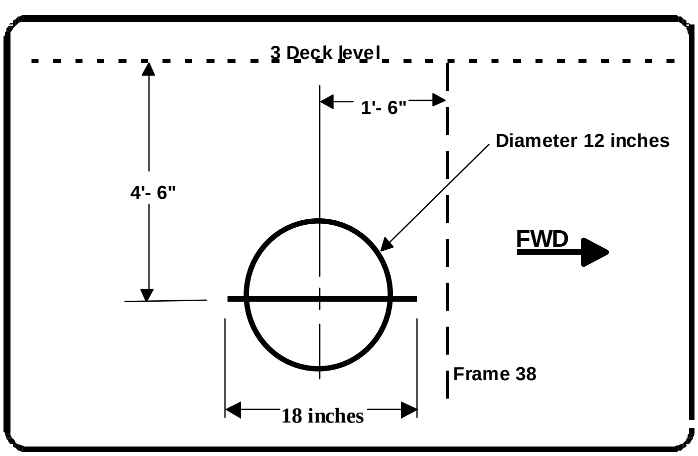
During this period of observation, it became clear that many ships were being lost due to overloading. To the owners, the volume of a ship's hold determined its capacity. No adjustment was made for sea state, local hazards or season.

In 1870, a member of the British parliament named Samuel Plimsoll raised the matter in the House. He referred to the "coffin ships" of the merchant fleet and proposed legislation to regulate the load a ship could carry. His suggestion was not welcomed by the lawmakers of the day and the bill was defeated in 1875. Were it not for widespread public awareness of the industry's greed and abuses of power, the bill would not have been resurrected and passed into British law in 1876.

Samuel Plimsoll's load line mark — an important addition to the weight-critical *Iroquois* class.

Equivalent load line legislation was put before the American Congress in 1920, but was not passed into law until 1929. In 1966 the International Maritime Organization adopted a load line standard and formalized the legal requirement for Plimsoll marks to be affixed to all seagoing vessels.

It is well known that *Iroquois*-class ships are weight-critical. As with most warships, the concern is with the ship's damaged stability capability. On completion of the Tribal-class Update and Modernization Program (TRUMP), the ships reentered service with no margin for weight growth. A process for monitoring the ship weight was subsequently initiated. Configuration changes that add weight to the ship are tracked and the ships' actual in-service drafts are collected throughout the year. As of the summer of 1998, the class mean displacement for these ships had grown 17 tons since the post-TRUMP inclining experiments. Of that growth, 11 tons is documented configuration change, while the remainder is undocumented growth (presumably due to locally implemented mission fits or habitability modifications).



From a practical sense, weight growth of this magnitude on a 5000-ton ship is of little import — it represents barely a centimetre of increased draft. The greater concern is that these ships routinely carry 20 to 80 tons of bilge water and have been observed to embark excess (predeployment) stores in the order of 100 tons. These loads are the sole purview of the ship's staff and can therefore only be controlled at that level.

MARCORD G-22 states that the overall responsibility for reporting and controlling changes to ship weight rests with the commanding officer. To assist in that duty, *Iroquois*-class ships are being fitted with load line marks. These will provide fixed, visual reference points against which to assess the ship's load.

The bottom edge of the horizontal load line marks the ship's limiting displacement. While the mark remains above the waterline, the ship retains her damaged stability capability. Conversely, with the load line submerged, the damaged stability capability is diminished and the ship will be at elevated risk of suffering interframe buckling of the hull structure. Thus, the ship's limiting displacement is clearly defined. **— LCdr G. Pettipas, DMSS 2-2-4.**

MARE Training Awards

Photos by Cpl. S. Gervais, CFB Halifax Photo

Mack Lynch Memorial Award

SLt Steve Whitehurst receives the 1997 Mack Lynch Memorial Award during an award ceremony held Aug. 26 on board HMCS *Preserver*. The award is presented annually to the officer who has achieved the highest scholastic average on completion of the MARE 44C Theory Course provided by DalTech (formerly TUNS), and who in the eyes of their peers demonstrated superior officer-like-qualities. The book *Orion, Mighty Warrior* forms the basis of this award and was presented by Ms. Jennifer Lynch, QC in memory of her father Captain Mack Lynch, RCN, a radar officer aboard HMS *Orion* during the Second World War.

