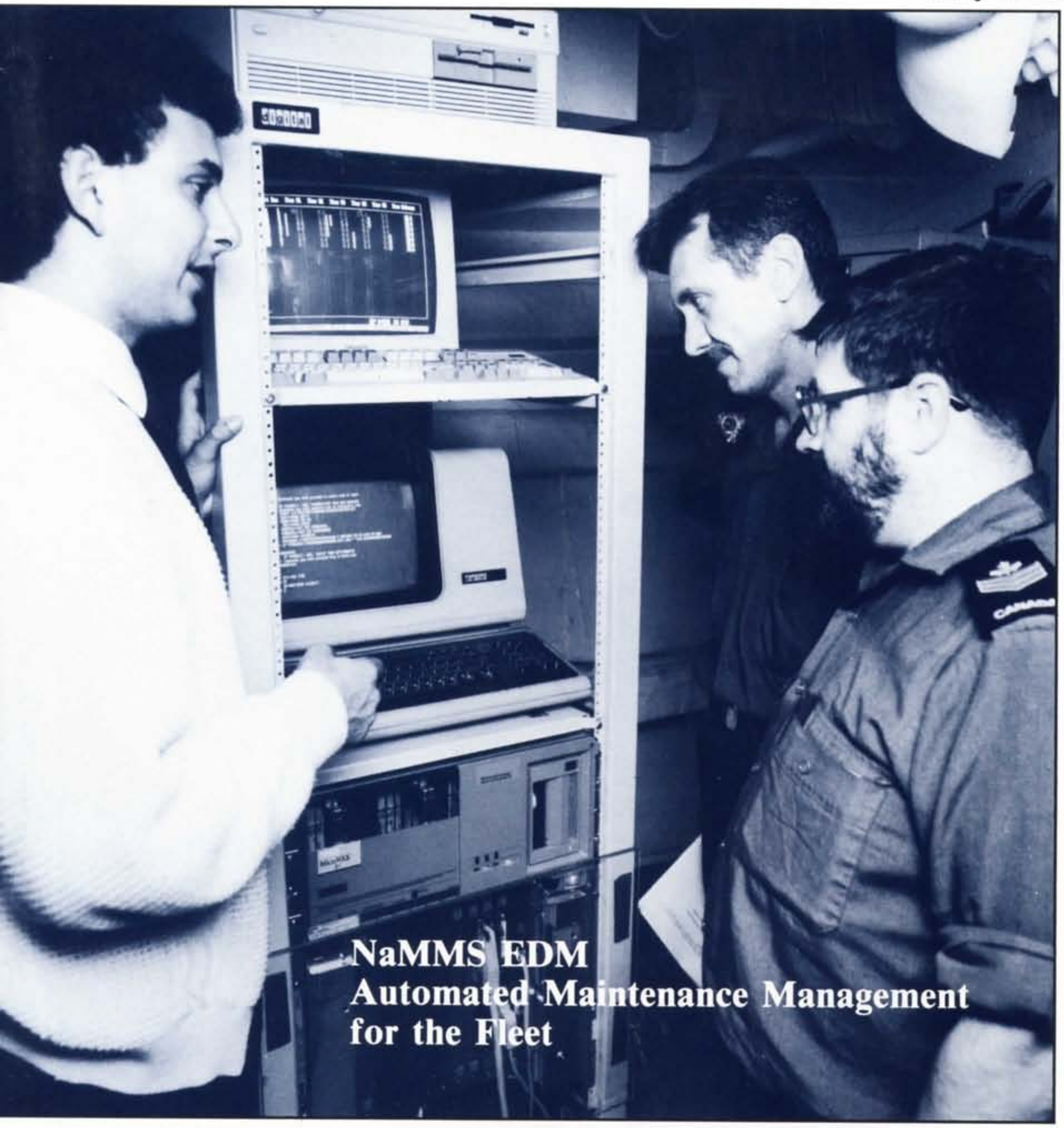
National Defence / Défense nationale

# Maritime Engineering Journal

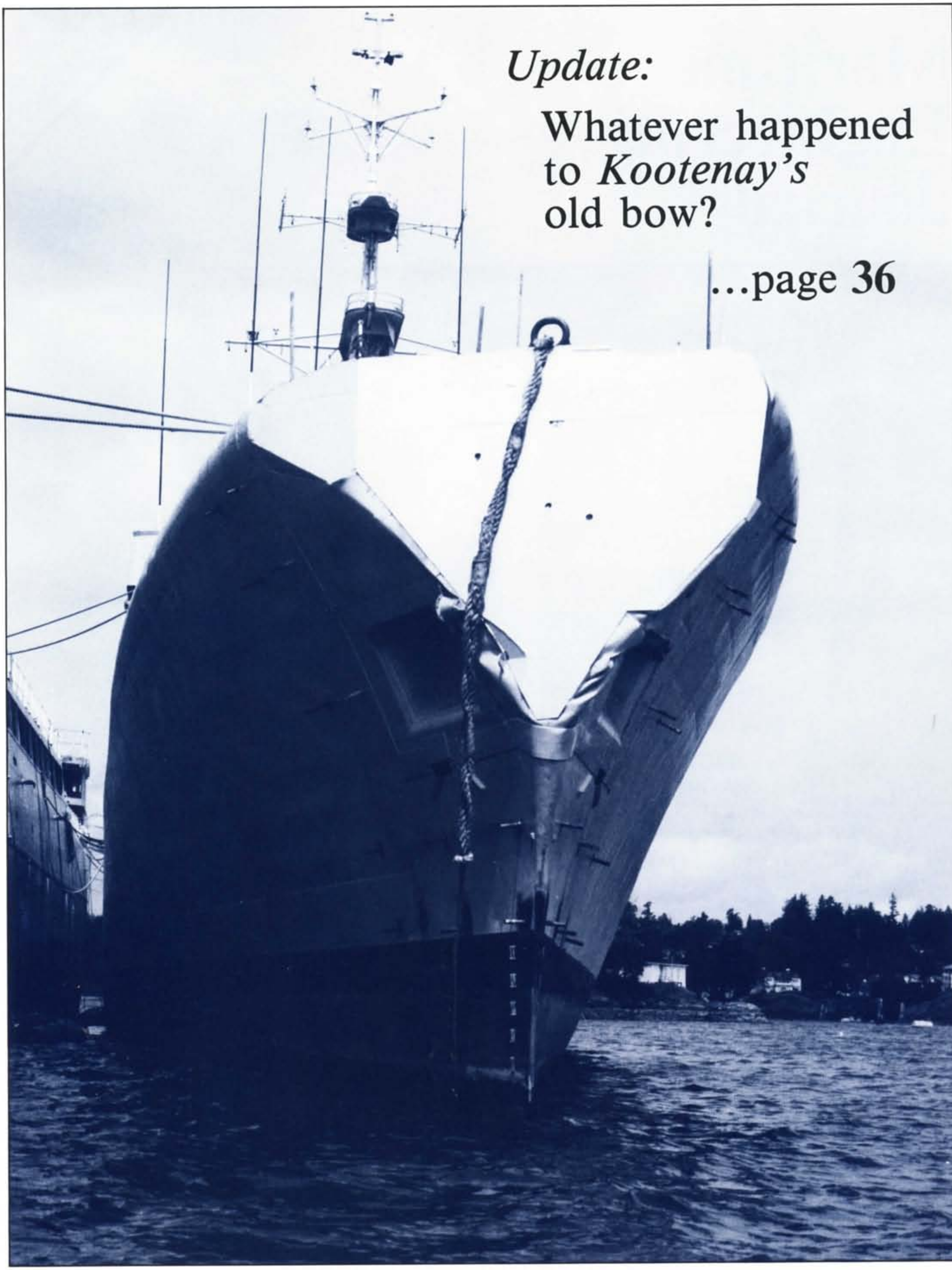
Now a Quarterly

July 1990



**NaMMS EDM**
**Automated Maintenance Management for the Fleet**

Canada




(CF Photo by MCpl Michel Albert, Base Photo Esquimalt)

# Maritime Engineering Journal

Director General
Maritime Engineering and
Maintenance
*Commodore W.J. Broughton*

Editor
*Capt(N) Dent Harrison*

Technical Editors
*Cdr Roger Cyr (Combat Systems)*
*LCdr Rick Bracken (Combat Systems)*
*LCdr N. Leak (Marine Systems)*
*LCdr Darcy Byrtus (Naval Architecture)*
*LCdr Cliff Johnston (Naval Architecture)*

Production Editor
*LCdr(R) Brian McCullough*
*(819) 997-9355*

Graphic Design
*Ivor Pontiroli DPGS 7-2*

Word Processing by DMAS/WPRC 4MS
*Mrs. Terry Brown, Supervisor*

Translation Services by
Secretary of State Translation Bureau
*Mrs. Elaine Lefebvre, Director*

**JULY 1990**



**OUR COVER**

Domenic Racanelli, NETE system manager for the NaMMS EDM (see story inside), explains VMS operating system commands to MSET Jim Green and P2 Gilles Desrosiers of HMCS *Huron. (CF photo by Cpl Richard Sirois, Base Photo Esquimalt)*

The Maritime Engineering Journal (ISSN 0713-0058) is an authorized, unofficial publication of the maritime engineers of the Canadian Forces, published four times a year by the Director General Maritime Engineering and Maintenance. Views expressed are those of the writers and do not necessarily reflect official opinion or policy. Correspondence can be addressed to: **The Editor, Maritime Engineering Journal, DMEE, National Defence Headquarters, MGen George R. Pearkes Building, Ottawa, Ontario, Canada K1A 0K2.** The editor reserves the right to reject or edit any editorial material, and while every effort is made to return artwork and photos in good condition the Journal can assume no responsibility for this. Unless otherwise stated, Journal articles may be reprinted with proper credit.

# Editor's Notes

## The investment is paying off — Keep those cards and letters coming in. . .

We've done it! After eight years of publication the *Maritime Engineering Journal* has officially gone quarterly. Only three issues will appear during this calendar year, but the publication of the issue you are reading now marks the beginning of our new quarterly production schedule. From here on in we'll be bringing you the *Journal* four times a year — in January, April, July and October.

This is a significant milestone for us because it marks the achievement of a goal that was set back in 1985. That was the year the *Journal* began publishing three times a year after being redesigned into more or less the format we see today. In the five years since then the editorial staff has been steadily grooming the *Journal* and streamlining its production process to make quarterly production of our branch journal a reality.

So why a quarterly. Well, it might interest you to know that we did *not* step up publication to accommodate an increasing number of article submissions. To the contrary, when the *Journal* was started along this path five years ago, there was some concern we wouldn't receive enough articles to "fill" four issues every year.

What *was* certain, however, was that the *Journal* had to be made more accessible to the membership it serves. Breaks of even four months between issues were just too long for the magazine to function properly as a working journal of Canadian maritime engineering activity, ideas and concerns. It would have to appear at least quarterly. So we pressed on, believing that somehow enough article submissions would find their way into our mail-bag.

As it turned out, the supply of articles was the least of the worries. Contributions have reached the point now where we *must* produce four issues a year just to accommodate them all within a reasonable time frame. This is tremendously encouraging, especially since we're beginning to see some fairly strong feedback to articles published in recent issues. If ever proof were needed of the *Journal's* importance within the maritime engineering branch, few things could be more convincing than the present demands for publishing space.

* * * * * * *

And finally, as I prepare to leave DMEE and the *Journal* to take up my new posting as Director of Military Program Planning in NDHQ, I would like to extend farewell best wishes to three senior MAREs who will be retiring this summer: Rear-Admiral D.R. Boyle (Chief of Engineering and Maintenance), Commodore Ed Bowkett (Project Manager Canadian Submarine Acquisition Project) and Commodore Bill Broughton (Director General Maritime Engineering and Maintenance). These officers deserve the congratulations of the maritime engineering community for their many years of dedicated and meaningful naval service.

Dent Harrison

*Our thanks go to Captain Harrison for the discerning editorial direction and guidance he provided during the past two years, and we extend to him our best wishes for a successful term with his new directorate. (The editorial staff)*

RAdm D.R. Boyle

Cmdre E.G.A. Bowkett

Cmdre W.J. Broughton

# Letters to the Editor

Dear Sir,

Thank you for sending me the (January/April issue) of the *Maritime Engineering Journal*. I especially enjoyed the article on the HMCS *Kootenay* collision repair as I was working at NEU(P) when this work was done.

Slt(R) Bruce Trayhurn
HMCS *Unicorn*
Saskatoon, Sask.

Dear Sir,

A short while ago I had occasion to read an article in the April 1989 edition of the *Maritime Engineering Journal* entitled "Naval Officers as Programmers – A Wasted Resource" by Cdr Roger Cyr. Being the present course officer for the Advanced Programmer Analyst course at the Canadian Forces Fleet School in Halifax, I am opposed to much of the content of this article. Accordingly, I am enclosing a paper which looks at Canadian naval programmers from a different perspective.

Lt(N) C.P. Conrad
APA Course Officer
CF Fleet School, Halifax

*(Lt Conrad's paper and other commentaries appear in the Forum section of this issue. – Ed.)*

Dear Sir,

We write this letter to explore certain aspects of professional engineering within the DND.

Provincial statutes (in Ontario "The Professional Engineers Act") require that no person shall practice engineering in the province without licensure as a Professional Engineer. This requirement is cascaded from a federal statute which requires the provinces to enact such legislation, but exempts employee engineers of the federal government from compliance with the licensing requirement.

To quote from the Ontario Act, Article 2.(3) : "The principal object of the Association is to regulate the practice of professional engineering and to govern its members, holders of certificates of authorization, holders of temporary licences and holders of limited licences in accordance with this Act, the regulations and the bylaws in order that the public interest may be served and protected." Clear evidence of the results of this activity are reflected in the bimonthly APEO journal "Engineering Dimensions," with its publishing of disciplinary actions against members.

Specific obligations under the Act include compliance with a Code of Professional Conduct, a Code of Ethics, and Performance Standards (Ontario Regulation 538/84 Sections 86, 91, and 91a). To quote from a letter issued by the Order of Engineers of Quebec : "...the engineer must affix his seal and signature on plans and specifications, sign reports and studies which he has prepared himself or which have been prepared by a non-member, under his immediate supervision. By performing such an act the engineer commits his entire responsibility relative to any fault resulting from his work."

There is no provision in the Act exempting licensed Professional Engineers from the requirements of the Act should they happen to work for the federal civil service.

The apparent contradiction is this: even though many engineers within the DND are licensed "P.Eng." (or "ing." in Quebec), we are not necessarily compliant with all of the requirements of the Act.

It would seem that the situation within the federal civil service creates an environment where incompetent and negligent engineers could continue to work, and escape responsibility and accountability for their actions.

A further complication arises in the MARE community as many of our number are relocated to different provinces on a regular basis. Should we be seeking to be relicensed every time this happens? An unworkable situation would result.

The opinions of the readership are solicited.

G.E.Clunis, P.Eng., ing.
(formerly) DMEE 2-7-3

M.L. Gingras, ing.
DMEE 2-3-4

# Commodore's Corner
## *The View from Washington*

*By Commodore E. Lawder*

I was delighted to be asked to write the Commodore's Corner for this issue. The last time I had the honour was in 1985 when I was COSMAT in Maritime Command. In that last job I was very much in a "technical" position so there was some logic to appear on this august page. Other than having "grown up" as a MARE, you may ask what are my credentials now for this honour since I am the Canadian Forces Naval Attache (CFNA) in Washington. Good question! Let me try to explain and then go on to give you some insights from "the most important capital in the world" as our hosts would have us believe.

By far the greatest number of naval attaches have been MARS officers. When VAdm Hotsenpiller was in the Personnel Branch he actively promoted a concept of "Best Sailor" for a number of "Naval Operations" and "Naval Engineering" jobs, meaning they would be filled by either MARS- or MARE-background officers. The Naval Attache job became one of those. From my experience, I can say that this job is one of the most gratifying and interesting jobs available to our MARE community.

What makes this job so interesting? On maritime matters for our navy, the Naval Attache Section is one of the main doors into the U.S. Navy. On behalf of our navy, we deal with the "technicalities" of engineering and operations matters. Where Canadian interests are jeopardized, we also deal with substantial issues at the diplomatic and political level. A current example concerns a maritime boundary dispute.

The CFNA staff's most important international activity is bilateral and multilateral relations with the USN. Our accreditation and location in Washington allow us to know with whom to deal, and therefore, who can best help us with Canada/U.S. Navy problems. At the direction of MARCOM or NDHQ, we can conduct discussions with the USN on an attributable basis which could lead to bilateral agreements. More importantly, though, we can conduct discussions on a non-attributable basis which can set the stage for agreements important to our naval interests. In cases like these, it is vital to look one's counterpart in the eye to judge if he is hiding something, is bluffing or is sincere about a common interest. Often, the opportunity to do this arises on short notice, and to seize the opportunity means the difference between capitalizing on it or missing it. This can only be done from Washington.

The importance of the relationship between the Canadian navy and the USN should not be minimized. The United States is our strongest ally and, compared to us, they have the ability to address problems with overwhelming resources. Canada can benefit from close ties if we have a common goal or interest. There is great potential for cooperation and greater payoff for cooperation that is successful. Notwith-

**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 may be controversial.
- To present practical maritime engineering articles.
- To present historical perspectives on current programs, situations and events.
- To provide announcements of programs concerning maritime engineering personnel.
- To provide personnel news not covered by official publications.

**WRITER'S GUIDE**

We are interested in receiving unclassified submissions, in English or French, on subjects that meet any of the stated objectives. Final selection of articles for publication is made by the Journal's editorial committee.

Article submissions must be typed, double spaced, on 8 1/2 × 11" paper and should as a rule not exceed 4,000 words (about 17 pages). The first page must include the author's name, address and telephone number. Photographs or illustrations accompanying the manuscript must have complete captions. We prefer to run author photographs alongside articles, but this is not a must. In any event, a short biographical note on the author should be included with the manuscript.

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

standing, the USN is a big self-interested bureaucracy where often the left hand doesn't know what the right hand is doing. They have relationships with many other navies and their attention to any single small navy is therefore limited. CFNA's job is to lobby the USN, and if necessary the Congress, on behalf of our Canadian naval interests to keep important Canadian issues in the forefront of their attention.

The Naval Attache staff can quickly respond to Canadian naval interests. By telephone, we handle a high volume of technical queries and a high volume of information on diverse subjects ranging from barbershop chairs to "poopy suits" for submariners. We are the "guardian" for many Information Exchange projects and memoranda of understanding. We provide support to major Crown projects like CPF and TRUMP by monitoring Foreign Military Sales projects for weapon and sensor systems. We also provide support through the Commercial Section of the Embassy to the many Canadian industries which do business with the USN.

