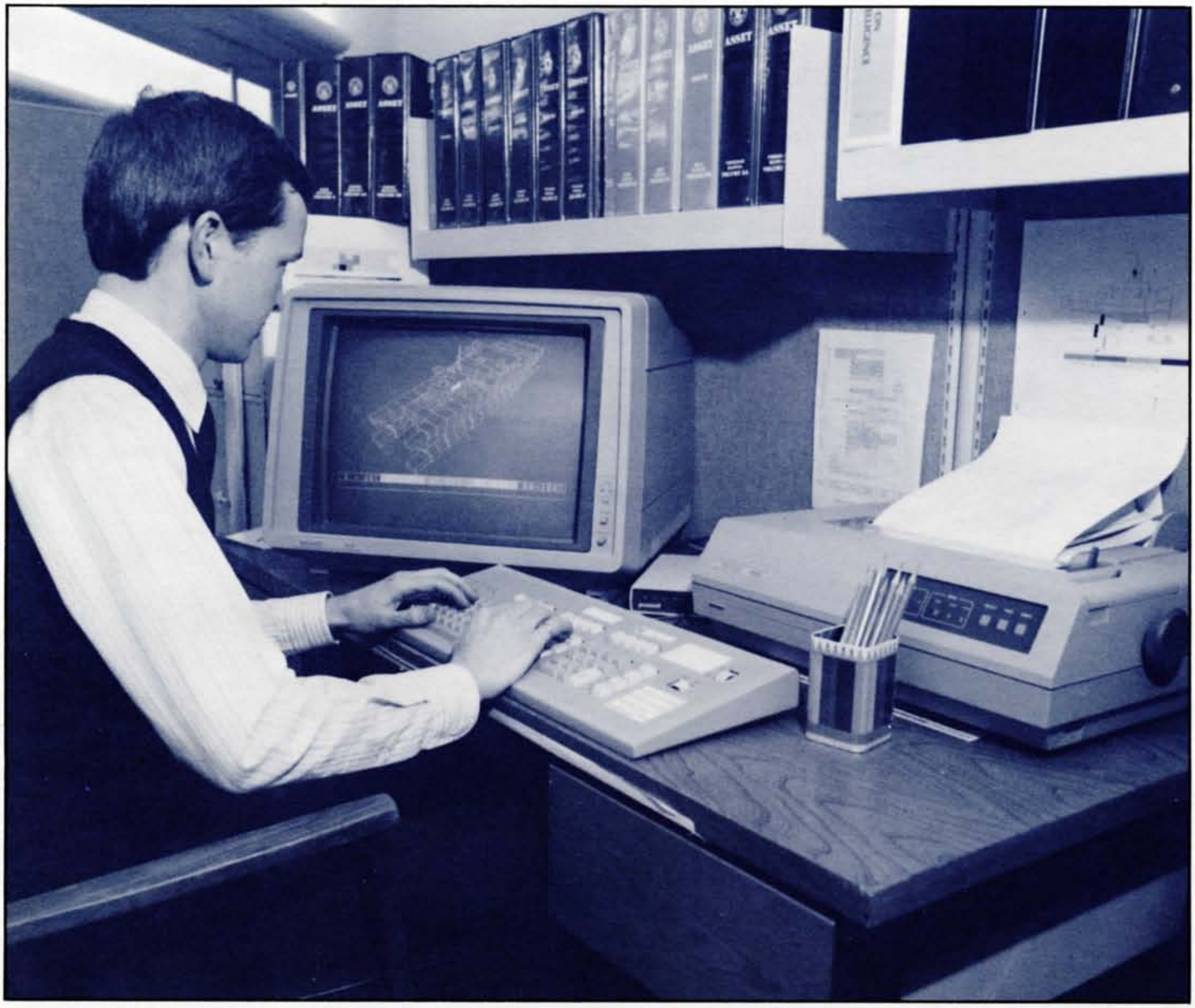
National Defence Défense nationale

MARITIME ENGINEERING Journal du GÉNIE MARITIME



Canada

April 1987 Avril

A Modest Proposal

Une proposition modeste

A CSE offers some low-cost options for upgrading the combat capabilities of the steamers
. . . page 22

Un ingénieur des systèmes de combat nous offre des options économiques pour l'amélioration de la capacité au combat de nos destroyers propulsés à la vapeur
. . . page 22

Margaree

MARITIME ENGINEERING

Journal

du GÉNIE MARITIME

Director-General
Maritime Engineering and
Maintenance
Commodore D.R. Boyle

OUR COVER

A civilian naval architect from DGMEM's Concept Formulation section calls up a hull-geometry profile from the navy's DISC ship-design system.

PHOTO COUVERTURE

Un architecte naval civil, membre de la section de formulation des concepts (DGGMM), démontre le profile géométrique de coque émanant du nouveau projet de conception intégrée des navires (DISC).

APRIL 1987 AVRIL

DEPARTMENTS/DÉPARTEMENTS

FEATURES/ARTICLES

MARITIME ENGINEERING JOURNAL
ISSN 0713-0058

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JOURNAL DU GÉNIE MARITIME
ISSN 0713-0058

Le Journal du Génie maritime (ISSN 0713-0058) est une publication autorisée et non-officielle des ingénieurs maritimes des Forces canadiennes. Elle est publiée trois fois l'an par le Directeur général du Génie maritime et de la maintenance. Les opinions exprimées sont celles des auteurs et ne reflètent pas nécessairement les politiques officielles. Le courrier doit être adressé au **Rédacteur en chef du Journal du Génie maritime, DMGE, Quartier général de la Défense nationale, Ottawa, Ont., K1A 0K2.** Le Rédacteur en chef se réserve le droit de rejeter ou d'éditer tout matériel soumis. Les articles de ce journal peuvent être reproduits tout en tenant compte des mérites de l'auteur.

Editor's Notes

Designing a warship is a complex, painstaking process of assessing and reassessing a seemingly endless succession of design options. Changing even one design variable, for instance examining the relative merits of one propulsion system over another, can lead the design engineers back through ponderous recalculations of such basic elements as general arrangement and stability. Computers have certainly made the chore easier over the years, but what's been missing is a system for integrating the various aspects of the design process in a common data base. Missing until now, that is.

In our lead article, Cdr John Edkins and Hugh Templin describe the new Design Integration for Ship Concepts (DISC) project that is going to do away with much of the tedium associated with naval ship design. Without a doubt DISC will be a boon to the navy's design engineers, especially during the early stages of the design process when their decisions have the greatest influence on the ultimate performance and cost of a new ship.

Also in this issue, an evaluation of the NETE SHIPALT package for the Solar Saturn gas-turbine alternator sets in the DDH-280s. As Ahmed Abdelrazik writes, correcting some of the deficiencies required only minor changes, but other entailed radical redesign.

We close off the Features section this time with two articles by LCdr Roger Cyr. In the first, he takes a hard look at the navy's software production method, in his words a traditional and obsolescent process, and points to the need for innovation in the areas of software transportability and system testing. In his second article, an interesting and detailed proposal for upgrading the combat capabilities of the steam destroyers, LCdr Cyr explains how the steamers can be modernized for a fraction of what it would cost to replace them with new ships.

Thursday May 21st is "Navy Day" at the week-long Canadian Engineering Centennial Convention in Montreal. Speakers from DGMEM will be presenting papers on Machinery Control Systems, Trends in Combat System Technology, SWATH Combatants, and the Development of Habitability Standards and Survivability Standards and their Impact on Ship Design. The *Journal* congratulates Canadian engineers everywhere as they celebrate the 100th anniversary of engineering as an organized profession in Canada.

We would also like to welcome LCdr Rick Houseman to our magazine staff. Fresh from three years at the CPF detachment in Saint John, LCdr Houseman takes over as the *Journal's* Nav. Arch. technical editor.

And finally, a word about the bilingual format of some of the sections in this issue. As you are probably aware, the government's policy regarding publications is that all federal government publications must be issued in both official languages. Naturally this applies to the *Journal*, so what you are seeing with this issue is the result of our efforts to make the magazine more bilingual. This is an intermediate step towards a completely bilingual format, and we hope to have the *Journal* available in English *and* French before too long.

Word of the tragic death of Commodore E.R. Ross was received just as this issue was going to press. On behalf of the naval engineering community we wish to express our condolences to his family.

Note de la rédaction

La conception d'un navire de guerre est une tâche complexe, laborieuse, qui consiste à élaborer et à évaluer une série de plans successifs qui sont sans cesse remis sur le «métier». La modification d'une seule variable—le système de propulsion par exemple—entraîne un nouveau calcul d'éléments de base comme la conception générale des aménagements et la stabilité du navire. Au fil des ans, les ordinateurs sont venus simplifier la tâche des ingénieurs, mais il manquait jusqu'à présent un système qui permette d'intégrer les divers aspects du processus de conception, dans une base commune de données. Cela est maintenant chose faite.