CAE Award

SLt Helga Budden receives the 1997 CAE Award during the Aug. 26 ceremony on board HMCS *Preserver*. The award is presented to the candidate who displays the highest standing of engineering excellence, academics and officer-like qualities on the MARE 44B Applications Course. Mrs. Wendy Allerton, Marketing Manager/Marine Control Systems of CAE Inc., presents the award.

CANTASS Update

Further to our report in the June issue, installation of CANTASS Baseline 3 software has begun, with an expected completion date sometime next spring. A first-of-class trial will then be conducted to determine the capability of the system and establish a quantifiable performance benchmark for CANTASS. Users are encouraged to forward their suggestions for an upcoming BL 4 software release.

Results of a CANTASS dual-tow trial conducted at CFMETR in September are forthcoming, and will be discussed at the next Underwater Warfare Systems Effectiveness Group meetings. Also, shipboard trials of the High-Fidelity Tactical Acoustic Sensor Simulator (HITASS) have been conducted, and Sea Training staff are now using the system in the fleet. It is estimated that the CANTASS Array Receiver and Video Graphics Recorder replacement will receive approval to implement in January.

Factory acceptance testing conducted on the CANTASS Mission Simulator (CMS) in July included a week-long operator free-play session which brought out minor software bugs and highlighted the concerns that fleet operators have with the system. Operators from both coasts as well as CFNOS instructors attended the free play. The testing proved the system's functionality, but uncovered a few outstanding issues which are being addressed. The result should be a superb training tool for senior analysts.

In August, the CANTASS Mission Simulator hardware (excluding one student station) was installed in Bldg. S-17, CFNOS Halifax. The other system components will remain at Array Systems Computing Inc. for High-Density Digital Recorder interface development and site acceptance testing preparations. A proposed CMS transition plan was presented to CFNOS in late September, where issues such as acceptance testing, technical and operator training, security accreditation, and maintenance and warranty items were discussed. **— LCdr Sean Midwood, PM CANTASS, DMSS 7-8.**

MARI-TECH '98: Focus on Partnerships

The Canadian Institute of Marine Engineering (CIMarE) held its annual technical conference and exhibition in Ottawa last June, and the focus was on "Partnership in Support of the Fleet."

In his luncheon address to conference delegates, the Hon. Fred J. Mifflin, Minister of Veterans Affairs (and former Fisheries Minister) said that the elements of Canada's maritime forces must work together. Citing the amalgamation of the Department of Fisheries and Oceans and the Coast Guard as one success story, the

(Cont'd)

DQA's "Navy" Desk

Many MAREs are aware of the story of the infamous DMEE mahogany desk which has been part of our naval engineering folklore since it was reinstated nearly 20 years ago to its rightful place after a brief hiatus in the office of a certain Minister of National Defence (*Maritime Engineering Journal*, January 1993, p. 18).

But there is another mahogany "navy" desk, just as impressive, which resides on the seventh floor of the Canadian Building in Ottawa. Rumour has it that the desk was salvaged from the furniture in HMCS *Bonaventure* when she was decommissioned.

Until very recently, the senior naval officer (serving or retired) in the Directorate of Quality Assurance enjoyed the privilege of using the desk. Former users include Gerry Lunn, Paul Brisson, Hal Ledsham, Dave McCracken (who at one point had to chain the desk down to prevent it falling into the evil hands of the light blue tribe), Bob Jones and Mick Varen.

The desk is now earmarked for refurbishment, after which it will continue to enjoy many more years of service in the care and custody of the Director General Equipment Program Services. In the interest of documenting the history of this naval artifact, anyone having information about this desk (its origins and how it came to reside in DGQA) is asked to contact the undersigned through the offices of the editor of the *Maritime Engineering Journal*. It is important that we not lose track of this small piece of naval engineering tradition. **— LCdr Bob Jones, Directorate of Quality Assurance, Ottawa.**

(Cont'd from p.27)

retired admiral said the key to Canada's maritime preparedness and effectiveness is flexibility, integration and partnership.

