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Maritime Engineering Journal

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Looking Back: Canadian Technical Involvement in the Design and Construction of HMCS *Bonaventure*

Also:

- ***MARE Historical Perspective***
- ***Guest Editorial: In Defence of the Canadian Court-martial System***

Canada

CDS Commendation —

(Photo by Cpl Frank Hudec, CFSU(Photo), Ottawa)

See "News Briefs"

Maritime Engineering Journal

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DEPARTMENTS

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LOOKING BACK

OUR COVER
HMCS *Bonaventure* in her heyday. (*Canadian Forces Photo*)

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Guest Editorial

In Defence of the Canadian Court-martial System

Article by Captain(N) D.V. Jacobson

In Canada at the moment, we live in a world in which some commentators — and, I sadly observe, embittered ex-servicemen — seem so anxious to declare evidence of a senior-officer-led conspiracy that their efforts and ill-informed commentary would be almost comical were it not for the damage they do to the reputation of the CF and to you and me as individuals.

At times like this I'm reminded of the vitally insightful observation of the 18th-century British statesman Edmund Burke who wrote, "The only thing necessary for the triumph of evil is for good men to do nothing." While that may be a bit strong for the circumstances, it nonetheless does have relevance in today's situation.

The Canadian system of courts-martial is under attack, and will likely remain so for some time. Properly researched critiques are something we need all welcome, but I have seen little evidence of this.

Because of my personal involvement in the Somalia courts-martial, I have thus far refrained from speaking out against the ill-informed commentary and the just plain wrong innuendo of corruption and conspiracy in our military justice system. The danger of course is that if those of us who have been involved don't come to the fore and at least use this type of internal forum to share our understanding and views, we leave those of you who haven't been tasked or otherwise exposed to our court-martial system to "spin in the wind" of the media criticism.

My purpose, then, in this long-winded "guest editorial" (bear with me) is to share some of what I have learned about the military justice system. A word of caution: I lay no claim to being either a legal historian or a legal expert, so take what I have to say here in the context of a legal lecture from a naval officer and engineer.

It *is* Different

A common thread in the criticism aimed at the court-martial system is that it is different from the civil system familiar to most Canadians. Given the popularly well-known checks and balances designed to ensure fairness in our civil system of trial by jury, the inferred "charge" is that the court-martial system must be therefore inferior and fundamentally unfair.

It is perhaps stating the obvious, but the Canadian civil trial by jury and court-martial systems are only two of many justice systems in existence around the world. Even restricting our sampling to our historical neighbourhood, we can see substantive differences in the make-up and processes of the various justice systems of Canada, Great Britain, the United States, France and Germany. Within Canada alone we could list several "subsystems," from magistrate to appeal courts, from small-claims and traffic courts to courts-martial and trials by jury. We might even include the emerging aboriginal justice system in such a list. Like any collection of systems, whether marine or legal, each of these national legal systems and Canadian legal "subsystems" has its features, advantages and disadvantages. Perhaps naval engineers better than most know that systems are nothing more and nothing less than an "optimum collection of compromises striving for the ideal." Legal systems are no different.

A Matter of History...and Need

Differences between the national systems owe as much, and perhaps more, to their peculiar evolutionary paths as to any fundamental difference of legal principle. Within Canada, the various court and legal systems have evolved from their colonial origins either to better serve the need for justice in certain situations — and the need for economy — or to meet a particular historical or cultural need (as in the case of Quebec's Napoleonic system of civil law).

The court-martial system evolved long ago to fill two compelling, competing requirements — the operational need for rapid resolution of major disciplinary infractions (to preserve the morale, discipline and moral integrity of the service), and the social need for justice to be done and to be seen to be done. The parallel evolution of the court-martial system recognized a further requirement: that the context of the military and of armed conflict is sufficiently different from the context of civilian life and peace that justice will not be served unless the infraction is judged by military personnel who are themselves familiar with the military context (including that of duty and discipline) and can quickly become familiar with the particular operational circumstances of the case.

Like any system, the military justice system continues to evolve in the many countries in which the need for a separate system is recognized. As you are probably aware, Canada has already made several changes as a result of the introduction of the Canadian Charter of Rights and Freedoms. Our experience with the Charter has been referred to extensively here in the United Kingdom as the British armed forces make a number of changes as a result of rulings made by the European Court of Justice.

Dear Capt(N) Embree — *As requested, I have reviewed Capt(N) Jacobson's proposed commentary. I must say immediately that it is an excellent piece of work. Your readers should find it interesting — in particular, I echo Capt(N) Jacobson's advice to "Go!" when called for court-martial duty. Beyond this, the piece is illuminating and useful for the legal participants in the court-martial system in that it provides an all-too-rare look at the system from an educated outside point of view. In that regard, would you consider asking Capt(N) Jacobson whether he would submit it to the JAG Newsletter? I believe it would be very welcome indeed. Thank you for giving me the chance to read the article.* — Capt(N) C.F. Blair, DJAG/Mat, NDHQ Ottawa

Military systems are not alone in their requirement for ongoing change. The civilian systems of justice also continue to evolve in equal recognition that no system of compromises can remain optimal as the factors which govern their balance continue to evolve. Countries outside North America, for example, are departing from what they see as the overly rigid requirement for juries to reach a unanimous verdict. (The U.K. and New Zealand, for instance, require only 10 of the 12 jurors to agree; Brazil has gone even further and requires a simple majority of seven of the 12 to agree.) Specialized courts such as the relatively recent small claims courts have also emerged in recognizing that justice has not always been done within the existing system.

Much the Same

The common roots and continuing interplay between our military and civil systems are apparent in the many similarities of process, safeguards and balance. To cite aspects common to a court-martial and a trial by jury which are evident to even my unpractised eye:

- both are conducted in public to ensure that justice is not only done, but seen to be done;
- publication bans can be applied where warranted in the public interest. (Bans are rare in practice. The case of Private Brown made Canadian legal history with the imposition of a partial publication ban when the pictures of the beaten Somali youth and his tormentors were barred from publication.);
- rules of evidence: what constitutes permissible evidence and how evidence must be handled;
- the burden of proof is the prosecutor's: i.e., the accused is innocent until proven guilty;
- the degree of proof required: beyond all reasonable doubt. (The prosecutor must establish proof beyond a reasonable doubt; the defence task is to raise every argument and/or piece of evidence which might, at the end of the day, establish that the prosecution has failed to discharge its burden of proof.);
- jurisprudence: legal precedent, established in higher court rulings, applies to all aspects of the trial — presentation and admissibility of evidence, judgments and sentencing. (A court may only differ from precedent if it considers that the underlying circumstances in the instant case are different; a court's departure from precedent — or interpretation of precedent in the situation at hand — is of course subject to appeal.)

Evidence as Presented

For those of us who are more familiar with the magistrate-like summary trial, it may be most significant to note that the court-martial system shares the fundamental feature of judgment based on the independent presentation of evidence by the counsels for the prosecution and defence. While it may be obvious to most, this aspect was the one that I found most illuminating to hoist in: it is not on the *evidence* of the case — whether by court-martial or civilian trial by jury — but on the *evidence as presented* that the court or jury makes its judgment.

It is the responsibility and prerogative of the prosecutor and defence counsel to decide what and how to present the details of their respective cases. It is the court's task to make it's judgment on what is presented, and it is the independence and interplay of all the players — prosecution, defence, court members and judge advocate or judge and jury — that makes it work. (The corollary to this "lesson learned" on my part is that I now understand that I cannot pretend to fully understand — or discount — the outcome of a trial unless I am there to hear, or have access to an accurate account of the nuances of testimony and the explanations of the finer points of law that are heard by those whose difficult task it is to judge the evidence.)

They Stand Alone

Military and civilian trials share another feature: they stand alone. A series of trials is connected only by the series of charges which are laid with respect to an incident. Although precedent only applies technically in respect of previous rulings and judgments from higher courts, specific points of evidence laboriously established at one trial may be accepted by the defence or prosecution at subsequent trials (to achieve some economy of time and effort where the evidence is not contested by either counsel).

But each trial is a stand-alone trial with, in the military case, a different and unconnected court membership. Despite the many suggestions of conspiracy to the contrary, there can be no more collusion from one court to the next than within the framework of any court system — provincial or federal — in Canada.

We can, I'm sure, all think of trials where we are led to think that there ought to have been more of a connection between trials, or fewer inhibiting safeguards standing in the way of what we were quite sure was the right outcome. At times like those, I am reminded of another wise observation, this one attributed to Winston Churchill. "Democracy," he concluded, "is the worst system devised by the wit of man, except for all the others." He could have been speaking of our legal system.

Bottom Line: Supreme Court

Perhaps most importantly, the bottom line is also the same for both the military and civilian systems: the Supreme Court of Canada. All of Canada's legal systems, including the military system, are subordinate to the Supreme Court. Just as civil courts are subordinate to the applicable Provincial Supreme Court and then the

Supreme Court of Canada, so are service tribunals subordinate, first to the Court-martial Appeal Court (composed of federal and provincial superior court judges to ensure independence) and then to the Supreme Court of Canada.

When you next hear of allegations of conspiracy, check to see if the case has been independently reviewed. In the case of Private Brown, for example, the appeal went forward to the Court-martial Appeal Court, where the judgments of law and the findings and ruling of the Court were all upheld. Check also to see which counsel is doing the majority of the appealing. You might be surprised to find that it is often the prosecution, a strange situation indeed if the media accusations of "whitewash and conspiracy" had any real foundation!

What is Different?

The major difference between a court-martial system and the more familiar trial by jury system lies in the structure of the military court and the role of the judge advocate. To a degree, the five members of the court are a combination of judge and jury, but with some important limits being prescribed. In this regard, a military court holds parallels to the magistrate's court, where the magistrate is both judge and jury.

Unlike a magistrate's court, however, the court-martial members do not have an extensive legal background and so safeguard their independence in judging the evidence put before them by not hearing arguments relating to points of law and admissibility of evidence. It is the role of the judge advocate to rule on such points and to ensure that due legal process is followed in the conduct of the trial. The independence of the court members and the judge advocate is further safeguarded by limiting communication between the judge advocate and the court to occasions when counsels for the prosecution and defence can be present.

Sentencing, too, is different. In the trial by jury system, the jury must find the accused guilty or not guilty, and the judge makes the finding with respect to sentence. In the court-martial system, the court members make both the finding of guilty or not guilty and pronounce the sentence. In the first instance the outcome is based on a majority vote of the members of the court, voting in reverse rank order to minimize rank influence; in the second, a consensus must be reached as to the sentence. In practice, I find it hard to imagine a court not striving for consensus on both.

Two trials then take place in effect. The first hears the evidence required to make a determination of guilt. If guilty, the second hears arguments (and precedents) for the finding of a recommended sentence. The deliberations of the court with respect to guilt and to sentencing are deliberately kept separate.

Two Advantages

There are, in addition, two small but helpful ways in which the court-martial system differs from the familiar trial by jury system, in both cases conferring — I believe — a distinct advantage in the pursuit of justice. The first of these permits court members to take and refer to notes, both with respect to witness testimony and any instruction from the judge advocate. Being a frequent note taker, I shudder to think of the confusion and uncertainty that can reign in the minds of jurors in trials where there are many strands of evidence to follow and points of law to consider. Although the generally voluminous court transcripts are later available for reference by juries, personal notes allow court members to directly and succinctly record their impressions as well as what they judge to be the key facts of the case.

The second difference is that military court members are free to ask questions of the witnesses to clarify their answers to counsel. Court members are not permitted to open up a new line of questioning, but they may ask questions if they need to clarify their understanding of a witness's replies. As a precaution, counsels are poised to object if necessary, and the judge advocate will make the ruling, hearing arguments from both the prosecution and defence. This trial within a trial is carried out in the presence of the public but in the absence of the court members.

Remembering that counsels for the defence and prosecution are generally intimately familiar with the vast majority of evidence to be presented (barring surprise testimony), and being human, they might not always pick up on the incompleteness of a reply from the perspective of the court. Again I shudder to think of the pieces of evidence left trailing in imprecision — or of the potentially dangerous leaps of logic that otherwise may have to be made by a civil jury in the absence of clarification.

Supreme Court Review

With its ultimate responsibility for both the civil and military justice systems, the Supreme Court of Canada has twice formally considered the ongoing relevance and appropriateness of the court-martial system, most recently in 1992. In each case, citing the need for swift resolution of disciplinary infractions in a military context, the Supreme Court has upheld the requirement for a distinct military court-martial system.

A Word of Caution

After presiding over the longest and most public court-martial in Canadian history — let me make this clear: taking part in a trial is *not* a claim to fame; it's a duty, pure and simple — I can give you my personal view, without question in my mind, that our military court-martial system is indeed a *just* system.

I do have one caveat, however. As the Supreme Court observed, the overriding need for a military justice system is not just to resolve issues affecting military discipline fairly, but quickly as well. It is in this area of rapidity and not in any ill-informed or ill-prepared outside criticism that I see the greatest risk to the continuing separate existence of our military justice system. While recognizing that a compromise is needed between swiftness and resources dictated by the complexity of the case, I fear that the balance has leaned too far toward economy of resources and away from swiftness of application. If by our corporate action our military demonstrates that time has ceased to be a factor, then a large part of the rationale for a separate military justice system will cease to exist.

It is not a change I would recommend. Discipline is essential to an armed force, but as any leader knows (including parents as leaders) disciplinary action that is drawn out can have an enduring, damaging effect on the spirit of all those affected. It behooves the Canadian Forces to ensure that the military police, investigative and legal resources are sufficient to ensure that justice is not only done and seen to be done, but that it is swiftly done.

Finally, a word of caution with respect to media and other commentary. I have generally found that journalists and newspaper/magazine commentators can be roughly divided into three groups. There are those who are assiduous in their coverage and give a balanced and fair account of what are often complex proceedings. There are those who drop in to a story from time to time — as other story priorities permit — and who can generally therefore only deal with the surface of an issue. And, finally, there are those who are not "journalists" in my understanding of the word (that is, they do not maintain a detailed "journal" of the event, analysing and writing about the event), but whose job it is to provide commentary and opinion, some of which is thoughtful and considered, and some of which is sadly bereft of fact. To a degree, these commentators give some credence to the adage that the stronger the opinion, the less well informed is the individual. Beware the distinction. (And be tolerant: it is a free country!)

Go!

There is obviously much more that can be written about the military court-martial system. In an atmosphere where some are convinced that corruption and conspiracy lie underneath every bilge plate, my intent here has been to set the record straight and share a "simple sailor's" appreciation of our court-martial system.

If you are called on to serve on a court-martial, I have only one word of advice: *Go!* Maritime Engineers bring both an operational perspective and a (usually) logical mind to bear. If you value a navy and a Canadian Forces that hold truth, integrity, discipline and justice to be vitally important, then you will welcome the opportunity to serve in this capacity.

Captain(N) Jacobson is the Naval Adviser with the Canadian Defence Liaison Staff in London, England. A Combat Systems Engineer and former technical editor of this journal, he was manager of the TRUMP project from 1992 to 1995. In February 1994 Capt(N) Jacobson was tasked to preside as President of the Court for the six-week court-martial of Pte. Kyle Brown.