On the personnel side, the Naval Attache staff looks after the interests of 84 naval officers, enlisted ranks and civilians who work in the United States with the USN. The most important task is the review of PERs. We also carry out a major function to clear and coordinate visits to the USN and to arrange bilateral staff talks between our navies.

In short, there are a considerable number of engineering, operational, diplomatic and administrative issues of importance to the Canadian navy which are woven into our relationship with the United States and the U.S. Navy. The office of the CFNA must be proactive in these issues in order to represent the interests of Canada and the Canadian navy. It is an interesting and at times a formidable task. Being on CFNA staff requires attention to a wide range of activities and is a challenging posting. Our southern neighbour is a friendly giant who sometimes forgets that we are there. Our task in the Naval Attache Section is to see that the right offices in the USN are prodded in order to convey Canada's and the Canadian navy's interests. The bottom line is that our efforts are to support you in NDHQ and in Maritime Command.

# A farewell message
## from Commodore W.J. Broughton, DGMEM

Just about the time that this issue goes to distribution, I will be going on retirement leave after thirty-seven years in the navy. Since entering the Royal Roads Military College in September, 1953 I have had numerous fortunate happenings, have met innumerable first-class officers and sailors, and had many challenging and interesting appointments.

Without question, the most rewarding and satisfying appointment has been this last one – as DGMEM and Branch Co-Adviser for the Naval Technical Occupations. The support I have enjoyed has been tremendous and it is with a deep sense of gratitude that I bid farewell.

Maritime Engineering will soon be in the very capable hands of Commodore Mike Saker, and I urge you all to give him the same high quality of support that you gave me.

Thank you and Godspeed.

Yours aye,

W.J. Broughton

# NaMMS EDM

## *Automated maintenance management for the fleet*

*By LCdr R.H. Bayne, LCdr W. Dziadyk and Lt (N) J. Roop*
*CF photos by Cpl Richard Sirois, Base Photo Esquimalt*

**Introduction**

At present the Naval Maintenance Management System Exploratory Development Model (NaMMS EDM) is one of the most important maintenance management projects of the Canadian navy. It has far-reaching implications for the maintenance and readiness of future naval vessels, including TRUMP and CPF. With the addition of these new naval vessels, along with updated marine and combat systems, the 1990s will bring great advances and even greater challenges in the field of automated data processing (ADP) within the Canadian navy. The installation and implementation of the HMCS *Huron* Exploratory Development Model is the first coordinated attempt at investigating the uses of networked ADP in automating the Naval Maintenance Management System.

**System Manager P1ET Jim Christie performs checks on the *Huron* EDM local area network. The success to date with the EDM signals a major step forward in the process of naval maintenance administration.**

**Background**

The Naval Maintenance Management System is the policy document that has directed the Canadian navy in maintenance administration for over a decade. NaMMS uses the Ship's Maintenance Management Information System (SMMIS) to provide computerized services throughout the navy. Although SMMIS has developed a large data base, its input/output mechanisms are obsolete and do not satisfy user requirements at each level of support.

In order to take advantage of new technology, a replacement information system, NAMMIS (Naval Maintenance Management Information System), is under development to upgrade not only the existing shipboard maintenance information system, but the command and NDHQ systems as well. Enhanced input/output features, state-of-the-art hardware and software, and user-oriented philosophy will combine to eliminate the deficiencies associated with first-generation information systems; in particular, SMMIS. From out of the NAMMIS development project, the NaMMS EDM was born as a demonstration project to prove the feasibility of shipborne ADP equipment and to develop the "way ahead."

**System Description and Scope of the EDM**

The scope of the NaMMS EDM project is to evaluate the feasibility of a computerized, on-board maintenance administration system over a two-year period. The first six months would be critical since opinions and work practices would be established during this initial stage.

In October 1988 DMES 6 installed ten colour Z286 PC-AT workstations in workshops and offices in HMCS *Huron*, each with its own dot matrix printer as shown in *Figure 1*. (*Huron* was selected for the trial because she will be the last of the Tribal class to undergo TRUMP refit.)

Using an ethernet local area network, the workstations were connected to a ruggedized, rack mounted, hard-disk data base which stores all the ship's data. The Digital Equipment of Canada Ltd. (DEC) VAX-based hardware and software platform is managed by two petty officer first class tradesmen (HT and ET). They ensure defective equipment is sent to the contractor (who has offices worldwide) and that system software is operating correctly.

The primary software under investigation is the Equipment Management System (EMS), a contractor-developed program for the automation and improvement of shipboard maintenance management. Designed particularly for ship's engineers and technicians, EMS is able to:

* screen a Maintenance Action Form (MAF) for endorsement;

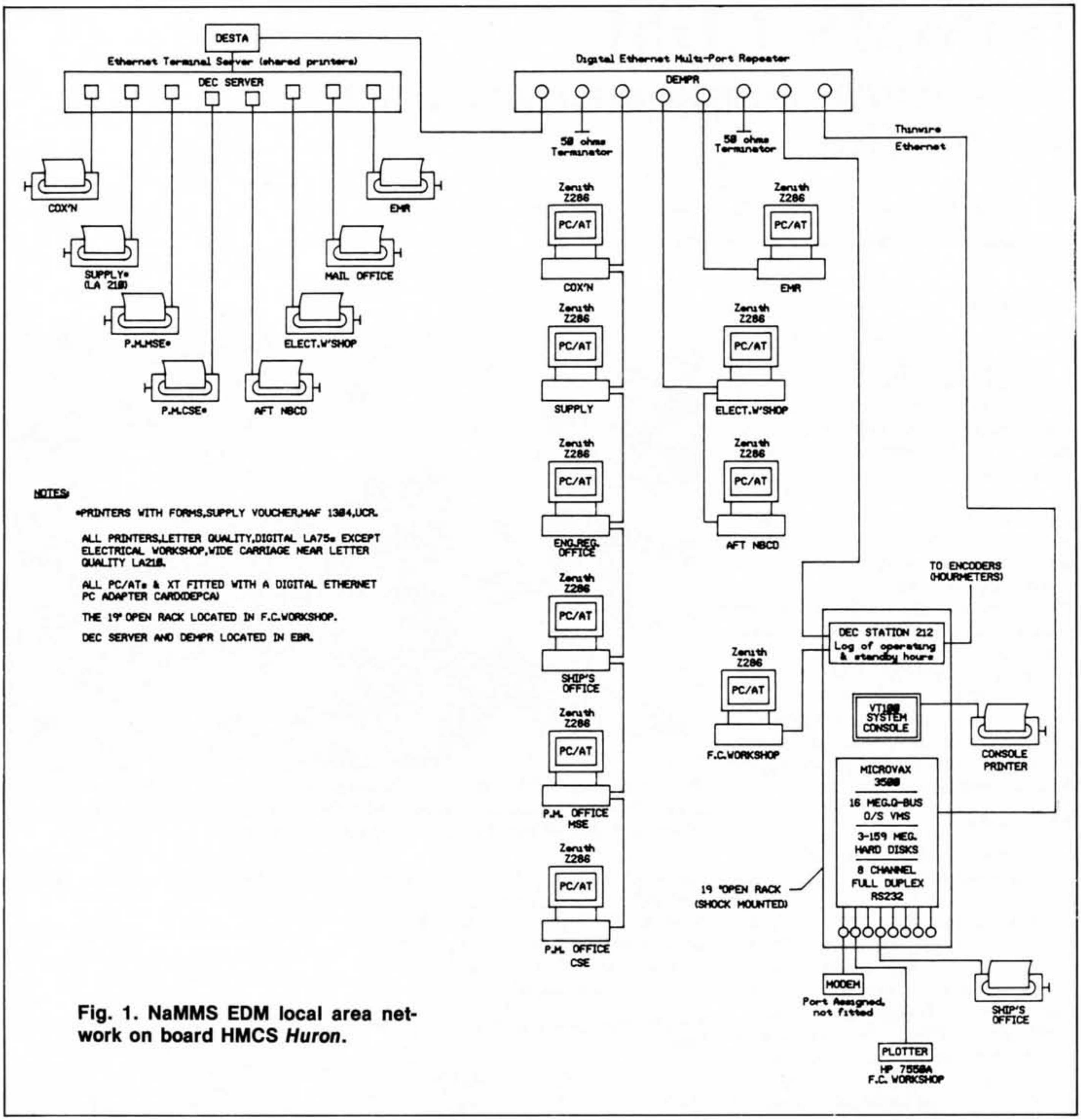



**Fig. 1. NaMMS EDM local area network on board HMCS *Huron*.**

* print the MAF for transmission to repair facilities ashore;
* schedule and print planned maintenance routines;
* transfer the MAF to floppy disk for upload to the SMMIS data base;
* automatically record MAF actions in the EMS "electronic Kalamazoo" equipment record register;
* screen and print UCRs and supply documents; and
* provide software for graphing, storing and reporting equipment health monitoring (EHM) activities within the ship.

A block diagram of the EMS application program is included as *Figure 2*.

The use of equipment health monitoring techniques is a prerequisite to the implementation of reliability centred maintenance (RCM) policies. RCM can eliminate unnecessary routine maintenance and prolong equipment life cycle. This means considerable cost savings both in terms of manpower and spare parts. The NaMMS EDM project includes an experimental EHM module which provides SOAP, Diesel Lube Oil Condition, Diesel Cooling Water Con-

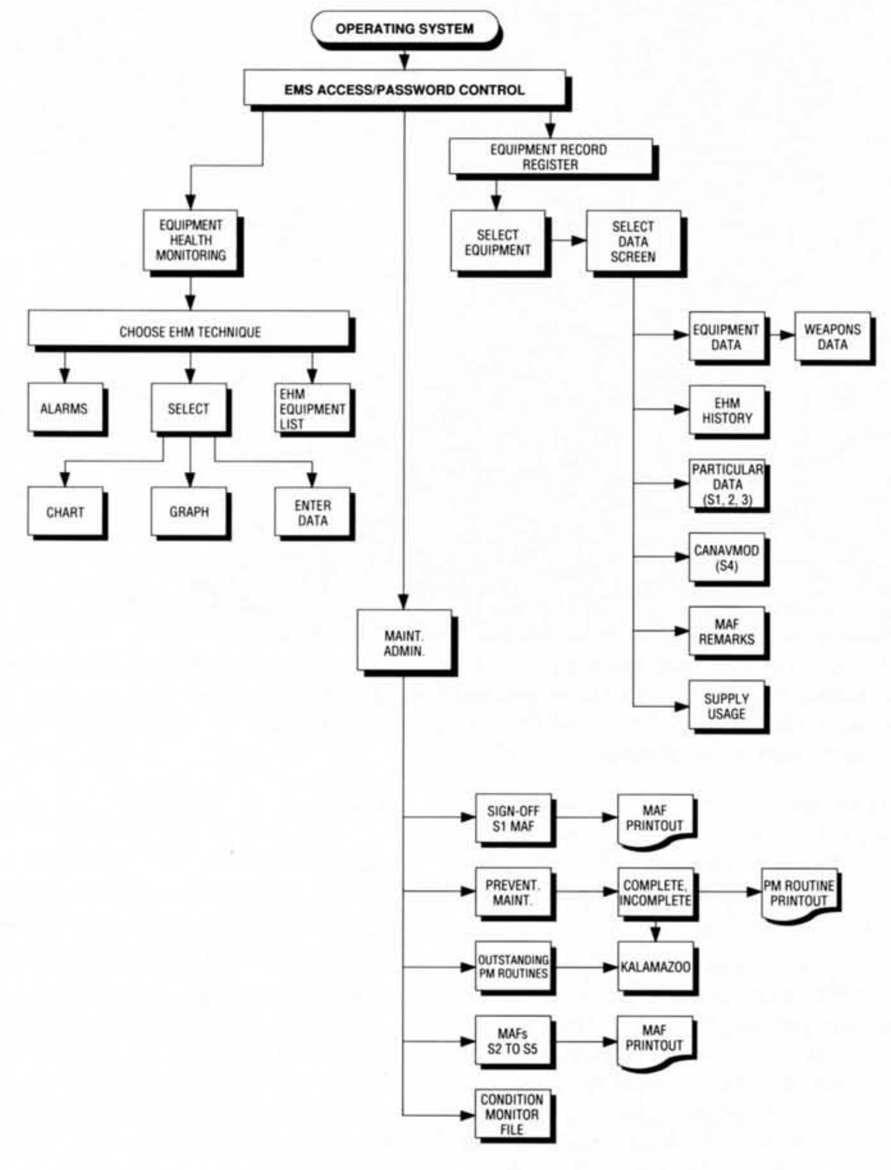



**Fig. 2. Equipment Management System Program Organization**

dition and Millipore Patch Test utility programs.

The *Huron* EDM also provides the opportunity to test the Computer Based Systems Timer (CBST), a device which automatically records equipment operating time for automatic recording on the MAF and UCR. This Canadian invention uses the power-main current fluctuations to indicate when the equipment is being switched on and off. In this manner, accurate mean time between failures (MTBF) can be obtained automatically.

The NaMMS EDM also hosts the shipborne version of BLIPSS-M, the military personnel administration part of the Base ADP program, soon to be installed in all Canadian Forces bases.

One of the NaMMS EDM objectives was to measure the usefulness of commercial microcomputer software under shipboard conditions. To assess this, a number of software packages were installed on the computer network together with a menu program which controls and records their usage rates. The network services include:

* a word processor with thesaurus and spell-checker;
* a database management system;
* a spreadsheet;
* two programming languages;
* a scheduler;
* a communications package;
* a windowing system which provides an appointment calendar, screenable clock, file cards, phone lists, editor, graphics program and many other handy programs; and
* several other software utility programs.

The NaMMS EDM project is also evaluating the suitability of both commercial grade and ruggedized computer hardware in a shipboard environment. (The Naval Engineering Test Establishment in LaSalle, Quebec developed appropriate mountings for the workstations for testing in an operational destroyer.)

**EDM Development and Preparation**

Development of such an ambitious EDM required specialists in computer engineering, the naval engineering disciplines of combat and marine systems, and in software design. These areas of expertise are provided, respectively, by NETE, DGMEM and Fleetway Consulting Services Inc. of Ottawa.

In January 1987, DMES 6 and NETE conducted a fleet-wide survey of ships' maintainers with the aim of assessing the requirements for a computerized maintenance management system. This study collected the data which formed the basis for the selection of the basic hardware and software systems which were used in *Huron*.

The next step was to approach the Naval Modification Review Board (NMRB) for permission to trial the equipment. NMRB was told that, based on the experience and information from such shipboard trials, the navy could develop a comprehensive maintenance maintenance management system for the entire fleet. Approval was granted in the fall of 1987.

The complete EDM system, including software, was first installed at NETE. For four months both the hardware and software underwent exhaustive testing and evaluation. This land-based testing and verification of the system proved to be extremely valuable. Several hardware and software failures were detected which could have crippled the evaluation had they occurred during the sea trials. The experience was similar in the case of the BLIPSS-M software.


**Ship's staff was very positive about the availability of computing equipment on board *Huron*. Computer expertise increased during the first six months of the NaMMS EDM trial, and the effect of computers on non-maintenance-related work was beneficial.**

After successfully passing this rigorous testing period, the system was moved to the Canadian Forces Fleet School in CFB Esquimalt. During the summer months classes were given on various software packages such as system management, word processing spreadsheets, MS-DOS applications and the Equipment Management System.

**NETE Involvement**

The Naval Engineering Test Establishment has established a section of computer specialists which has as one of its mandates the evaluation of commercial grade ADP equipment for use in HMC ships. NETE engineered and supervised the *Huron* installation and assisted in training ship's staff for the EDM. They also provided ongoing hardware and software maintenance support for *Huron*. NETE set up the following evaluation plan:

* Conduct a preinstallation survey to establish baseline maintenance practices and attitudes of the ship's company;
* Conduct a six-month post-installation survey, reassessing maintenance practices and attitudes;
* Automatically record computer usage according to user class, station and software package employed;
* Record all relevant information, interruptions, system malfunctions, etc. on event logs;
* Compare automatic time recorder readings with results of manual logs of hourmeters;
* Assess the effectiveness of training through interviews and surveys;
* Compare, where appropriate, the NaMMS EDM survey results with the findings of the original, January 1987, fleet-wide survey; and
* Conduct periodic post-installation assessments.

**Interim EDM Findings**

In March 1989 DMES 6 and the Naval Engineering Test Establishment conducted a six-month post-installation assessment of the NaMMS EDM on board *Huron*. In addition to collecting and analyzing technical data, the ship's officers and maintainers were questioned to determine maintenance administration practices and attitudes. This information was compared to the July 1988 pre-installation baseline data and, wherever possible, to the fleet-wide survey results from 1987.