Dans notre article de tête, le Cdr John Edkins et Hugh Templin décrivent le nouveau Projet de conception intégrée des navires (DISC) qui permettra d'éliminer en bonne partie la monotonie de la conception navale. Le projet DISC sera sans doute un auxiliaire précieux des ingénieurs de construction navale, surtout au cours des premières étapes de la conception lorsque les décisions prises influent le plus sur la performance et le coût du navire.

On trouvera aussi une évaluation de l'ensemble des modifications proposées par le CETM concernant les groupes alternateurs à turbines à gaz Solar Saturn équipant les navires de la série DDH-280. Comme l'écrit Ahmed Abdelrazik, des modifications mineures ont permis de corriger certaines lacunes, mais d'autres ont exigé une conception totalement nouvelle.

Notre numéro se termine par deux articles du Lieutenant Commander Roger Cyr. Le premier porte sur la méthode de production de logiciels dans la marine qu'il qualifie de traditionnelle et de désuète. Il souligne le besion d'innover dans les domaines de la portabilité des programmes et de la mise à l'épreuve des systèmes. Dans le second article, il propose une façon intéressante et détailée d'améliorer la capacité au combat des destroyers propulsés par turbines à vapeur. Il explique comment ces unités pourraient être modernisées pour une fraction du coût de remplacement.

La Journée de la Marine aura lieu à Montréal le jeudi 21 mai, durant la semaine du Congrès du Centenaire du génie canadien. Les conférenciers de la DGGMM présenteront des communications sur les systèmes de contrôle de l'outillage, sur les tendances de la technologie des systèmes de combat, sur les unités de combat multicoques à petite surface de flottaison, et sur l'élaboration de normes d'habitabilité et de survivabilité, et leur impact sur la conception des navires. À l'occasion du Centenaire du génie canadien, le Journal adresse ses félicitations et ses bons voeux à tous les ingénieurs du pays.

Nous souhaitons aussi la bienvenue dans nos pages au LCdr Rick Houseman qui assurera la rédaction de la chronique consacrée à l'architecture navale. Auparavant, durant trois ans, il a fait partie de détachement des Forces canadiennes à Saint-John.

Pour terminer, un mot sur les articles en français de ce numéro. Vous savez peut-être que la politique gouvernementale en matière de publication exige que toute publication fédérale soit publiée dans les deux langues officielles. Bien entendu, cette politique s'applique au Journal. Dans le présent numéro, nous avons tenté d'observer ces règles de publication. Nos lecteurs français seront ravis d'apprendre qu'il s'agit d'une étape intermédiaire vers la publication de la totalité du Journal dans les deux langues.

Nous avons appris la mort tragique de commondore E.R. Ross juste au moment de mettre le présent numéro sous presse. Au nom de tous les ingénieurs maritimes, nous tenons à offrir nos condoléances à la famille éprouvée.

In Memoriam

1930  *1987*

Commodore E. Raymond Ross

It was with a deep sense of sorrow and loss that the naval community learned of the death of Commodore Ray Ross in late February. A former Maritime Command chief of staff and engineer-in-chief of the navy, Commodore Ross was greatly admired and respected by friends and associates alike for his devotion to family and dedication to duty. Wherever he went, this educated and articulate naval officer became known for his personal leadership, his standards of excellence and his unflappable professionalism.

During a long and distinguished career with the navy, Commodore Ross made his mark with a number of professional achievements. He was instrumental in creating the CSE subclassification following the demise of the electrical and ordnance branches, and is considered to be the professional father of today's highly competent young corps of combat systems engineers. He was also responsible, perhaps more than any other officer, for the development of the Canadian Sea Sparrow missile and for the introduction of missiles into the Canadian navy. A handbook which he wrote in the early sixties still serves as the NATO "Bible" on the assessment of guided missiles. Possibly his greatest professional legacy is the far-reaching maritime R & D program he authored in the 1970s. Still basically followed today, the program spawned some of the most technically sophisticated and advanced naval combat systems in the world — systems such as CANEWS and the "SHIN" family which will go to sea in the modernized Tribal-class destroyers and the Canadian Patrol Frigate. Canada today leads the world in small-ship integration of combat systems, and for this Commodore Ross justly deserves a lion's share of the credit.

In eulogizing Commodore Ross, Cmdre D.R. Boyle voiced the feelings of those of us who ever had the pleasure of meeting this gentle, likeable man when he said:

> You have enhanced and enriched all the lives which you
> have touched.
> You have given us all so much.
> At the going down of the sun,
> and in the morning,
> We will remember you.

Today, Commodore Ross' old blue uniform rests on display in the foyer of the Bytown Naval Officers' Mess where he was once president. He donated it to the mess after Unification as a memorial to the Royal Canadian Navy, but now it serves also to remind us of a naval officer and engineer who was loved and respected by all.

L'annonce du décès du commodore Ray Ross, en février dernier, a plongé les marins dans une profonde tristesse. Ancien chef de l'état-major du commandement maritime et ingénieur-en-chef de la Marine, le commodore Ross était l'objet d'une grande admiration de la part de ses amis et de ses collègues, qui le respectaient beaucoup pour son dévouement envers sa famille et envers son travail. Partout où il est allé, ce marin cultivé qui savait bien s'exprimer s'est fait connaître par ses qualités de chef, par ses normes d'excellence et par son professionnalisme à toute épreuve.

Tout au long de sa remarquable carrière, le commodore Ross s'est fait remarquer par un certain nombre de ses réalisations professionnelles. Il a contribué à la création de la sous-classification d'ISC suite à l'élimination des services de génie électrique et de génie technique du matériel. Il est considéré comme le père de ce jeune groupe très compétent que forme aujourd'hui le corps des ingénieurs des systèmes de combat. C'est également à lui plus qu'à quiconque que nous devons la création du missile canadien Sea Sparrow et l'introduction des missiles dans la Marine canadienne. Un manuel qu'il avait rédigé au début des années 1960, sert toujours de "bible" à l'OTAN en ce qui a trait à l'évaluation des missiles guidés. Le programme de R et D maritime d'une portée considérable qu'il a mis sur pied dans les années 1970 est probablement sa plus grande contribution professionnelle. Le programme, qui est à la base encore suivi aujourd'hui, a engendré certains systèmes de combat maritimes les plus perfectionnés au monde — des systèmes tels que CANEWS et SHIN, qui seront installés à bord des navires de la classe Tribal modernisés et de la Frégate canadienne de patrouille. À l'heure actuelle, le Canada est le premier pays du monde à intégrer des systèmes de combat à bord de petits navires et ce, il le doit en grande partie au commodore Ross.

Dans le panégyrique qu'il a fait sur le commodore Ross, le cmdre D.R. Boyle a exprimé les sentiments de ceux d'entre nous qui ont eu le plaisir de rencontrer cet homme si gentil et si aimable. Le commodore Boyle s'est exprimé en ces termes:

> Vous avez enrichi et amélioré les vies de tous ceux que vous
> avez côtoyés,
> Vous nous avez à tous tant donné.
> Au coucher du soleil
> et à l'aube,
> Nous nous souviendrons de vous.

Aujourd'hui, l'ancien uniforme bleu du commodore Ross est exposé dans le hall du Mess des officiers de la Marine Bytown, duquel il a déjà été président. Il avait fait don de cet uniforme au mess après l'unification des Forces en souvenir de la Marine royale canadienne, mais dorénavant cette relique rappellera à notre mémoire un marin et un ingénieur que tous aimaient et respectaient.

Letters to the Editor

Lettres au rédacteur

Dear Editor,

On behalf of the staff of this MARCOM outport in Quebec, may I add a few more longer phrases than those that your survey form will permit. The *Maritime Engineering Journal* is an essential element of the professional reading of all of my staff. The sole criticism must be that the issues are neither long enough nor frequent enough. Recognizing however that, as in the case of all periodicals, convincing prospective authors to spend the time to compose an article is exhausting, you continue to provide a broad spectrum of valuable and thought provoking discussions.

We the tactical operators must keep a firm focus on the technical capabilities of present and planned systems. The first move in any future sea battle is being made now as the technical specifications for CPF, TRUMP, CASAP and so on are translated into hardware. There are many other exciting developments underway and perhaps some of our civilian counterparts could provide articles for the *Journal*: SPAR and IRSTD, DREV's ship survivability simulation, PARAMAX and the CPF combat suite, etc. In this vein there are few modern developments in Naval Reserve engineering, but perhaps a general article on objectives and standards might be of use in developing a "one-Navy" engineering community. We shall undertake to force some action.