[Editor's Note: On Dec. 31, while this article was being prepared for publication, the minister of national defence announced a sweeping three-month review of the Canadian Forces, including a review of the military justice system and the military investigation system.]

Editor's Notes

Moderation and balance — the answer to many an ethical dilemma

By Captain(N) Sherm Embree, CD, P.Eng., CIMarE
Director of Maritime Management and Support

We have been fortunate in that, for nearly 15 years now, the *Maritime Engineering Journal* has been able to provide the naval engineering community with an open forum for historical, current and future-looking perspectives on our profession and on topical issues of interest. Some of the views have certainly been more pointed than others: recall the many thought-provoking articles written by Cdr Roger Cyr over the years, or MARS Cdr Dave Kyle's "no holds barred" piece on the CO/MSEO/CSEO relationship, Lt(N) Chantal Pitre's spirited defence of the A/HOD position as a working billet, and LCdr Bruce Grychowski's call for standards in shipboard CS damage control.

More recently, BGen Curleigh's article, "Wisdom and Morality in the Age of Information" (*MEJ* October 1996) was a most inspiring commentary that received many praiseworthy comments, especially as it appeared in conjunction with CPO1 Steeb's Forum article, "Truth Versus Loyalty." And if you have just read Capt(N) Jacobson's endorsement of the Canadian court-martial system, you will see that our contributors continue to use the *Journal* to promote professionalism and understanding at all levels, both within and outside of the naval engineering community.

And that's what it's all about, really. Each of these particular articles tackles a problem or question that may have been in the minds of many of us, but what really sets them apart is that the authors decided to take a public stand. By allowing their convictions to be examined critically by their peers, they are doing their bit to make the navy a better organization. It's a matter of ethics.

Playing true to a strong code of ethics has perhaps never been more in demand in Canada's peacetime military than it is right now. As we look for answers to questions both great and small — Will the Somalia Inquiry answer the many broad questions on leadership raised during its hearings? At what point does realistic training become personal abuse? Are we dealing with our technical investigations thoroughly and openly enough? — we attempt to discover if the values and ethics of our senior leaders are the same as our own.

The Defence Management Committee (DMC), along with various of its support organizations, has been grappling with this idea of establishing a common sense of purpose throughout the Department of National Defence. In the December 1996 issue of *Defence 2000 News* the DMC presented its views on the concept of the "defence team," along with definitive statements regarding DND's mission, vision and shared values.

But how does this help us as leaders and provide a common focus across the breadth of DND's financial, personnel and operational functions? Are such generalized and fundamental statements understood and accepted — or do we need to be reminded of our role and values by writing them out? On their own, are statements enough to reinforce the quality and ethical fibre of our leadership?

When it comes right down to it, the answer to many of our ethical dilemmas can be found in the sense of moderation and balance we bring to everything we do. Mostly it is a personal thing, based on our individual development within, and our relationship with, Canadian society. And yet, do we tend to hide ourselves in a separate military society and undervalue that which most Canadians value highly? Some of our individual TIES contracts are in the multi-million-dollar range, many times the cost of some of the basic necessities of a compassionate and functional society. Is our value system within DND the same as that of Canadian society in general? Do we have a reasonable sense of balance when we, as individuals, make expenditure requests or authorizations on behalf of the government?

We may not have all the answers, but we shouldn't be afraid of examining the issues and making a stand for what we think is right. If you have questions without answers, or if senior officers are not addressing the topics that are of real interest to you, let your supervisors and seniors know about it. Consider also carrying the debate to the pages of the *Maritime Engineering Journal*. After all, your branch journal exists to serve you as a gateway through which you can present your views and concerns to a wide audience of colleagues, peers and senior personnel.

Commodore's Corner

The MARE Council

By Commodore F.W. Gibson, OMM, CD
Director General Maritime Equipment Program Management

Preparations are being made at the time of writing for the first meeting of the MARE Council in 1997. While reviewing the proposed agenda, I could not help but wonder if the Council's purpose is understood by the naval engineering community. Most MARE officers and naval technicians have heard of the Council, but do they realize the extent to which they are affected by the Council's deliberations? Is there a clear perception of what the Council is and why it is required? I fear that the answer to these questions in many cases is no. The last comprehensive article in the *Journal* concerning the MARE Council appeared in 1987. Therefore, I would like to take this opportunity to provide some insight into the Council's composition, purpose and activities, and to stress the importance of your input to the deliberations of its members.

The MARE Council is in place to advise both DGMEPM (as the nominal senior MARE officer) and the MARE branch adviser on issues, priorities and actions affecting the MARE officer and naval technician occupations. It comprises the navy's senior engineering officers at the rank of commodore and captain(N) and meets at least once a year. Subject matter experts are invited to brief the Council as required, while open discussion periods are interspersed throughout the meeting to ensure adequate time for round-table consideration of agenda items and any other issues that might be raised by Council members.

Up until last year the senior MARE officer and branch adviser were one and the same, but at the direction of ADM(Per) the position of branch adviser was designated at the rank of captain(N). The Council is currently chaired by me as DGMEPM, while the branch adviser is Capt(N) Sherm Embree. Both the senior MARE and the branch adviser provide a focal point for branch identity, and are sources of specialist knowledge to Maritime Command and ADM(Per) staffs.

The proposed agenda for the upcoming Council meeting is indicative of the kinds of topics that are discussed by this body. Some issues deal with the MARE occupation — such as updates on the MARE military occupation structure (MOS) review and occupation analysis (OA) — while others focus on the naval technician occupations (e.g. the MOS review of the naval technician occupations, the Marine Systems Technician OA, and the Combat Systems Technician vision paper). Still other items such as career development issues and gender integration in the navy encompass both groups.

Communication to and from the Council is an important element in the Council's effectiveness and its relevance to the naval engineering community. The results of the Council's deliberations are promulgated to the community at large in a number of ways, including direct correspondence, articles in this journal and through presentations at various seminars and working groups. Feedback to the Council is equally important and I encourage you to make your views known. Items that you think should be considered by the Council, or comments and questions regarding the Council's deliberations may be directed to any Council member, or to the secretary, Cdr Don Flemming, DGMEPM Special Projects Officer at (819) 994-8720.

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.

In Defence of Shock Testing

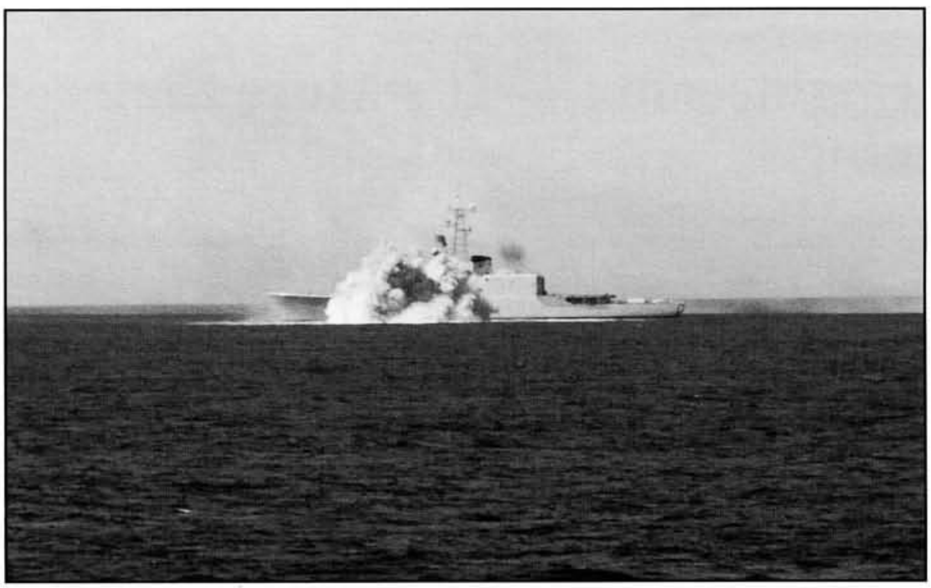
Article by R.S. Norminton, P. Eng.,
Nor-Red Engineering Ltd.

We were pleasantly surprised by the several articles on the CPF shock trial in your June 1996 issue. The pleasure arose because it seems we are not, after all, alone in continuing to advocate shock testing of systems for combatant ships. DND has taken a step further by testing the ship itself, together with its systems. The surprise arose because I have been startled not infrequently over the past few years by apparently quite serious remarks from responsible DND personnel suggesting that shock qualification of equipment for combatant ships will no longer be required, and that "commercial off-the-shelf" (COTS) equipment will suffice. The usual justification for this argument is that it is immaterial whether the equipment has survived or disintegrated if the ship has been sunk.

We hope this will never become official defence policy. If it were to be, it would be in disregard of certain irrefutable facts, an exercise in self-deception, and in ignorance of to what extent shock qualification affects both the designer and the design.

The two most important specifications governing shock in North America are MIL-S-901 and CFTO D-03-003-007/SF-000. We have designed many pieces of equipment to meet both these specifications. Much of this equipment had to pass medium-weight and heavyweight floating barge shock tests. Since all of it did so, I feel qualified to speak on this subject.

In the first place, direct hits causing sufficient damage to sink a ship are not the only considerations. Near misses which the ship will survive, but which can be devastating to ship and crew, are likely to be more frequent. Have we all forgotten the lesson of HMS *Belfast*?[1, 2] This cruiser, having hit a mine in the Firth of Forth in 1940, suffered massive damage to the main propulsion machinery, main armament and electrical power and lighting systems. Yet she survived. The use of COTS equipment would ensure a repetition of this lesson under battle conditions. This is why we agree wholeheartedly with the statement that "commercial off-the-shelf (COTS) additions may be made with good intentions, but under combat conditions they can have a significant impact on a ship's ability to avoid cheap-kill damage."[3] It is for this reason that a statement allowing commercial equipment is always immediately qualified by a further statement that the equipment must not break loose and become a missile under combat conditions.



HMCS *Iroquois*: 1983

It is the commercial designation qualified by the "no missile" requirement which is self-deceptive, for the following reasons:

a. The qualification statement does not entirely remove the military shock requirement. The equipment merely has to meet a lower grade, Grade 3 in the case of D-03-003-007/SF-000, and Grade B for MIL-S-901. The equipment is therefore still military, not commercial.

b. As an experienced designer of shock-qualified equipment, I would estimate that between 30 and 60 percent of commercial machinery (depending on category) currently on the market will not meet even these reduced requirements. And if you mention the "no-missile" qualification, perhaps 25 percent of the manufacturers will meet you with blank, uncomprehending stares, and another 25 percent will withdraw their equipment from consideration because they don't need these extra risks attached to any defence work that probably forms a small percentage of their total business.

For 13 years I designed motors and generators (including some navy motors) in sizes ranging between 30 h.p. and 15,000 h.p. It is not surprising, then, that one of the most blatant examples of unacceptable equipment which comes readily to mind is commercial electric motors in CEMA/NEMA frame sizes, where standard grey cast iron endbells will explode under shock along the motor axis, forcibly expelling the rotors, and where cast iron stator feet may break off under shock applied at right angles to the motor axis.

In a significant number of cases the extra effort required in designing machinery foundations and a few other key items to meet a reduced, "no-missile" requirement may be as much as 85 percent of what it takes to design and build for the most stringent shock requirement. For this reason, any weight or cost savings in going from militarized to commercial equipment may well be illusory.

There may, however, be other opportunities for substantial cost savings. One such opportunity *might* be allowing qualification by calculation rather than by testing, particularly on equipment normally shock-qualified on the heavyweight floating barge. This facility exists only in the U.S., is extremely costly to use, and back in the heyday of high-level defence spending of the early 1970s could have a two-year waiting list. Anything other than a quickly repairable, minor failure during test could force you back to the end of the waiting line. Qualification by calculation is not as precedent-setting as it sounds. Both Sweden and Germany allow it for heavy equipment;[4] and where vessel shock tests have revealed acceleration isobars[5] throughout the hull for which the equipment is destined to supplement G levels in D-03-003-007/SF-000, qualification by calculation becomes practical. It also makes eminent sense for the simple reason that, without prior calculation, initial design cannot be carried out, and because blind testing is ill-advised. We cannot emphasize enough, however, that where such qualification is permitted, the calculations must be submitted as a line item in the contract requirements data list and be properly reviewed.

The arguments against commercial equipment based on shock also extend to other areas, notably vibration. We all know vibration is endemic on board ship, and I can think of several instances where commercial equipment will not withstand Type I environmental vibration as laid down in MIL-STD-167.

We have written this because we feel it is one thing to make foolish and unthinking statements promoting the acceptability of commercial equipment, and quite another to find them promulgated as official defence policy. This is, if you like, a plea for sober and informed reflection before formal action is taken which later may be bitterly regretted.

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R.S. Norminton is a founding partner of Nor-Red Engineering Ltd. of Niagara Falls, Ontario. In 1995 he took semi-retirement from the company, relinquishing the position of president to his partner Brian Redding. He has since been re-engaged part-time as company mechanical engineer.

Software Engineering — It's More than Programming

Article by Lt(N) Howard Morris

"Wanted: Software Engineer with relevant C/C++ and Unix experience. Computer-aided system/software engineering (CASE) knowledge desirable. Applications may be sent to...."

Classified ads such as this are prevalent in major newspapers and for most of us it is the only time we see the term "software engineer." It could easily be assumed from these advertisements that a software engineer is just a senior programmer with an area of expertise; however, this is not the case. Most ads are actually looking for programmer/analysts and have borrowed the phrase "software engineer" because it sounds flashy. Suffice it to say that a software engineer should know how to program, but the knowledge base goes well beyond programming.

Software engineers have to face a variety of questions, simply because theirs is an emerging discipline. A common question is, "If it's an *engineering* discipline, is mathematics employed?" While mathematical algorithms are commonly employed within software programs, mathematics is rarely used in designing the structure of software programs. Software is a form of communication, and hence its design is typically a case of mapping flows of information. As a result, software is perhaps *managed* more than it is engineered. Mary Shaw, professor of software engineering at Carnegie Mellon University in Pittsburgh, notes that software management would be a much more appropriate term.[1] So where did the term arise? "Software Engineering" emerged in 1968 as a name for a conference convened by NATO to discuss problems of software production.[2] In 1976 Barry Boehm of TRW proposed a definition for software engineering as "the practical application of scientific knowledge in the design and construction of computer programs and the associated documentation required to develop, operate, and maintain them."[3]

In his definition, Boehm alludes to engineering as an appropriate term for the process of software development. In fact, the contemporary definition of a software engineer is one who is fully cognizant of the *process* of developing software, i.e. what to avoid, what to improve and how to improve it. In the recent past there have been many problems with software production, mostly due to a lack of understanding of some common pitfalls. For example, it does *not* make sense to add programmers to a project that is already behind schedule. Software creation is so heavily dependent upon communication that it would take too long to bring new members up to speed.

Software engineers are constantly concerned about efficiency. A major step forward came with the understanding of the software life cycle, the most well-known model being the so-called Waterfall model. By examining each stage of the life cycle, software engineers were able to determine when and how improvements could be made. For example they found that errors created during the first stage of the life cycle — requirements — become increasingly more expensive to correct as the project progresses. Hence, it makes sense to spend more effort, i.e. time and money, meticulously examining software requirements and removing as many of the errors as possible before proceeding.