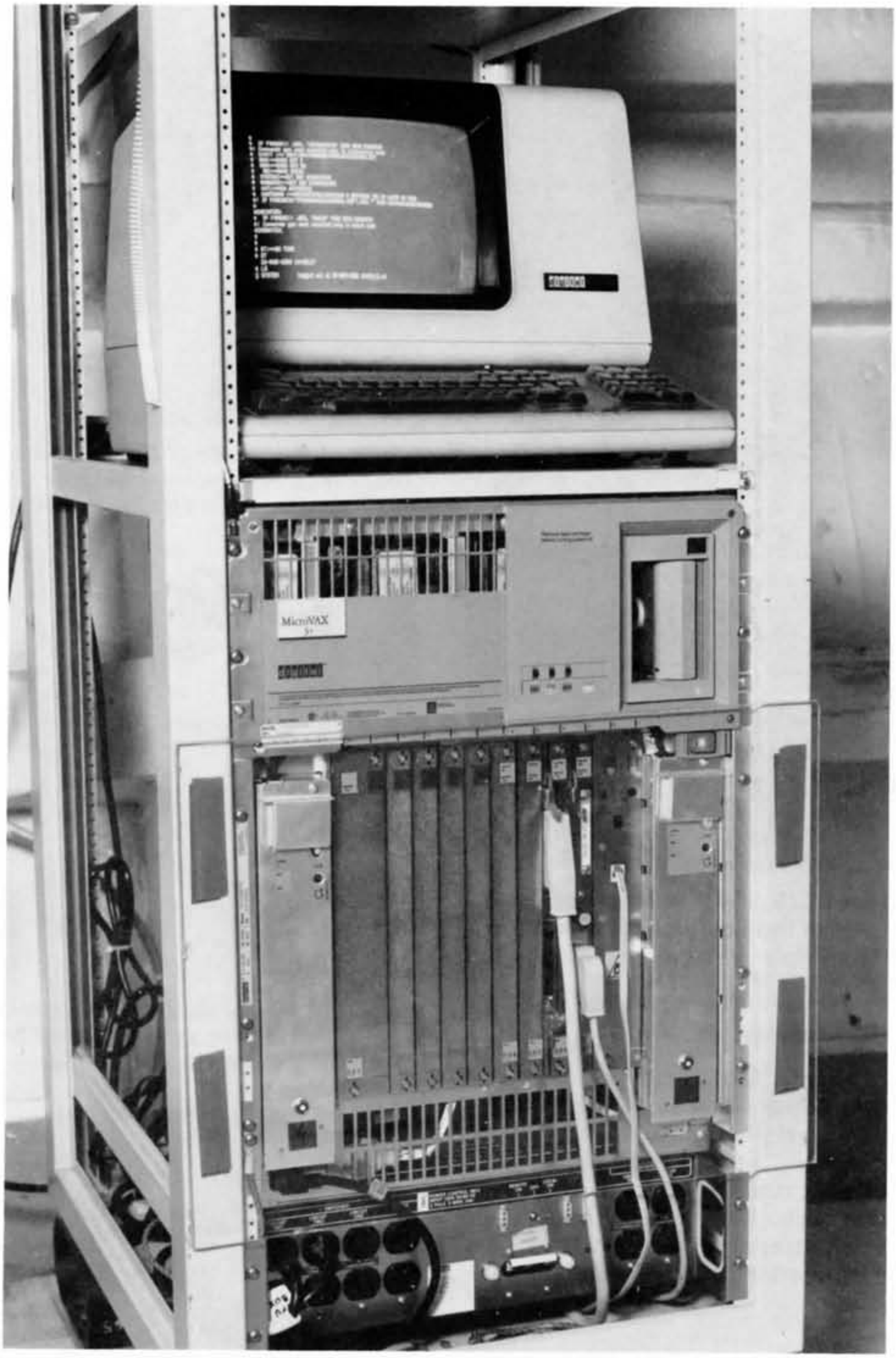
The assessment of the DMES 6/NETE evaluation team was unanimous in judging the NaMMS EDM trial, to date, a success. Moreover, the majority of the ship's company warmly endorsed the project, having adapted their work pattern to the computerized maintenance management system. All in all, *Huron's* staff judged it to be more efficient than the manual process. For example, whereas most maintainers readily admitted the paper version of the equipment record register does not provide an accurate indication of equipment status, the automatic database update and MAF search features of the NaMMS EMS electronic Kalamazoo met with their unequivocal approval.

The complaints voiced most often during the interviews focused on the slow response time of the system and the lack of an adequate number of workstations. In particular, a workstation is required in the Avionics Workshop. The system response problem will be addressed by the installation of the latest DEC software, and several other areas requiring system improvement have already been actioned.

The use of the EHM utility programs such as SOAP, Diesel Cooling Water Condition and Millipore Patch Test was low during the trial. However, those maintainers who did make use of the applications felt they were beneficial.

The most popular packages proved to be the word processing and database management systems. Other software was only available on a single-user basis, which may explain its relatively low usage rate. Generally, the ship's staff was very positive about the availability of computing equipment on board HMCS *Huron*. According to 60 percent of the survey respondents, computer expertise increased during the first six months of the trial and the effect of computers on non-maintenance-related work (such as the watch-and-station-bill) was also beneficial.

The commercial grade microcomputers were found to perform acceptably in the operational environment, provided they were mounted to withstand shock and vibration. Unfortunately, the performance of the ruggedized MicroVAX met with design problems and was replaced in March 1990 by a commercial grade CPU which is expected to be more reliable. The Equipment Management System software used during the EDM trial fulfilled the require-



**The central processing unit for the NaMMS EDM network with the system manager's workstation mounted above it. Atop this (not shown here, but visible on this issue's front cover) is the Computer Based Systems Timer.**

ments, and the low-cost commercial software packages were found to be adequate for other shipboard work.

There is no question that the effectiveness of ship's maintenance, to a great extent, depends on accurate record-keeping. Based on analysis of the collected data, short-term maintenance decisions are made and long-term policies established. The current method of maintenance action recording utilizes an outdated system, SMMIS, which does not hold the confidence of its major users, the LCMMs and ship maintainers. The NaMMS EDM project is demonstrating that the first step in improving maintenance record-keeping must be at the level of data input.

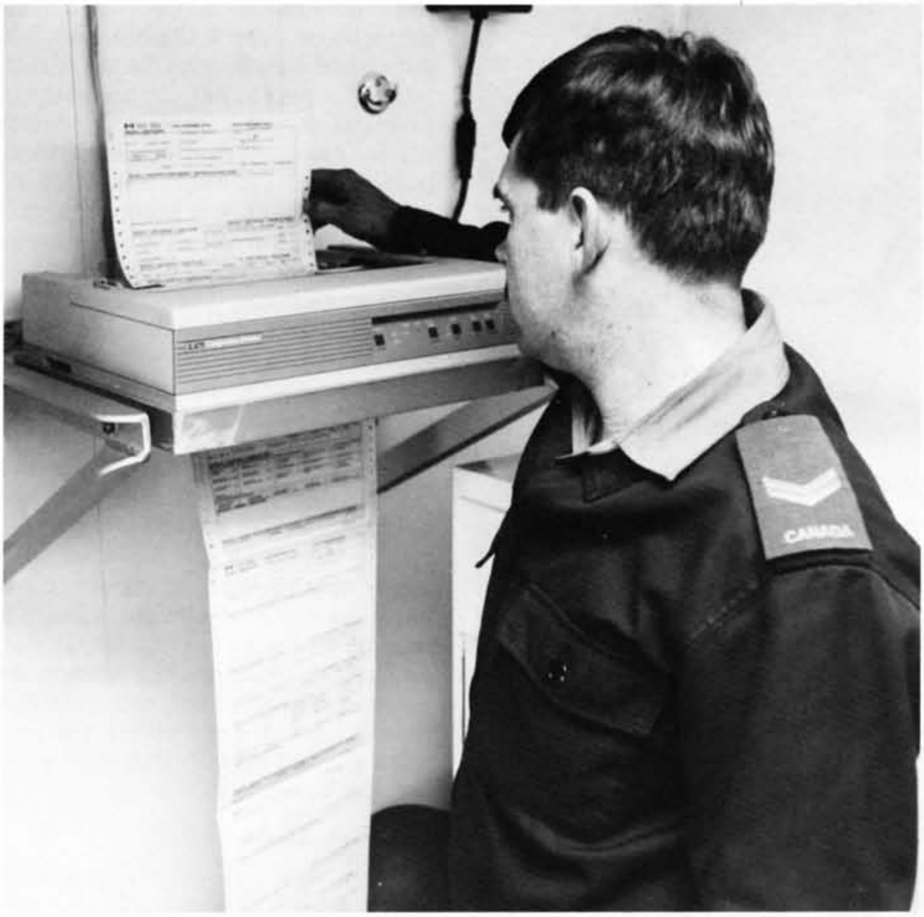
In addition to naval maintenance management, several shipboard applications could benefit from the use of computers: personnel management, financial services, inventory control, office automation, supplies/stores, training and the requirements of the medical office. Care, however, should be taken to coordinate the hardware installations and system development for these applications. The current addition of the BLIPSS-M application to the NaMMS EDM hardware is a good example of such coordination and efficient use of the physical resources.

The NaMMS EDM project is providing valuable first-hand experience with a shipboard ADP installation. The success to date with the EDM signals a major step forward in the process of naval maintenance administration. The feasibility of a fleet-wide, computerized on-board maintenance management system now seems assured, and it can only be a matter of time before the navy reaps the full benefits that such a system can provide.

**The Way Ahead**

The first six months of the EDM were just the first step in the introduction of on-board non-tactical ADP to the ships of the fleet. The NaMMS EDM will continue until HMCS *Huron* enters TRUMP refit. The major activities associated with the remainder of the EDM are:

* Suggestions of the ship's staff and the evaluation team are being considered for immediate implementation. (Most will have been done by the time this article appears in print).
* Planned improvements to the system are being carried out; e.g., transfer of MAF data to the Data Collection Centre through asynchronous communication lines. (Those considered cost-effective have either been done or are being engineered.)
* System management staffing requirements are being determined. A new "System Manager" role is emerging which will be a departure from the traditional Assistant and Departmental Maintenance Coordinator roles of the past.
* Concepts introduced by the NaMMS EDM are being consi-



**A Maintenance Action Form is printed on the LA75 printer in *Huron's* Planned Maintenance Office. The automated features of the Equipment Management System software were well received by the ship's maintenance personnel.**

dered for adoption in the new vessels of the Canadian navy.

* A comprehensive report and feedback will be given to the staff of HMCS *Huron*.
* A second interim evaluation will be conducted a year and a half from the date of installation.

At the time of writing the second interim evaluation was under way in *Huron* . Although the full data had not yet been assessed, early indications seemed to support the successful results of the March 1989 evaluation. One thing is clear, though. If the fleet is to capitalize on this positive, initial experience with a NaMMS exploratory development model, both a process and an organization to oversee the updating of non-tactical ADP software will be required within the Canadian navy.

**Acknowledgment**

The authors would like to express their appreciation to the captain and crew of HMCS *Huron* for making the shipboard evaluation of the NaMMS EDM a success. In particular, P1HT Don Nicholson and PIET Jim Christie deserve special mention for their efforts in pioneering the new System Manager position.

**Reference**

1. NETE Report 33/89, "Interim Evaluation of the NaMMS EDM on HMCS HURON", by Ivan G. Fuchs.

*LCdr R.H. Bayne is the DMES 6 subsection head for naval maintenance information systems and is Project Director for NAMMIS.*

*LT(N) J. Roop was the DMES 6 NaMMS EDM project officer from 1987 until his posting last February to PM DELEX.*

*LCdr W. Dziadyk was the HMCS Huron Combat Systems Engineer during the NaMMS EDM evaluation. He is currently the senior electronic warfare project officer in DMCS 9.*

# AAW Computer Modelling of CPF and TRUMP

*By Michel Beaulne and Greg Walker*

**Introduction**

As the application of computers continually expands, computer simulation is being realized as an increasingly more important and cost-effective tool for decision-making and analysis. Computer models and simulations are used to predict the operation of physical systems. These models are defined by mathematical or logical relationships which correspond to processes and events in a "real-world" system. As *Figure 1* might suggest, experimentation with the actual system or physical model is not always possible and a validated computer model can be beneficial. Some of the benefits for naval combat system simulations are:

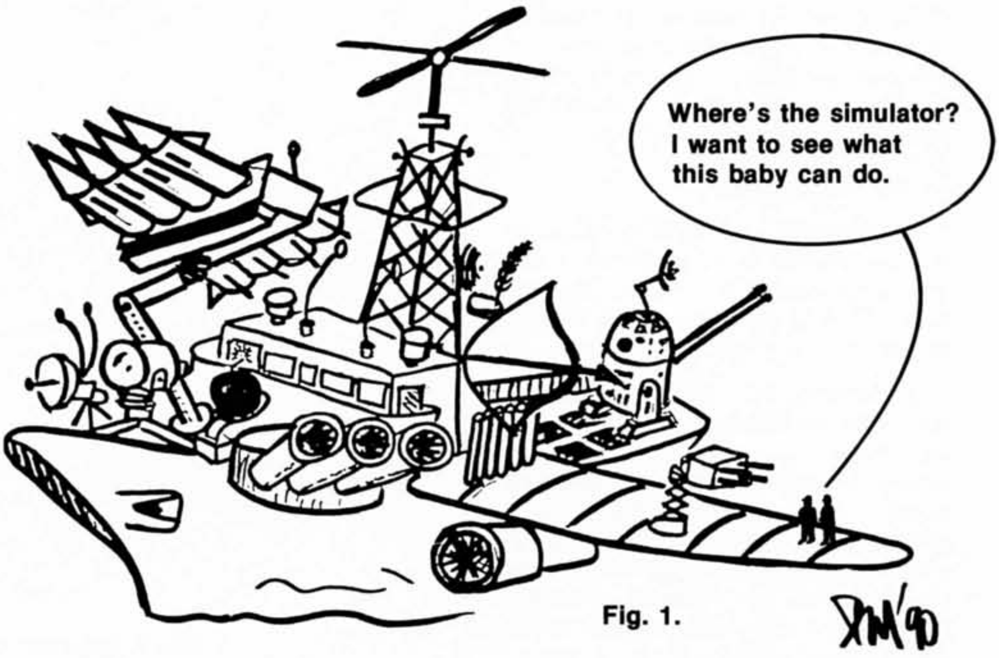



Fig. 1.

a. Cost — a computer model reduces the number of costly sea trials requiring test targets, aircraft, ammunition, ships, and crew. (Note: some sea trials are required to validate the computer model.)

b. Repeatability — performance evaluation scenarios can be repeated as many times as is necessary, using the model with identical target, environmental and ship system conditions,

c. Adaptability — parameters representing weapons, sensors and threats are easily modified to evaluate ship performance under different scenarios.

It is important to note that it is not inexpensive, in terms of time and money, to design, develop and validate a computer simulation. However, these costs can be reduced by using an existing validated model possessing sufficient fidelity to do the studies desired. If a combat system model is well documented, modular and written in a high-level language, it should be relatively easy for new users to acquaint themselves with its limitations and tailor it with the parameters of their own combat system. By having a common naval combat system model, many users can benefit from sharing such developments as parameters for a given ship, modules describing a new weapon, and the post-processors used as analysis tools. This leads naturally to increased communication and exchange, while reducing redundant effort.

**Background**

In 1988 the Surface and Anti-Air Weapons Systems section of DMCS acquired a powerful, validated Ship Combat System Simulation (SCSS) model from the U.S. Naval Surface Warfare Center in Dahlgren, Virginia. The model is currently being tailored to simulate the anti-air warfare (AAW) suites for TRUMP and CPF.

SCSS is a simulation program written in SIMSCRIPT II.5, a general-purpose simulation language which supports software engineering principles such as structured programming and modularity. SIMSCRIPT provides constructs such as processes, resources, events, attributes, entities and sets designed especially to make formulation of a simulation model easier. The modular design of the SCSS program allows for reconfiguration into different combat system architectures.

An SCSS user's group with members in DMCS, Defence Research Establishment Valcartier and Defence Research Establishment Suffield is working to establish this simulator as a common tool. Upgrades for electronic warfare, threat profiles and new weapon modules are being exchanged within the group and with the U.S. Naval Surface Warfare Center.

**Immediate Applications**

The flexibility of SCSS to model naval combat systems and threat scenarios has suggested some immediate applications.

The contractors for TRUMP and CPF have proposed weapon-system acceptance trials which have been designed to demonstrate the capabilities of their systems through a series of test scenarios. It is not feasible to test the ships against a full range of threats due to technical, safety and cost reasons, so the contractors have developed their own computer models to demonstrate contractual compliance. SCSS can act as the Crown's comparison model to validate the contractor model's predicted ship's performance against these types of threats.

The correct choice of vertically launched missile to install aboard the TRUMP ships can also be verified by modifying SCSS with the parameters defining various systems. The models can be run under the same series of scenarios for each missile configuration to determine if there is a significant difference in ship survivability.

**Future Applications**

Experiments with SCSS code can be used to develop more powerful, faster Threat Evaluation and Weapon Assignment (TEWA) algorithms which will optimize ship survivability.

A ship's separate tracking and illumination radars (STIR) "light up" incoming threats to provide guidance for semi-active missiles. Thus the number of missiles which can be launched and guided is limited by the illuminating radars (typically fire-control radars) and the way they are employed. An optimum TEWA scheduling algorithm can control the missile launches so that an illuminating radar will be available to "light up" the target when the missile enters terminal mode. Thus each illuminator could control several missiles in the air simultaneously if the missiles are spaced appropriately. The TEWA scheduling algorithms will be investigated using SCSS to achieve this capability for Canadian ships.

Improvements will also be necessary for the TEWA algorithms which compute weapon assignment tactics utilizing all the weapon systems available to the ship. The perfect TEWA processor would be one that could instantly read the incoming threat, examine all the possible defence scenarios and execute, in fully automatic mode, or recommend to the Command team in semi-automatic mode, the defensive action which optimizes the ship's survivability. Task force TEWA characteristics could also be improved to quickly coordinate all weapons into a defence plan which optimizes the force's survivability.

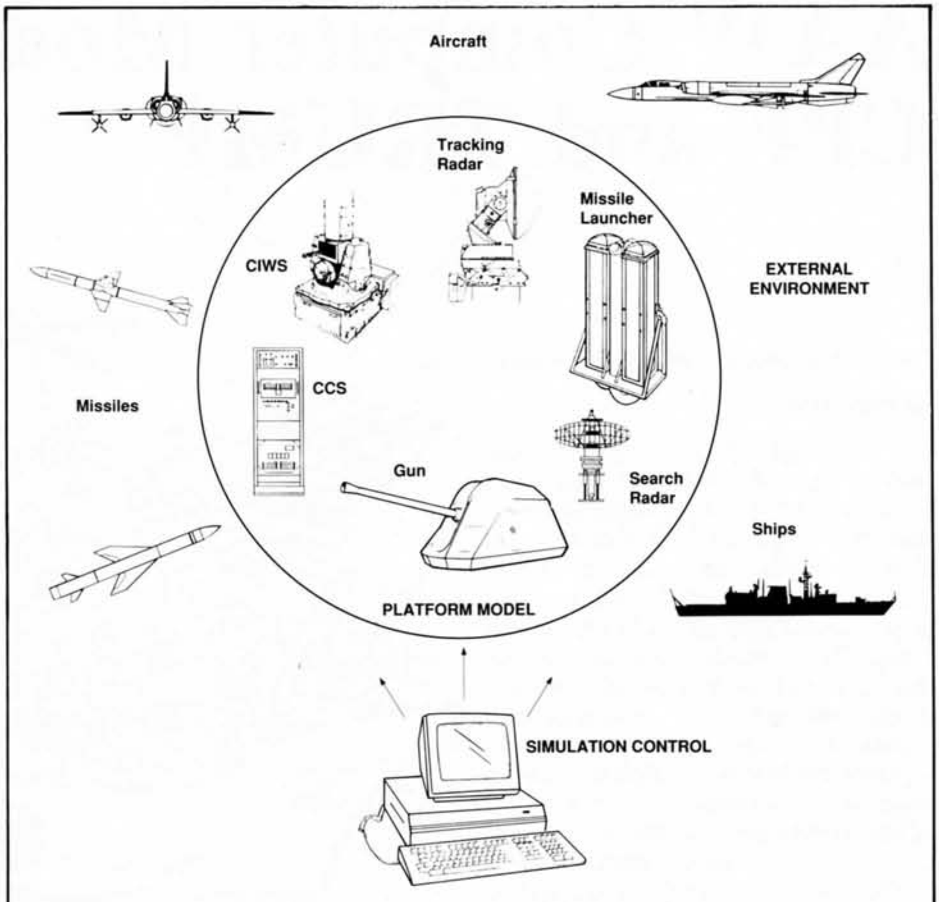


**Fig. 2. Structure of the SCSS Model**

**Validation**

A validation test plan is necessary to show that the components of a simulation model operate as expected. The Crown as well as the CPF and TRUMP contractors have designed tests to validate their own models.