Sir, the *Journal* is a valuable communication tool which we support entirely.

Cdr D.C. Morse
Naval Reserve Divisions
Headquarters

Rédacteur,

Permettez-moi, au nom du personnel de l'unité du Commandement maritime à Québec, d'ajouter quelques commentaires aux remarques consignées dans votre questionnaire. Le *Journal du génie maritime* figure au nombre des revues jugées essentielles au perfectionnement des membres de mon personnel. Le seul inconvénient, à notre avis, c'est qu'il ne paraît pas assez fréquemment et qu'il ne compte pas assez de pages. Il n'est pas facile, j'en conviens, de convaincre les spécialistes de prendre le temps d'écrire un article, mais vous continuez, malgré cette lacune, à publier un large éventail d'articles intéressants qui incitent à la réflexion.

En tant qu'exploitants tactiques, nous sommes tenus de focaliser nos efforts sur la capacité technique des systèmes actuels et prévus. La première étape des futures batailles navales se déroule dès maintenant, au niveau des projets de la nouvelle frégate de patrouille, TRUMP et CASAP, qui se traduiront demain en matériels. De nombreuses innovations sont en voie de développement, et il est à souhaiter que nos homologues civils publient des articles dans le *Journal*: la compagnie SPAR Aerospace et le Système infrarouge de surveillance et de désignation d'objectifs, le CRDV et la simulation de survivabilité des navires, le groupe PARAMAX et les systèmes de combat de la nouvelle frégate de patrouille. Il existe peu d'innovations en génie maritime à la Réserve, mais il serait peut-être utile de publier un article sur les objectifs généraux à poursuivre et les normes susceptibles de favoriser le regroupement des diverses unités en une seule communauté de génie maritime. Nous tenterons d'obtenir des résultats sur ce plan.

Le *Journal* est un outil précieux de communication qui a notre entier appui.

Commander D.C. Morse
Quartier général
Divisions de la Réserve navale

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 programmes, situations and events.
- To provide announcements of programmes concerning maritime engineering personnel.
- To provide personnel news not covered by official publications.

LES OBJECTIFS DU JOURNAL DU GÉNIE MARITIME

— promouvoir le professionnalisme chez les ingénieurs et les techniciens du génie maritime.
— offrir une tribune libre où l'on peut traiter de questions d'intérêt pour la collectivité du génie maritime, même si elles sont controversées.
— présenter des articles d'ordre pratique sur des questions de génie maritime.
— présenter des articles retraçant l'historique des programmes actuels et des situations et événements d'actualité.
— annoncer les programmes touchant le personnel du génie maritime.
— publier des nouvelles sur le personnel qui n'ont pas paru dans les publications officielles.

Commodore's Corner

Chronique du Commodore

by Commodore W.J. Broughton

Texte commodore W.J. Broughton

It is a distinct honour and privilege to accept the invitation of your Branch Adviser to address the MARE community in the Commodore's Corner of the *Maritime Engineering Journal*.

In view of my continuing and new responsibilities in the personnel world, it seems only fitting that I should talk about some aspects of "people business" in the CF.

Many engineers, particularly our younger officers, ask why an engineer's/naval architect's special skills and knowledge should be put aside in out-of-MOC appointments. I had that question put to me forcefully last spring by a CELE student at the CF Staff School. Why, indeed! In my case, I am now on my third appointment in just over three years in the ADM(Per) group, having spent one year as the MARE Get-Well Project Officer, two years as the Director of Personnel and Careers Other Ranks (DPCOR), and now DGRET. There is no pat answer to this often-posed question, but let me offer a couple of thoughts of my own.

This may sound trite and superficial, but *someone* has to recruit, *someone* has to train, and *someone* has to run professional development. Some may say that these duties should be performed by personnel administration officers, training development officers, or officers of other occupations. To a degree they very much are performed by them, but did you know that over 20,000 CF members are involved just in delivering training of one form or another? Much as we all prize our TDOs, clearly every MOC has a stake in personnel matters.

I would go even further. The MARE who seeks a stint in Personnel is fulfilling one of our roles, which is in part ". . . the

cont'd on page 6

J'ai l'honneur et le privilège d'accepter l'invitation que m'a faite le conseiller de votre direction de m'adresser aux membres du Génie maritime par la voix de la Chronique du commodore.

Vu les responsabilités qui me sont dévolues depuis quelques années dans le domaine du personnel, il est à propos que je m'entretienne de ce sujet.

Nombreux sont les ingénieurs, en particulier les jeunes officiers, qui demandent pourquoi l'ingénieur ou l'architecte naval devrait mettre de côté ses connaissances et compétences spécialisées au profit d'autres fonctions comme le personnel. La question m'a été posée de façon percutante le printemps dernier par un membre de GE Comm à l'École d'état-major des FC. Pourquoi alors? Étant donné que j'entame ma troisième affectation en un peu plus de trois ans au sein du Groupe du SMA(Per) — j'ai été pendant un an chargé du projet "Get-Well" du G Mar, deux ans directeur des Carrières du Personnel non-officier (DCMP), et me voilà directeur général — Recrutement, éducation et instruction (DGREI), permettez-moi de vous faire part de mes réflexions sur la question.

Au risque de donner l'impression de manquer de profondeur, je dirai tout d'abord qu'il faut bien que *quelqu'un* se charge du recrutement, de l'instruction et du perfectionnement. Certains diront peut-être que ces fonctions incombent aux officiers d'administration du personnel, aux officiers de perfectionnement de l'instruction, ou à des officiers d'autres groupes professionnels. Dans une certaine mesure, ces fonctions sont exercées par ces personnes, mais saviez-vous que plus de 20 000 membres des Forces canadiennes s'occupent exclusivement de l'instruction sous une forme ou sous une autre? Sans nier l'importance des

suite à la page 6

WRITER'S GUIDE

We are interested in receiving *unclassified* submissions on subjects that meet any of the stated objectives. Manuscripts and letters may be submitted in French or English, and those selected by the Editorial Committee for publication will be run without translation in the language which they were submitted.

Article submissions must be typed, double-spaced, on $8^1/_2 \times 11$ white bond paper and should as a rule not exceed 6,000 words (about 25 pages double-spaced). Photographs or illustrations accompanying the manuscript must have complete captions, and a short biographical note on the author should be included in the manuscript.

Letters of any length are welcome, but only signed correspondence will be considered for publication. The first page of all submissions must include the author's name, address and telephone number.

At the moment we are only able to run a limited number of black and white photographs in each issue, so photo quality is important. Diagrams, sketches and line drawings reproduce extremely well and should be submitted whenever possible. Every effort will be made to return photos and artwork in good condition, but the **Journal** can assume no responsibility for this. Authors are advised to keep a copy of their manuscripts.

GUIDE DE RÉDACTION

Nous désirons recevoir des textes non classifiés qui répondent à l'un ou l'autre des objectifs mentionnés précédemment. Les manuscrits et les lettres peuvent être présentés en anglais ou en français, et les textes choisis seront publiés dans la langue d'origine, sans traduction.

Les articles doivent être dactylographiés à double interligne sur feuilles de papier à lettre de 8-1/2 sur 11 et, en règle générale, ils ne doivent pas dépasser 6,000 mots (environ 25 pages à double interligne). Les illustrations et les photographies doivent être accompagnées d'une légende complète, et le manuscrit doit comprendre une brève note biographique sur l'auteur.

Les lettres de toutes longueurs sont les bienvenues. Cependant, seules les lettres signées pourront être publiées. La première page de tout texte doit indiquer le nom, l'adresse et le numéro de téléphone de l'auteur.

À l'heure actuelle, nous ne pouvons publier qu'un nombre limité de photographies en noir et blanc dans chaque numéro. C'est pourquoi la qualité des photos est très importante. La reproduction des diagrammes, des croquis et des dessins est d'excellente qualité et nous vous encourageons à nous en faire parveir lorsque c'est possible. Nous ferons tout en notre possible pour vous retourner les photos et les présentations graphiques en bon état. Cependant, le Journal ne peut assumer aucune responsabilité à cet égard. Les auteurs sont priés de conserver une copie de leurs manuscrits.

provision of formal training policies, facilities, equipment, documentation and instructors to permit the regular rotation and development of engineering personnel''. A distinguishing mark of professionals is that they are people who live more for the future than the present. And our future depends with equal importance upon our personnel as it does upon the renewal of our ships, systems and equipment. So an appointment to personnel duties, as one example, represents out-of-MOC employment that is not only appropriate, or even desirable, but essential.

Let me now turn to another ''people topic'', perhaps one that is even closer to home. As the former project officer for the MARE Get-Well Project, an update to the MARE community at large would seem in order.