The process of creating software has also been improved by embracing some aspects of traditional engineering disciplines. For example, configuration management, quality assurance and system tests are now aggressively incorporated into large-scale software projects. Improvements to the process have also been forwarded by organizations whose sole purpose is to make software better. The Software Engineering Institute, for example, a U.S. DoD-funded extension to Carnegie Mellon University, published the Capability Maturity Model, a guide for assessing software productivity based upon the underlying development process. In Canada, the CRIM consortium of Montreal has created a model called S-Prime, which is meant to identify the major risks in developing code.

So what makes software engineering so important? As mentioned, one reason has to do with money. Not only does the cost of fixing software errors increases exponentially the later the errors are corrected in the development process, but the maintenance of legacy software has been shown to account for at least half the cost of the entire development. A 1994 IBM survey of 24 companies using software in complicated computer systems reported that 55% of software development projects cost more than projected, 68% took longer to complete than predicted and 88% had to be substantially redesigned.

Money is not the only issue. Safety is equally important. As we become used to the seemingly endless chores that computers and software can perform, we have become complacent with their capability. We are asking software to perform increasingly complex tasks without questioning whether or not we should be using software for a particular purpose. One of the fathers of software engineering, David Parnas, reportedly left his position on the Strategic Defense Initiative (SDI) project in the 1980s because he believed that too much was being asked of software. His concerns are not without basis. An excellent *Report on Business* article discussing software safety notes that accidents caused by computer failure are now showing up in such fields as aviation, public transit, automotive and medicine. In some cases, severe injury or death has been the result.[4]

The Canadian Forces abounds with costly, complex systems, most of which require some form of software. So it is with good reason that we remain actively involved with the latest developments in software engineering. Sponsoring post-graduate study in the field has benefits from both an economical point of view and a safety point of view. Since military software engineers are concerned with everything from initial requirements to ongoing maintenance, having a complete knowledge of the software life cycle helps reduce the risk of escalating costs and ensures that tax dollars are spent efficiently. In addition, since these systems are used in a variety of scenarios that directly involve human life, knowing how to make software safer is more than a responsibility, it is a necessity. Whether we like it or not, software will continue to provide technological solutions. It is best, therefore, that we continue to be educated on the developmental aspects of the medium, as well as on its limitations and proper use.

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Letters

In Memoriam Captain(N) Farrell

Thank you very much for a very complimentary and tasteful article in the magazine. Keith was a good and clever man and would have much appreciated the piece, as have his family.

Sincerely,
Doreen W. Farrell

Wisdom and Morality

First, a grateful thank you for the continued receipt of the *Journal* here at ADGA. Rest assured it is read with interest and enjoyment by all retired sailors. Second, a vote of support for the fine article by BGen (ret'd) Curleigh, which I think sheds light on a topic management and staff need to discuss more frequently and openly if our professional health is to be maintained.

Yours Aye,
Grant Ralph

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 MARE Historical Perspective — How We Got to Where We are Today

Article by LCdr Derek Davis and LCdr Joe Murphy

(From a presentation to the Eastern Region MARE Seminar, held in Halifax, N.S., May 9, 1996.)

Yesterday, Cdr Flemming spoke of the military occupation structure review, a study which *might* lead to changes in the make-up of the navy's technical branch. Today, after our speech, the Director of Naval Requirements will speak about the future of the navy. By their nature, both speeches must be speculative and deal with possibilities. They do not resemble the day-to-day realities we deal with — remars and establishments — yet both their possibilities and our day-to-day work are based on what has happened in the past. Given this we thought it might be useful to go over what this past consists of, generally from a naval viewpoint, but more particularly from that of the MARE branch.

Overall, the current Canadian Forces maritime technical branches are largely derived from their Royal Canadian Navy predecessors. These in turn were usually, but not always, derived from the Royal Navy. If we go back to 1910 and the birth of what we now think of as the Canadian navy, there were six officers and a variety of stokers and engineering artificers who made up the engineering branch (including LCdr Murphy's great-uncle, Petty Officer Conrad Donnevan). They were a combination of new recruits and transfers and loans from the RN.

Within the branch were what we would now think of as the Marine Systems and Constructor groups. The latter group was then known as carpenters and traced its ancestry back to the ships' carpenters of the Tudor navy. They, together with the gunner and boatswain were called "Standing Officers." Unlike the rest of the crew they remained with their ship at all times even when she was paid off. As such the fabric of the ship was in their "charge," something which often distressed their lordships when they found parts of Her Majesty's vessels sold off to pay wages. Despite their importance they were not admitted to the wardroom.

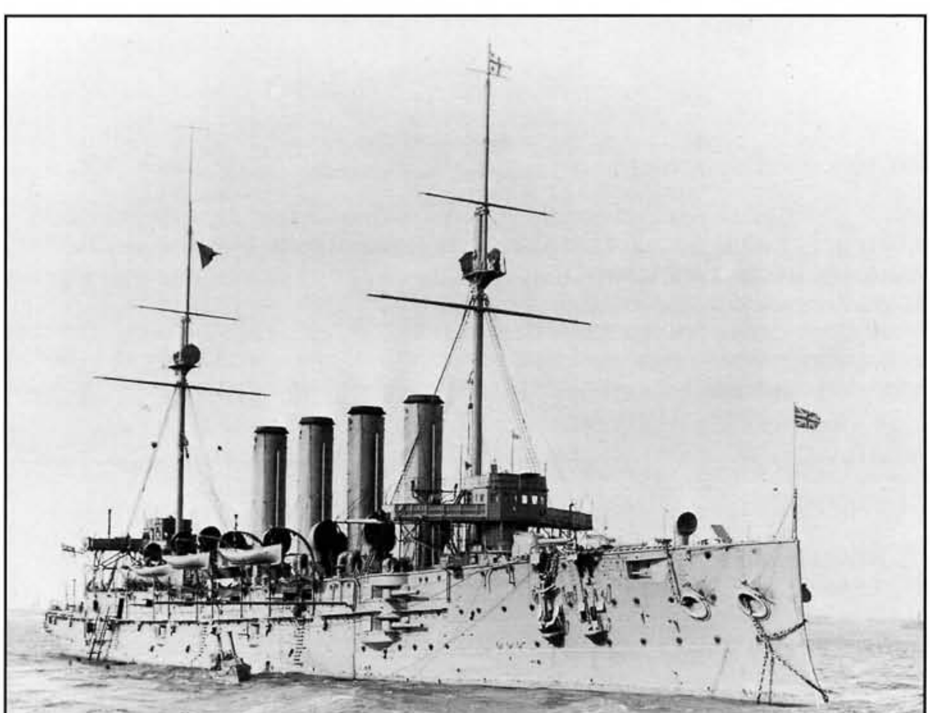
By the time of the Canadian navy's birth the carpenters had become overshadowed, outnumbered and somewhat subsumed by those we now call the Marine Systems branch. This group comes from the early 19th-century age of steam when civilian engineers manned a warship's propulsion machinery. Only in 1837 were they formed into a branch of the navy. They were considered warrant officers and were ranked with, *but after*, carpenters. In 1868 the branch was divided into what we would now think of as officers and NCMs.

The status of the engineer was such that in the latter half of the 19th century only the chief engineer would be allowed in the wardroom and was subservient to the lowliest lieutenant. At the end of the century they were still considered non-combatants and on their sleeves carried a purple stripe without the executive curl to prove it.

In 1903, however, the Selborne-Fisher reforms came in. These sought to give back to the executive officer his control of the motive power of the ship and to make the engineer a true naval officer. All executive, engineering and marine midshipman were to receive the same training up until the time they were lieutenants. (This training was to include considerable engineering.) Once lieutenants, they would specialize in either engineering, gunnery, navigation, torpedo or marine. The previous purple stripe was to be removed.

This led to a situation where the older, more senior engineers were still considered civilians, whereas the junior ones were now considered full naval officers. This did not pose immediate concern to the Canadian engineers since they were all at, or below, lieutenant rank, but it would lead to changes after World War I that would effect the branch.

These new engineers entered a Canadian naval service of only two warships (although there were also the dozen vessels of the Fisheries Protection Service). Still, there was the promise that within a few years the Canadian navy would number five cruisers and six destroyers. The only question appeared to be whether to build the ships in Canada or



Canada's second warship, HMCS *Niobe*, arrived in Halifax on October 21, 1910. *(Canadian Forces Photo)*

Constructor Officer G.L. Stephens was a member of the original *Niobe* crew and went on to become Canada's first engineer rear-admiral. *(Canadian Forces Photo)*

the U.K. Our almost non-existent shipbuilding industry was hungry for orders, but it would cost a third more to build the ships in Canada.

The small group of engineers and the navy as a whole were soon to be disappointed. Although some officers and men had started to train with the RN for the future fleet, it was not to be. By 1912 the parliamentary bill for the new fleet had been defeated, and by 1914 a dispirited Canadian navy numbered only 330 all ranks, with only one ship in commission.

With the outbreak of World War I the Naval Service found itself thrust into the limelight. It began recruiting officers and men both for its own expansion and for that of the Royal Navy. Including vessels taken over from the Fisheries Protection Service, new builds and ships acquired from private owners, the Naval Service numbered more than 100 hulls by the end of hostilities. The shipyards did well, producing several hundred vessels, including submarines, for Canada, Great Britain, France, Italy and Russia.

All this was carried out by a navy which numbered slightly more than 5,000 personnel. The technical branches had grown, particularly on the NCM side where many new motor mechanics and stokers were required to man the many small vessels which composed the fleet. The officer cadre was still small and a large proportion served in RN rather than Canadian ships. At the end of the war there was a valiant attempt to create a larger naval service, but fiscal reality intervened. In 1919 the force consisted of two submarines, a cruiser, two destroyers and some auxiliary vessels.

By 1920 the minister became so fed up with his cabinet colleagues' lack of enthusiasm for a naval service that he almost got rid of it. Then in 1922, appropriations were cut by 40 percent and the force was down to two destroyers and four trawlers. As if that weren't bad enough — integration hit. Instead of having three services each reporting to the minister, all three were now part of the Department of National Defence, reporting through (what we would consider) a chief of the defence staff. This decision was eventually overturned in 1928, and the navy once again had direct access to the minister.

On the technical side, the next influence during this time was that the RN found that their previous reforms, among other things, were not producing sufficiently competent technical officers. In 1921, in an attempt to resolve this shortcoming, engineering officers began their separate training as midshipman, and in 1922 what became known as the Long Engineering Course started at Keyham (the precursor to RNEC Manadon, now HMS *Sultan*). RCN engineering midshipman would attend the course.

In 1925 an order-in-council reversed the Selborne-Fisher arrangement by establishing 12 categories of naval officer. It limited command positions to executive officers and brought back the purple stripe for engineers.

Throughout the 20s and 30s the RCN's technical branch remained fairly small in keeping with the size of the fleet. Training was done with the Royal Navy and while shortages were made up with officers and men on loan from the larger service (or recruiting them from it). In 1933, for the second time in just over ten years, the Navy was almost scrapped. On a rare positive note, the first vessels designed and built specifically for Canada, *Skeena* and *Saguenay*, arrived during this era.

Finally, in the late 1930s when it appeared that there was war on the horizon, the navy began to expand. Between 1936 and 1939 additional ships were purchased

TECHNICAL OFFICERS
1939 - 1945

	ENGR	SPEC BR	ELECT
RCN	63		2
RCNVR	386	751	430
RCNR	144		1

from Britain and personnel ceilings were raised. With the declaration of war in 1939 the RCN began to expand explosively, acquiring larger ships, introducing a naval air service and building warships in Canada. This produced a need for technical officers with skills which previously had either not been needed, or had been supplied by the Royal Navy. The technical branches relied extensively on naval reserve entrants who brought with them skills from civilian life which helped the Navy deal with the rapid advances in technology.

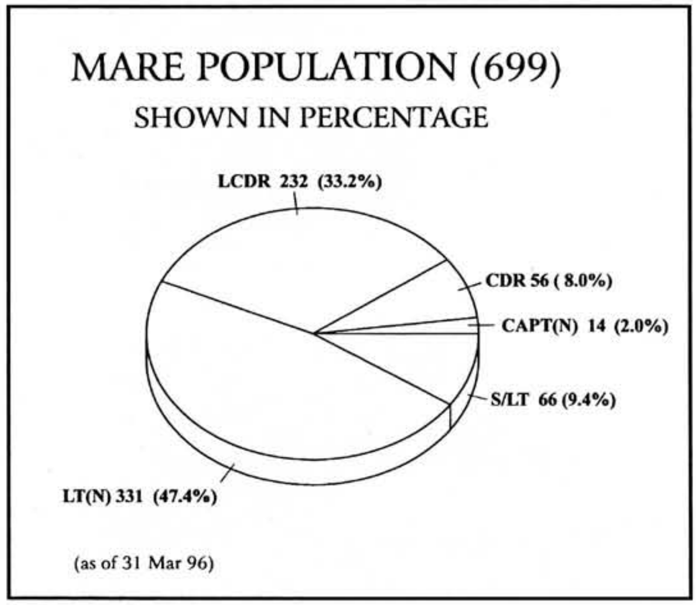
In 1941 the Royal Corps of Naval Constructors lent personnel to head up naval construction in Canada. This group was descended from the master shipwrights of the 16th century who used to run the Admiralty dockyards. Their more modern duties included designing, building and overseeing refits of RN vessels. These people, along with reserve naval architects brought in during the war and the few prewar shipwright officers, formed the Constructor branch at war's end.

In 1942 the ordnance and gun-mounting subspecialization was added to the engineering branch. Aeronautical engineering became the second subspecialization in 1944. In 1942-43 the expanding role of electronics and the greater reliance on electrical power led to reserve electrical engineers being brought into the service and used within schools, yards and the engineering directorates in Ottawa. In 1945 they were recognized as a separate branch.

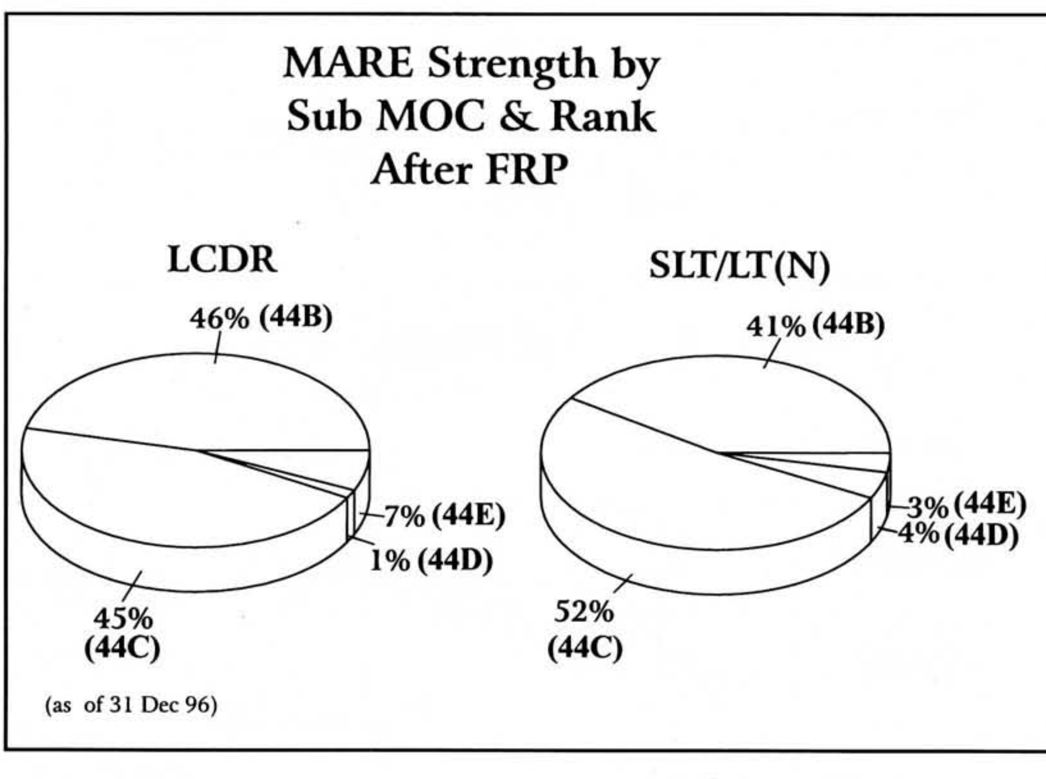
A similar wartime expansion in weapon systems and a reliance on reserve expertise led to the establishment of an ordnance branch, the modern equivalent of the armourers carried by sailing men-of-war. This brought together a disparate group including executive officers with ordnance experience, along with torpedo, gunnery and engineering personnel. There was also a small band of civil engineers responsible for shore-support facilities such as wharves and drydocks.