As an example of a test scenario for the TRUMP AAW suite, ten shallow-diving missiles could be simulated attacking the ship. TEWA would compile the threat list as each is detected and calculate engageability. The STIRs, missiles, 76 mm gun and the close-in weapon system (CIWS) would be assigned their targets. The Monte Carlo "dice" would be rolled and the scenario would unfold.

Validation tests such as this are designed to give an incremental approach in validating a model's capabilities. In this way, components which have been validated in earlier tests can be incorporated in later, more complicated scenarios.

Each scenario described in the plans has been analyzed and the expected times and ranges at which significant events should occur have been predicted. After executing a statistically significant number of runs of a particular scenario, the results will be compared to the expected values and any large deviations will give cause to further investigation and refinement. By examining results from other models, such as Thomson's Tactical Simulation (TACSIT) model, discrepancies can be attributed to invalid expected values or the models' design.

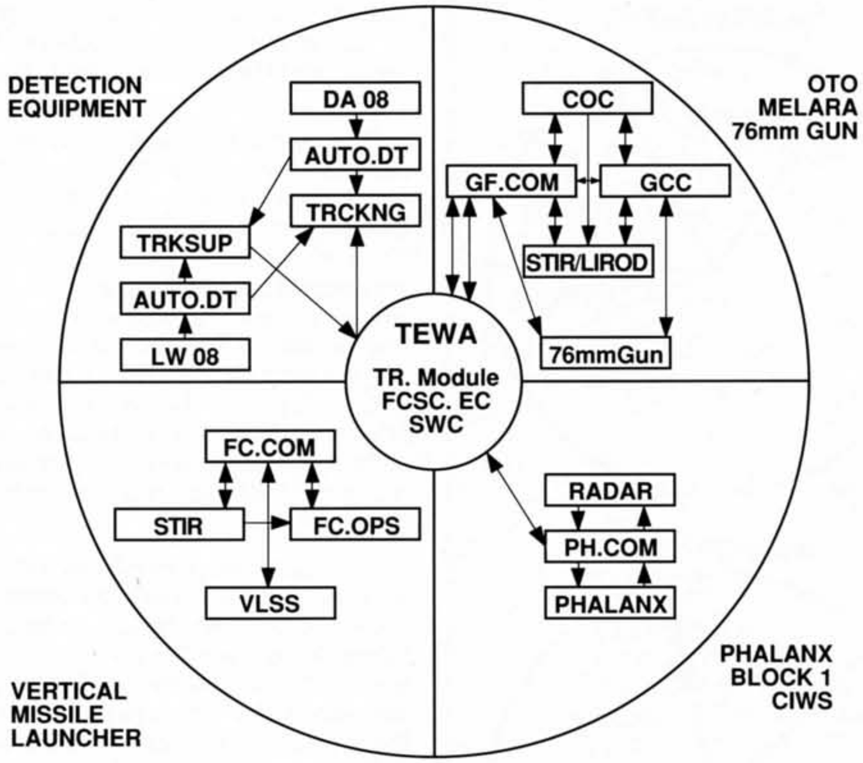
**Model Structure**

The structure of the SCSS model can be broken down into three distinct components (*see Figure 2*):

a. the external environment model;

b. the platform model; and

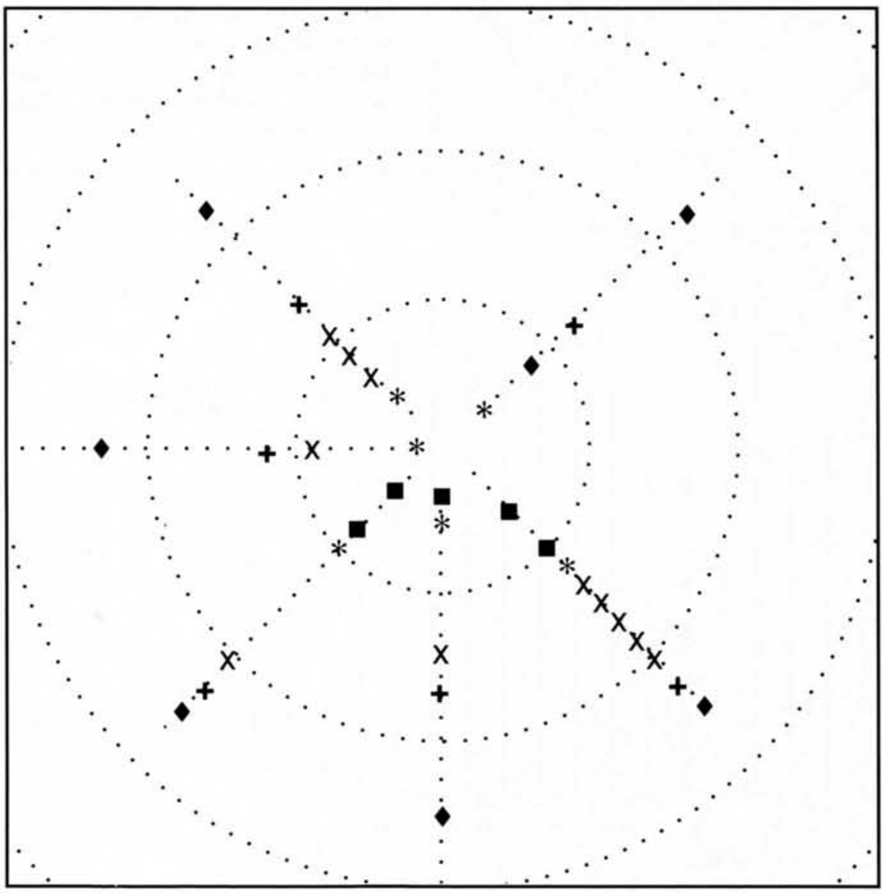
c. the simulation control and data input/output management routines.




**LEGEND**

| | |
|---|---|
| **DA 08** | — Medium-Range Search Radar |
| **AUTO.DT** | — Automatic Detect and Track |
| **TRCKNG** | — Tracking |
| **TRKSUP** | — Tracking Supervisor |
| **LW 08** | — Long-Range Search Radar |
| **COC** | — Control Officer Console |
| **GF.COM** | — Gun-Fire Computer |
| **GCC** | — Gun Control Console |
| **LIROD** | — Lightweight Radar Optronic Director |
| **76mm Gun** | — Gun |
| **FC.COM** | — Fire-Control Computer |
| **FC.OPS** | — Fire-Control Operations |
| **VLSS** | — Vertical Launch Sea Sparrow |
| **RADAR** | — Tracking and Search Radar |
| **PH.COM** | — Phalanx Computer |
| **PHALANX** | — Phalanx Gun |

**Fig. 3. TRUMP ship platform components as represented by SCSS**



SCSS POLAR PLOT

DATE : 15-MAY-1989 SHIP : HMCS-TRUMP
SPEED : 0.1 m/s HEADING : 180.0°

TITLE : EXAMPLE

INITIAL THREAT INFORMATION

TYPE : ASM RCS : 3.0 BEARING : 135°
HEADING : 315° ALT : 1000.0m SPEED : 354 m/s

TYPE : ASM RCS : 3.0 BEARING : 225°
HEADING : 45° ALT : 1000.0m SPEED : 354 m/s

TYPE : ASM RCS : 3.0 BEARING : 45°
HEADING : 225° ALT : 1000.0m SPEED : 354 m/s

TYPE : ASM RCS : 3.0 BEARING : 315°
HEADING : 135° ALT : 1000.0m SPEED : 354 m/s

TYPE : ASM RCS : 3.0 BEARING : 180°
HEADING : 0° ALT : 1000.0m SPEED : 350 m/s

TYPE : ASM RCS : 3.0 BEARING : 270°
HEADING : 90° ALT : 1000.0m SPEED : 350 m/s

ENGAGEMENT INFORMATION

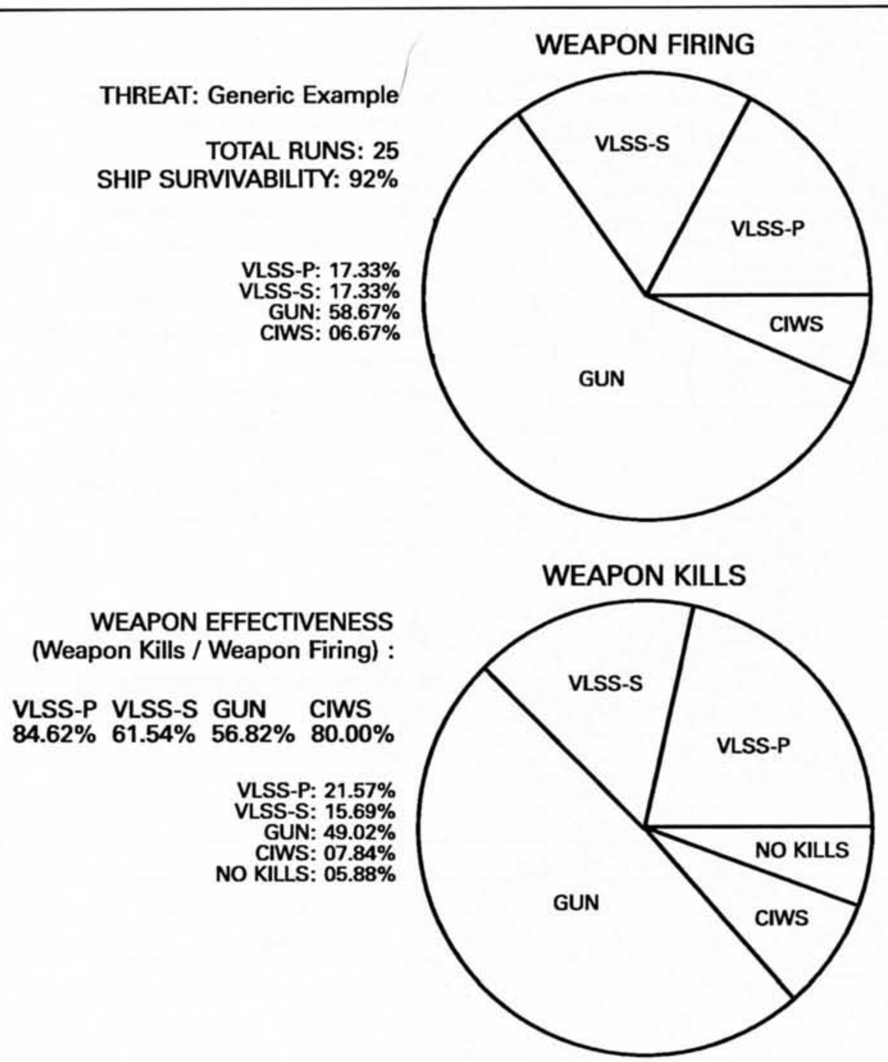
| SYM | EVENT | THRT# | WPN | TIME | RANGE | BEAR |
|---|---|---|---|---|---|---|
| ♦ | FIRM TRACK | 1 | --- | 12 s | 16097 m | 135° |
| + | WPN DESIG | 1 | SAM | 13 s | 15385 m | 135° |
| + | WPN DESIG | 1 | GUN | 13 s | 15321 m | 135° |
| x | MSL LAUNCH | 1 | SAM | 17 s | 14187 m | 135° |
| x | GUN FIRING | 1 | GUN | 19 s | 13618 m | 135° |
| x | GUN FIRING | 1 | GUN | 23 s | 12320 m | 135° |
| x | GUN FIRING | 1 | GUN | 27 s | 11075 m | 135° |
| x | GUN FIRING | 1 | GUN | 31 s | 9814 m | 135° |
| * | DESTROYED | 1 | GUN | 34 s | 8981 m | 135° |
| ♦ | FIRM TRACK | 2 | --- | 13 s | 16753 m | 225° |
| + | WPN DESIG | 2 | SAM | 14 s | 15703 m | 225° |
| x | MSL LAUNCH | 2 | SAM | 19 s | 14087 m | 225° |
| * | DESTROYED | 2 | SAM | 45 s | 6421 m | 225° |
| ♦ | FIRM TRACK | 3 | --- | 15 s | 15771 m | 45° |
| + | WPN DESIG | 3 | SAM | 34 s | 9735 m | 45° |
| ♦ | FIRM TRACK | 3 | --- | 47 s | 6061 m | 45° |
| ■ | CIWS FIRING | 3 | RFG | 59 s | 2477 m | 45° |
| * | DESTROYED | 3 | RFG | 59 s | 2477 m | 45° |
| ♦ | FIRM TRACK | 4 | --- | 18 s | 16422 m | 315° |

**Fig. 4. Polar Plot Example**

The external environment model creates and maintains the physical objects in the scenario. These objects include hostile and friendly ships, aircraft and missiles.

The platform model describes the combat systems of a ship. *Figure 3* illustrates the nodes and links of the TRUMP ship's platform model as defined by the SCSS model. Each node represents a key component of the combat system and the links represent the communication lines between the nodes. For example the fire-control computer (FC.COM) and the vertical missile launcher (VLSS) are represented, and since each of these nodes must communicate with the other there is a link between them.

The simulation control and data input/output management component of the model oversees the interactions between the user and the program. These interactions are limited mostly to input and output files. Through the input file, the user has control of the parameters defining the capabilities of the modelled ship, the nature of the threats, the structure of the simulated scenario and the degree of output detail produced in the output files. The output files contain external object information, event variable numbers and all on-board messages between combat systems during a scenario run.



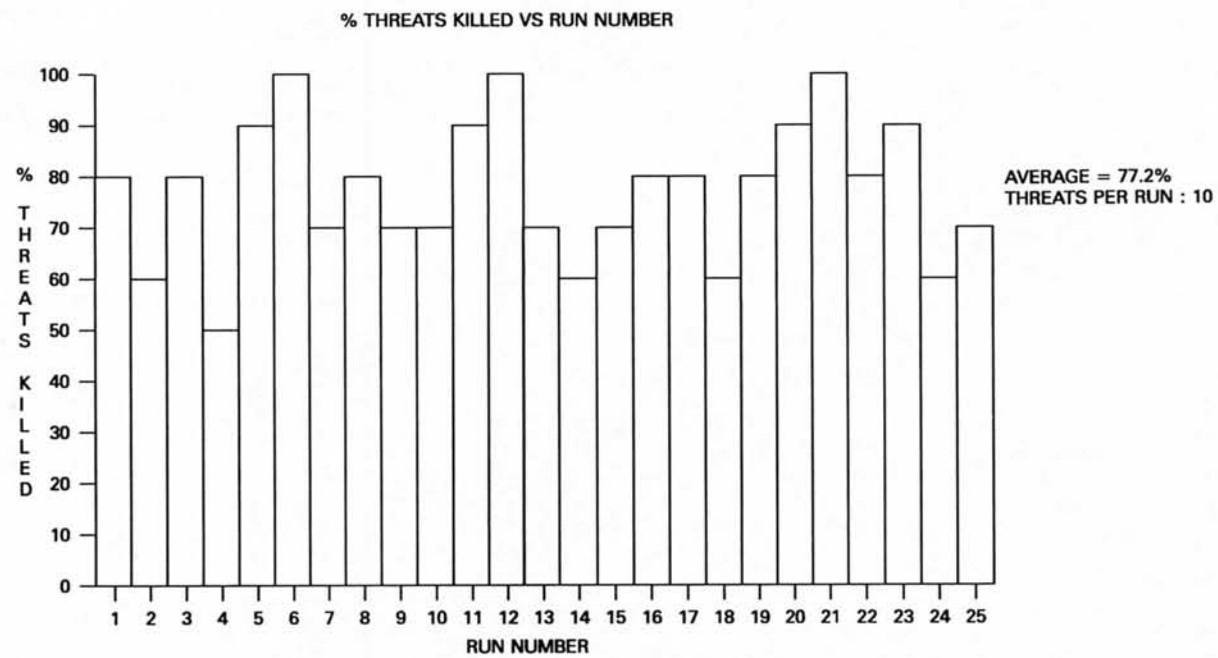




**Fig. 5. Pie Chart and Histogram Examples**

## Model Adaptation

The SCSS model will be modified and refined to create two versions, using the sensor and weapon parameters and combat doctrines of TRUMP and CPF. An existing contract has installed SCSS on DMCS 2's Tempest MicroVax and has created a data file and working executable image of the TRUMP AAW combat suite. This data file represents the vertical launch missile, gun, CIWS, command and control system, associated radars and TEWA. SCSS is being modified in-house, at DMCS 2, to incorporate the main features of the CPF AAW combat suite.

More specific enhancements are required for the models to facilitate the test scenarios described in the validation test plan. Some of these enhancements include:

a. modifying the platform model to include soft-kill capability; i.e. developing nodes and links to simulate flare and CHAFF systems;

b. IFF capability to classify targets as friendly or hostile with an appropriate time delay;

c. a capability to insert and use NO FIRE zones; and

d. more detailed output from the LW08 long-range and DA08 medium-range search radars; i.e. status of each radar scan — hit or miss, track creation or track drop.

## Post-Processors

The information gathered in the SCSS output files can be used by post-processors to serve in the detailed analysis of each SCSS simulation run. One such processor called Polar Plot uses the positions of the simulated objects in a naval combat scenario to overlay their trajectory plots on a polar graph. Significant events such as firm tracks, weapon designations, weapon firings and weapon kills are represented on the plot by distinct symbols for each type of event. The ship is located at the centre of the plot (*Figure 4*) and the positions of the symbols indicate where the event occurred with respect to the ship's position at that time. The text data section to the right of the plot includes ship, initial threat, engagement and engagement summary information.

Post-processors for generating pie charts and histograms to illustrate statistical information have also been created (*see Figure 5*). A number of runs of a particular scenario must be executed. Each run will have the same type and number of threats, but the heading of the threats and probable results will differ from one run to the next. Information accumulated by the post-processors, such as the percentage of threats killed per run and the percentages of weapon firings/kills for each scenario, will help in determining weapon effectiveness.

## Conclusion

A naval combat simulator's ability to predict the performance of an actual AAW suite makes it an important tool in development and analysis. Numerous applications for the modified SCSS program have already been suggested for the Canadian Patrol Frigate and Tribal Class Update and Modernization projects, with a view to maximizing the effectiveness of these ships. Wider use of computer simulation, however, is essential to evaluating the naval technological advances and changes in operational doctrine designed to optimize the ships' performance against the challenging threats of the present and future.