First some numbers. (We engineers may not always be considered literate, but we do understand numbers and the stories they tell!)

officiers du perfectionnement de l'instruction, il faut reconnaître que tous les groupes professionnels ont un rôle à jouer dans le recrutement et l'instruction du personnel.

De fait, l'officier du G Mar en affectation au Personnel accomplit des fonctions essentielles: il fournit les politiques d'instruction, les installations, le matériel, la documentation et les instructeurs nécessaires à la relève et au perfectionnement des membres du Génie. On reconnaît généralement le professionnel à l'importance qu'il accorde à l'avenir plutôt qu'au présent. L'avenir du G Mar repose tant sur son personnel que sur le renouvellement de ses navires, systèmes et équipements. Une affectation au service du personnel, par conséquent, est une étape professionnelle non seulement souhaitable, mais essentielle.

Permettez-moi de vous citer quelques chiffres sur l'ensemble de la collectivité du G Mar.

	80/81	**81/82**	**82/83**	**83/84**	**84/85**	**85/86**	**86/87**	**87/88**	
Attrition (No.)	50	56	54	38	33	38	31+	-	**Attrition (nombre)**
Attrition (%)	10.0	10.7	12.2	8.7	7.5	8.5	6.0+	-	**Attrition (pourcentage)**
Target Strength	559	548	587	549	607	598	603	644	**Effectif visé**
Trained Strength	475	466	451	456	465	479	428	-	**Effectif ayant suivi l'instruction**
Enrolled (ROTP)	61	46	47	73	84	79	80	-	**Enrôlement (PFOR)**
Enrolled (DEO)	10	6	22	74	61	62	35+	-	**Enrôlement (EDO)**
UTPM (No.)	2	2	5	7	3	9	3	-	**PFUNO (nombre)**
CFR (No.)	0	2	2	7	7	5	5	-	**Nombre d'inscriptions des FC**

(+ Nos. for 86/87 are as of 30 Nov 86) (+ au 30 nov 1986)

The above trends are encouraging. Attrition is down, enrolments are way up, and the training plant is bulging at the seams. I should point out that the apparent drop in trained strength in 86/87 is the result of a change in accounting procedures. Officers on subclassification training are now counted on the Basic Training List rather than on the functional (employable) strength. Using the old accounting, trained strength would show as about 510 vice 428.

There are other positive factors, as well, that do not show up in the table. ROTP francophone recruiting is very much improved at over 30% for each of the last three years, and this year the MARE classification garnered a sixth commodore. Lastly, and equally important, much progress has been made to reduce the shortfalls in the Other Ranks occupations, without which we could not function effectively, let alone efficiently.

Referring once more to the table, you will notice the increased target strength for the new fiscal year. Although important strides have been made, the classification is not out of the woods yet. The problem is particularly acute for CSEs where the shortage was considerably larger to begin with, and DEO recruiting continues to be more difficult. Nevertheless, if we can continue to recruit to our training capacity, there will be a successful outcome. That is a continuing aim of the personnel world. One measure of its success is the upcoming first reduction in the number of vacancies that will be left at the end of APS 87.

On that note, I will return to my first point. It continues to be a privilege to serve all my fellow service members and to share these few thoughts with you.

Commodore Broughton is the Director-General for Recruiting, Education and Training in the Canadian Forces.

Ces tendances sont fort encourageantes. L'attrition est à la baisse, l'enrôlement est à la hausse, et la machine de l'instruction fonctionne à toute vapeur. À noter que ce qui peut avoir l'air d'une diminution de l'effectif ayant suivi l'instruction en 1986-1987 est attribuable à une modification des procédures comptables. Les officiers en formation dans leur spécialité comptent maintenant dans l'effectif en formation élémentaire plutôt que dans l'effectif fonctionnel. Selon l'ancienne méthode comptable, l'effectif ayant suivi l'instruction équivaudrait à 510 personnes au lieu de 428.

Il y a d'autres facteurs encourageants, qui ne paraissent pas au tableau. Le recrutement de francophones dans le cadre du PFOR a subi une hausse sensible — il a dépassé 30 p. 100 les trois dernières années. Cette année, le groupe des G Mar s'est enrichi d'un sixième commodore. On a aussi fait de grands progrès en vue de combler les lacunes dans les groupes professionnels du personnel non-officier, qui nous sont très précieux.

Vous remarquerez au tableau que l'effectif visé pour la nouvelle année financière a augmenté. Même si la situation s'améliore, il reste encore des progrès à faire. Il manque en particulier de spécialistes des systèmes de combat, secteur où il y avait plus de postes à combler au départ, et le recrutement direct en qualité d'officier (EDO) est toujours plus difficile. Malgré cela, si nous pouvons continuer de recruter ainsi de personnes que nous pouvons former, les résultats seront heureux. D'ailleurs, nous sommes fiers du fait qu'à la fin de la période active d'affectations de 1987, le nombre de postes vacants aura diminué pour la première fois.

J'espère que ces brefs renseignements vous persuadront de l'importance d'une affectation au Personnel, et sachez que c'est pour moi un grand plaisir de servir les Forces canadiennes.

Le commodore Broughton est Directeur général — Recrutement, éducation et instruction, au QGDN.

DISC — Integrated Software for Ship Design and Analysis

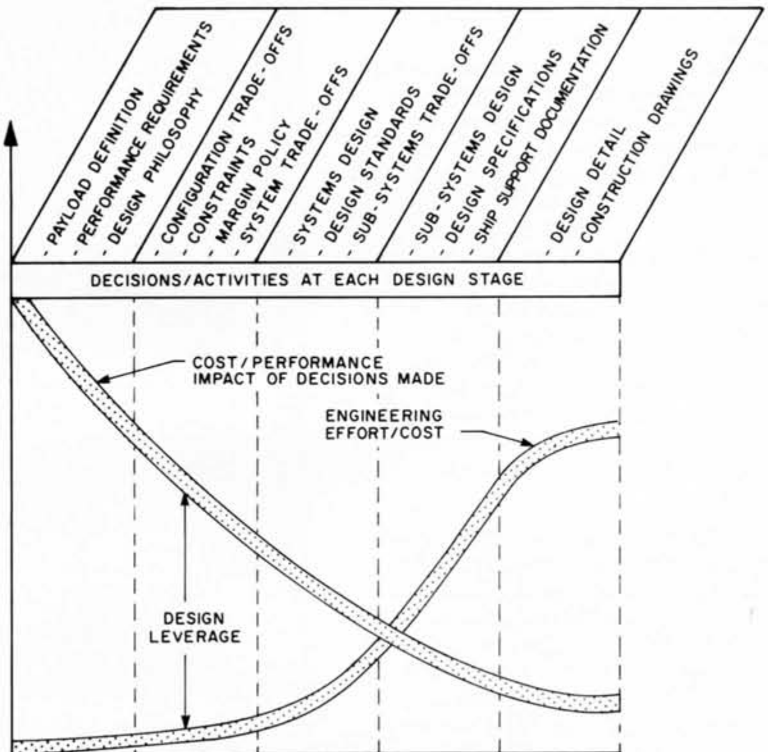
by Cdr John N. Edkins and Hugh Templin

Introduction

As warships become more complex and expensive, it becomes increasingly important that we improve our ability to deal with their many design aspects thoroughly and efficiently. In the end we must be confident that the ship commissioned 10 to 15 years after its conception is the best possible compromise between cost and performance.

The ship-design process is multiphased, ranging from concept exploration studies to detailed design, but experience has shown that decisions made in the early stages are the most basic, producing the greatest impact on the ship's final cost and performance (Figure 1). Furthermore, these decisions are made by a small team on a relatively small budget. This so-called design leverage is important because it allows the navy's small maritime operations and engineering communities to exert a great deal of influence over the designs of our future warships, even if our creative participation is restricted to the early stages.

This article describes a newly funded project called DISC (Design Integration for Ship Concepts) which will provide the navy with a comprehensive, early stage warship design-and-analysis system. The project, which is being developed through funding from the Chief of Research and Development, will integrate a series of approximately twenty computer programs in a common data base, enabling ship data to be passed easily from one program to another. Many of the individual programs currently exist, some are under development, and the requirements for the remainder are being defined.



DESIGN STAGE	CONCEPT EXPLORATION	CONCEPT DEVELOPMENT	PRELIMINARY DESIGN	CONTRACT DESIGN	DETAIL DESIGN
DURATION (YEARS)	1/2	1	1	2	3
COST ($ M)	—	1/2	10	100	300

Figure 1. The Importance of Decisions Made During the Early Stages of Ship Design

DISC Applications

The DISC system will be used primarily by naval architects in the Directorate of Maritime Engineering and Maintenance to aid in the following design-related functions:

a. early stage design of new ships;

b. whole-ship impact assessments of proposed conversions, refits and alterations;

c. monitoring of contractor-performed design/analysis;

d. parametric studies; and

e. responding to "what-if" questions generated by the Chief of Maritime Doctrine and Operations.