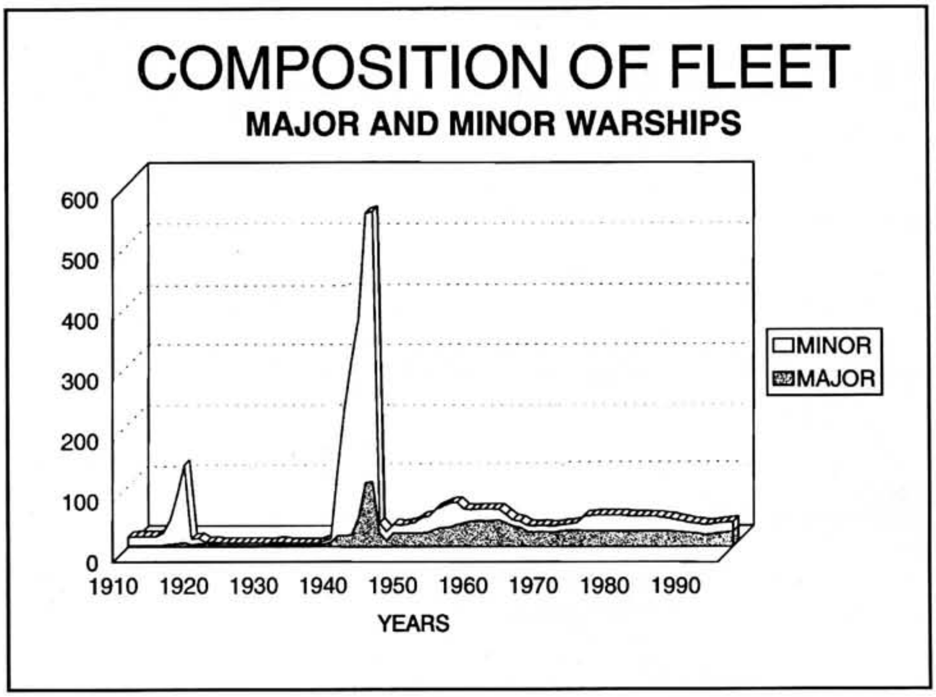
By the end of the war the RCN technical community had grown tremendously. Although it still received support from its previous benefactor, the Royal Navy, it had begun to stand on its own feet and develop its own technical branches. Once again, there was considerable planning as to the state of the peacetime fleet. The navy wanted a force of two cruisers, two carriers, 12 destroyers and assorted minor warships, but once again economics intervened and plans were revised downward. By 1947 the navy was down to ten major and minor warships in active service, although the permanent force had expanded to an authorized strength of 7,500. The Korean conflict prompted rapid expansion plans (there was even talk of a 100-ship navy), but reality once more prevailed.

By the mid-1950s the RCN employed several different types of technical officer (who, since 1947, no longer collected specialist pay). These officers were employed in the significant build programs for the *St. Laurent* and *Restigouche* classes, updating the 14 *Prestonian*-class frigates, and developing such things as datar, variable-depth sonar and hydrofoils. There were also thoughts of nuclear submarines, and thus some officers took the RN nuclear course at Greenwich.



In 1959 a variety of concerns regarding naval personnel structures in the new technological era led to an examination of the entire personnel structure. This, the Tisdal Report, sought to create a naval officer who would be a seamen first, but who would possess an engineering degree, an engineering certificate and a bridge watchkeeping ticket. The majority of naval officers would be designated as general list (which was in turn subdivided into general and specialist categories). The latter would include officers in the specialist fields of marine, electrical, electronic, weapon, design and construction engineering, together with supply, law and meteorology. What we now con-





sider CFR officers would form a group of limited duty officers.

It was this report that led to the disappearance of the green, purple, blue, grey and orange stripes of the different engineering branches (electrical, engineering, ordnance, constructor and civil). The early and mid-60s saw the start and finish of the general-purpose frigate and nuclear submarine projects, however the *Mackenzie* and *Annapolis* classes came into service, followed shortly afterward by the O-boats.

In 1963 there was a severe shortage of recruits with the requisite education. As a result, a new study was commissioned under Admiral Landymore. It lowered the academic requirements for executive officers, removing the requirement for them to get their engineering certificate of competency, but it still allowed all engineers to gain a bridge watchkeeping ticket prior to specialist engineering training.

In 1966 the Charles Report recognized that with the reduction in the number of RCN ships, there was no longer sufficient space to train all general list officers to the same level of overall seamanship. As a result, engineering and supply officers no longer had to obtain bridge watchkeeping tickets.

The next major event was unification in 1968. The various naval executive and technical branches were blended to form the Sea Operations group from which the MARS and MARE MOCS were produced. This led to the deletion of such groups as the naval civil and air engineers. It took from 1969 to 1972 to achieve an initial MARE specification. Initially all engineers were simply to be MAREs, but this came to be subdivided into the Marine Systems and Combat Systems groups. The MS group was made up principally of the old Engineering and Constructor branches, while the CS group was an amalgam of various ordnance, weapons and electrical engineers, along with some executive officers who had taken the long weapons course.

Unfortunately, during an NDHQ management review in the early 1970s the hard environmental engineering two-star positions were civilianized. Integration meant that the engineering support functions for all three services would now be gathered within ADM(MAT), thus limiting the height to which military technical officers could realistically reach.

The 1970s saw the completion of the supply ships *Preserver* and *Protecteur* and the introduction of the DDH-280s. The steam destroyers also began to undergo life-extension refits, and initial work began on the CPF and TRUMP programs. In addition, the trio of Shinpads, Shinmacs and Shincom — the digitally integrated shipboard systems for processing and display, machinery control, and interior communications — first came to light.

All this work led to an increase in MARE requirements. In 1973 the MARE trained strength was 343, while in 1983 it had risen to 450 (although the need was for 587, a shortfall of approximately a third). That same year a MARE study was conducted, leading to changes in the training of MS and CS officers, and the creation of the Constructor and Naval Architect sub-MOCS. The branch expanded greatly at that time, and it is just now that we are coming down from that high. The MARE trained strength now stands at 580.

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LCdr Davis is the career manager for MARE Combat Systems, Naval Constructor and Naval Architect officers. LCdr Joe Murphy is the career manager for Marine Systems and MARE 44Z officers.

A Dynamic Approach to Assessing Ship Stability

Article by Mr. Michael F. Dervin and Dr. Kevin A. McTaggart

The Canadian navy's ship stability standards are, as with other NATO navies, based on work carried out in the 1960s by the U.S. Navy. This work derived a set of empirical factors used as criteria to assess a ship's static stability. This comparatively simple method is effective in that the result is intrinsically safe ships. However, it is widely regarded as being ineffective in determining the actual stability capability of the ship and does not identify the conditions (speed, heading and sea state combinations) when a ship is at risk of capsizing.

The naval architecture and scientific communities, on a global basis, are expending significant effort to develop an approach to assessing ship stability that will address this issue. The approach involves simulating the actual dynamic behaviour of the ship in a realistic seaway and thus determining in a rational way the ship's stability capabilities. This paper presents an overview of the objectives, ongoing work and results of the activities of the Cooperative Research Navies (CRNav) project on Dynamic Stability.

Sponsoring members for the CRNav Dynamic Stability Project are the Maritime Research Institute Netherlands (MARIN), the United States Coast Guard and navies from Australia, Canada, the Netherlands, the United Kingdom and the United States. In addition to being a sponsoring member, MARIN is also the prime contractor for the project. The first phase of the project, which went from 1990 until 1993, focused on *intact* dynamic stability of frigates[1]. The second phase of the project, which continues until 1997, is examining the dynamic stability of *damaged* frigates and intact low-length-to-beam vessels such as the maritime coastal defence vessels (MCDVs).

As a result of this project, a computer program was developed to simulate and study the motion behaviour of a steered ship in severe sea conditions. Using this software along with model test results, design and operational guidelines are being produced to provide information on how to minimize the capsize risk for frigate-type ships.

Background

The current approach to assessing ship stability, based on the work of Sarchin and Goldberg[2], while not being an unsafe approach, does not adequately address all aspects of stability for several reasons:

- the physical and statistical reference material was derived from what are now outdated hull forms (ships from the 1940s and 1950s) with damage scenarios based on WWII damage cases;
- it is based on *static* stability (calm water, zero forward speed, with only static righting forces considered) and does not include the *dynamic* response of the ship to waves, wind and manoeuvring forces;
- although the current approach includes an allowance for beam waves and wind (a simplistic reduction applied to the righting arm curve), it does not take into account following or stern quartering seas (typically the worst scenario for ship survivability);
- it does not address extreme motion responses such as broaching (a sudden, violent change of heading) or various forms of dynamic capsize; and,
- it does not account for the dynamics of the flooding ship, including the movement of water into and within the hull and on the weather deck.

Operational experience suggests that the current stability criteria produce very safe ship designs; however, these criteria may place excessive constraints on designers and operators. To address the shortfalls of the existing approach to ship stability, the CRNav project aims to fulfill the following objectives:

- study the physics of ship capsize to determine which factors influence dynamic ship behaviour;
- develop a rational, scientifically based stability assessment process and evaluation criteria appropriate for modern naval vessels;
- produce guidelines for the design of frigate-type hulls to ensure a low risk of capsize;
- produce operational guidelines and training material for educational purposes; and,
- develop and validate computer programs for assessing ship dynamic capsize behaviour.

For *intact* frigates these objectives have been largely met. Much of the continuing work is focused on further program validation and the modeling of *damaged* ships in waves.

Approach to the Problem

Preliminary work has included an extensive literature review of existing stability criteria and previous research into ship

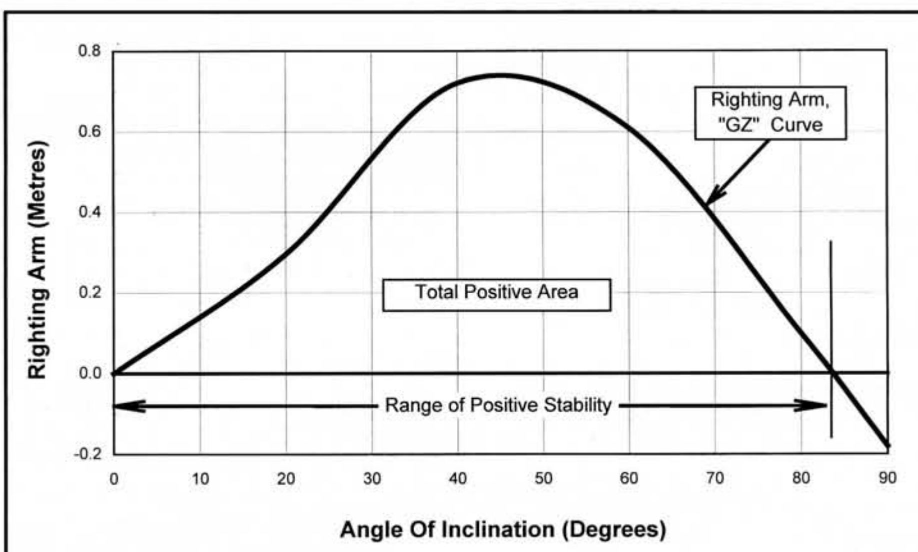

Fig. 1. Calm Water Static Stability Curve

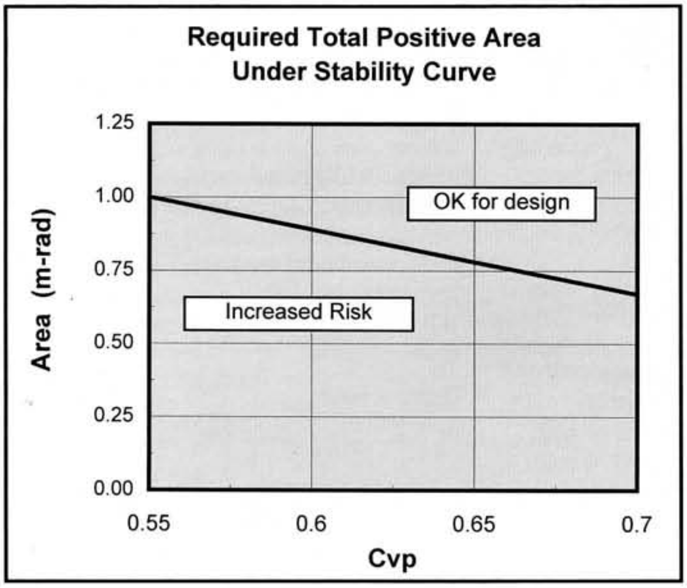

Fig. 2. Required Area Under Stability Curve

capsize. Project members decided it would be feasible to use numerical simulations to examine the physics of ship capsize behaviour. The computer program FREDYN (FRigatE DYNamics), originally developed by Hooft and Pieffers[3], was selected for numerical modeling because it was a satisfactory compromise between the conflicting requirements of accuracy and computational efficiency. FREDYN uses a nonlinear time domain approach to solve the motions of a frigate in response to forces from waves, wind and manoeuvring. Thus, FREDYN can adequately handle ship motions such as broaching and ultimately, capsize.

Following initial validation and code refinement, FREDYN was used for extensive parametric simulations of ships capsizing in waves. Thousands of computer simulations and animations helped to identify several capsize modes and their likelihood of occurrence. As it turns out, capsize occurs most easily in following to stern quartering seas. When a ship is travelling approximately in the same direction and at the same speed as the waves it can capsize while riding on a wave crest because the hydrostatic properties of the ship deteriorate relative to the calm water case. Broaching and subsequent capsize can also occur in following to stern quartering seas. Capsize at other headings generally only occurs when waves are exceptionally steep and/or resonance phenomena develop. For all capsize modes, the risk of capsize can be greatly increased by gusting winds, sloshing water on the weather deck and deck-edge submergence.