*Greg Walker is the DMCS 2 project engineer for above-water warfare computer simulation at NDHQ.*

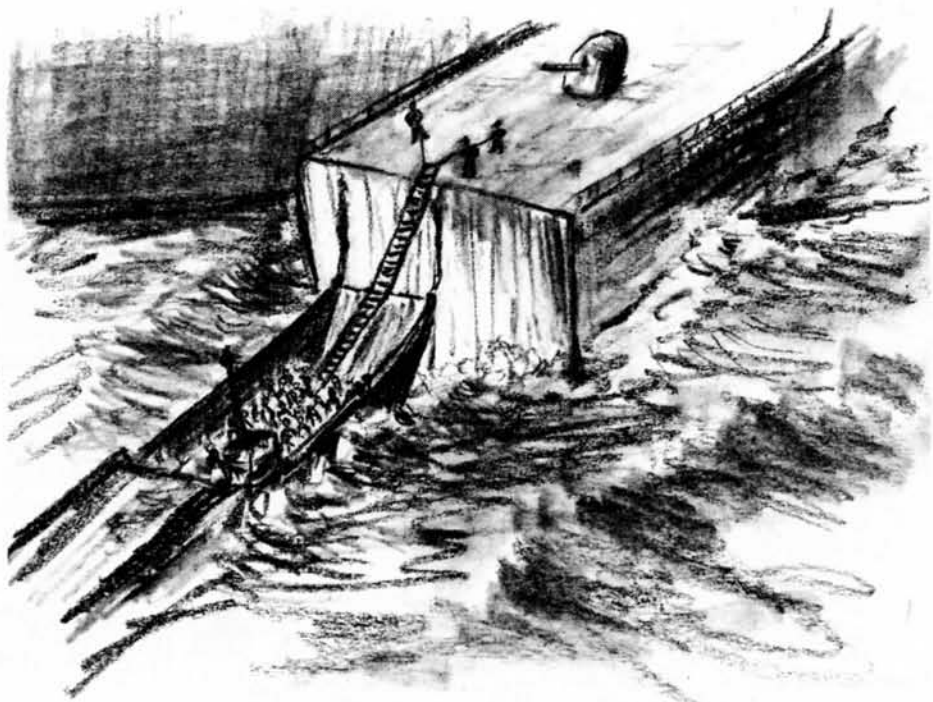
*Michel Beaulne was a University of Waterloo Co-op student in DMCS 2 during the summer of 1989. Last fall he entered his graduate year in Waterloo's Applied Mathematics and Computer Science program.*

# U.S. Navy Ship Shock Trial
## *An observer's account*

*By Ole Bezemer*

As part of our information exchange and cooperative R & D programs with the United States Navy, Canada was invited to witness the underwater shock trial of the "Improved Spruance"-class destroyer, USS *Kidd. Kidd* and three sister ships had originally been constructed for the Iranian navy, but were diverted to the USN in 1979 following the Iran hostage crisis. The ships were sufficiently different from the 963 class to warrant a separate shock trial. Since the trial would take place off Key West, Florida, this visit looked most attractive in addition to being interesting.

I flew first to Fort Lauderdale* where the U.S. trial teams had gathered for briefings and a walkabout inspection on board the *Kidd*. It was surprising to see how many people were involved in the trial. In addition to the ship's crew, there were at least a hundred. I met two other observers, one from Australia and one from the U.K., both pleasant fellows. (**The reason for meeting the ship in Fort Lauderdale was that* Kidd's *sonar dome stuck too deeply into the water for her to comfortably enter Key West harbour. This meant that once in Key West all trials personnel would have to be ferried to and from the ship at sea each day, an exciting prospect because the sea was quite rough from a storm just a few days before.*)



The day after arriving in Key West we departed the motel at five in the morning in pitch darkness. The temperature already hovered around 27° C. About 80 of us boarded an open landing craft and chugged out to join *Kidd* at sea. As soon as we hit open water the situation became miserable. The sea was rough and at regular intervals waves would break over the square bow, drenching us. I was glad to have hidden my briefcase under a waterproof tarpaulin because the seawater soakings meant certain corrosion for unprotected briefcases. I saw the results next day: the metalwork on many briefcases had turned a vivid rust colour. At last dawn broke and we spotted the menacing silhouette of the USS *Kidd* on the grey horizon.

Earlier I had noticed a hinged ladder-like contraption on the landing craft's bow. Its purpose became clear when we approached the square stern of the *Kidd*. The idea was to come right up against the stern with the rubber buffers on each side of the landing craft's bow, and open the ladder up onto the destroyer's flight-deck. Not a bad idea in a dead calm sea. However, when we butted up to the *Kidd's* stern in the considerable swell, the rubber scraped away from the buffers of the landing craft and we began gouging *Kidd's* stern with our metal bow. (Apart from the horrendous noise, we were literally making a deep impression on the poor ship.) The ladder in the meantime was folding up and down alarmingly and only three brave and foolhardy souls scampered across before an enraged destroyer captain waved us off. The chaps who got across seemed heavy-hearted as they watched us bear away for terra firma and cool drinks poolside. They were stuck on a "dry" ship with a C.O. who, not surprisingly, heartily disliked the prospect of having 100 irreverent civilian trials personnel knock his ship about for the next four days.

Back in Key West I spent the day with the two other observers seriously discussing the trial and reminiscing over past ones. Next morning we dutifully boarded the landing craft and chugged out again. The sea was still rough and we heaved and rolled towards the intrepid *Kidd*. Farther out to sea I noticed the huge floating crane which would be used to handle the explosive charges for the trial. (The charge for the most severe shock weighed 20 tons!) Halfway to the *Kidd*, though, we received the message to turn back because the crane's cables had become entangled while lifting one of the charges in the rough sea.

Day three arrived with calmer weather. Once again we went out in our (by now) familiar craft, clutching irreversibly corroded briefcases. The boarding procedure had been sensibly modified, and we now boarded the destroyer via a jacobs ladder which hung over the side of the ship. One simply grabbed the ladder when the landing craft was on the crest of a wave and climbed up! Once on board we gathered in the huge hangar where tables had been set up for the use of the test crews.

Toward the end of the morning the ship was ready for the first shock. We took our designated places and waited for the countdown. The explosion came exactly as planned and felt as if the ship had been hit with a heavy hammer. The effect of this relatively mild shock was only very minor and no significant damage was noticed. At the end of the afternoon we boarded the landing craft and returned to Key West.

Next day, to make up for time lost during the first two days, the trial agenda was pushed ahead to proceed directly with the "third" shot. For this one I positioned myself on the bridge. The effect of the shock on the bridge was bizarre. While the radar unit closest to the shock side survived undamaged, the unit on the far side had lifted off its pedestal and been heavily damaged. The low-frequency response of the bridge superstructure to the shock energy must have been considerable and complex. After this, I was not looking forward to what was in store for us the next day.

Day five: for the final, severest shock of the trial I was stationed in the main machinery control room. The countdown was agony, and when the explosion came my first thought was that, surely, the ship would open up and send us gurgling down to feed the sharks. The machinery that had been running had stopped instantly and now we were bathed in the unearthly glow of the emergency lighting. Amidst the pandemonium of console alarm claxons, sirens, horns and blinking red lights I saw the officer-in-charge gaping at the confusion with open mouth. I sympathized with him — "What the hell do you do first!"

It could only have been seconds before he reacted. His first move was correct as far as I was concerned: he started one of the three diesel generators. When everything seemed all right he started one propulsion engine after the other. During the damage assessments later that day I learned that all the machinery had tripped on spurious signals like excessive vibration, low fuel pressure, etc., except for the third generator. It had tripped on overload since it could not shed its load quickly enough when the other two generators shut down.

It was heartening to see what little damage there was. A few bulkheads had mildly buckled at the deck joints and some equipment damage had occurred, but nothing that would prevent the ship from moving and manoeuvring. The crew's reaction to the trial was interesting. Obviously they were relieved it was over, but also — and this is something I have observed during other shock trials — they had developed a strong confidence in the ability of their ship to survive combat conditions.

While quite a few of the trials personnel remained on board to work on their reports, my two observer friends and I returned to Key West. There we celebrated the end of an eventful week at the famous Sloppy Joe bar (of Hemingway fame). Later as we were walking back to the motel a passing car backfired loudly. The three of us jumped at the sound. Obviously, we had become sensitive to explosive sounds! We laughed nervously and walked on, somewhat chastened by the experience.

*Ole Bezemer is the DMES 3 section head for naval passive protection systems.*

# *Authors' Proposal*
# A Naval Reserve NCM Engineer Training Plan

*By Lt(N) Dave Marecek*

*and PO1 Ken Quick, CD*

**Introduction**

Traditionally, naval reserve NCM engineers have been operator-maintainers responsible for engineering, hull, electrical, fire-fighting and damage control. Currently, the trade is defined as R315 Diesel Mechanic, with the majority of training emphasizing diesel theory and operation. The training over the last ten years has led the Diesel Mechanics down a road to where the naval reserve has diesel watchkeepers, but few charge-tickets and a minimal number of qualified maintainers capable of first-line maintenance.

**New Role**

The naval reserve today has responsibility for two maritime functions: naval control of shipping and maritime coastal defence, including the clearing of mines. With the new role, upgrading of the reserve NCM engineer will be of paramount importance due to the massive shift from 1940s technology to modern integrated systems. The delivery of mine countermeasure vessels and their full complement of integrated machinery control systems means the reserve engineer will have to have improved operational training. But more importantly, the reserve engineer must become a knowledgeable first-line maintainer of modern integrated machinery control, electrical, propulsion, control and auxiliary systems.

**Aim**

It is the purpose of this paper to propose a naval reserve NCM engineer training plan which would allow the naval reserve to meet the engineering commitments of maritime coastal defence. The prime focus of the discussion is the training of NCM engineers from the recruit level through to the qualified CERA, within the confines of the naval reserve training system. This will include a proposed training plan to

Photo CPO2 Ian MacDougall

cover in-unit training (September-May) and out-of-unit summer training for both the operation and maintenance of naval reserve marine engineering systems.

**Background**

The naval reserve Diesel Mechanic trade R315 (DMech) is composed of three trade-ticket levels (*Fig. 1*). For a minor war vessel (MWV) to put to sea, the minimum manning is one C-ticket, two B-tickets and two A-tickets for day sailing, and an additional A- and B-ticket for overnight steaming.

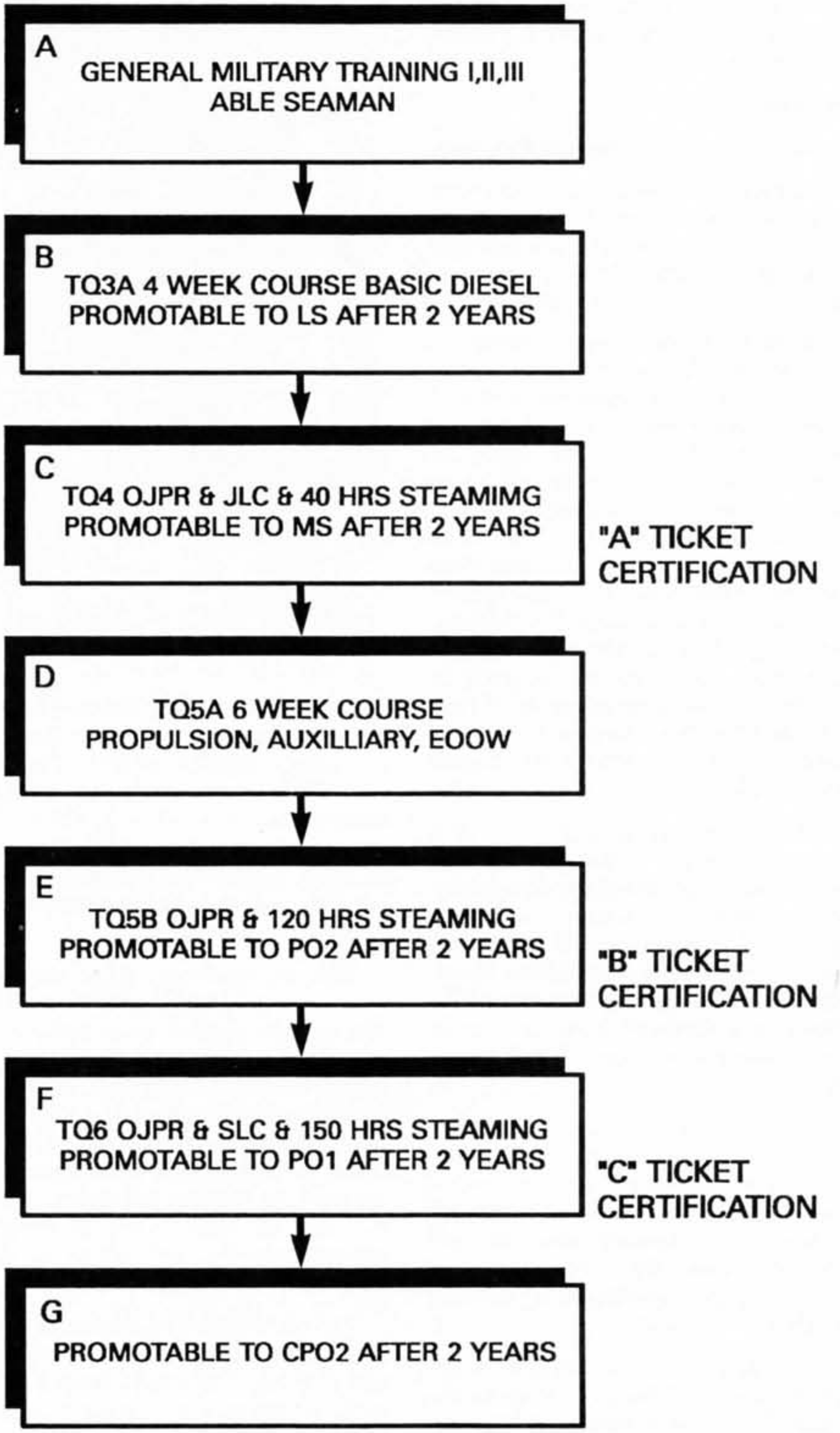



**Fig. 1. Diesel Mechanic R315 Career Progression**

**Current DMech Training Problems**

The naval reserve DMech training system in its current state is not meeting the goal of training qualified diesel mechanic operators and maintainers. The following list of concerns arises from the current DMech training policy and standards:

a. The fleet standard for A-, B- or C-tickets is unidentifiable as there is no TQ4 or TQ6 course available. The available course content and duration do not follow the trade progression of the DMech.

b. There is no consistency in training at the TQ4 and TQ5 levels as there are no objectives, and only OJPR (on-the-job performance requirements) at the TQ5 level. The bulk of the knowledge is passed down from senior to junior personnel — hence, procedures vary throughout the fleet.

c. The training relies on the assumption that the recruit has basic mechanical experience and familiarity with hand tools, which is not the case in the student-centred recruiting.

d. Personnel are rushed to get their tickets with too few steaming hours and minimal experience, resulting in poorly qualified operators and no maintainers. This can be attributed to the limited number of vessels for training, inefficient use of fleet school facilities, insufficient numbers of trained instructors, and ticket shortages caused by limited retention (i.e. 2-5 years).

e. Maintenance, both preventive and corrective, is not covered on courses or demonstrated in the fleet due to limited vessels. DMechs are normally not on hand while actual maintenance is being carried out by Reserve Training Unit staff.

f. Personnel employed by civilian employers have only two weeks (average) a year for training and operations.

g. Trade qualifications are linked to rank and promotion. The unavailability of training time and the inability to attain a higher trade qualification stops promotion which leads to unit demoralization or the loss of a trained member.

**Discussion**

**Naval Reserve NCM Engineer Functions**

To meet the commitments imposed upon the naval reserve, the question that must be asked is "What is the function of the naval reserve NCM engineer in relation to the role of the naval reserve?"

In the naval reserve environment, an engineer must be able to take a vessel to sea and support the engineering system from an operational and maintenance perspective. The engineer must be familiar with more than diesels, as an MWV has electrical, control, auxiliary, hydraulic and hull systems. With all of these individual systems, it is proposed that the naval reserve NCM engineer training cover all aspects of MWV engineering systems to allow the engineer to operate competently and perform first-line corrective maintenance. (Please note that the title "Engineer" is being used in lieu of DMech for the reasons just stated.)

The MOC of DMech or Engineer is an issue under the Total Force concept, as the reserve would require a trade that does not exist in the regular force. Since an MWV will probably not have more than 40 billets, and seven billets are required for engineers (20 percent of the crew), there will be no room for separate engineering trades as there is in the regular force.

This would require that the reserve engineer be a reserve-specific trade that would use various portions of regular force engineering training packages for diesels, hull, auxiliary, electrical and control systems. By using portions of each package, equivalence of training would be achievable.

It is proposed that the reserve engineer be one of the exceptions to the Total Force trade structure. The remainder of the discussion will proceed on the assumption that the reserve NCM engineer is a reserve-specific trade.

**Training Concept**

It would be preferable to follow the naval trade structure of separate operators and maintainers. However, with only one engineering MOC and limited space on an MWV, the operator-maintainer concept must be applied to the engineering trade. The naval training system has a concept that could be successfully applied, whereby engineers are trained as operators only until the leading seaman level or A-ticket. The naval reserve could then follow the regular force engineering maintainer training for the B-ticket and administrative training for the C-ticket.

This concept would allow the naval reserve to build up a cadre of qualified operators by concentrating initial training on operating only. This would include all systems, but from an operational perspective. Once the members become qualified operators they would embark on their maintainer training working towards a B-ticket. The final step of their career progression would be the C-ticket with its administrative duties.

The training should also be modified such that all courses are two-week modules (TWM). This would allow a TWM to be taught as a term course (in-unit) or as a concentrated course at a specialized facility (e.g. fleet school). Two weeks is specified because this is the average time a reservist has available from his civilian employer. When a reservist has a larger block of time, several modules could be completed. Included in every TWM would be a Command-wide exam. This system would allow reservists' training to *proceed* rather than stagnate.

The training concept must also address in-unit training. Currently, there are no in-unit training courses. However, 20 out of 40 A-ticket OJPRs, 15 out of 30 B-ticket OJPRs and 24 out of 27 C-ticket OJPRs could be taught in-unit. Under the present training plan, engineers spend a large proportion of their time on the coast in class instead of steaming and operating equipment. By conducting the training in-unit, the operational time would be maximized.

The proposed training concept would be valid for the following reasons:

a. The naval reserve has its largest resource pool in the first 2-5 years due to student recruiting. In this time span operator training only would be conducted, thereby minimizing training costs.

b. With an earlier operational qualification, the number of qualified operators would increase to allow the reserve to meet its operational commitments.

c. If personnel choose to make a long-term commitment to the naval reserve (i.e. more than three years), they would progress on maintenance training toward their B-ticket. Since this is time-consuming and expensive training, it makes sense to fund it only for personnel who are committed to the naval reserve.