The system's use, however, would not be restricted to DMEM and design tasks only, as it is hoped that engineers throughout the maritime engineering community will find uses specific to their own disciplines. Many naval engineering applications rely on a ship description as a basis for analysis, and the following are examples of those which might make use of individual DISC programs and the ship-description data base:

a. assessing the performance implications of installing new propellers;

b. analyzing the cost-benefits of electrical propulsion systems;

c. determining the stability and seakeeping implications of installing new combat systems;

d. assessing the survivability improvements from applying lightweight armour; and

e. determining the whole-ship impact of applying a new technology.

The beauty of the system is that it will allow naval architects and engineers to thoroughly address the many aspects of modern ship design without having to perform massive and repetitive data input. For any application, though, the utility of DISC will depend on the users' ability to input, manipulate and interpret data correctly and, in some cases, creatively.

DISC System Architecture

A number of ship design-and-analysis programs have been developed over the years, some more successfully than others. In all cases, however, they were developed in virtual isolation and run independently. Since a geometric description of the ship is required input to many of these programs, it was not unusual to find that the subject ship had been modelled in a half-dozen different ways. The result is that there is a great deal of data input required for each and every program run. Unfortunately, early stage ship design is an iterative process of synthesis and analysis involving repetitive incremental changes, and where large data-input requirements are inconvenient for even a single run, they become intolerable for multiple runs of each program.

The DISC system architecture illustrated in Figure 2 was designed to take advantage of existing software, while dramatically reducing the volume of data required to exercise the programs. Central to the concept is the Integrated Data Base (IDB) which is essentially a relational parameter listing of the ship description. While the exact content of the IDB has not yet been finalized, it will contain in the order of 400 parameters (scalar and array values of numeric and alphanumeric data types), the most concise description required to run each of the associated programs. The vast majority of these parameters will be either synthesized, interactively input, or provided as default values, thus relieving most of the user's data-input burden. The basic principle is to provide a common data base for all of the programs in the system.

The programs themselves are classified as being either *design*- or *analysis*-type programs. The distinction between the two, as used in DISC, is simple; both types may extract data from the IDB, but only *design* programs may add to the IDB, the ship description.

It can also be seen from Figure 2 that the individual programs are aligned with different design stages; the most global applications occur during concept exploration while the most specialized are used during detail design. The primary focus for DISC development will be on the early stages of design: concept exploration, concept development and, to a lesser extent, preliminary design. This is consistent with the discussion on design leverage.

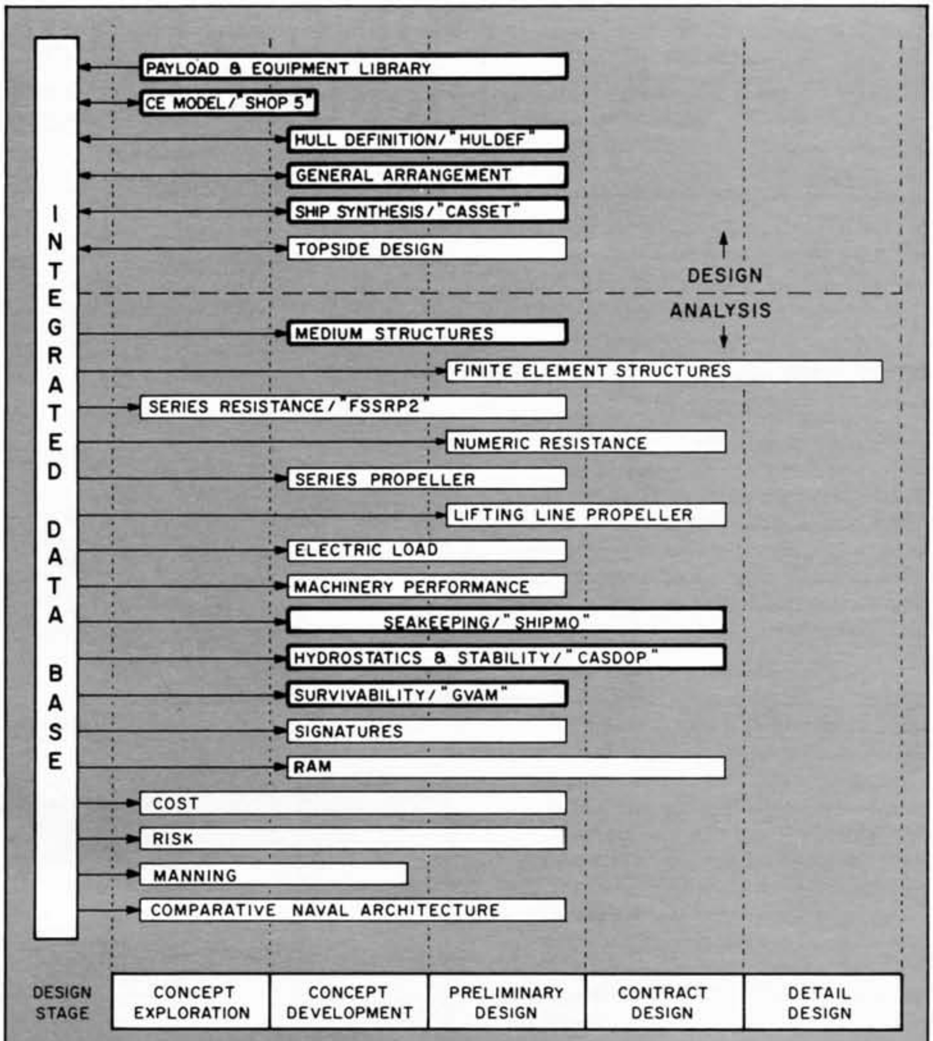


Figure 2. DISC System Architecture

During the next three years Phase I of Project DISC will integrate many programs which are now used separately, and a number of programs which can be developed during that time frame. Program correction and enhancement will also be included in this phase. (Phase I programs are indicated in Figure 2 by dark outlines.) Phase II work will build on the foundation achieved in Phase I.

The next section describes, in the context of a hypothetical design session, the details of some of the programs comprising the first phase of this project.

Typical Design Procedure using the DISC System

The task is to develop a ship design to satisfy a given statement of platform and combat capability requirements. Figure 3 illustrates a representative design process and is used to introduce some of the DISC component programs.

Statement of Requirements

The first step is to enter these requirements into the relational data base which will hold the resulting ship description. A database management program called RIM (Relational Information Management) has been purchased from Boeing Computer Services to manage the IDB.

Equipment Library and Selection

A library of combat systems equipment, with listings of their performance characteristics and physical properties, will be developed using RIM, and arranged in accordance with the Canadian Weight Classification System. The relational feature of RIM allows the designer to list, for example, all the radars in the library which meet the detection range requirement for the ship to be designed. One of these could then