"The opportunities for partnership are incredible," Mifflin said. "I truly believe that partnerships will have to be the way of the future for a maritime nation such as Canada."

The two-day technical conference and trade exhibit offered delegates a chance to meet with 40 exhibitors, and to attend a number of excellent paper presentations:

- *Flexible Diesel Engine Maintenance Options* (Caterpillar)
- *FMF 2000 — Beyond the New Horizon* (DND FMF *Cape Scott*)
- *MAREX OS, New Technology for Control of Propulsion Plants* (Basic Technologies)
- *Trends in Electric Propulsion* (GEC Alsthom Canada Ltd.)
- *A Floating Nuclear Cogeneration System — An International Partnership Opportunity for Canada* (Candesal Enterprises Inc.)
- *Cost Effective Maintenance Management Today* (GasTOPS Ltd.)

The Canadian Institute of Marine Engineering exists for the benefit of people employed in, or associated with, the marine engineering field and material support community. The Institute has eight branches across Canada, where members can meet and discuss matters concerning the marine community.

For more information, contact the CIMarE at:

http://www.cimare.org

Update: Canadian Alumni Association USNPGS Monterey

Response to our notice in the June issue of the *Journal* has been good. Please note, however, the new telephone number for Maj. Ian Glenn. The Canadian chapter of the alumni association of the U.S. Navy Postgraduate School at Monterey, CA continues to encourage all serving and retired Canadian grads to contact the association at:

LCdr Sean Midwood
DMSS 7-8/PM CANTASS
(819) 994-8532 / fax (819) 997-0494
(smidwood@dmcs.dnd.ca)

or:

Maj. Ian Glenn
DLCSPM (819) 996-7913
(inglenn@ibm.net)

All graduates are also requested to register at the NPS web site:

http://www.nps.navy.mil/~alumni/

National Defence / Défense nationale

OCTOBER 1998

News

CANADIAN NAVAL TECHNICAL HISTORY ASSOCIATION

Inside this issue:

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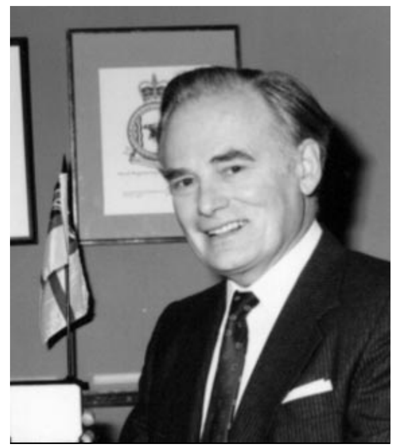
In this life…

In mid-August many of us were saddened to learn of the death of long-time colleague, Don Nicholson. Beginning in the early post-war era, Don was involved in the specification and design of the propulsion systems for all Canadian warships. He was "Mr. Propulsion" to a great many of us.



Don Nicholson

As my boss for three years in the early '70s he taught me a great deal, including weighing the value of every word. If it isn't necessary or if it doesn't have value, take it out. It was a lesson that I was to pass on to many others (often to their chagrin).

Over the past few years Don had been busy putting together an authoritative history of propulsion systems in the Canadian navy. Unfortunately, he fell ill before he could complete his work. With the kind permission of his family we are hoping to pick up where he left off and complete his work.

Perhaps in his death, Don leaves us with one final lesson — in this life we are given only so much time to do our work. If you have been thinking of helping us out, why not start right now. Don, rest in peace.

Mike Saker

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 casual readers alike. So how can you get to read some of it? For the moment there is only one copy of the Collection, situated at the Directorate of History and Heritage located at 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 is on hand to retrieve the information you request and to help in any way. Photocopy facilities are available on a self-serve basis. Access to the building requires a visitor's pass, easily obtained from the commissionaire at the front door. Copies of the index to the Collection may be obtained by writing to DHH.