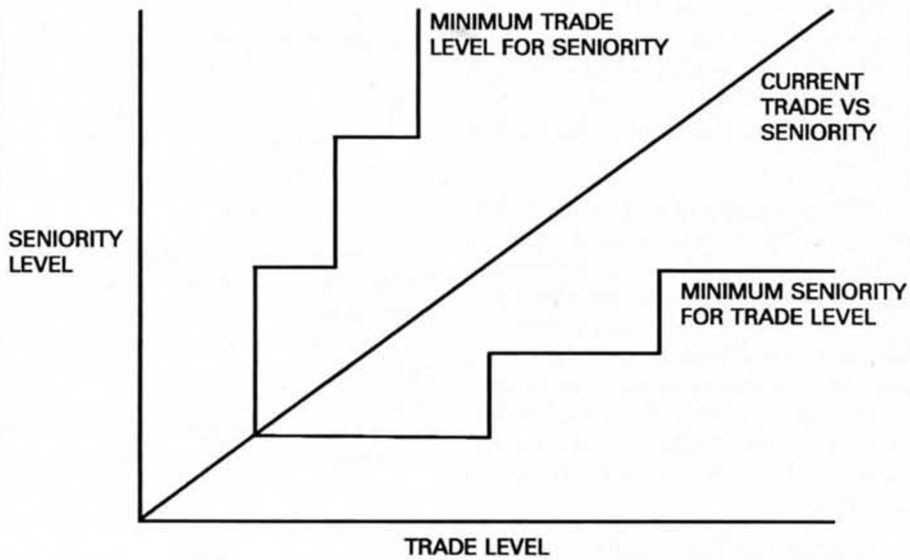



**Fig. 2. Seniority vs. Trade Level**

d. This concept would allow individuals to continue training throughout their career, thus improving morale and job satisfaction.

e. This concept of two-week training modules would make it easier for reservists (and civilian employers) to schedule time off for naval training.

f. This concept would allow classroom training to proceed in-unit and maximize operational time on the coast, leading to more confident operators.

With the function of the naval reserve NCM engineer defined and a training concept established, the naval reserve NCM engineering training plan can be outlined.

**NCM Engineering Training Plan**

***Personnel***

Under the CF recruiting plan, university students form the majority of new recruits in the naval reserve each year. In addition to out-of-unit training (four months each summer for the first four years), the in-unit training covers approximately 28 $3\frac{1}{2}$-hour training nights per year (equates to 3 weeks) and approximately eight weekends per year (3 weeks). Thus, in the first four years, there are approximately 18 weeks per year for training. However, after four years, training is reduced to a maximum of eight weeks per year if the member can get leave from civilian employment. With the constraint of training time for reservists, the training plan must be structured to maximize available time.

The respecification of Mobilization Military Occupational Classifications (MOBMOC) to allow a wider separation between trade and rank qualifications would allow the reserve to accept trained personnel from industry into a high trade class, but low seniority class (*Fig. 2*). Additionally, the change would give personnel more latitude in their careers by allowing them to become proficient in either management (rank) or technology (trade).

This concept could increase recruiting of skilled personnel from industry, thus reducing the CF training costs. It could also decrease attrition by allowing flexibility of career progression to either management or technology, and could improve morale as job satisfaction would be increased. The concept would ideally suit the training availability limitations placed on reservists.

***Facilities***

Naval reserve engineers train in three locations: in-unit, West Coast and East Coast. The majority of the units have only classrooms and a cutaway diesel for teaching. At the coasts, fleet school facilities and operational vessels are available. Some exceptions do exist where a unit has a fleet tender for local steaming during part of the year.

The brunt of the operational hands-on training must occur at the coasts on vessels or in fleet school shops. With the current facilities at units, some watch-keeping may be done in-unit on fleet tenders and during gate-vessel weekends (at the coast). However, the unit is still best suited for classroom instruction in operational procedures, maintenance procedures and theory supporting the proposed training concept.

Improvements in the training aids at each unit may be helpful, but it does not seem feasible to mock up electrical, auxiliary, control, hydraulic and hull systems at the 24 units across the country when these mock-ups already exist in the fleet schools. One solution may be to conduct fleet-school weekends for trades throughout the year. In fact, use of fleet school facilities for teaching senior maintenance courses on weekends could add the much-needed training time after the initial four-year period.

Another option is to procure mobile training facilities through the purchase of a 40-foot trailer. Operational diesel, electrical, auxiliary and control systems could then be trucked from unit to unit throughout the training year, thereby eliminating TD travel to a fleet school. During one four-week stopover, up to 12 full training days could be achieved with the equipment.

***Trade Progression***

Trade and rank progression in the naval reserve are highly dependent upon the amount of training time available. Thus the critical path for rank becomes trade qualifications under the current trade structure. In addition to qualifications, the minimum time requirements for each rank still apply as set out by the CF. With the incorporation of MOBMOC, trade progression would offer more latitude as the engineer would be able to progress either upwards with military knowledge or laterally with technology.

The following naval reserve NCM engineer rank progression is proposed:

a. For Able Seaman, the member should complete basic military knowledge, basic seamanship and engineering outside roundsman classroom training, and at least 80 hours of steaming time as an outside roundsman.

b. For Leading Seaman, the member should be a qualified operator holding an A-ticket. This would require at least three TWMs of classroom time and 120 hours of steaming toward an A-ticket.

c. For Master Seaman, at least four TWMs of maintenance training in the time frame prior to the fourth year as this would be the last available time period for a long training course. After the classroom, at least 240 hours of steaming time would be required prior to sitting the B-ticket board.

d. For Petty Officer 2nd class, three TWMs on administration would be completed.

e. For Petty Officer 1st class, at least 480 hours of steaming time as a B-ticket would be required, followed by the C-ticket board.

### *Course Specifications*

Based on all previous assumptions within this paper, the following are the proposed course specifications for naval reserve NCM engineering training:

*General Military Training*
GMT I/II in-unit basic military knowledge (1 TWM)
GMT III at-sea basic seamanship (1 TWM)

*TQ3 Engineering Outside Roundsman*
TQ3A in-unit outside engineering rounds (1 TWM)
TQ3B on-board outside roundsman (80 hours)

*TQ4 Engineering Operator*
TQ4A in-unit operating procedures, all systems (2 TWMs)
TQ4B fleet school operating procedures (2 TWMs)
TQ4C steaming time toward A-ticket (120 hours)

*TQ5 Engineering Maintenance*
TQ5A in-unit first-line maintenance (1 TWM)
TQ5B fleet school maintenance course (3 TWMs)
TQ5C maintenance steaming hours (240 hours)

*TQ6 Engineering Administration*
TQ6A in-unit administration self-study (2 TWMs)
TQ6B fleet school administration course (1 TWM)
TQ6C CERA steaming time (480 hours)

With the trade and rank levels defined, every course should have a Course Training Standard developed. For in-unit training, it is especially important that a standard course package be made available to naval reserve units such that engineers across the country receive the same level of instruction. Exams for every module should be administered at a national level by Command.

Additionally, the OJPRs for the A-, B- and C-tickets should be split into two packages. The first part would be non-vessel-specific. The second portion would be vessel-specific in the same manner as the regular force training where the type of vessel an individual is assigned to defines the training package.

### Conclusions

The current DMech training system and standards are producing neither the confident operators nor the qualified maintainers needed to meet the naval reserve's operational commitments. Meeting the challenge of creating trained naval reserve NCM engineers is feasible if priority is placed on training. It is proposed that the following concepts be considered as the possible way ahead for reserve NCM engineers:

a. redefinition of the DMech trade to Engineer,

b. operator training in the first three years,

c. development of two-week modules for training,

d. increased in-unit training of OJPRs,

e. reserve-wide course training specifications and exams,

f. increased operational steaming hours for each ticket,

g. MOBMOC changes, allowing latitude in career progression,

h. institution of trade-training weekends at fleet schools,

i. portable training facilities for in-unit training.

Recently, in-unit training of reserve NCM engineers has been discarded, yet more in-unit training and more steaming hours are needed to provide confident, qualified operators and maintainers. This paradox must be addressed at the Command level with a rationalization of engineering training.

*Lieutenant Marecek is the Engineering Officer of HMCS* Carleton *in Ottawa. An ex-regular force CSE, he is now a program manager with DY-4 Systems Inc. of Nepean.*

*Petty Officer Quick is the Chief ERA of HMCS* Carleton. *He has been a reserve DMech for 14 years and has held a C-ticket for six years. He is currently a self-employed computer consultant.*

# Why Ada Makes Good Sense

*By Cdr Roger Cyr*

### Introduction

Doubts are often being expressed about the benefits of using Ada for military software applications. Some of the questions that are raised regarding Ada include:

a. Is software more maintainable with Ada?

b. Will it cost less to implement a project with Ada?

c. Will the use of Ada improve the performance of a system?

The intent of this article is to answer these questions and clear away the misconceptions regarding Ada.

### Background

Software has become a very expensive commodity. The U.S. Department of Defense spent $12 billion on embedded computer software in 1987, and estimates show that this expense is increasing at an annual rate of 17 percent. By its own estimates the U.S. DOD will be spending $42 billion per year on military software by 1995.

Past experience with the U.S. DOD, however, has revealed that many controllable factors have made software acquisition unnecessarily expensive. One of these factors is diversity. In the late 1970s as many as 300 different computer programming languages were being used for military software. There was also the problem of ownership of the software being developed in insolation by a large number of contractors. There was no clear understanding as to whether DOD actually owned the software being produced. In addition, there was no plan to reuse existing software, and since production methods did not make use of engineering tools, the production process was considered somewhat archaic.

To this was added the fact that quality control of software was minimal. In a large number of cases the code was actually written before the high-level system design or software design was done. The end result was unreliable and unpredictable software which was expensive to build and even more expensive to maintain. Yet, this unreliable software was intended to be the controlling element of tactical and strategic systems.

### The Creation of Ada

Faced with what was referred to as a software crisis, the Department of Defense initiated a program to develop and enforce software standards. The High-Order Language Working Group was formed in 1975 to come up with a standard language which would be usable for all applications. The language eventually developed by this group was initially called DoD-1. However, in the post-Vietnam era it was felt this name sounded too military and would be scorned by the academic sector. In 1979 the language was officially named Ada, in honour of Augusta Ada Byron, Countess of Lovelace. Ada Byron was considered the world's first programmer since she was involved in programming what is known as the first computer invented by Charles Babbage.

The purpose in developing Ada was to create a language that could be used to program the embedded computers that are components of major systems, such as those found in the various sensor and weapons subsystems of a ship's combat suite. In these applications, where reliability is critical, software requirements are complex. The software product is usually very expensive to develop, has a long life-cycle and requires frequent enhancement.

Some of the organizations which adopted Ada as a standard include:

* the Ada Joint Program Office, which is the U.S. DOD office responsible for the implementation of the language;
* the American National Standards Institute; and
* the International Standards Organization.

### Software Technology and Concepts

To appreciate the benefits that can be derived from Ada, it is important to understand the technology and concepts of software as they apply to Ada. In the past, specialized languages were developed for specific uses since no language was suitable for all applications. For example, Cobol was developed for business applications, and Fortran for scientific applications.

Ada was developed primarily for embedded computer applications since this was considered to be the mainstay of military applications. However, Ada was the first language to be also considered well suited for all types of applications, be they military or commercial. It is a sophisticated language which, because of its special features, allows system designers to describe precise system parameters early in the design phase. This saves on test, integration and maintenance costs, and makes the programming of the design much simpler.

Ada as a programming language incorporates improved features which make programming simpler and easier. The more pertinent of these features are:

a. *Strong Data Typing* ensures that data fields only contain the type of data that was specified for that particular field. For example, a programmer could not inadvertently have numbers assigned to a field which had been declared to contain letters. This sort of error would automatically be detected during compilation with Ada.

b. *Exception Handling* specifies what the program will do when an abnormal condition occurs as a result of a programming error. Instead of the program corrupting and blowing up as would happen in the old days of the CCS-280 system, program execution would now continue in accordance with prescribed actions.

c. *Modularity* — Ada programs can be broken down into self-contained modular components called tasks or packages. All data associated with a particular package is contained within that module, with the interfaces to other modules being well defined. These module interfaces are controlled by strict rules that are enforced by the Ada compiler. This process eliminates the old ways of jumping in and out of subprograms which resulted in the eventual degradation of the program and in maintenance nightmares.

   SPAR Aerospace used Ada to program the Space Station Remote Manipulator System. In this application it was found that system integration was much easier than if Fortran or Pascal had been used, because Ada compilers checked program interfaces as the program was being compiled.

d. *Concurrency* is supported by the tasking feature of Ada. It provides the ability to specify multiple tasks that can be executed concurrently. This parallel processing is most useful since it allows for a number of tasks to be performed at the same time, resulting in much faster execution of programs.

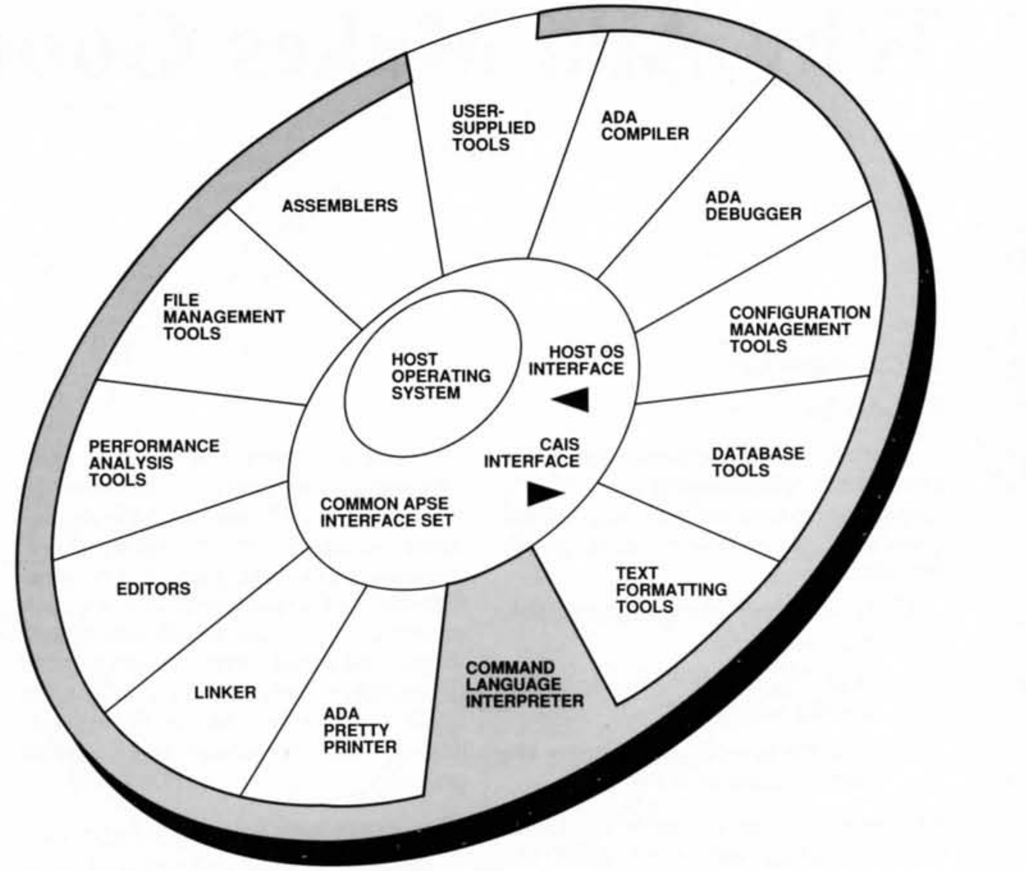



**Fig. 1. Ada Language System**

Compilers are also an important element of the Ada technology and concepts. Compilers translate the high-level language into a sequence of machine instructions that will be stored in the computer and will form the program to be executed. One difference with Ada compilers is that they must be tested and certified as correct by the Ada Joint Project Office.

Ada compilers are unique in that they have a program library feature which stores the results of each successful translation. A task being compiled can be compared with tasks previously compiled to ensure that the required interfaces have been included. Other tools in the program library allow for such things as the analysis and management of the software development process.

An aspect of programming support which is flourishing with Ada is the availability of tools and environments (*Fig. 1*) that make software production more integrated, structured and controlled. Such environments incorporate all the necessary tools to design software systems in a top-down fashion, and also support the management of software. These are called Ada Programming Support Environments or APSEs. An APSE is a total system used to specify, design and manage software. Some of the tools that form an APSE include:

* Computer-Aided Software Engineering tools,
* Dynamic tools,
* Debuggers,
* Optimizers,
* Configuration Managers, and
* Database Managers.

One more aspect of compilers in general is the run-time executive, a small layer of software typically contained in embedded computers. In the past, the application software called on this software to make hardware-specific applications happen. This was a problem since all run-time executives were different. As a result, application software was not portable from one computer to the other. Ada, however, provides the run-time executive features as part of the Ada language itself. Consequently, special run-time executives do not directly

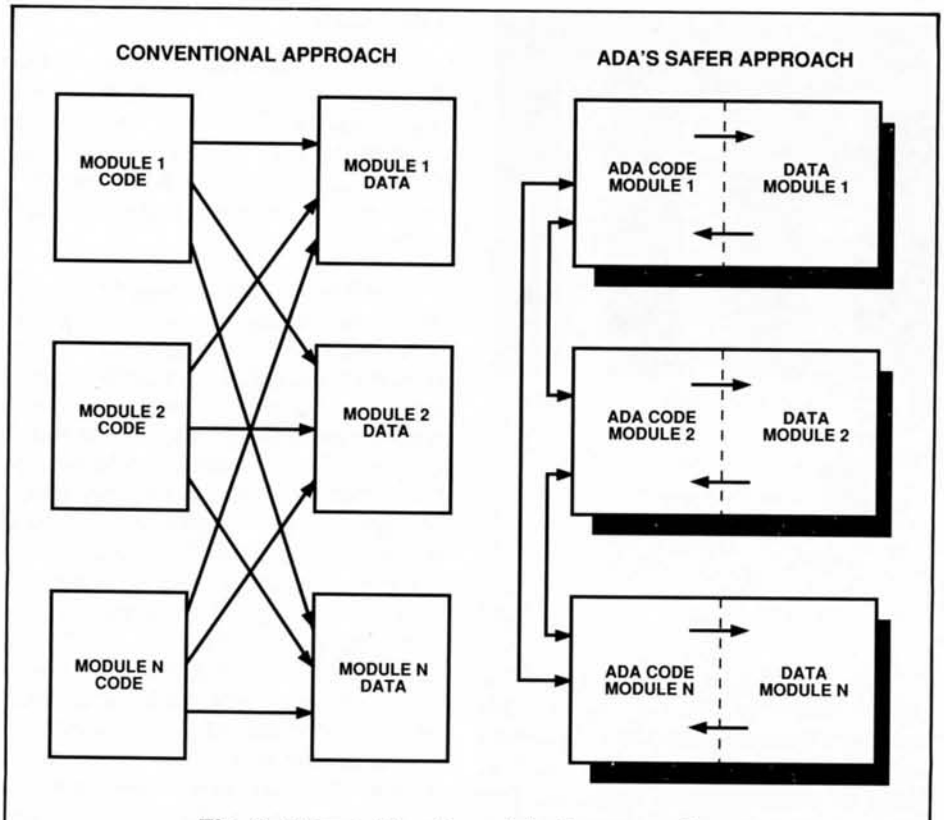



**Fig. 2. Conventional vs. Ada Programming**

interface with the applications, and Ada software becomes portable between different compilers and, hence, different computers.