Design Guidelines for Frigates

To develop new design guidelines incorporating the influence of dynamic effects on ship capsize, the correlation between various ship parameters and the susceptibility to capsize was examined. Susceptibility to capsize for a given ship is quantified by a "Capsize Index," which is the percentage of cases that capsize during a standard set of simulations in severe conditions. The standard set of simulations includes a range of ship speeds, headings and wave conditions.

The project attempted to identify relationships between the Capsize Index and other parameters such as ship dimensions and properties of the calm water static stability curve (GZ Curve, *Fig. 1*). For frigate-type ships, the analysis revealed that safety against dynamic capsize can be strongly dependent on the following three parameters:

- the range of positive stability (i.e. the maximum angle of inclination for which the ship will return to an upright position in calm water);
- the positive area under the calm water static stability curve; and,
- the ship's vertical prismatic coefficient (Cvp) [Cvp = underwater volume ÷ (draft x waterplane area)].

Based on these results, the following new design guidelines have been proposed for intact frigates covering a range of displacements between 3,000 and 6,000 tonnes:

1. the range of positive stability must be at least 90 degrees; and,
2. the area under the calm water static stability curve over the range of positive stability must be at least 1.00 m-rad for ships with a vertical prismatic coefficient of 0.55, and must be at least 0.67 m-rad for ships with a vertical prismatic coefficient of 0.70 (*Fig. 2*).

These new design guidelines complement rather than replace existing assessment criteria. The simplicity of the new guidelines makes them easy to understand and apply while still considering dynamic effects. However, a considerably more rigorous evaluation is required to demonstrate actual dynamic performance in a given environment. The process and product of such a rigorous evaluation is, in part, discussed in the following sections.

Operational Guidelines

To assist operators in identifying under what conditions there is an increased risk of capsize, FREDYN can be used to develop operational guidelines. Such guidelines may take the form of polar plots which efficiently indicate speed and heading combinations that correspond to zones of increased risk of capsize. Each plot is specific to a particular ship in a given loading condition and environment. *Figure 3* illustrates a typical speed polar plot for a notional ship where speed is measured on the radiating spokes for the different headings, with the shaded areas indicating zones of maximum roll angle. High roll angle (greater than 30°) is treated as a criterion for indicating capsize risk. Roll angles of 30° to 60° correspond to a range of low to moderate risk of capsize, while angles greater than 60° correspond to high risk. In this illustration the maximum roll angle indicated is that

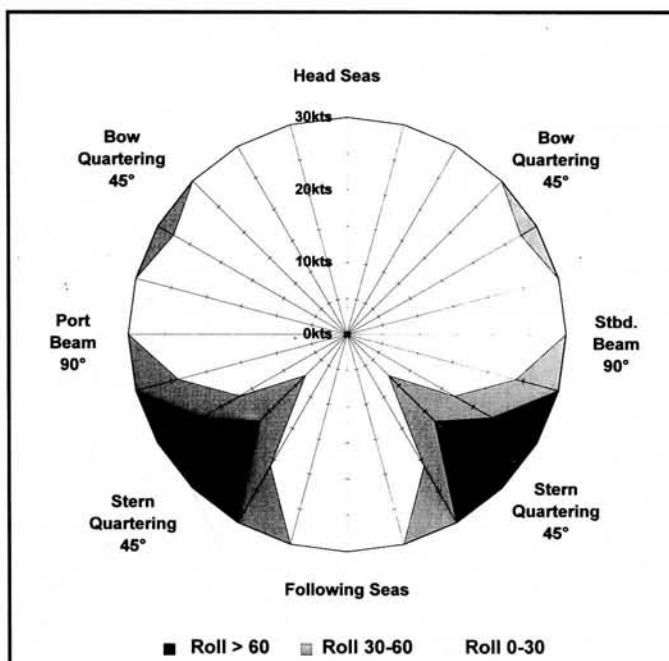

Fig. 3. Maximum Roll / Capsize-Risk Polar Plot (sea state 7)

which was predicted by a thirty-minute simulation at each combination of speed and heading investigated.

Based on the parametric simulations of the CRNav members' frigates and destroyers, it was concluded that capsize is most likely to occur when the following occur simultaneously:

- high sea states (high end of sea state 7 and above);
- following or stern quartering seas (headings less than 60° off stern); and,
- relatively high ship speed for the sea conditions (greater than 12 knots in this scenario).

Fortunately, the operator is usually able to alter speed and/or heading to reduce capsize risk to acceptable levels.

The ship motion program FREDYN has been adapted for interactive simulation including animation as shown in *Figure 4*. The operator can vary the rudder angle and propeller r.p.m. settings in real time to examine the influence of varying ship speed and heading. An autopilot option is also available. Interactive simulations may be very useful for training ship operators about effective ship handling in both calm and extreme sea conditions.

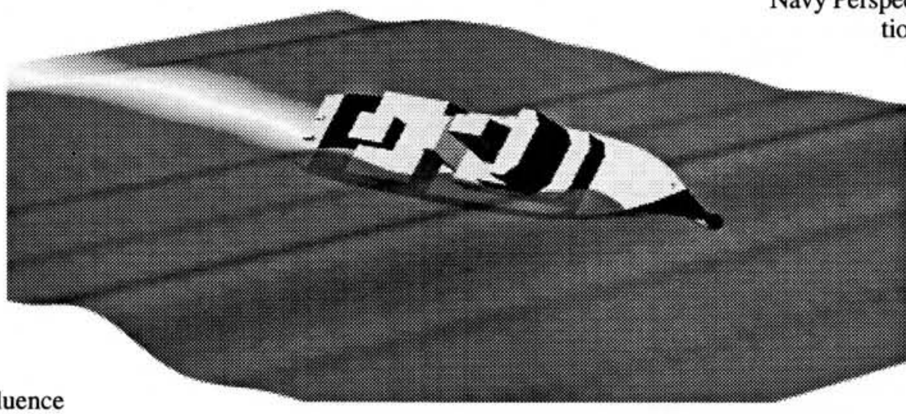

Fig. 4. Animation from Interactive Computer Simulation

Risk Analysis

In recent years risk analysis has become commonplace for engineering design. Risk analysis offers a rational approach for achieving designs with acceptable levels of safety. For novel ship designs, the lack of previous design and operational experience necessitates the use of risk analysis. Engineering experience suggests that, for a given ship, capsize risk should be less than one in 10^6 annually. Prediction of capsize risk levels requires adequate simulation tools and environmental data. The FREDYN program appears to provide satisfactory capsize predictions for risk analysis. Sufficient statistical wave data also exist for risk assessments in extreme conditions. The quality of both ship motion simulations and statistical data continue to improve with further research. McTaggart[4] presents applications of FREDYN for the prediction of capsize risk for an example frigate. The paper demonstrates the feasibility of predicting capsize risk, indicating that such procedures could be used for routine ship design and operational analysis.

Ongoing Work

The CRNav Dynamic Stability Project is continuing with work in several areas. Validation and quality assurance procedures are being continually applied to the FREDYN program because of its key role. The scope of the project has been expanded to include low length-to-beam vessels such as the MCDV. The different geometry of such ships suggests that stability criteria different from those for frigates are required. The project is also examining damage stability for frigates by considering the influence of ship motions on flooding. For warships, damage stability is typically the limiting design condition.

As the dynamic approach to assessing ship stability evolves, Canadian naval ships are being studied along with other CRNav ships. Canadian naval ships continue to hold up well as compared to similar ships from the other participating nations.

While the processes discussed here are still under development, advances in numerical simulation of ship motions and capsize risk analysis are leading to more rational methods for assessing ship stability under realistic operating conditions. It will be possible to quantify the ship's capability to survive in severe seas rather than gauge the ship's stability characteristics against empirical formulations. Design methods being developed will lead to a more consistent level of safety against capsize while permitting greater freedom in design. Interactive simulation tools to be used for training, along with ship-specific operational guidelines, will help to reduce the risk of capsize and exploit the full extent of the ship's operational envelope.

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Mr. Michael F. Dervin is the hydrodynamics engineer in the Directorate of Maritime Ship Support at NDHQ. Dr. Kevin A. McTaggart is a defence scientist in the Ship Dynamics Group at Defence Research Establishment Atlantic. Both are members of the CRNav project team on dynamic stability.

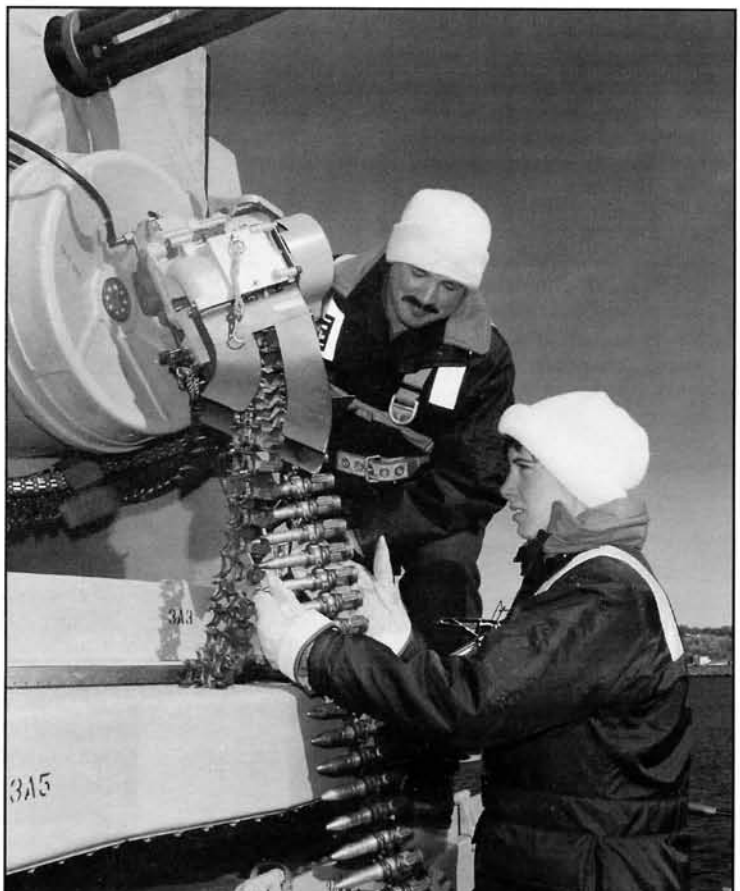
The Combat Systems Technician Vision — Adapting to New Challenges

The Creation of the Naval Electronics and Naval Weapons Technician Occupations

Article by CPO1 Craig Calvert

The past 16 years have been a period of many changes for combat systems technicians. In 1985, as part of the Maritime Other Ranks Production Study (MORPS), four new technical military occupation codes (MOCs) were created for Naval Electronics Technicians (NET): NET (Acoustic), NET (Communications), NET (Tactical) and NET (Systems). These were developed as maintainer MOCs, a departure from the previous user-maintainer structure. The previously created Naval Weapons Technician (NWT) MOC, however, remained a user-maintainer MOC.

In the following years, two lateral entry plans were introduced to supplement the production of technicians — the Naval Combat Systems Technical Training Plan and the Skilled Trades Entry Plan. This was followed by seemingly endless adjustments to the academic and applications training programs in the fleet school. As combat systems equipment training for the Canadian Patrol Frigate (CPF) Project and the Tribal-class Update and Modernization Program (TRUMP) loomed nearer, it became apparent that MORPS assumptions on MOC training and MOC equipment groupings were not the most effective structures for the new technology equipment. This would necessitate further tuning of the MOC structures and, indeed, was anticipated in the MORPS study.



Improving The Occupation Structures

Under MORPS, Naval Electronics Technician qualification level (QL) 5 and QL 6A academic and applications training was organized into "terminal" and "data" equipment, respectively. Terminal equipment is sensors, displays, etc., whereas data equipment referred to standard digital equipment such as the AN/YUK computers and their peripherals. As CPF and TRUMP equipment training geared up, shortcomings in this approach became apparent. In many cases the digital techniques employed in the QL5 terminal equipment was as complex as those employed in the QL6A data equipment. Consequently, QL6A training was discontinued and the QL5 academic training was increased to cover the difference.

This brought the journeyman qualification down to the leading seaman level from the master seaman and petty officer 2nd class level. By doing so, the Combat Systems branch came closer in line with the Canadian Forces apprentice, journeyman, supervisor, and manager concept of MOC structures. It should be noted, however, that at this point the ship and shore establishments were not adjusted to reflect this change.

The next significant change was the Naval Electronics Occupation Restructuring Project, and later the Naval Weapons Technician Working Group. In part, these projects completed the Naval Electronics and Naval Weapons Technician shift to the apprentice, journeyman, supervisor and manager MOC structure. This was accompanied by a dramatic down-ranking and reduction in the combat system non-commissioned member establishment. This was most visible at the petty officer 2nd class rank, both ashore and afloat. The lost petty officer 2nd class positions were largely offset by an increase in the number of able seaman apprentices and leading seaman and master seaman journeyman. Considerable reductions in the number of PO1 and CPO positions also occurred at this time. Despite these important changes, the technology of the new combat systems suggested further changes would be required.

The Vision

At the CSE Military Occupation Advisory Group meeting (formerly the COS MAT briefing) in October 1995, the problems with the current MOC structure were discussed. A recommendation was made to have a group representing all combat system MOCs from both coasts sit together to investigate the perceived deficiencies. As a result, a Vision Paper Writing Board convened in April 1996 to consider combat system MOC structures that would best meet the needs of the navy in the 21st century. As a starting point, the board reviewed the perceived disadvantages of the status quo. Among others, these included:

- two separate formal training periods ashore (QL3 and QL5) lead to reduced employability of technicians, since the first employment period is taken up with Ordinary Seaman Under Training and On-The-Job Training Level 4 qualification, and the final course occurs prior to the expiration of Basic Engagement 2. Hence, there is little employment value from apprentices and inadequate opportunity to assess candidates for career potential;
- the workload distribution between MOCs is not equitable as indicated by the different number of personnel employed within each MOC on board HMC ships; and
- no MOC has a full system responsibility from sensor through to prosecution. In other words, no system-level approach is developed in the technician prior to the supervisor or management periods where they are expected to demonstrate system-level knowledge.

After confirming that there were substantial dissatisfiers and deficiencies in the current MOC structures, the board investigated alternative MOC structures by analyzing:

- current employment practices in ships and submarines, including workload distribution;
- commonality of job tasks;
- commonality of training, and
- present and future health of MOCs and military occupation structures

From their deliberations the board developed a matrix of possibilities. To arrive at a recommended solution, a weighting scheme was used to balance the pros and cons of each scenario. Ultimately, the board arrived at a series of recommendations on MOC structure and training. The following are the highlights:

- MOC structure: A number of options were examined that ranged from an increase to five MOCs to a decrease to one MOC. In the final analysis, redistributing the present equipment workloads among the existing MOCs was determined to be the best option;
- equipment responsibilities: redistribute the equipment between MOCs to better balance the MOCs and give a full system approach;
- academic and equipment training: In lieu of the current apprentice and journeyman training program, it was recommended that common academics and separate equipment training be given "up front" prior to technicians being posted to their first ship, and
- be occupation transferred to a common terminal combat systems technical MOC upon promotion to chief petty officer 2nd class.