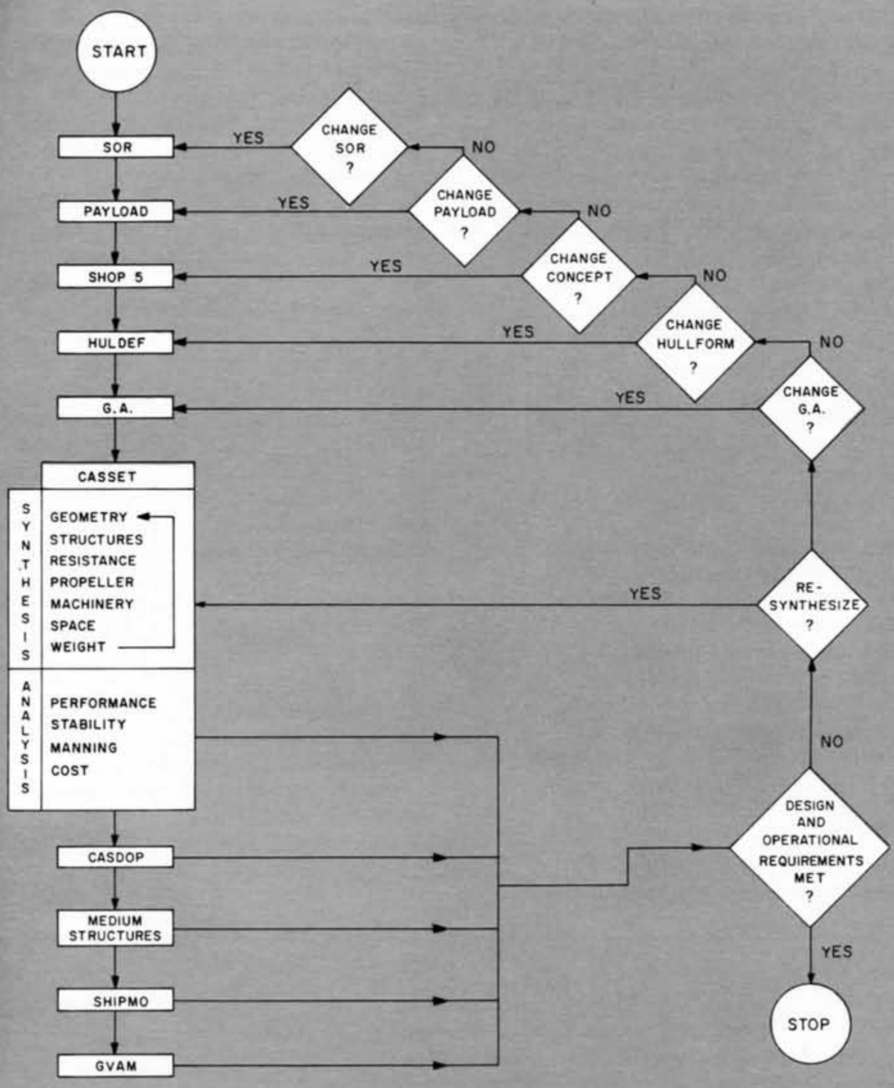


Figure 3. Representative Early Stage Ship-Design Process Using the DISC System

be selected on the basis of other capabilities such as weight, cost, etc. The physical properties of this radar and its related equipment would be copied into a new relation which would eventually contain the entire combat suite for the ship. RIM can automatically sum the weights of the equipment for use in the initial design stages.

SHOP 5

With the payload weight defined and only a general idea of the size and shape of the ship platform required, the naval architect can use the Concept Exploration Model, SHOP 5, to arrive at a baseline design suitable for more detailed study. Developed by the Defence Research Establishment Atlantic (DREA), the program can generate up to 800 variations at a time for a given range of dimensions, displacement, and hull-form coefficients. Each variant is evaluated against the platform capability requirements (e.g. top speed, range, and seakeeping), and those that pass are compared graphically for a full range of characteristics. The ship chosen from this comparison can provide the basic information for the ship description in the IDB, which may then be used by other programs.

HULL DEF

A combination of two DREA programs, HULL DEF and SM HULL, will take the hull dimensions and form coefficients from the ship description in the IDB, and interactively produce a three-dimensional spline definition. This will be used as the master hull-geometry description from which offsets may be derived for other programs in the system. This program will also have a digitizing input capability to model existing ship hulls.

General Arrangements

A commercial computer-aided drawing (CAD) program will form the basis of a General Arrangement (GA) program. Preprogrammed steps will allow the user to take the hull-geometry description from the IDB, form a three-dimensional description internal to the CAD package, and perform a number of manipulations interactively using a small graphics tablet. The major structure, such as watertight bulkheads, superstructure, and intake/exhaust trunks, would be created on the terminal screen in three dimensions. Decks would be defined at various heights and their profiles displayed on the screen. Minor bulkheads would complete each deck to the level of detail required. The GA drawing can be repeatedly refined as the design reaches its final form. Each space would be labelled, and its area, volume and centre calculated. Decks could be superimposed to verify vertical access routes. All the newly created geometry and space calculations would be stored for transfer to the ship description in the IDB.

Equipment in the combat system list would be assigned a location corresponding to the general arrangement. Their weights, combined with the centres of spaces, would give a payload centre of gravity.

CASSET

CASSET (Canadian Advanced Surface-Ship Evaluation Tool) is a concept development model which produces a balanced design using a synthesis loop encompassing geometry, structures, resistance, propeller, machinery, and weight. The program is a modified version of the U.S. Navy's ASSET program. CASSET has incorporated Canadian specifications such as the Canadian Weight Classification System, and theory such as the National Research Council's Fast Surface Ship (FSS) series for residual resistance calculations. CASSET already uses RIM to store its ship description, and will form the basis for the IDB. It considers much more detail than SHOP 5, calculating frame sizes and plate thicknesses, resistance in waves, propeller series data, engine and generator sizes, transmission losses, and weights to the subgroup (component) level. The user has the option of specifying a large number of parameters or leaving them open for CASSET to calculate. The analysis modules allow the user to study the range and fuel consumption for combinations of speed and sea state, hydrostatics and stability, seakeeping, cost, space, and manning. The space analysis module will compare the area and volume allocated for various functions in the General Arrangement program with that which is normally found on similar modern naval ships. CASSET also provides the longitudinal centre of gravity of the fuel required to give level trim. Sample outputs of the geometry module are shown in Figure 4.

CASDOP

The hydrostatics, intact stability and damaged stability could be studied in more detail using an updated version of the existing Canadian Adapted Ship Design Oriented Program. This would also calculate tank soundings to check the placement of fuel and water tanks, and provide free-surface information for stability calculations. The CAD program will serve as an interface to interactively choose compartments from the general arrangement for analyzing damage or tankage, after which the information will be passed automatically to the CASDOP program. The displacement and centre of gravity from the ship description in the IDB could be used directly, or other conditions could be specified by the user.

MED STRUCT

A medium-level structures program will either be purchased or developed and incorporated in the DISC system. This program will analyze the ship structure to a level of detail and accuracy between CASSET and fine-mesh finite elements. It is anticipated that it will perform a broad-mesh finite element analysis of the entire ship, considering individual structural components such as frames and plating. It will make a better estimate of structural weight and centre of gravity than is possible in CASSET. The program will start with the structural data in the IDB, which was produced by CASSET, and optimize the scantlings for a given set of loading conditions. CASSET would then be run again with the new structures data overriding its own to arrive at a balanced design for the IDB. Figure 5 is an output of the MAESTRO program which is being considered for this role in the DISC System.

SHIPMO

Ship motions in various sea states at any heading and speed can be studied using the SHIPMO program developed by DREA. Vertical accelerations and slamming pressures are calculated for the hull form in the ship description. This allows an analysis of the seakeeping properties at a level of accuracy appropriate to Concept Development without the expense of model testing.

GVAM

The vulnerability and survivability of the ship can be assessed with a group of programs called GVAM (General Vulnerability Assessment Model) developed by the Defence Research Establishment Valcartier (DREV). These programs use extensive colour graphics to illustrate the damage to be expected from internal and external air blasts and from fragmentation. Figure 6 shows internal and external blast results for an advanced concept SWATH model. A rating is given for the combat and mobility mission degradation due to damage. GVAM uses a model of the hull represented by rectangular prisms which could be generated interactively or automatically using the CAD program. Information about the structural boundaries and contents of compartments is also required and is obtained from the ship description in the IDB. GVAM can be run with various levels of detail, so it could be used after the first run of CASSET with a rough general arrangement, and again after the design is further refined. In this way the concerns of survivability can be accommodated at the major decision points.

Refinement

After initial and subsequent analyses of the ship, the general arrangement could be increased in detail or altered to correct areas of weakness such as damaged stability, habitability requirements, or vulnerability. Figure 3 shows that it may be necessary to back-track the