### Software Engineering

The major feature of Ada, and obviously the major reason for using it, is that it promotes sound software engineering practices which result in the early detection of errors and in lower life-cycle costs. Sound software engineering practices require that programming be structured. Ada as a language enforces the requirement for structured programming and places the emphasis on the design stage during the production cycle. The coding activity then becomes secondary to the design effort and flows from it. This process forces the design engineer to produce a system design that will be manageable throughout its life cycle.

Some of the features which support long life-cycles include:

a. *Modularity, Abstraction or Information Hiding* — program modules are composed of two physically separate parts — the specification and the body. This way it is possible to compile programs which make use of a module before the module body even exists. All of the information needed to compile programs referencing a module is given in the module specification. This structure ensures that modules are functionally independent from each other (*Fig. 2*) and that their interfaces are well defined early in the system design process.

b. *Syntax Checks* — rigorous checking of the syntax facilitates final integration of the various modules of a large program by ensuring the consistency of module interfaces.

c. *Testing* — Ada code can be tested on different target computers, making development easier and faster.

d. *Reusability* — The same Ada modules can be reused for a number of different projects, meaning the initial investment can be amortized over a longer time frame.

Software production with Ada can be compared to a civil engineering situation where an engineer produces a design specification and a bricklayer stacks the bricks in accordance with the specification. Similarly with Ada, the system or software engineer produces the design specification and the programmer stacks the programming instructions. With previous languages the percentage split between design, coding and testing was 40-30-30. With Ada, there is a greater emphasis on design, the split being 60-20-20.

### Rationale for using Ada

The Ada language has been accepted worldwide as one standard. Unlike other languages, there is only one Ada. Ada is undoubtedly the best there is at this time. It allows the software designer to ignore the hardware specifics and is not dependent on a specific compiler or computer. Ada code can run on any machine for which there is an Ada compiler, and when better machines come along the code can be easily transported.

Ada also means software engineering. The language promotes the use of sound software engineering principles. Because Ada makes software engineering easier, it has made the use of the language more widespread. Ada ensures that software is developed in a disciplined fashion and as such contributes to the production of quality software. The high-level features of the language ensure that a structured approach is followed in the development of software, thereby ensuring good design.

Finally, and most importantly, because Ada software is not system-specific, programs will not only be reusable, but they will also be available as off-the-shelf software. Indeed, Ada will undoubtedly change the way software is produced since the language provides the opportunity to basically do away with tailor-made software. It is quite

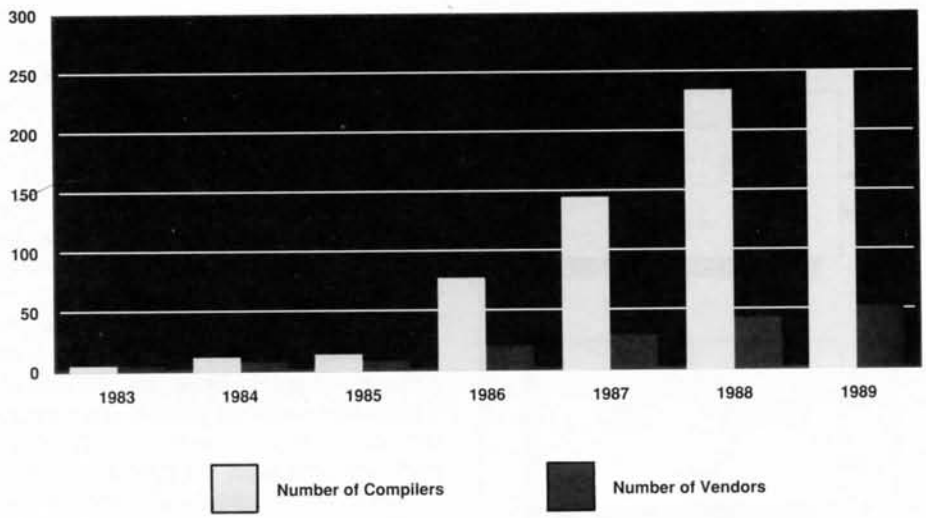



**Fig. 3. Current Ada Technology Status**

feasible that software for most applications, be they military or commercial will one day be available over the counter.

### Cost of using Ada

The bottom line for using Ada today is cost. Recent studies conducted by the U.S. Navy indicate that the cost to produce one line of code in any of the old languages such as Fortran or CMS-2 is $200 (Cdn), whereas the cost to produce the same line of code in Ada is $65.00 (Cdn).

Another interesting aspect of cost is that for traditional languages a line of code gets more expensive as the project gets larger. With Ada, the line of code gets cheaper as the project gets larger. This is because Ada, with its structured engineering approach to programming, actually results in ease of integration and economies of scale. For the same reasons, life-cycle maintenance costs are expected to be much lower for Ada software than for code produced in the traditional languages.

### Current Situation with Ada

There are now more than 200 validated Ada compilers available in the marketplace from about 50 different vendors (*Fig. 3*). The compilers cover the entire spectrum of the software and computer industry. APSE tools are also readily available from more than 100 vendors around the world.

Ada is now also undergoing its formal review with Project 9X. For this review, a team of industrial and military experts has been assembled to look at ways of improving the language. One particular aspect of the language that is being looked at is the use of Ada in multiprocessing environments.

What is particularly interesting about the growth of Ada is its worldwide appeal. Some of the commercial projects using Ada now include:

* the Canadian Air Traffic Control System
* project Columbus, of the European Space Agency
* the Copenhagen Airport Traffic Control System
* the Inter-Bank Banking System of Finland
* the Australian Lottery System
* the Nippon Telephone and Telegraph Company (for a computerized telephone network in Japan)

### Expectations

There is no doubt that the process of standardizing on Ada will continue. Nor is it too presumptuous to believe that there could eventually be global repositories of Ada software applications packages. Indeed, with Ada, there is no reason why software programs for naval systems of the future cannot be assembled from standard software components.

### Conclusion

First and foremost with Ada is that it promotes the use of software engineering practices. It is making software production truly evolve from an art-form to an engineering discipline. Ada enforces the software engineering discipline.

Ada's importance in supporting software engineering has been recognized worldwide. What is most surprising is that even though it was initially developed for the military sector, it is now widely used commercially. Major industrial projects have chosen Ada because the technology is unquestionably mature enough for their applications. Eighty percent of Ada use in Europe is in commercial applications such as communications, banking and teleprocessing. The underlying value of Ada is that, for the first time since the invention of software, a single language is being accepted as a world standard for both military and commercial applications. A move which will undoubtedly have tremendous long-term benefits for the military.

*Commander Cyr is the DMCS 8 section head for naval computer technology at NDHQ.*

# Forum

## Naval Officers as Programmers – *A programmer's viewpoint*

*By Lt(N) Chester Conrad*

**Introduction**

Over the past two decades, a misconception has existed that all naval officers employed in the field of tactical programming are severely career-limited and fulfil at best a mechanical function, more appropriately carried out by any technician with a bit of training in a programming language.

This attitude is perhaps best exemplified in the April 1989 edition of the Maritime Engineering Journal in an article by Cdr Roger Cyr entitled "Naval Officers as Programmers – A Wasted Resource."

The article assumes a level of naivete on the reader's part of very large proportions. Anyone who has had the slightest involvement with command and control systems – or any computerized naval application for that matter – would find it difficult to believe that any large software system could be maintained and upgraded over the years by a group of untrained junior officers having little or no background experience whatsoever.

In a previous article published in the September 1988 edition of the Journal, entitled "Software and the MARE," Cdr Cyr pointed out that the entire evolutionary model for system development may be repeated throughout the maintenance phase of a system's life-cycle. "Maintenance" is perhaps a weak word to describe the effort required to manage a naval tactical system over some twenty years without any major changes in the underlying hardware architecture – despite the exponentially increasing number of requirements that must be addressed. The qualities required to be successful in this endeavour include innovation, resourcefulness, tenacity and a good ration of common sense. Analysis review, redesign, coding and retesting require every bit as much skill and grey matter – perhaps even more – than designing new systems from the start. To suggest that these qualities are limited to the Combat Systems Engineer is ridiculous. The premise that software design requires engineering skills and should be performed by a Combat Systems Engineer is analogous to saying that writing a letter is a literary skill that should be performed only by a person possessing an Arts degree with a major in English.

**Software Production – A Methodical Process**

It is generally accepted that the phases of modern software development are Analysis, Design, Coding, Testing and Maintenance. When we speak of programming, it is understood that this means coding, or converting the software design into a form recognizable to a computer by using a programming language. There is nothing magical about this process, and yes it is a mechanical function that can be performed by a person with the requisite technical background.

Requirements analysis, software design and testing are phases of generic design that also proceed in a methodical fashion. They produce the functional specifications, design specifications and validation documentation to see the system through to its completion.

In a perfect world, with ample money, personnel and time, we could certainly give the coding tasks strictly to programmers, and our computer literate end-users could produce glowing Statements of Requirements that any designer would have no trouble interpreting. They could also test our system in great detail, having full knowledge of the required inputs and expected results.

However, the world is not perfect! End-users require help in expressing requirements in technical terms. The navy does not have platoons of automatons, known as coders, fallen-in three-deep waiting to code their next application. Testing can be so complex at times that it requires the combined efforts of end-users, designers and hardware experts just to perform a validity check.

*"The navy does not have platoons of automatons... fallen-in three-deep waiting to code their next application."*

What the navy does have is a character known as a Programmer Analyst. This person may commence his or her other career in software by learning a few programming languages and performing the duties of a coder. As time goes on though, the programmer analyst learns to deal with end-users, helping them to see things from an automated standpoint, and assisting in requirements specification. He or she begins to understand the concepts behind structured analysis and design and realizes the importance of following established practices in software design and development. Programmer Analysts may not be engineers, but that does not mean that they can't apply sound engineering principles to produce high-quality software products.

In short, the effectiveness of any programmer analyst involved not only with naval tactical applications, but any sizable software project, should be measured by the way in which that person puts his or her experience to good use. Software engineering in today's navy is a career, and the people within that career stream work long and hard to become proficient at what they do. It is not a function that can be carried out as a secondary duty by somebody just because their job description contains the word "engineer."

**Conclusion**

Software maintenance is a very different activity than hardware maintenance. In some cases, software maintenance may require the whole development life-cycle of a system from analysis through testing be completely redone. The programmer analysts and system designers that the navy produces today in the Canadian Forces Fleet School are capable of taking a system from its inception as an idea through to the final phases of testing and documentation, regardless of whether these people are MARS officers, marine Systems Engineers, or Combat Systems Engineers. The necessary requirements for a person to be successful in this type of career are aptitude and willingness to learn.

The greatest problem facing Canadian naval software applications is a lack of personnel to handle the ever-increasing workload. If we continue to perceive Canadian software specialists as "career-limited" and "lacking the requisite engineering skills or tactical experience to adequately produce or manage software," then we will continually fail to attract the professional and dedicated people that the Canadian navy requires to meet the software crisis head on.

*Lt(N) Conrad is the Advanced Programmer Analyst Course Officer at the Canadian Forces Fleet School in Halifax.*

# Naval Combat Trades Structure –

## *Changes now would be premature*

*By LCdr B.H. Grychowski*

It is commendable that the MARE Journal provides a showplace for new ideas. This forum is essential to the health and growth of the entire MARE community including the technicians. When a controversial idea is aired, the Journal also forms the avenue for discussing it.

I consider the concept put forward at Cdr Cyr's article "A Proprosed Naval Combat Trades Structure for the 1990s" in the September 1989 edition to be very controversial. His argument maintains that the systems and equipment to be employed in CPF and TRUMP will be extremely reliable and maintainable. With respect to that supposition, Cdr Cyr's article proposes to walk back on the MORPS concept to that of user/maintainer. It is my understanding that MORPS was developed in anticipation of CPF. MORPS is the product of effort by representatives at all rank levels and represents a "corporate plan" for the trades structure. In CPF the numbers, trade specialties and rank levels were assigned at some effort. That structure has not yet been tested at sea; therefore, it seems premature to be considering changes.

There are several problems foreseen with Cdr Cyr's proposed restructure of the Combat Systems Department. The first is numbers. No amount of skill can make up for concurrent activity over an extended time period. The purported skills of technologists will never overcome the problems of a lack of skilled manpower to perform the duties required in a warship on a 24-7 basis. Not only are departmental staff required to be technically competent but they are also required to be sailors. As such the Combat Systems Department has responsibilities for seamanship evolutions and ship's husbandry duties. The full scope of ship operations and requirements must be taken into account when considering any change in manning levels.

The plan proposed by Cdr Cyr only discusses low- and medium-level maintenance in passing. Bringing the operators up to the skill levels necessary to produce quality workmanship would require a training course load equivalent to that of the current TQ5. Partially trained personnel could cause maintenance-induced failures. There is more to performing maintenance than reading an instruction set in PM schedules. Under the previous user/maintainer concept untrained personnel were only employed under the close supervision of technically trained supervisors. As junior technicians demonstrated more knowledge and skill they were given increasing responsibility. They were required to complete technical On Job Training (OJT) Packages, which was time consuming. They also require time to learn to operate the equipment. In the CPF, learning to operate the equipment is considered to be a full-time activity with its own OJT requirements.

The next problem foreseen with this proposal is the amount of faith placed in the ability of BITE, BIT and software-driven testing. These facilities are an aid to the technician, not the answer to the repair function. Much of the equipment in CPF, as mature equipment, is of older design. As such, there remains a significant requirement for conventional fault finding.

With the extent of software used in the new systems there is also a requirement for Combat Systems Department and the senior Combat Department personnel to become intimately familiar with the system software. Further, Combat Systems Department personnel must become experts in their own equipment and knowledgeable on other equipment outside of their discipline in order to share the maintenance load. Keeping up with the greater number of systems and equipment will require a more extensive effort by technical personnel than ever before. With the requirement for operators to be very familiar with the detail of software in addition to their operational functions, there may not be time in their careers to train them in hardware repair action.

*"There is more to performing maintenance than reading an instruction set in PM schedules."*

The matter of control must now be addressed. It is anticipated that it will be difficult to coordinate and control the action of the existing dedicated technical staff. Complicating the issue by having to solicit support from another department will make it more difficult. The Combat Operators have team and individual training to perform in harbour. At sea they will stand in the two-watch system. The ORS can be trained to handle routine problems on the system, but the more serious problems will have to be processed by the technicians. With the spread of the system throughout the entire ship this becomes a manpower intensive task.

An area not examined in the proposed trade structure is career progression. If all Combat System Personnel were technologists, arrived at from an METTP-like system, they would all have to be of fairly senior rank. With no junior personnel, who would do the cleaning stations and seamanship evolutions for the Department? Would all this revert to the Combat Department? In either case serious dissatisfaction would arise. The "technologists" might feel demeaned should they have to perform menial tasks. The Combat Department would feel cheated if it all fell to them.

To retain a Department comprised solely of technologists would be untenable. With highly marketable skills and experience, the technologists will be in demand both in industry and in the officer corps. Who will replace them should they go? A working, functional Department must be a cohesive organization with all rank levels represented. It must have its own ordinary seamen and it must have its own chief and petty officers and officers to ensure that it acts as a viable organization. Our navy has not yet reached this enviable position and already the winds of change are upon us. The proposed trade structure could set the Combat System Department back to a point where there would be no realistic department as was the case in the early 70s.

In his second-to-last paragraph Cdr Cyr states that the Royal Navy is reevaluating their trade structure because of the Falklands. It would be interesting to read about the system they intend to reach and why they are making changes. We are now mature enough as a navy to not change just because the RN changes. They might be wrong.

In conclusion, we, the Mare community should not attempt to change the make-up of the Combat System Department until there is sufficient documented evidence that it is required. Then, changes may be made taking all aspects of the current problem and future requirements into consideration.

*LCdr Grychowski is the CSEO (designate) for HMCS* Halifax.

# Naval Combat Trades Structure – *Some insight to the NET occupations*

*By LCdr William G. Dziadyk*

The article "A Proposed Naval Combat Trades Structure for the 1990s" by Cdr Roger Cyr in the September 1989 issue was read with interest. The article will serve well as a catalyst to generate further discussion on the subject of which naval combat system technician occupation structures are required to effectively maintain the next generation of sophisticated CPF, TRUMP and SSK(?) combat systems. However, for such discussions to proceed effectively, the paper should be put in its proper perspective with respect to the current problems in the Naval Electronic Technician (NET) occupations. Any changes to the trades structure must address the known problems as well as the maintenance needs of the next generation of combat systems. The readers should also be made aware of the mechanism which has been put in place to address and hopefully solve these problems.

It is unfortunate that the term "proposed" was used in the subject article. The term implies that the discussed occupation structure might be an official proposal. Such terminology has caused some confusion and uncertainty amongst members of the NWT and four NET occupations. Rumours have started, which were not based on fact.

The NWT occupation is relatively healthy and its Occupation Specifications have been updated to reflect the needs of CPF and TRUMP. However, few Combat Systems Engineers or senior technicians would argue the question as to whether or not there are major problems in the NET occupations. It is difficult to distinguish the NET "problems" from the "symptoms," however the major areas of concern are believed to be:

a. **Critical shortage of qualified technicians** – The major NET problem is a critical shortage of qualified technicians for ships' positions. In the three feeder trades, there is a combined shortage of 66% and 88% respectively for the Leading Seamen QL5 and Master Seamen QL6A journeymen technicians. These journeymen technician positions at sea are thus being filled by personnel lacking the required qualifications. This shortage of qualified journeymen causes other problems such as the misemployment and overtasking of senior qualified petty officers.

b. **Attrition** – The individual reasons for leaving the service are complex and it is not yet possible to generalize as to what a primary common cause would be. The subject article's conjecture that technicians are leaving "primarily because their professional qualifications as combat systems technicians are going unrecognized" is only one factor in a complex formula.

c. **Delayed start of technician training** – The prospective NETs are loaded on to their first technical course (QL5) after about five years' service as operators rather than after the MORPS ideal of about 30 months' service. Very little technical knowledge and skill is gained by the NET during this five-year operator employment. This late initiation of technical training has resulted in:

   (1) Waivers to promotion policies to allow the use of the Acting Rank / Lacking Qualifications anomaly,

   (2) Very high failure rates,

   (3) Morale problems with respect to the Combat Department operators. The Combat Department operators are getting their QL5 courses essentially on time while the junior NETs often stay on board to provide operator continuity.