HMCS *Labrador*: Starboard Motor Room Flooding

Recounted by Cdr D.C. Waring, RCN (Ret.), Victoria, B.C.

Editor's Note

The Canadian icebreaker HMCS *Labrador* was built in the early 1950s in recognition of the growing strategic importance of Canada's Arctic region, and with a view to asserting sovereignty there. Commissioned on July 8, 1954 at Sorel, *Labrador* sailed that summer, without any work-ups, on the first of four voyages she would make to the Arctic as a naval vessel. On that initial voyage to conduct scientific investigations and carry out resupply missions, she became the first warship to negotiate the Northwest Passage and, by returning to Halifax via the Panama Canal, the first to circumnavigate North America.

Labrador had a diesel-electric propulsion system in which the shafts were driven by electric motors supplied, in turn, by diesel generators. She was the only ship in the RCN where personnel of the electrical branch had an operator's role in the traditional domain of the marine engineer. The author of the (condensed and edited) tale that follows is retired RCN Cdr D.C. Waring, who served 18 months as *Labrador*'s first electrical officer. The incident he describes occurred at the ship's last port of call prior to returning to Halifax on her history-making maiden voyage around North America in 1954.

Leaving the Panama Canal about mid-November 1954, *Labrador* sailed across the Caribbean to the island of Grenada and anchored off the port of St. George's. On anchoring, the ship service distribution was set with the forward and after switchboards joined by the bus tie, with a single generator in no.1 generator room supplying power. Early the next morning we awoke to absolute stillness — a situation most sailors find can act as a perfect alarm clock after a period at sea amidst the ever-present noise in a ship. Power was out. Lights and fans were off. I quickly made way to no.1 generator room to learn what was happening. My immediate reaction was that the diesel had lost its fuel source, until I learned that an overload had occurred and the unit had shut down.

By restarting the diesel and closing the generator circuit breaker, normal habitability seemed to be restored. Lights came on and fans began circulating air about the ship, but we still hadn't solved what had really happened. Personnel making rounds of the compartments discovered flooding in the lower level of the starboard motor-room. The local power distribution panel sited on the forward bulkhead of the compartment was partly immersed. As the space was still in darkness with the circuit breaker tripped on the after switchboard, we brought in emergency supply for lighting and emergency pumps. The source of the seawater flooding was found to be a broken plug in one of the booster pump lines. This was sealed off and pumping of the compartment began.

The glass inspection ports were removed from the main motor above the watchkeepers' platform. With the top row of brushes removed it was possible for a thin person to pass beyond the brush holder bar, down around the commutator, and sight the level of flooding within the motor frame. Because the motor angled downward aft, the bottom main pole and adjacent interpoles were well immersed. The armature back end also appeared to get some water.

Once the salt water was removed from the compartment, the interior flooded areas of the motor were washed down with fresh water to remove as much salt contamination as possible. Insulation readings read zero. The service power panel sited on the forward bulkhead of the motor-room lower level had also been flooded, and a portion of the interior bus from which the circuit breakers for auxiliaries and lighting drew power was melted and misshapen due to the surge of power on short circuit. Now that it was possible to make some judgment as to what had happened, departmental officers conferred with the captain who then directed that the ship proceed as quickly as possible to Halifax using the port motor only, allowing the starboard shaft and propeller to trail.

Temporary repairs at the distribution panel made it possible for all necessary services to draw supply. The main motor brush gear was replaced, the motor bearing lubricating pump was activated, and after we had been under way awhile, external heated air was piped into the motor for most of the journey back to Halifax. Continuous watch was maintained.

Safely back in Halifax, the overriding consideration was to ensure the ship had completely reliable propulsion plants for proceeding into Arctic waters in the future. The starboard motor was repaired by removing the lower main pole and adjacent interpoles aft through the freshwater tank and up through various compartments with minor disruption. Canadian Westinghouse (Moncton) carried out the necessary detachment and reconnection of the field-winding interconnections, while dockyard Halifax riggers skillfully removed and replaced the long, heavy poles by working in the gap between the poles and the armature.