Way Ahead

At the time of writing, the Vision Paper had been distributed for comment. Once the comments have been reviewed, Maritime Command will determine how it wishes to proceed with the recommendations. Assuming that at least some of the recommendations will be adopted, the next step would likely be to convene a working group to develop an implementation plan.

Conclusion

Considering all the changes that have taken place over the past 16 years it is understandable that proposing further changes may be viewed by some with skepticism. Within the context of other MOC reviews currently under way, the recommendations in the Combat Systems Vision Paper are evolutionary rather than radical in direction. It should also be remembered that the combat systems MOCs have already rationalized their establishment both in size and by rank to job. What remains by comparison is a gentler transition to up-front training and to equipment redistribution by system responsibility. If adopted, these changes should provide long-term stability and correctly position the combat systems technicians to fulfil their maintenance responsibilities into the 21st century.

CPO1 Calvert is the former Branch Chief for Naval Electronic Technicians. He is now coxswain on board HMCS Iroquois.

The Environmentally Sound Ship of the 21st Century

Article by John H. Klie, Msc,
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NATO navy ships designed and constructed in the 21st century must be environmentally sound and capable of operation worldwide without constraint by existing and future regulations. At present, these vessels are continually operating under restrictions imposed by environmental regulations which curtail their operational flexibility. The NIAG SG/50 has been studying the feasibility of "The Environmentally Sound Ship of the 21st Century" and is in the process of presenting its findings to NATO.

The objective of the study was to explore solutions for environmental protection from all types of shipboard waste streams, including solid waste, liquid waste, air emissions, hazardous waste and medical waste. Specifically, the study group was to review existing, new and emerging technologies that have high potential for improving the capabilities of NATO maritime forces in waste reduction and elimination. Also, the group was to provide an assessment of technologies best suited for integration aboard naval vessels of the next century and assessment of the drivers and constraints on the use of these technologies. Finally, recommendations for development plans for use by NATO navies were to be provided.

HMCS *Algonquin* enters Esquimalt Harbour *(CFB Esquimalt Photo)*

Twenty companies from seven NATO nations have participated in the study since it commenced in February 1995. Industrialists provided an in-depth knowledge base covering all areas from environmental technology to ship/marine design in all disciplines. Some of the world's best environmental companies along with Europe's largest shipbuilders formed a powerful combination leading to a very comprehensive examination of the study objectives.

Study Approach

NIAG SG/50 commenced its work by assessing the properties of the different waste streams on board ship and examining the existing regulations affecting the maritime environment. The probable development of future regulations was extrapolated from these analyses. This was a significant focus of the study as experts from across many different disciplines were consulted and research was conducted to form a collective opinion.

Against these future regulations of the next century, numerous technologies were examined in detail. This formed the basis of the study, and all relevant data concerning these technologies was studied and documented. The intent was to provide NATO with a framework upon which to base future equipment development and selection. Moreover, value analysis criteria were developed for the technologies considered.

Following the technology review, ship design investigations of small, medium and large naval vessels of the 21st century were undertaken. Examples of environmental systems for these ships were designed by the study group, and their advantages and disadvantages were examined in detail.

Preliminary Findings

The results of the study are now being collated and will be presented to NATO in the near future. Preliminary review by the industrialists indicates the objective is feasible and that "The Environmentally Sound Ship of the 21st Century" is achievable.

Future naval vessels will achieve environmental compliance through an optimum waste management strategy. Rather than focusing on technologies for treating wastes, it must be recognized that minimization of waste generated is equally important and may provide an even greater impact in time and cost.

The ideal waste management hierarchy for managing shipboard waste is defined as follows:

- Pollution Prevention
  - source reduction
  - substitution
- Waste Reduction (volume minimization)
  - Waste Recycle/Reuse
  - On-board Treatment/Direct Discharge
  - Collect, Hold, Offload

HMCS *St. John's* (CFB Halifax Photo)

The environmental regulations affecting the conclusions of the study and the waste management strategy indicate that these regulations are becoming increasingly stringent. For example, by the year 2005 both grey water and oily water, as well as oily wastes, will require treatment for discharge. Such treatment will be necessary both in national and international waters. Only the level of contaminants permitted in the discharge is in question. Currently, blackwater discharge is generally unrestricted. This will change to requiring treatment within three nautical miles, perhaps out to the national territorial limits of 12 nautical miles.

Waste treatment technologies must aim at significantly reducing the waste volume and weight, to free valuable ship's space for combat functions. Where total destruction of waste makes sense and achieves significant gain and progress in the overall approach to the waste management problem, such equipment needs to be developed.

This is an area where current technologies are not yet mature enough for military shipboard application. The study identified several technologies which will contribute a major share to waste treatment. These include membrane technology, bioreactors and thermal treatment. These technologies are at various stages of development. Whereas membranes are fairly advanced and the industrial/commercial community has been employing them for many years, their potential advantage when coupled with bioreactors has one of the strongest potential paybacks.

The application of thermal treatment technology hinges either on future regulations for gaseous emissions at sea or on its required shipboard performance, which is still at a very early stage. Performance achieved to date is not satisfactory. Three thermal treatment technologies have been identified for further development: improved conventional incinerators, supercritical water oxidation, and plasma arc technology.

Summary

The NIAG SG/50 study on "The Environmentally Sound Ship of the 21st Century" has progressed well on its way to providing a comprehensive report which will be of significant value to NATO naval forces. The complex arena of environmental regulations has been examined in conjunction with the latest developments in environmental technology to provide NATO with a detailed overview of this ever-increasing area of importance.

Reprinted from the Canadian NIAG Newsletter, Issue 26, Spring 1996.

Canadian Technical Involvement in the Design and Construction of HMCS *Bonaventure*

Article by RAdm William B. Christie, RCN (Ret.)

In June 1952 the Canadian government approved the purchase of a partially completed *Majestic*-class light fleet aircraft carrier from the Royal Navy for $21 million dollars. The hull had been laid down in November 1943 at the Harland & Wolff Shipyard in Belfast, Northern Ireland for completion as HMS *Powerful*. The partially completed ship was launched on Feb. 27, 1945, but with the cessation of the Second World War was immediately placed in reserve. Apart from some preservation work on the machinery that had been already fitted, all work on the ship ceased.

The Royal Canadian Navy had for several years had the loan from the RN of an earlier *Majestic*-class carrier, HMCS *Magnificent*. In 1952, with the assistance of the Department of Defence Production, an agreement was negotiated with the British Admiralty to purchase the unfinished *Powerful* as an eventual replacement for *Magnificent*. The new ship was to be completed by the Admiralty with all alterations and additions (A&As) then extant for light fleet carriers. Equipment for the ship's communications, weapons, fire-control, and 60-Hz and 400-Hz AC electric power generation/distribution systems, as well as cabling material, would be supplied from North America by the RCN. Aircraft flying and handling arrangements were to be modified as necessary to accommodate the ASW Tracker and Banshee jet aircraft, and habitability arrangements were to be as close as possible to RCN standards.

Meeting these Canadian requirements would involve major redesign of the ship in many areas. It was therefore agreed that a Canadian naval technical team would participate in the design and overseeing tasks. The team was given the name PRCNTR (Principal RCN Technical Representative) Belfast, and was directed to be "responsible to Naval Headquarters Ottawa for the interpretation in detail of the peculiar RCN requirements for completion of the ship, and to work with and through the [British] Admiralty Overseeing Staff in the interpretation of detailed RCN requirements."

In July 1952 a nucleus group took up offices in the H&W shipyard. The initial team was made up of :

- Cdr(E) Ray McKeown [OIC & Marine Engineering (later replaced by Cdr(A/E) John Doherty)]
- Cdr(S) Don McClure [Supply]
- Con.-LCdr David Moore [Nav. Arch. (later replaced by Ship/LCdr Jack MacFie)]
- Lt(L) Bill Christie [Electrical (promoted LCdr(L) 1953; joined ship's staff as deputy L/O on commissioning)]

The team members were borne on the books of HMCS *Niobe* in London, but were directly responsible technically and contractually to HQ in Ottawa. They operated in much the same fashion as the PNO staffs in Canada — responsible technically to their respective parent technical authorities, all under Chief of Naval Technical Services. On the Admiralty side, the Canadian team worked with the Commodore Superintendent Contract Built Ships and his local overseers in the shipyard such as the warship production and electrical superintendents. As a considerable amount of material was to be supplied from Canada, the team eventually included a sizable supply echelon for material handling and material identification duties.

For much of the equipment being manufactured to special RCN requirements in the U.K. and Sweden, liaison was carried out with the companies involved during design and production. The output of the design phase was contractual guidance drawings for the shipbuilder. In the case of the AC power, radio, radar, weapon and fire-control systems, the basic guidance was almost exclusively Canadian.

The shipbuilder was responsible for the production of detail working drawings, and eventually all "as-fitted" drawings, with assistance from the PRCNTR staff where appropriate. All drawings were subject to co-approval by the Canadian and Admiralty staff. During construction the PRCNTR staff worked in company with the Admiralty overseers in the "lining-out" and approval of work as it proceeded in the ship. Following trials and commissioning, the final technical acceptance of the ship by the RCN was given by Capt(L) John Dean, A/CNTS (Ships).

With the technical staffs in Canada very heavily involved at that time with the 205/257 DDE programs, the PRCNTR group was granted an extraordinarily high degree of local authority in way of technical approvals. This enabled design work to proceed in such fashion that building in the shipyard could carry on with minimal delay.

Since major elements of the redesign involved the ship's structure, arrangement and electrical and electronic systems, Dave Moore and I spent most of the first year at a satellite office at Foxhill, Bath. (In fact, I initially moved my family directly from Canada to Bath, where we lived for that first year before moving up to Belfast for what turned out to be four more years).

As the work proceeded, the PRCNTR overseeing staff was progressively augmented by both officer and enlisted personnel, eventually numbering 35 people in all. Some who joined the PRCNTR team during the first year (1952-53) were:

- LCdr(P) Barry Hayter [Air (later replaced by LCdr(P) Stan Woods)]*
- LCdr(A/E) Peter Poole-Warren [Air Eng.]*

• Lt(S) Arnold Bronskill [Supply (prom. LCdr(S) 1954)]*
• Lt(L) Roby Harper [Electronics]*
• Lt(L) Gwynn Holtby [IC/FC]*
• Lt(E) Don McGinnis [Mar. Eng.]*
• Con.-Lt. Ian Bailee [Nav. Arch. (later replaced by Con.-Lt. Bob Orme)]
• Lt(L) Fred Slater [Material Identification]
(*Joined ship on commissioning as ship's officers.)

Redesigning the Ship

As the space requirements were being determined for the vast array of new equipment desired by the RCN, it rapidly became evident that we were trying to fit as best we could "a quart into a pint bottle." For example, to accommodate the heavier twin-engined ASW Tracker and the jet-engined Banshee aircraft, the flight-deck, hangar, handling and support facilities would have to be considerably beefed up. The expanded radar, communications and fire-control systems would also require an increased and better regulated AC electrical supply, which in turn led to the need to increase the basic DC generating capacity in the ship.

The increased space requirements for the new equipment meant that the remaining space available for crew accommodation would have to be rearranged. Involved was the problem of accommodating a larger crew in less space than in *Magnificent*, yet achieving as closely as possible RCN habitability standards. Since these two requirements were mutually incompatible, the eventual accommodation arrangements left much to be desired. For example, although the mess decks were to be fitted with Canadian-supplied aluminum bunks, the spaces had been designed for hammocks. The bunks left little space for sitting in the mess decks themselves, and to accommodate the numbers most bunks were arranged four high, with a separation of about 48 cm (19 in.). The two-dining-hall arrangement was retained.

The officers' cabin areas were subcompartmented utilizing a fire-retardant Formica-faced material tradenamed Marinite. This made for cleaner, quieter and easier maintained cabins. In the CO and senior officer suites the use of more decorative panel surfaces afforded a relative degree of luxury. The bunks and furniture for the cabins were supplied from Canada, being identical to those being fitted in the concurrent DDE program at home. The bunks were of course standard, except in one case. When we learned that the XO-designate was one Cdr Arthur McPhee, well known as the tallest man in the RCN, we modified the bunk for the XO's cabin to be longer, and altered the bulkhead spacing to suit! The wardroom/gunroom spaces were custom-designed, with the final decor in these areas and the senior officer cabins done through a separate contract with the T. Eaton Co. of Toronto.

Operations Spaces

The arrangements in the operational spaces — bridge, ops room, aircraft control room (ACR), gun-direction room (GDR) and flying control position (FCP) — were to specific Canadian requirements as defined by the operations branches in NDHQ for the equipment being supplied from Canada. Much assistance in developing these spaces was provided by the Defence Research Board and by Walter Harper, a representative of the Defence Research Electronic Laboratory in Toronto who had considerable expertise with similar U.S. work and who spent several months in Belfast working with PRCNTR.

Space arrangement drawings were produced in the shipyard and sent to NDHQ for approval in principal. These were then developed into building drawings, but prior to outfitting taking place, full-scale wooden mock-ups were constructed for each space. A special HQ team flew to Belfast to inspect the mock-ups. This inspection lasted a week, after which the team went off for another week while the mock-ups were modified to include the changes they wished incorporated. The team then returned for final inspection and approval of the arrangements. The arrangements were then agreed to be free from any further modification prior to ship's completion, a move which ultimately was of great benefit in minimizing delays in completing the ship.

The value of freezing the arrangement became evident. Toward the end of construction, the officer designated to become the first Senior Officer Afloat Atlantic borne in *Bonaventure* (stationed in London at the time) decided the ship needed a senior officer's bridge in the island structure. Since such a space did not exist, under the established approval process the modification had to be deferred until after the ship was delivered to the RCN. The change became RCN A&A No.1, and was taken in hand by HMC Dockyard Halifax. The ship's meteorological office was expropriated for the purpose.

Tracker flight operations on board *Bonaventure* in 1969. *(DND archive photo BN4869 courtesy Directorate of History and Heritage)*

North American aluminum was used in the operational spaces, both in perforated sheets covering the fibreglass external insulation, and in removable false deck-tile equipment bearing structures and cable troughs. Aluminum was being used in identical fashion in the new construction in Canada.

The island and adjacent structure had to be enlarged and almost completely redesigned. This was necessary to accommodate the new bridge, FCP and carrier controlled approach (CCA) rooms, and to allow minimization of waveguide and antenna feed lengths for the following equipment:

- AN/SPS-10 surface warning radar
- AN/SPS-12 air warning radar
- AN/SPS-8A height finder radar
- AN/SPN-8 CCA radar
- Sperry HDWS navigation radar
- TACAN aircraft beacon
- AEW airborne early warning system
- UHF radios (30 sets)
- VHF radios (12 sets)
- CAW common aerial working equipment

All of this electronic equipment was supplied from Canada, with the CAW equipment being specially developed for this installation by Dr. Geo. Sinclair of Sinclair Labs. in Toronto. On 03 deck aft in the island, a new compartment was constructed to accommodate the CCA radar and its operating console. The stabilized scanner in its dome was then mounted immediately above with a clear view aft. Dave Moore produced the basic design for the two lattice masts to support the antennas for these systems, many of which were larger than previously fitted in this class of ship. At the same time, to lead the funnel gases away from the antenna area, the uptakes were canted aft in the upper part of the island, giving *Bonaventure* her unique and distinctive funnel shape.