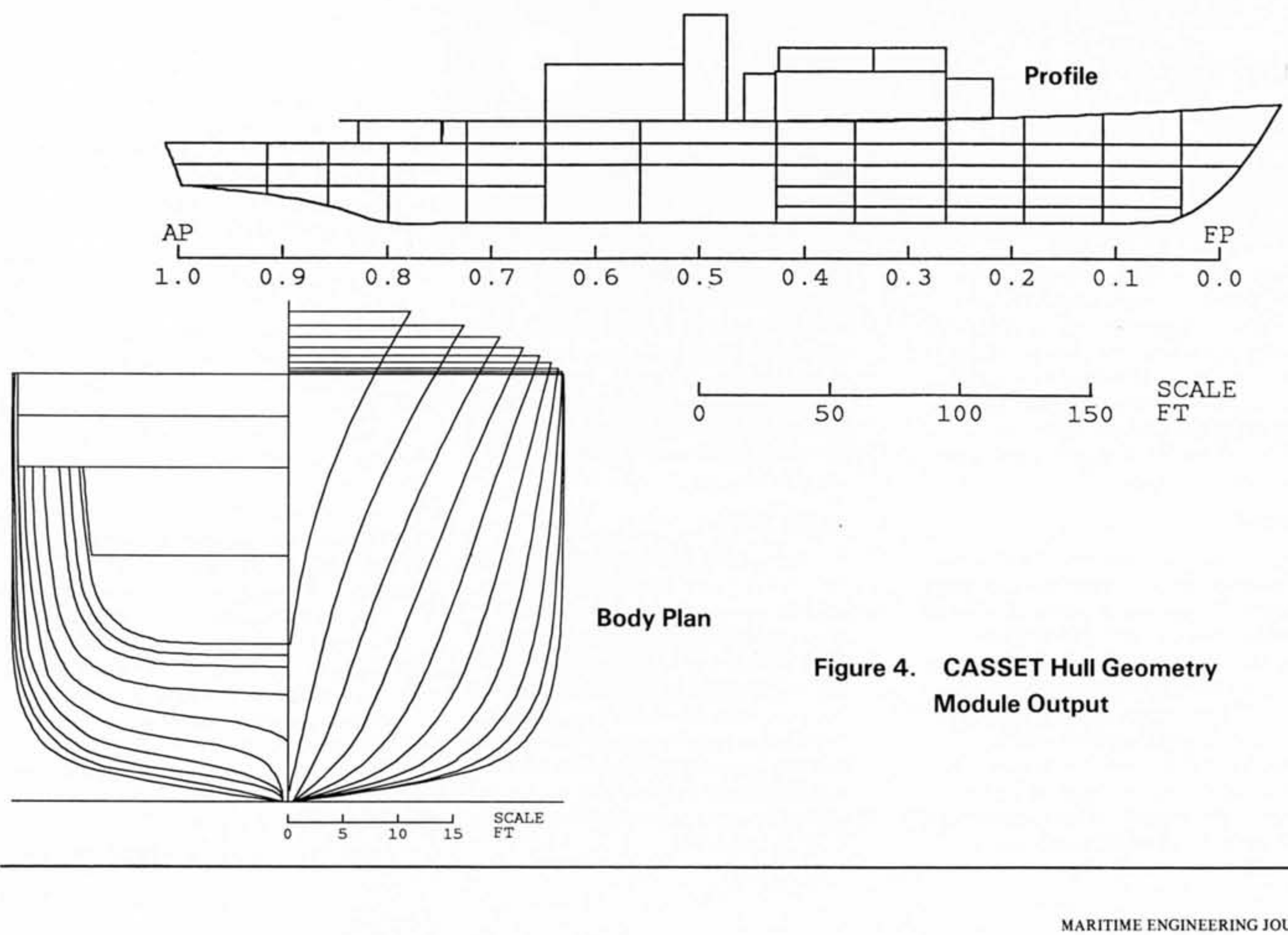


Figure 4. CASSET Hull Geometry Module Output

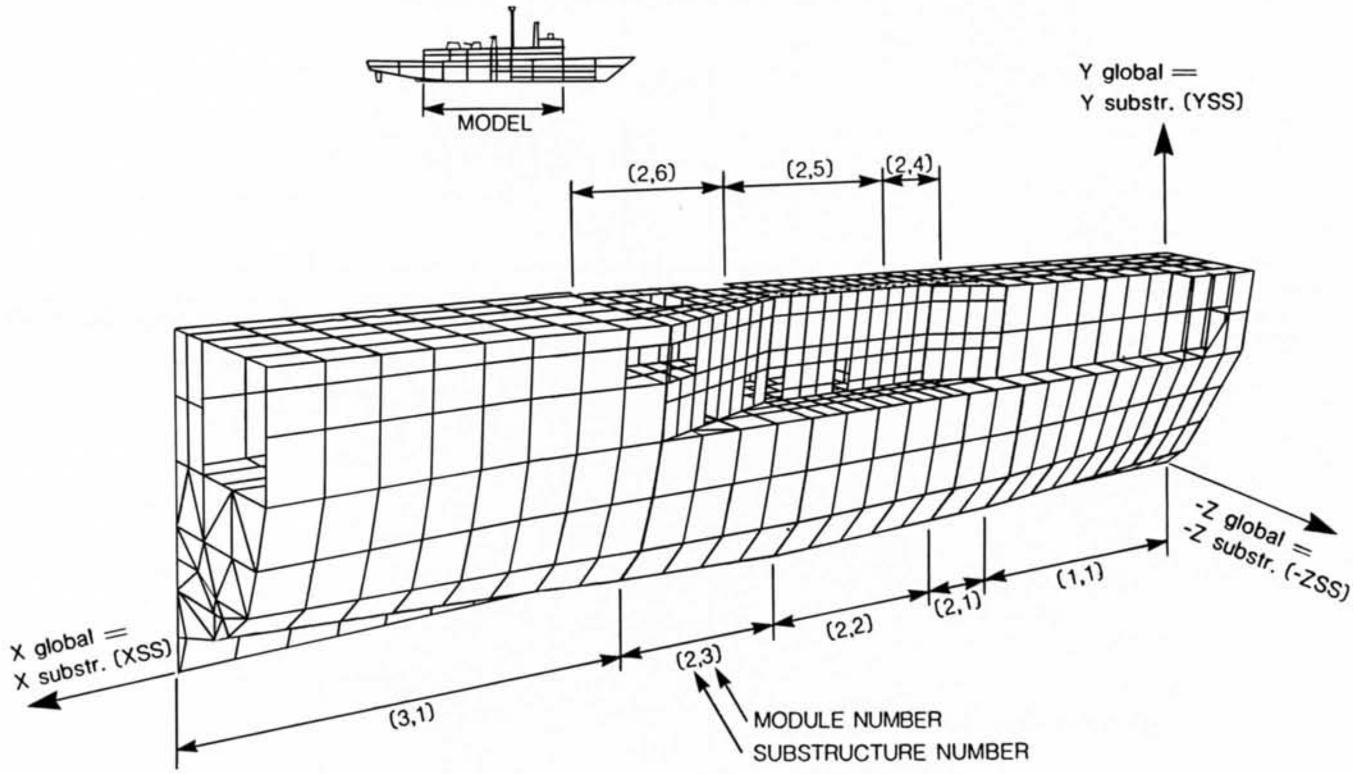


Figure 5. Sample MAESTRO Structural Model

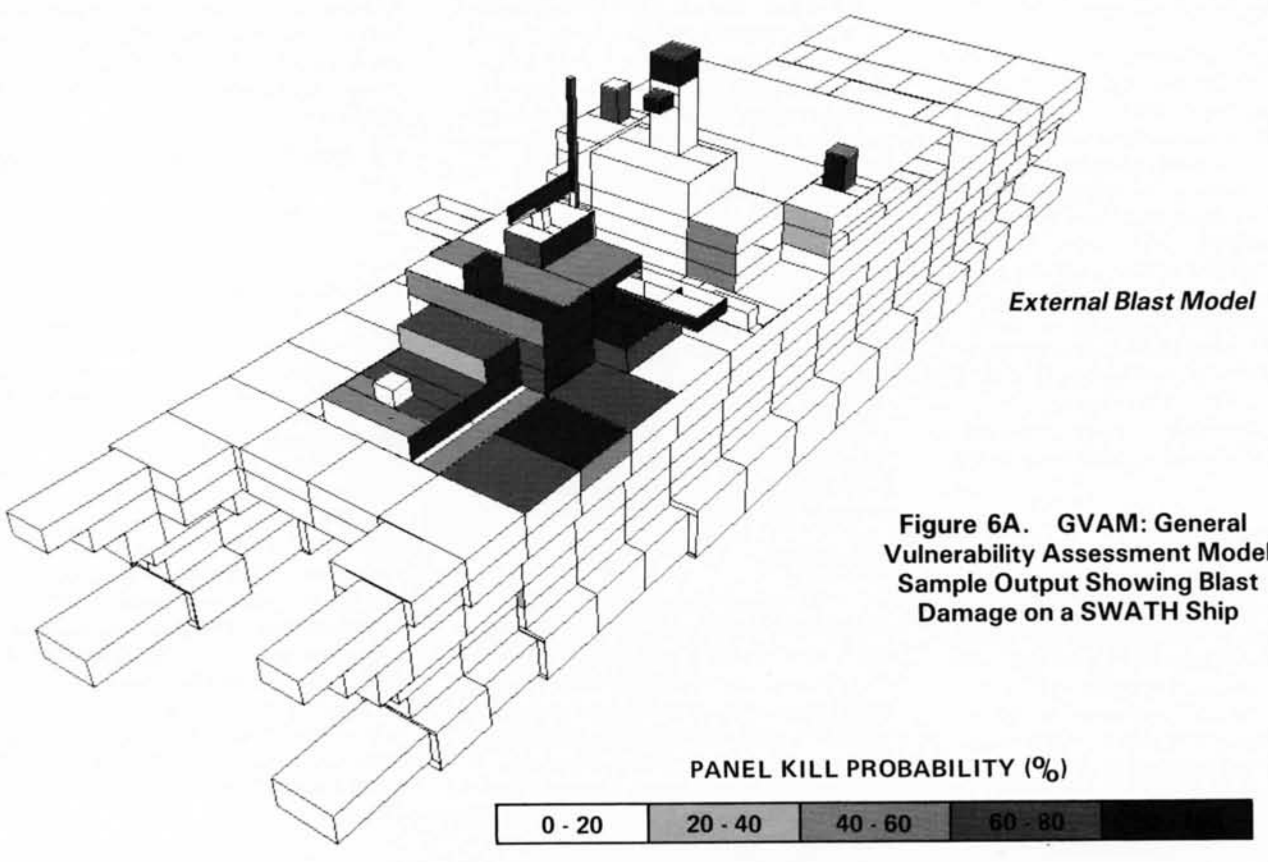
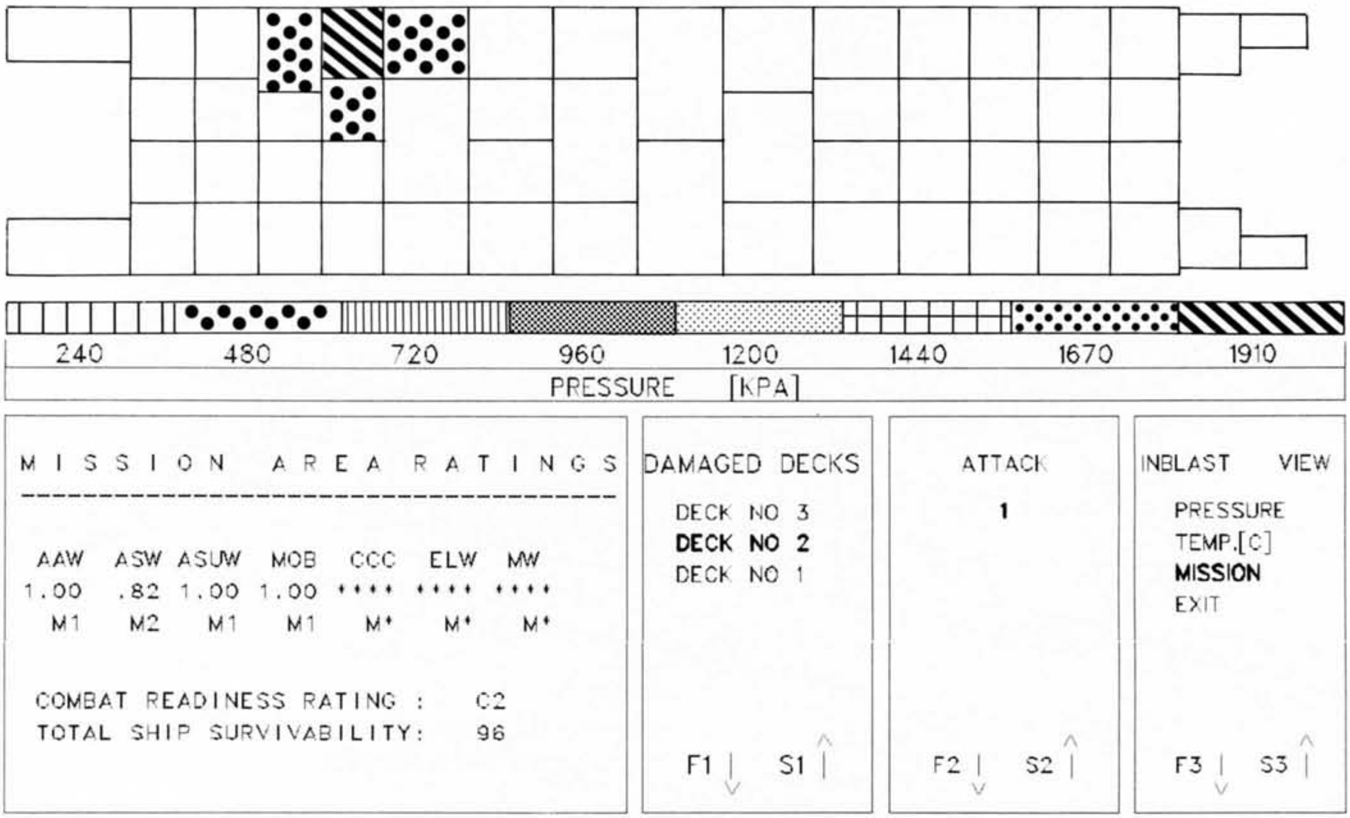


Figure 6A. GVAM: General Vulnerability Assessment Model Sample Output Showing Blast Damage on a SWATH Ship



Internal Blast Model

Figure 6B GVAM Output

decision process due to unforeseen considerations.

This typical design procedure shows how a ship design can be developed, starting with only a statement of requirement, to a level of detail sufficient to begin preliminary design. Each program would be capable of being run individually, given the necessary information, or in a different sequence from that given above. An existing ship could be modelled in order to analyze its characteristics or to act as a baseline to study variations. A general executive program will offer choices of programs, and control the storage and retrieval of ship descriptions. The CAD program will be capable of displaying the final ship configuration in 3-D shaded perspective from any angle.

Future Developments

Future developments of DISC will be guided by a number of influences, not the least of which will be the success of Phase I. Since user feedback will play an important part in determining the utility of Phase I, a "change request" system will be implemented to document and assess priorities of suggestions for program correction and enhancement. Efforts are already in progress to ensure that the suite of programs is properly maintained and supported.

Within the current DISC architecture described in Figure 2, there remain several programs requiring development: *Topside Design* would interactively aid the user in arranging sensors and weapons, ensuring optimum arcs of fire and minimum wooding; *Signatures* would analyze a ship's susceptibility to radar, infra-red, magnetic and acoustic detection; *RAM* (Reliability, Availability, Maintainability) would, in the minimum, perform reliability analyses of major mechanical and combat systems; *Comparative Naval Architecture* would permit the user to perform a comparative analysis between his design and historical trends or archived ships. (The utility of this program would be in highlighting and explaining significant differences during the early design.) Finally, and always the bottom line, a reliable cost-analysis program should be sought.

Conclusion

Naval ship engineering comprises a diverse range of disciplines, and, really, no one individual can knowledgeably handle every aspect. Major undertakings require close cooperation between operators and engineers, generalists and specialists; the design team concept. This is especially important during the early stages of the ship-design process when the guidance and creativity of the naval community have the greatest influence on the eventual performance and cost of a new ship. Project DISC, therefore, aims to provide a system of integrated computer programs which will make it easier for naval engineers to work together by enabling them to view the design task in a larger context, that of the whole ship.