Prior to undertaking the DEW Line resupply role in Foxe Basin in 1955, *Labrador* proceeded to the measured mile course off the coast of Maine for propulsion and speed trials. The starboard motor performed beautifully.

[Further Reading: *The Ice Was All Between*, T.A. Irvine, Longmans, Green and Company, Toronto 1959.]

HMCS *Labrador*

Canadian VDS in the RN

Everyone knows that the RCN was the first of the Western navies to get a production VDS to sea — or was it? It seems that the Royal Navy adopted it more rapidly than the RCN. After comparative trials of the Canadian CAST-1X VDS and the RN's own Type 194 VDS in August 1958, the Board of Admiralty decided in February 1959 to abandon its own set. It decided to fit Canadian equipment in eight of its new general-purpose (*Leander*-class) frigates.

The Canadian decision to fit VDS in the *St. Laurent* DDH conversions was delayed while the details of conversion were worked out. So HMS *Leander* commissioned in March 1963 with Canadian-built VDS, renamed Sonar Type 199. The first Canadian ship to get production AN/SQS-504 equipment was HMCS *Assiniboine*, commissioned after conversion to a DDH three months later. (Of course, a preproduction 504 had been fitted in HMCS *Crescent* in 1960.)

Canadian VDS also found its way (as Type 199) to Australia and India. The sonar was retired from service in the RN in the mid-1980s. — ***Hal Smith***

The Collection

Our Collection now stands at 346 Items.

Our latest offering is a group of seven documents, largely letters, written between 1952 and 1969 donated by Lieutenant Thomas A. Parkinsin, a retired engineer officer. These items cover various topics generally related to John Inglis Co., in the building of engines for the DDE 205/257/261-class vessels. In particular, a copy of the contract through which the Queen purchased land, plant and equipment from John Inglis in 1952 is included.

According to Lieutenant Parkinsin, these were the only remaining documents from the naval overseer, Toronto area office. At the time the office was closed there were 24 filing cabinets full of contracts and supporting documentation.

If anyone else can produce any musty papers please do so and receive our gratitude! Contributions from a single paragraph to a book can be sent to me directly:

by mail: 673 Farmington Ave., Ottawa, Ont., K1V 7H4
by fax: (613) 738-3894
by E-mail as436@freenet.carleton .ca

Phil Munro

Information Exchange Groups

Readers with e-mail access may find two information exchange groups (IEG) of some interest. The Marine History IEG, operated by the Marine Museum of the Great Lakes, Kingston, Ontario, has about 480 subscribers all over the world, and covers every aspect of marine history. The standard of contribution is usually high. It is very active and you have to sift through the 50 or so postings a day to extract whatever is of interest. There is a reasonable amount of Canadian content. A specific question sent to the list will usually elicit good information, often from unexpected sources. To subscribe, send an e-mail to listserv@post.queensu.ca (without subject line or signature) and text 'SUBSCRIBE MARHST-L' (without the quotes).

The RCN History IEG is a new list with a specific emphasis on Canadian naval history, moderated by Dave Shirlaw of Vancouver. It currently has around 50 subscribers. Since it is new, its standards are yet to be established. To subscribe, send an empty message (no subject, no signature, no text) to rcn-history-subscribe@makelist.com.

IEGs can be a great time-waster if you let them become so. The 'delete' key is your best friend. The best way of using them is to ask a fairly specific question about something that interests you and then see what happens. — ***Hal Smith***

Letters

(To Jim Dean)

I admire you for taking on this history project, and wish I could help more. Regarding submarines, I did serve in *Grilse* from 1963 to 1965. The first engineer was Rusty MacKay, who lives in Victoria. Julie Ferguson (the wife of James Ferguson, who works for Jim McFarlane at International Submarine Engineering in Vancouver) wrote a book on Canadian submarines [*Through A Canadian Periscope*, Dundurn Press, 1995], and I turned all of my *Grilse* papers over to her. I suggest you contact Bill Sargent in Victoria as he ran the first-ever submarine refit — *Grilse* in 1963/64. It was a major accomplishment, and introduced us to high-level welding for submarine pressure hulls. We worked closely with the Americans on this and did an outstanding job.