Aircraft Considerations

As part of the *Majestic*-class modernization, much of the forward flight-deck structure had to be removed and a redesigned structure substituted to accommodate the new BS-4 steam catapult trough and shuttle retardation tank. This equipment, along with that being fitted around the same time in HMS *Bulwark*, HMS *Centaur* and HMAS *Melbourne*, was one of the first steam catapults to enter fleet service. To complete the catapult installation, considerable space at the 2-deck and 3-deck levels had to be taken up for the large steam receiver/accumulator, the shuttle tube and retardation tank and its associated pump, and the catapult operating room.

Anti-submarine air power: Twin-engine Tracker aircraft share the flight-deck with HO4S Sikorsky helicopters. ***(DND archive photo DNS 21956 courtesy Directorate of History and Heritage)***

The angled deck design requiring additional structure on the port side amidships and the starboard side aft was also used by HMAS *Melbourne*, HMNS *Karel Doorman* and HMIS *Vikrant*. Since it was a requirement that *Bonaventure* be able to transit the Panama Canal, the outer portion of the port excrescence to a width of some 3.7 m (12 ft) was constructed in bolted sections that could be removed by the ship's FD mobile crane to meet width restrictions in the Canal.

The two aircraft lifts were increased in size and capacity (to the size of those being fitted in *Bulwark* and *Centaur*) and given larger motor-drive systems that required more space than those in *Magnificent*. To facilitate arming the aircraft on deck, a rocket/missile lift designed by Stothert & Pitt ran from the rocket magazine well below decks to the port side of the flight-deck. New aircraft maintenance facilities were constructed contiguous with the hangar.

Extended sponsons were also designed for port and starboard sides to accommodate the two mirror deck-landing aids (MDLAs) which were just completing development by the Admiralty. The MDLAs fitted in *Bonaventure* were among the first to be installed in an operational aircraft carrier.

The arrester gear had to be beefed up and its pull-out range increased to the maximum allowed by the angled deck. Even so, the equipment would be stressed to its maximum in arresting the heavy Tracker and high-speed-landing Banshee jet aircraft. The increased weight of the RCN aircraft necessitated some augmentation to the under-deck support structure in the touch-down area aft, and greater capacity for the fixed flight-deck crane as well.

A major redesign required the existing A/C fuel tanks, both fore and aft, to be completely removed. The new structure incorporated the first-ever internal avgas tanks, surrounded by JP-5 fuel saddle tanks, with the whole surrounded by plenum tanks to be filled with inert gas. This involved opening the ship up from flight-deck to keel to allow the new tankage to be constructed. The fuel pumping system was designed to incorporate fuel blending pumps to provide selected mixtures of avgas and JP-5 fuel at the fuel outlet positions. Canadian-supplied Bowser units with special filter capabilities were located at these positions in the hangar and around the edge of the flight-deck.

To provide starting and servicing power for the aircraft, several separate 28.5-VDC motor-generators were situated around and below the flight-deck, and a 400-c/s, 450/205-V, 3-phase power system was installed based on two 100-KVA motor-alternators sited fore and aft on 4 deck, controlled for frequency and voltage by magnetic amplifier units developed in the U.K. This equipment was also being fitted in *Bulwark* and *Centaur*.

A specific requirement of the RCN was for a relatively large briefing room for aircrew. As no suitable space existed in the hull, a box-like excrescence was designed to extend outboard from the gallery deck (2 deck) immediately abaft, and out to the full width of the island structure. The briefing room was outfitted with special USN-type room chairs supplied from Canada.

Main Machinery Spaces

The ship's forward and after main machinery spaces already had the propulsion turbines, shafting, gearing and most of the auxiliaries in place, as well as two 500-kW, 220-VDC turbogenerators. New Maxim evaporators were supplied from Canada. The steam-expansion air-conditioning plant was retained, but was augmented by two large compressors in the machinery spaces.

Some rearrangement of equipment in the spaces was undertaken to accommodate two additional 500-kW T/Gs. These additional units were obtained from HMS *Blake*, a *Tiger*-class cruiser under construction on the Clyde for the RN. That ship was among the first to be completed by the Admiralty with an AC main electrical power system, the change being made after the ship was partially completed. The other two of her four T/Gs went to HMY *Britannia*, also building on the Clyde at the time.

Ship's Electrical Power

Additional spaces had to be provided on 4 deck to accommodate two large DC/AC motor-generators for the new AC power system. The existing diesel generator compartments forward and aft on that same deck also had to be enlarged to accommodate two units each rather than one. These were 300-kW, 220-VDC units powered by General Motors diesels supplied from Canada.

A considerably larger space had to be designed amidships to accommodate the main power switchboard. Because of the eight-generator system, *Bonaventure*'s switchboard turned out to be the largest fitted by the Admiralty to that time. Contiguous with that compartment were new and larger spaces for other auxiliary electrical power equipment and the main switchboard for the AC supply system.

Bonnie Specs

During her 14 years of service with the Canadian navy *Bonaventure* steamed some 375,000 nautical miles, ranging from the Arctic to South America. Easily the largest ship ever carried in the Canadian fleet inventory, *Bonnie* featured:

LOA: 214.6 m (704 ft.)

Beam: 24.5 m (80 ft) at the hull

Draught: 7.6 m (25 ft.)

Displacement: 19,920 tons full load

Armament: 4 twin 3"/50 cal. anti-aircraft guns

Machinery: 4 boilers, 2 Parsons turbines, two shafts, 41,368 shp, 8 generators for electric power

Speed: 24.5 knots

Range: 12,000 nautical miles at 14 knots (3,200 tons fuel oil)

Complement: 810 ship's company; 560 air branch

Aircraft: 10 Banshee jet fighters (until 1962), 10 or 12 Tracker ASW search and patrol aircraft, 10 Sea King helicopters (after 1962), plus Sikorsky HO4S rescue helicopter

Equipment: 8° angled flight-deck, mirror landing system (replaced by Fresnel lens optical landing system), 6 arrester wires, BS-4 steam catapult system, Carrier Controlled Approach System to allow zero-visibility flying operations.

At the ring-main level, the portions of the ring main already fitted had to be removed entirely, and replaced by heavier, steel-armoured pressure-filled w/p cable. The associated breaker rooms at that level had to be enlarged to accommodate the many additional remote-controlled supply and branch breakers for the new services.

From a four-generator system (2 T/Gs + 2 D/Gs) à la *Magnificent*, a new load analysis to include all the equipment desired by the RCN led to an eight-generator, 220-VDC main power system, with four 500-kW turbogenerators and four 300-kW diesel generators. This doubling of power inputs required a new ring main with a considerably expanded number of ring-main, supply and branch breakers. The system called for extended breaker rooms on 5 deck and double cross-connects in addition to further sectionalization of the ring itself.

The switchboard providing LP control of this switchgear was one of the largest produced by the Admiralty up to that time. It also incorporated specific breaker control of the ship's ventilation system to enable rapid shut-down and transfer to internal air circulation as an anti-contamination measure. The old lead-cased electric cable that had been run in the ship in the 1940s was removed and salvaged for lead and copper content. The DC systems were then cabled using unarmoured, Admiralty pattern PVC cable in accordance with the then Royal Navy practice.

One of my first tasks in Bath was to do a load analysis and basic design for the AC power system. This led to a requirement for two 150-KVA, 450-V 60-c/s, 3-phase motor-alternators to be fed off the 220-VDC ring main.

As all the electronics and weapon equipment being provided by Canada required well-regulated frequency and voltage, the motor-alternators were originally scheduled as RCN supply. As the project progressed, however, considerable delays in obtaining the units from Canada forced us to raise an urgent requirement for the Admiralty to have them produced by EDC in the U.K. To meet the short delivery time, a number of separate existing generator designs were used to assemble two heavy and rather clumsy motor-alternator (M/A) sets. They each comprised direct-connected motor and alternator in association with belt-driven

HMCS *Bonaventure* and the destroyer HMCS *St. Laurent* refuel from the fleet replenishment ship HMCS *Provider* as they return to Halifax in March 1968 following two months of ASW exercises in the Caribbean. *(Canadian Forces archive photo BV-68-468 courtesy Directorate of History and Heritage)*

field exciter generators for both motor and alternator, as well as a permanent magnet pilot exciter generator motor for frequency control. All of this was automatically controlled by two magnetic amplifier stacks which were among the first of their type produced for naval use by the Admiralty.

The output of these M/As was fed into a double-tree system with two interconnects, each separated by side and deck level. The switchboard/control panel (aside from local control panels) was fitted in the MSB room along with the distribution switchboard, which was constructed by the shipbuilder to my basic design, utilizing AQB breakers supplied from Canada.

The tree system fed some 12 to 14 load and secondary distribution centres that used transformers and PT breaker distribution panels of the same type as those being fitted in the DDEs. A BUSHIPS type armoured basket-weave cabling was used for this system, as well as for the radar, radio and fire-control systems.

The two 100-KVA M/As providing power for aircraft servicing did not provide closely enough controlled voltage and frequency (+/- 3 percent) to feed the gunnar fire-control systems being supplied by the RCN. A ship's 400-cycle system was therefore designed, based on two 30-KVA M/As manufactured by Bogue Electric Ltd. in Ottawa, similar to smaller units being fitted in the DDEs. These mag/amp.-controlled units were fitted adjacent to the MSB room where the control and distribution boards were fitted. The latter were manufactured in the shipyard as for the 60-cycle system units.

The 24-VDC supply system (the LP system in RN parlance) used two MGs backed up by a battery bank located in the auxiliary power space. Its principal purpose was to provide power for remote switchboard control of the main ringmain switchboard, but also served various alarm and internal communication systems.

Lighting Systems

The general internal space lighting utilized some 3,000 of the new Admiralty pattern fluorescent fittings which had just come into production. Although they were economical in terms of power consumption, they proved to be excessive consumers of starters and tubes, making for an unplanned maintenance load.

For a great variety of other services, several hundred different types of incandescent light fittings were examined in detail by PRCNTR staff to determine their suitability for modification for use in North American screw-base lamps. The shipbuilder modified more than 2,800 fittings with new base units, which greatly eased the eventual logistics problem after the ship left the U.K.

There is an amusing footnote to the story of the lamps. By long practice the shipyard workers had become notorious for taking lamps from ships under construction for use in their own homes. With *Bonaventure*, however, the pilferage ceased practically overnight when the workers discovered they could not use the screw-base units in their bayonet sockets at home!

Interior Communications

The 300-line dial telephone exchange was fitted in a new room adjacent to the MSB, as were the main and FD broadcast amplifier stacks. For selective intercom broadcast systems, 40 Executone units of the type being used in the DDEs were supplied from Canada. In addition to two Sperry Admiralty gyrocompasses, a vertical reference gyro unit was supplied from Canada to provide reference data to the height-finding radar, the CCA radar and the MDLAs. To provide a quick transfer of visual data between operational spaces, the Pye Television Co. in the U.K. was contracted to develop and supply a closed-circuit television system, the first such system to be used in carriers produced by the Admiralty.

Weapon Systems

Space had to be created to fit four twin-3"/50 gun mounts and their associated power and control systems, as well as to provide a local magazine stowage in their immediate vicinity. Dave Moore and I conceived the "deep-bellied" sponsons which enabled the gun mounts to be sited at each quarter of the ship, and the immediate off-mount power equipment to be accommodated in the belly of the sponsons.

The extra-high deckhead on 2 and 3 decks adjacent to the hangar directly inboard of the sponsons allowed the construction of 'tween decks to accommodate the gunnar control rooms and local magazines for the adjacent gun mounts. The four gunnar systems were linked electrically to the GDR for overall gun-direction control.

Since it was also planned to fit *Bonaventure* with eight L70 Bofors gun mounts, suitable sponsons were constructed at the four corners of the ship to accommodate two mountings each. The production of the guns was undertaken by Bofors in Karlskoga, Sweden, and we visited there several times to acquire suitable fitting information. We proceeded to cable the ship to suit, but unfortunately excess top-weight considerations prevented these guns from being fitted. Instead, three saluting guns were placed in the port after sponson. The L70 mounts produced for *Bonaventure* eventually became part of the airfield defence system at CFB Lahr in Germany.

Completion

The ship was scheduled to be completed in 1956, but a shipyard strike in the final months delayed completion until late that year. By then, HMCS *Magnificent* had already called at Belfast on her way to being returned to the RN at Plymouth. She off-loaded an HO4S helicopter for us, along with a considerable amount of naval stores (although we never did see the many cases of beer Bruce Oland swore he sent to us via *Magnificent*).

Many of *Maggie*'s ship's staff came up later to join the *Bonaventure* crew.

Commissioning took place on Jan. 17, 1957. The ship's sponsor was Mrs. Ralph Campney, wife of the defence minister. The first CO was Captain H.V.W. Groos, RCN, with Graham Bridgman as Cdr(E), Lou Bowen as Cdr(L), Ken Roy as Cdr(S), Pop Fotheringham as Cdr(Air) and Walter Elliot as Surg.-Cdr.

The ship proceeded on trials in the Irish Sea, following which on Jan. 21, 1957 *Bonaventure* was provisionally accepted from the shipbuilder by Cmdre P. Carne, RN, the CSCBS, on behalf of the Admiralty, and then from the Admiralty by Capt(L) John Dean RCN, A/CNTS (Ships), on behalf of the RCN. The acceptance was provisional, subject to the satisfactory completion of flying trials.

The ship was held up in Belfast for some weeks while the avgas/JP-5 fuel tanks were recoated, but eventually arrived in Plymouth during the first week of March 1957 to proceed with flying trials. For the trials, a detachment of two Tracker and two Banshee aircraft from VX-10 were flown over from Canada under Cdr Jim Hunter. As noted, the helicopter was already on board. Trials went off successfully, with no unplanned incidents. The first aircraft flown on board was piloted by the ship's Cdr(Air), "Pop" Fotheringham.

HMCS *Bonaventure* sailed for Canada on June 19, 1957 to begin nearly 14 years of service with the Royal Canadian Navy.

[This article was sponsored by the Canadian Naval Technical History Association.]

About the Author

Rear-Admiral William B. Christie was born in Calais, Maine on Sept. 20, 1919 and was raised in Digby, N.S. He served in the British and Canadian merchant fleets from 1936 to 1941, before embarking on a 34-year career in the Royal Canadian Navy and Canadian Forces.

During his naval career, aside from periods of service at sea in the Atlantic and during the Korean conflict, he was concerned principally with naval engineering and ship construction/repair in Canada, the United States, Britain and Northern Ireland. During the post-war years he was involved in the design and construction of the aircraft carrier *Bonaventure*, first at Admiralty Bath and later for some years at Harland & Wolff Shipyard, Belfast.

In the late 1950s he served with a team studying the feasibility of building nuclear submarines in Canada, and in the early 1960s led a technical team to Britain to participate in the redesign and construction of modified Oberon-class submarines at HM Dockyard, Chatham. Following a period as Director of Weapon Systems at NDHQ, he took command of HMC Dockyard Halifax where, among other things, he was responsible for the first major conversion upgrade of post-war ASW destroyer escort vessels, and later the first major submarine refits in Canada.