   (4) Poor seasoning of knowledge, skills and leadership at sea due to resulting back-to-back coursing. (When a candidate eventually gets his QL5 qualification, he is often already time-in-rank for both promotion and the next qualification course.)

d. **Inadequate occupation specifications** – The Occupation Specifications do not adequately reflect the current requirements of the navy. Notwithstanding the CPF and TRUMP contractual requirements that the maintenance philosophy shall be repair-by-replacement to the card level and that the appropriate BITE and ATE shall allow appropriate fault detection, isolation and repair, the real first-line maintenance requirements are still quite uncertain. The various system-specific maintenance plans and associated level of repair analysis are not yet fully visible to the navy. The NET Occupation Specifications must eventually be updated to reflect the requirements of CPF and TRUMP.

> *"It is unfortunate that the term 'proposed' was used.... Rumours have started, which were not based on fact."*

e. **Inverse rank ratios of established positions** – The NET problems are being exacerbated by an inability of the trades to reach the steady state MORPS structure of established positions. The occupation profile progression has become quite volatile due to the need to provide replacement personnel to the large number of senior technician and shore infrastructure positions from the present number of journeyman positions.

f. **Delayed start of digital training** – The QL5 courses do not presently provide the level of digital training which is required by CPF and TRUMP.

g. **CPF maintenance workload** – The CPF CSE Department technician establishment of:

   (1) one CSE coordinator (CP02 QL6B NET(S) or NWT),

   (2) nine NWTs (four QL3/4/5 OS/AB/LS, four QL6A MS/PO2 and one QL6B PO1), and

   (3) sixteen NETs (four QL5 LS, eleven QL6A MS/PO2 and one QL6B PO1)

   may not be adequate for the real requirements of the operational CPF. The subject article proposes that the three NWT and NET(S) QL6B systems level technicians and the twenty QL3/5/6A electronics and weapons subsystem technicians be replaced by nine "Combat Systems Engineering Technologists" possessing "a high degree of technical knowledge of the total system and the interaction between its various subsystems or components." The degree of required maintenance effort may be greater than that originally expected and contracted for. If this is the case, there will likely be a need to rationalize the establishment after the navy has obtained a full understanding of the maintenance requirements of the individual subsystems. The subject article states that "with the technology incorporated in the systems of our new ships, the medium-level maintenance skills are no longer required." Such a conclusion cannot yet be drawn from the known maintenance needs of the individual subsystems. To the contrary, there is strong evidence that the NWT, NET(C), NET(T) and NET(A) QL5/6A journeyman technicians will be essential resources on CPF and TRUMP.

h. **Employability of QL6B systems technicians in shore infrastructure** – The present QL6B training is not appropriate for some 75% of the NET(SYSTEMS) taskings. The tasks in only 25% of the PO1 Systems Technician positions can be properly conducted by any steady state Systems Technician. These tasks are those which would be performed in shipboard positions. The remaining 75% of the positions involve tasks in the shore engineering and training infrastructure. These positions require specialized subsystem backgrounds and thus cannot be effectively manned by any steady state PO1 Systems Technician.

The present NET Occupation problems (or symptoms) must be fully investigated before any proposals for the 1990s are developed to change our current naval combat trades structure. Any proposals must be fully substantiated and must reflect the real technical needs of the future fleet and shore infrastructure. In October 1989 the NPPP convened an NET Occupation Review Team under the sponsorship of DGMEM to fully examine the NET problems in detail and recommend solutions. The major activities in the Occupation Review are:

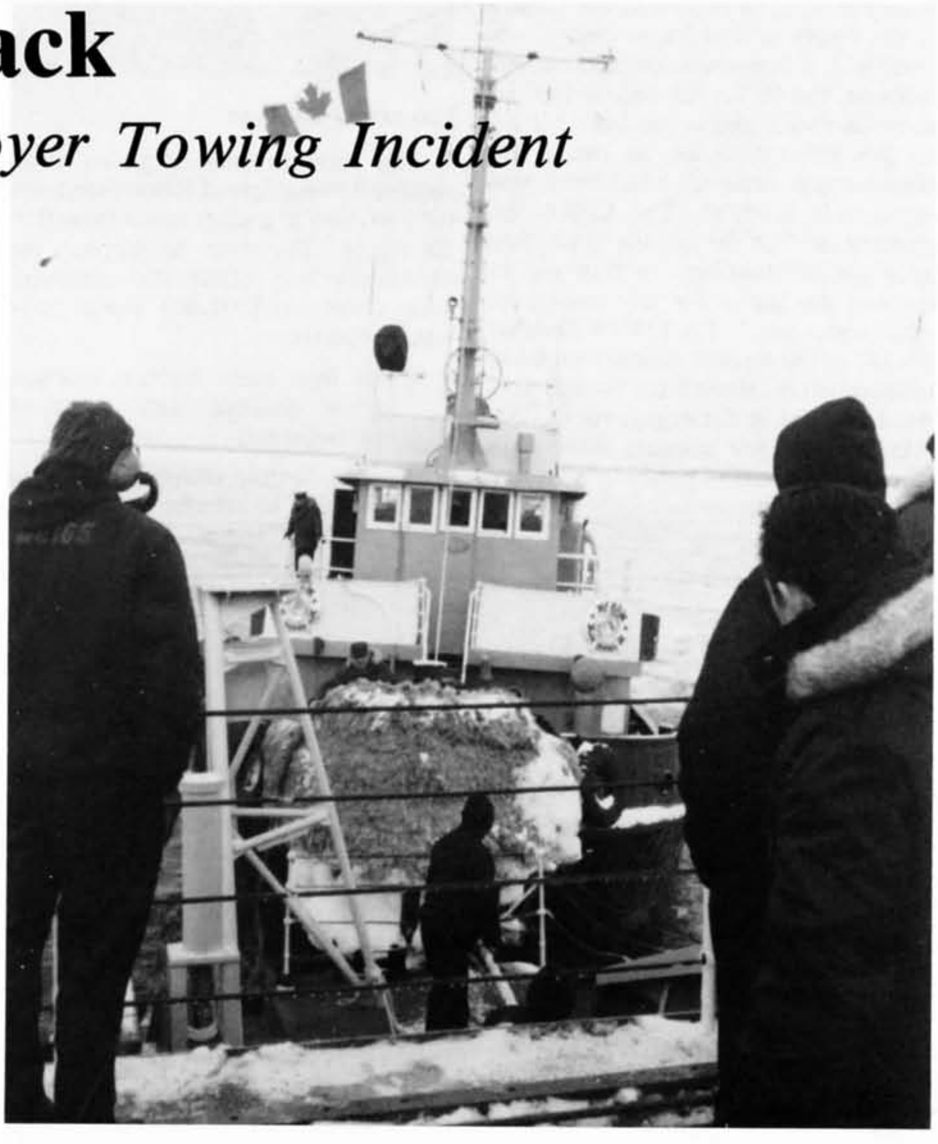
- Complete Problem Definition,
- Review Occupation Specifications,
- Establishment Review,
- Develop Training Profiles,
- Occupation Structure Analysis,
- Training Analysis, and
- Develop Implementation Plan.

As the NET trade adviser within DMCS, I hope that I have met my objectives of providing some insight to the current problems within the NET occupation and provoking further discussion. This insight may assist the community of Combat Systems Engineers and senior Naval Electronic Technicians, through discussion and participation in the NET occupation review process, to effectively develop further perceptions of the problems and the way ahead.

*LCdr Dziadyk has NET trade adviser responsibilities within DMCS.*

# Looking Back

## *DDH-205 Destroyer Towing Incident*



**Introduction**

Several years ago, a DDH-205 was attempting to make her way to Halifax after refit in Montreal. It was the middle of winter and the St. Lawrence River was heavy with slush, and both pan and rafting ice. At 0735 on 30 Jan the ship was moved off the jetty by tugs with the intention of proceeding down river under her own power. Almost immediately, ingestion of ice caused the loss of seawater circulation to both turbo-alternators, both main condensers, no. 1 diesel and three hull-and-fire pumps. The machinery plant was shut down and the ship was returned to her berth by tug.

On 5 Feb the ship was prepared to be towed. Ice conditions were still so severe however, that the sailing was postponed until 0800 6 Feb.

**Events**

During the shutdown after the aborted 5 Feb sailing, the engine-room inside roundsman received a telephone call from the 2 i/c outside machinery advising that "they wanted the steering motors out." As the steering motors were already off and the inside roundsman was no longer sure of what he had heard, the senior man present (a PO1) decided they wanted the "turning gear out." The turning gear was removed without the Engine-Room Chief, CERA or the Engineering Officer being informed.

Prior to sailing on the morning of 6 Feb the CERA received reports from the Boiler Room, Engine Room and Outside Machinery Chiefs that their spaces were ready for sea including confirmation that turning gear was in. (The Engine Room Chief had last sighted the turning gear on the previous morning and had not made rounds of the engine-room on the day of sailing.) The CERA then reported to the EO that the department was ready for sea.

The ship slipped under tow at 0755 with "modified" special sea dutymen. The EO was certain that there would be icing of sea water intakes and had stationed himself in HQ1 and the CERA in the Engineer's office to deal effectively with the imminent damage control problem. The CERA directed the EOOW to remain with him in the EO's office. At that point there was no one in the engine-room since all machinery was supposedly stopped. The CERA instructed the EOOW that the machinery state notwithstanding, "a man was to observe the shafts for any movement while under tow." The EOOW detailed the job to the outside roundsman who, unfortunately, started his rounds forward and not in the engine-room. Within the next few minutes there were several hull-and-fire pump failures due to ice ingestion.

At 0805 the Engine Room Chief went below and heard the shafts turning. He started the electric forced lube oil pump immediately and notified the EO and the CERA. The ship continued down river under tow and the propulsion system bearings were inspected that night while the ship was secured alongside.

**Machinery Damage**

The main propulsion power train rotated without forced lubrication from 0755 to 0805 at a shaft speed from 0 to 20 r.p.m. The cost to inspect the machinery and effect the necessary repairs was over $200,000. The damage was as follows:

a. all four main turbine bearings were scuffed and required replacement;

b. both flexible couplings required cleaning to remove flaked metal particles; and

c. the port-side after cruising gear wheel bearing was wiped and required dressing.

**Lessons Learned**

A similar incident occurred in 1964 so it is important to take note of the following lessons learned *this time:*

a. clear orders are essential — the EO's night order book was not explicit enough to prepare the ship for departure and there were no EO's technical instructions or temporary memoranda giving direction in this peculiar situation. Verbal orders can be, and in this case were, easily misinterpreted. The order to shut down the steering motors that resulted in the removal of turning gear is a prime example. Another is the CERA's order to sight the shafts which lost its urgency by the time the roundsman received it;

b. engineering special sea dutymen should close up in accordance with a standard operating procedure;

c. constant supervision of shafting must be provided in a locked-shaft towing evolution;

d. the turning gear was removed under unusual circumstances and should have been reported to higher authority; and

e. *never assume* that the machinery state is as you left it a few hours or days previous.

# News Briefs

## *Bravo Zulu*

Congratulations go out once again to LCdr Kevin Woodhouse of NEU(A). His article "The Trouble with Turbo-blowers" (*MEJ* Jan/Apr 90) will be reprinted in the summer issue of *Marine Engineering Digest.*

## *CIMarE Digest editor retires*

Retired naval engineer Captain(N) Hank Arnsdorf steps down this summer as editor of *Marine Engineering Digest.* Arnsdorf, 66, was among the first RCN cadet class at the newly opened Royal Canadian Naval College in Victoria in 1942. Following his retirement from the navy in 1979, he joined The Canadian Institute of Marine Engineering and in 1981 became editor of the Institute's budding *Digest.*

## *706 Communication Squadron Reunion*

On the weekend of 14-16 September 1990, the 25th anniversary of 706 Communication Squadron and the 30th anniversary of Camp Borden Signals Squadron will be celebrated at CFB Borden. All former members, their spouses and anyone with prior affiliations with this unit are cordially invited to attend.

In order to facilitate planning, the organizers strongly urge all those desiring to attend to make it known to the committee as soon as possible.

For further information, or to confirm attendance, contact 706 Reunion PR Chairman, 2Lt Peter Karagiannis at the following address:

706 Reunion Committee
706 Communication Squadron
Borden, Ontario
L0M 1C0

Tel: 424-1200 extn: 84-7284
or
CSN: 270-7284

## *Mixed gender crew accommodation*

The navy has done just about as much as it can for now to integrate female crew in ships — at least from an engineering standpoint. Structural conversion shipalts to accommodate mixed gender crews are complete in *Provider, Preserver, Protecteur, Cormorant* and *Nipigon,* as well as in the naval reserve gate vessels and the PBs (minesweepers). The modifications consist of providing separate sanitary facilities and messdecks for male and female crew.

The only other steam destroyer scheduled for conversion is HMCS *Annapolis,* and her shipalt will be completed during refit in mid-1991. According to John O'Connor, the DMES 5 subsection head for habitability systems at NDHQ, *Annapolis* will benefit from the engineering experience of *Nipigon*'s 1989 shipalt for the navy's Combat Related Employment of Women (CREW) trial.

"There was a big rush to get the thing done," O'Connor said. "We ran into some hiccups with it." Most of the problems have since been sorted out, he added.

CPF and TRUMP shipalts will have to wait until the vessel design warranties expire. In the case of CPF that means two years after delivery of HMCS *Halifax* and one year after each of the follow-on ships. The TRUMP design warranty expires one year after delivery of the *last* ship.

The shipalts have been something of a "design nightmare," as O'Connor puts it, but the results to date have been largely satisfactory. According to O'Connor, CPF and TRUMP will be the last ships to bear the burden of late-stage design for mixed gender accommodation. "All shipbuilding programs from this point on," he said, "will be capable (from the outset) of accommodating mixed gender. MCDV will actually be the first ship that is *designed* for mixed gender crew."

## *Hydraulic Test Facility opens at SRUA*

A new state-of-the-art Hydraulic Test Facility capable of testing and certifying a full range of hydraulic pumps, motors, actuators and valves opened for business at the Ship Repair Unit (Atlantic) in May. Designed by Basic Hydraulics Limited of Welland, Ontario, the facility's four computer-controlled test benches will allow diagnostic and post-overhaul testing of virtually all hydraulic components existing in NATO ships. According to DGMEM Project Manager Mike Edwards, the advanced technology available in this facility will make it possible to test new and repaired hydraulic components before they are installed on board ship.

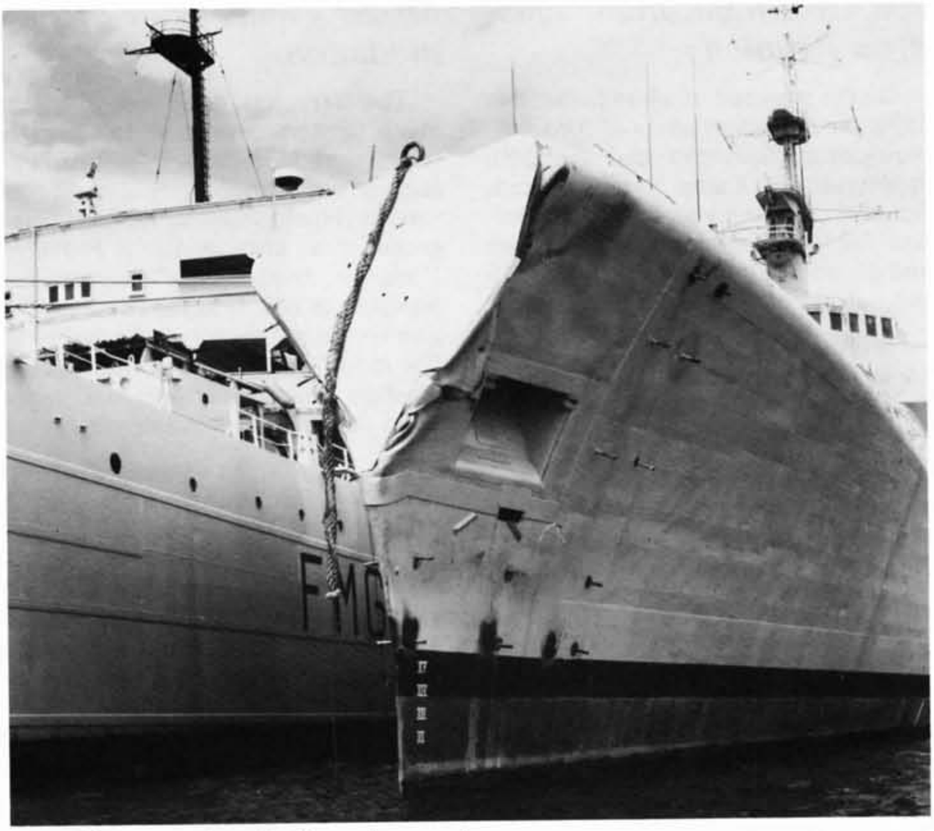
**SRUA commanding officer Captain(N) C. Baker accepts the new Hydraulic Test Facility from Boyd DeWaard of Basic Hydraulics Ltd. (*CFB Halifax photo by Cpl P.L. Tremblett*)**

## *"Kootenay bow" update*

In our last issue LCdr Vern Archibald and Lt(N) Doug O'Reilly told the story of how a prefabricated bow unit from the decommissioned *Chaudiere* was used to replace a damaged bow unit in HMCS *Kootenay*. By way of a postcript to that article, LCdr Richard Houseman, Naval Architect Officer at NEUP, answers the question, where did the *Kootenay* bow go?

"With plans well under way for the disposal of *Chaudiere*, the ship had to be prepared for the possibility of a final Pacific voyage when disposed of through Crown assets. Without a bow, however, the seakeeping and stability capabilities of the ship would be compromised.

"The most cost-effective "fix" was to replace the missing section of bow with the damaged unit from *Kootenay*. Repair specifications were prepared by NEUP, and the work was efficiently completed earlier this year by SRU(P). The photograph of *Chaudiere* alongside *Cape Breton* illustrates just how cost-effective this fix really was!"



**Chaudiere wearing *Kootenay's* nose!**

(CF photo by MCpl Michel Albert, Base Photo Esquimalt)

# Maritime Environmental Protection ...
# How the navy fits in

## *Coming up in October*