Regarding the O-boats, I was the engineer of *Onondaga* and stood by her in Chatham. The overseeing crew included Al Kastner, Phil Muir, Bob Mitchell (supply) and Jim McFarlane (naval architect). The team was led by Cdr Ewen Galbraith (deceased). Again, Julie Ferguson's book gives a great deal of information on this subject. I could tell you a few stories when we meet, and Jim McFarlane would be able to give you fascinating tales about the Canadian design changes to the second and third O-boats, particularly the introduction of a cafeteria, something the Brits found outrageous! When I went to the drawing office to get the weights and their distribution for the first trim dive I was handed a huge sheet, written in pencil, with everything in long tons, hundredweights and stones! Chatham Dockyard is now a museum — a reminder of my age.

Keep in touch. — **Ed Murray**

[*Note: We understand that Bill Sargent is now in Windsor, Nova Scotia. — Ed.*]

VAdm Lane-Poole's Maxims for Naval R&D

Sir Charles Goodeve, the man who masterminded the first ahead-throwing anti-submarine weapon (Hedgehog),was born and brought up in Canada, settled in England in 1928, transferred from the RCNVR, and began an unsuccessful campaign to have the Admiralty recruit other scientists and engineers for the RNVR. Deeply involved in degaussing efforts until May 1940, he got himself transferred (his ability to bypass authority became legendary and originated the term "to do a Goodeve") to what would become the unorthodox and highly successful Directorate of Miscellaneous Weapons.

Among his papers is an account by VAdm Lane-Poole, Superintendent of Demagnetization (SDG), of degaussing efforts during the Second World War. It includes the following five rules for scientific development in the navy, very much in accord with Goodeve's own methods and likely equally pertinent today.

Dr. Alec Douglas

In December 1939 SDG was in Portsmouth at HMS *Vernon*, with the Superintendent of Mine Development (SMD). Since speed was of the essence, he moved to the Admiralty to be near the Naval Staff, leaving the range section at Portsmouth for liaison with *Vernon* and SMD.

Maxim No.1. If your business has considerable operational aspect, direction must be in contact with naval staff.

In May 1940, because *Vernon* and SMD could not or would not co-operate, SDG got the navy to lease Butlin's Fun Fair to accommodate a combined *Vernon* (experimental establishment portion) and SMD.

Maxim No.2. Research and experimental work to build up naval design (such as this) must be carried out by a team of sailors and highbrows working together, direction coming from the former.

In September 1940 the combined *Vernon* and SMD degaussing establishment migrated to Helensburgh, on the Clyde, in time to avoid the bombs which demolished their fun fair.

Maxim No.3. Avoid target areas when choosing a site for an experimental establishment.

In October 1940 there were more delays because direction was under a separate roof (The Admiralty) from development and application (Bath).

Maxim No.4. If delay is not to occur in getting the stuff on the drawing board, the man responsible for actual design must have all the necessary data at the shortest possible notice. Consequently those in possession of this data must be easily accessible.

In September 1941 the geographical triangle (The Admiralty, Bath and *Vernon*), and the lack of accountability of scientists and technicians to SDG began to hinder progress. On Nov. 25, 1942, SDG won approval to eliminate SMD and assume responsibility for direction of experiment, research, application and design of degaussing.

"The superabundant high brow staff was dispersed and the practical residue brought down to Bath and housed under the same roof as the Naval Officers responsible to me for the direction of design. Since then all R&D [is] under immediate direction of my deputy at Bath in close proximity to DEM, DMC, Director of Dockyards, etc. DELAYS HAVE NOW CEASED."

Maxim No.5. In any organisation the appropriate man to direct development is the man responsible for its administration.

We'd love to hear from you…

If you have information, documents or questions you'd like to pass along to the Canadian Naval Technical History Association, please contact the Directorate of History and Heritage, NDHQ, MGen George R. Pearkes Bldg., Ottawa, Canada K1A 0K2 Tel.: (613) 998-7045/Fax: (613) 990-8579