During subsequent appointments as Director of Marine and Electrical Engineering, and later as Director General Maritime Systems, he became involved with the design and production of the DDH-280-class ships and the gas-turbine propulsion system installed in these vessels. In 1972 he became Deputy Chief of Engineering for the Canadian Forces, and

his last appointment in DND was as Associate Assistant Deputy Minister (Materiel).

In 1973 RAdm Christie was seconded to the Department of Supply and Services as director of the Shipbuilding Branch. He retired from the navy in 1974 and continued in DSS as Director General of the Marine and Industrial Machinery Centre until 1979, with responsibility for all government contracting of heavy machinery, combat and special vehicles, ships and marine equipment.

RAdm Christie went on to enjoy civilian employment as director of business development with Canadian Vickers Ltd, and later accepted an appointment as president of Versatile Systems Engineering Inc. In 1985 he became president of YARD Inc., followed in 1987 by an appointment as president of VSEL Defence Systems Canada, from which company he retired from full-time work in 1989. He continues as a director of that company.

RAdm Christie is a graduate of Dalhousie University and Nova Scotia Technical College in Halifax, and of the Imperial Defence College in London, England. He is a life member of the Engineering Institute of Canada, a professional engineer in Ontario and Nova Scotia, and is a past chairman of the Eastern Canadian section of the Society of Naval Architects and Marine Engineers.

RAdm Christie makes his home in Ottawa with his wife Maxine.

News Briefs

NETE NEWS

Wireless Data Acquisition

The Naval Engineering Test Establishment (NETE) is heavily involved in the acquisition of data from a variety of sources in land-based and shipboard locations. To ensure optimum results, different data acquisition systems are used. This article describes two uses of wireless technology to measure data from sensors mounted on a rotating shaft.

Wireless data collection is not new. It has been used in various forms since the early days of wireless. The principle is simple. The voltage output from a sensor is used to modulate a radio frequency transmitter. The radiated signal is received some distance from the transmitter, the receiver demodulates the signal and the original sensor signal is reproduced. Early wireless systems were limited in their application by the size and weight of the transmitter. As the miniaturization of electronic circuitry advanced, however, the size of the transmitter became small enough to allow its use in a number of different applications. Today it is used in everything from monitoring polar bears in the arctic to taking torque measurements on ships.

NETE began using a two-channel wireless data acquisition system in the early 1980s. The system proved limited in its applications because the transmitter was only capable of operating with strain gauges and was limited to a single sensitivity. In addition, the radio band chosen by the manufacturer was the same as the commercial FM band, making it difficult, if not impossible, to sometimes find a clear frequency for operation.

The requirements of two projects in recent months caused us to reassess wireless technology. We found there were systems available that had small, efficient transmitters with variable sensitivity on frequencies removed from the commercial bands. NETE eventually purchased a nine-channel system consisting of nine individual transmitters and three receiver units, each consisting of three individual receivers. *Figure 1* shows three transmitters, a receiver unit and one of the receiving antennas supplied with the system.

Torque Measurement

The first application was the calibration of the torque measuring system on board HMCS *Huron* (DDH-281). The ship's system consists of a series of coils mounted around the shaft. Half the coils are connected so as to become the primary of a transformer, the other half the secondary, with the shaft acting as the transformer core. The phase of the secondary output is compared with that of the primary and the difference is proportional to the torque. The relationship between the phase of the secondary and the actual torque is not linear.

Whenever the coil assembly is removed from the shaft and subsequently reinstalled, the system has to be recalibrated. This is achieved by measuring the actual torque developed on the shaft from zero to full power, then adjusting the system electronics to produce a linear output from the non-linear signal. As both the port and starboard torque measuring assemblies had been removed from HMCS *Huron*, both had to be recalibrated.

To measure the torque on each shaft, we mounted four strain gauges — the torque being directly proportional to strain — and connected them in a bridge configuration. (Prior to this calibration we had used a slip-ring assembly to apply the excitation to the gauges and to read the output voltage. Although satisfactory, it was difficult to install and required that the brush assembly be applied only during the actual measurement so as to reduce wear on the brushes. For this calibration we decided to go with the wireless system.)

We installed the wireless torque measuring system in *Huron*'s auxiliary machinery room. The system consisted of a strain gauge assembly, transmitter unit and battery assembly mounted on each shaft, along with a receiver unit fitted with two receivers. The strain gauges were weldable, two-gauge rosettes designed specifically for torque measurement. The low mass of the transmitter and battery assembly allowed us to tape them in place without any special adhesives or brackets. The installation on both shafts was completed in half the time taken for previous installations.

The signal from the two transmitters was picked up by a single antenna mounted centrally above the shafts. The output of the antenna was connected to the two receiver modules which produced a voltage proportional to torque. The receiver modules feature both a wideband

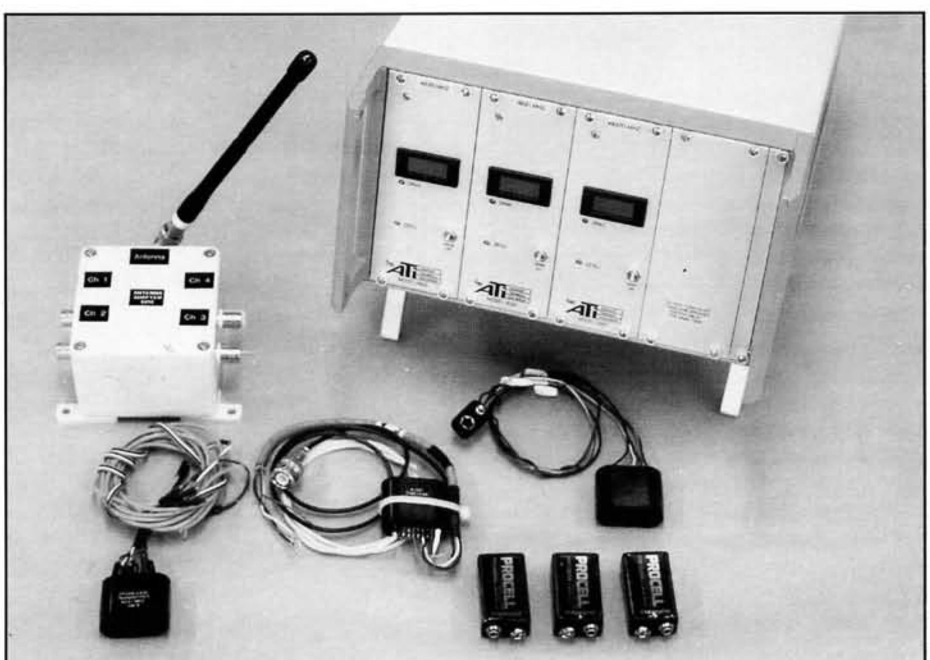

Fig. 1. A three-channel system *(Photo by George Csukly, NETE)*

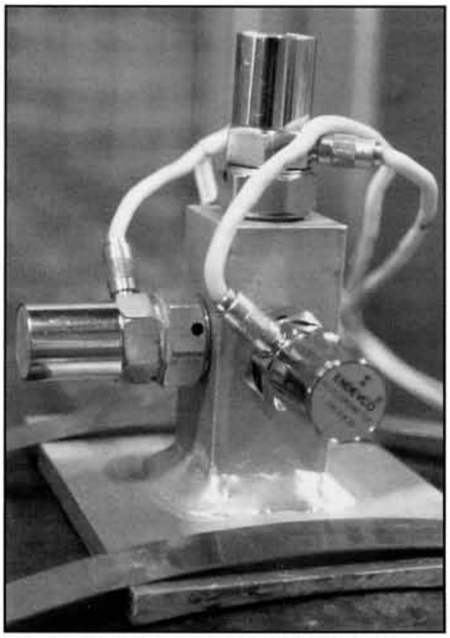

Fig. 2. Triaxial accelerometer arrangement *(Photo by George Csukly, NETE)*

output with a frequency response of DC to 1250 Hz and a filtered output with a response of DC to 10 Hz. For this application we used the filtered output which was then fed to the machinery control room where the torque measuring system's signal conditioning equipment is located. The output from each of the wireless systems was connected to a data processing system along with the output from the fitted torque system.

The calibration procedure called for the ship's torductor linearizing circuitry to be disabled during the procedure. Normally this would leave ship's staff without any means of determining the actual torque being developed. The linearizer must be adjusted by varying four resistance values, but as each resistor has some effect on the others a satisfactory adjustment can take several hours, a limitation which can affect the ship's operation. On this occasion, however, the wireless system was able to provide accurate torque measurements during the calibration.

Shaft Vibration

The second application was the measurement of vibration that might be present on the main propulsion shaft of the *Halifax*-class ship HMCS *St. John's* (FFH-340). Data was to be collected from accelerometers mounted at three positions on the shaft, each position having three accelerometers to measure vibration in each plane (*Fig. 2*). Two of the positions would be close to one another in the forward engine-room (FER), the third would be in the sewage treatment compartment aft. The use of slip rings was precluded for this application because of the inherently high level of noise present on the signal caused by the less-than-perfect brush contact. In the case of torque measurements this noise can be removed by filtering without affecting the required data. In this application it was necessary to retain the higher frequencies in the signal and the most practical solution was to utilize some form of wireless system.

The system consisted of nine transmitters and three receiver units (each containing three receiver modules). Each accelerometer was connected to a transmitter which had its own transmitting antenna and battery supply. The six transmitters in the FER were mounted fairly close to each other to facilitate mounting on the shaft. The two receiver units in the FER each had a receiving antenna. The three accelerometers and transmitters in the sewage treatment compartment were similarly mounted (*Fig. 3*). The data output from the receiver units in the FER was recorded on an eight-channel digital tape recorder, as was that from the sewage treatment compartment installation.

For this application it was necessary to use the full frequency response of the receiver modules as opposed to the filtered bandwidth used for the torque measuring application. During testing at NETE we found that the signal output had a noise signal that peaked once per shaft revolution. This was caused by variations in the signal strength as the transmitter and its antenna were rotated. After a number of trials the correct placement of the transmitting antenna and receiving antenna was determined and the system was packed for deployment on the ship.

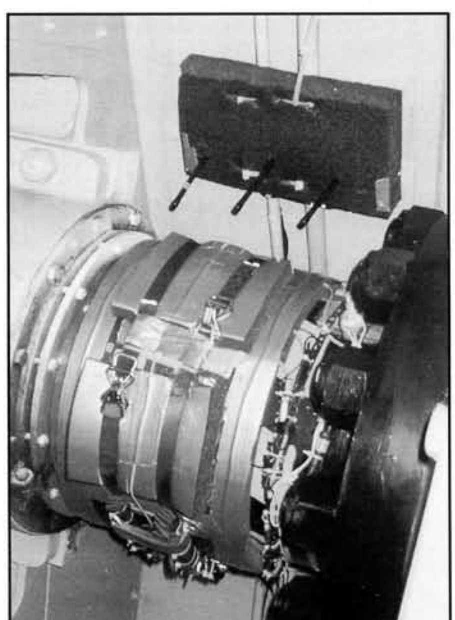

Fig. 3. Completed shaft vibration installation *(Photo by Marcel Baribeau, NETE)*

Installation on board *St. John's* was straightforward. Using the experience gained during testing at NETE any noise problems were quickly eliminated and within a day the system was ready for use. The trial consisted of running the ship at different speeds and recording the data from each of the nine accelerometers for analysis ashore. The trial was considered a success with useful data having been collected.

Conclusions

These two applications of wireless data gathering show that the technology has a role to play at NETE. The use of a wireless system for the torque calibration resulted in a significant reduction in installation time. For the shaft vibration measurement, the use of a wireless system was the easiest and most practical method to use.

Although the system at NETE is restricted to strain gauge (or strain-gauge-based) sensors, there are transmitters available that can operate with voltage inputs, thermocouples and piezotronic accelerometers. The use of this technology need not be restricted to data gathering on rotating shafts. Tests at NETE have shown that the range of the transmitters can be up to three metres, making it possible to acquire data from areas where running a cable is either impossible or impractical. It is anticipated that the wireless system will see a great deal of use. — **Rodney Kennett, Supervisor, Technical Services**

CDS Commendation

Naval Architect LCdr Serge Garon was awarded the Chief of the Defence Staff Commendation for his outstanding achievement as project director of the 1994 CPF first-of-class shock trial (Maritime Engineering Journal, June 1996). Garon, who received the award from Gen. Jean Boyle on Sept. 4, told the Journal that the shock trial was a team effort and that he "accepted the commendation on behalf of the team." Standing next to Garon is his wife Marthe Touchette, along with his stepmother Denise Viel and father Yvon Garon who were invited from their home in Quebec City by the CDS to attend the presentation. LCdr Garon is currently employed as deputy project manager of the Joint Space Project in Ottawa. Bravo Zulu! *(CFSU Photo by Cpl Frank Hudec)*

Call for Papers

The Centre for Foreign Policy Studies announces that the eighth in the very successful series of International Maritime Security Conferences will be held at Dalhousie University over the weekend May 30 to June 1, 1997.

This year's theme will be: **The Strategic Importance of International Shipping.** The aim of the 1997 conference, which will take the form of an informal colloquium, is to examine the strategic importance of shipping in the broadest political terms.

To register, submit a proposal for a paper, or for more information, please contact either conference co-ordinator, Mr. Peter Haydon, or the Director of the Centre, Professor Timothy M. Shaw, at:

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E-mail: `centre@is.dal.ca`

Lockheed-Martin Award

A well-deserved Bravo Zulu goes out to Lt(N) J.E. Wall for qualifying as the top Combat Systems Engineering candidate of 1995. Wall was one of four MARE 44C finalists to appear before a selection board in Halifax. Capt(N) G. Humby, CO FMF *Cape Scott*, chaired the board, assisted by four senior officers representing both coasts and NDHQ. For his achievement, Lt(N) Wall was presented with the prestigious Lockheed-Martin Award. The award of a naval sword was presented by Capt(N) Humby on behalf of Lockheed-Martin. (*CFB Halifax Photo by Cpl D. Bernier*)

Korean War Paint

Talk about long memories. When the Ontario Science Museum came to the Directorate of Maritime Ship Support last summer looking for the paint scheme that was used on Canadian ships involved in the Korean conflict — they didn't go away empty handed.

Their intention was to paint HMCS *Haida* in the 1950s' wartime colours. *Haida* has long since been deactivated, but saw action in Korea and is Canada's only remaining Second World War-vintage tribal-class destroyer. The ship is now on display at Ontario Place on the shore of Lake Ontario in Toronto.

Thanks to the diligent research of Susan Pecman and the collaboration of Ian Buchanan (the man who never throws anything out), the specialized grey paint scheme, complete with decent paint chips, was forwarded to former navy commander Bob Wilson of the *Haida* restoration team. He was tickled pink, to say the least.— **Adapted from the DMSS 2 Weekly Report.**

1997 Maritime Engineering Seminars

MARE

Central Region Seminar

Monday, April 14, 1997

National Archives of Canada
Wellington St., Ottawa

LCdr Tom Shirriff, DMSS 4-10
Tel. (819) 997-9366

Eastern Region Seminar

April 30 to May 1, 1997

Maritime Warfare Centre
CFB Halifax

LCdr Kevin Woodhouse
Tel. (902) 427-0550
(ext. 5404)

Western Region Seminar

To Be Announced

Index to 1996 Articles

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 format. A photograph of the author would be appreciated.