Cdr John Edkins graduated from CMR/RMC in 1974 with a B. Eng. in civil engineering, and in 1980 completed post-graduate studies in naval architecture and ocean engineering at the Massachusetts Institute of Technology. He has served on exchange duty at the U.S. Navy's David Taylor Naval Ship Research and Development Center, and is currently the section head for concept formulation in DMEM.

Hugh Templin graduated from Carleton University in 1976 with a B. Eng. in mechanical engineering, and in 1977 received his Certificate of Naval Architecture from the University of Newcastle-upon-Tyne. After short periods of employment in private industry and DMEM 3, he spent four and a half years in the naval architectural office of NEU(A) where he eventually became the NEU(A) submarine update project coordinator and NAO sub-section head for submarines. Mr. Templin is currently the project manager for DISC in the Concept Formulation section of DMEM.

Evaluation of the Solar Saturn SHIPALT Package

by Ahmed Abdelrazik

Background

The Solar Saturn gas-turbine-driven, alternator/waste-heat-boiler package manufactured by Garret Corporation of Canada for the Tribal-class destroyers has had an unhappy performance history. Some of the problems have been directly associated with the Solar Saturn gas turbines; others have been the result of the poor design of the shipboard installation. Moreover, restricted access to the engine and its accessories, as illustrated in Figures 1 and 2, led to a number of poor maintenance practices which adversely affected overall system performance. The situation was worsened by unreliable fault diagnoses which resulted in the unwarranted removal of engines for costly repairs.

Consequently, National Defence Headquarters decided to prepare a SHIPALT package for the engine system and installation, and to evaluate the package at the Naval Engineering Test Establishment (NETE). The installation of the unit in the gas-turbine/diesel-engine test cell at NETE was described in the September 1986 issue of this journal. The present article reviews its evaluation and discusses some of the modifications that were made to the alternator set in the course of testing. The waste-heat boiler (which is not included in the SHIPALT package) is outside the scope of this investigation.

Specifically, the SHIPALT package encompassed design changes to the following systems and components:

a. the acoustic enclosure;

b. the engine mountings;

c. the air-intake ducting;

d. the control system;

e. the exhaust ducting; and

f. the lubricating-oil system.

The design changes in each of these areas, and the principal modifications which extensive testing subsequently identified, are outlined below.

Acoustic Enclosure

The original acoustic enclosure in the Tribal-class destroyers (Fig. 2) restricted

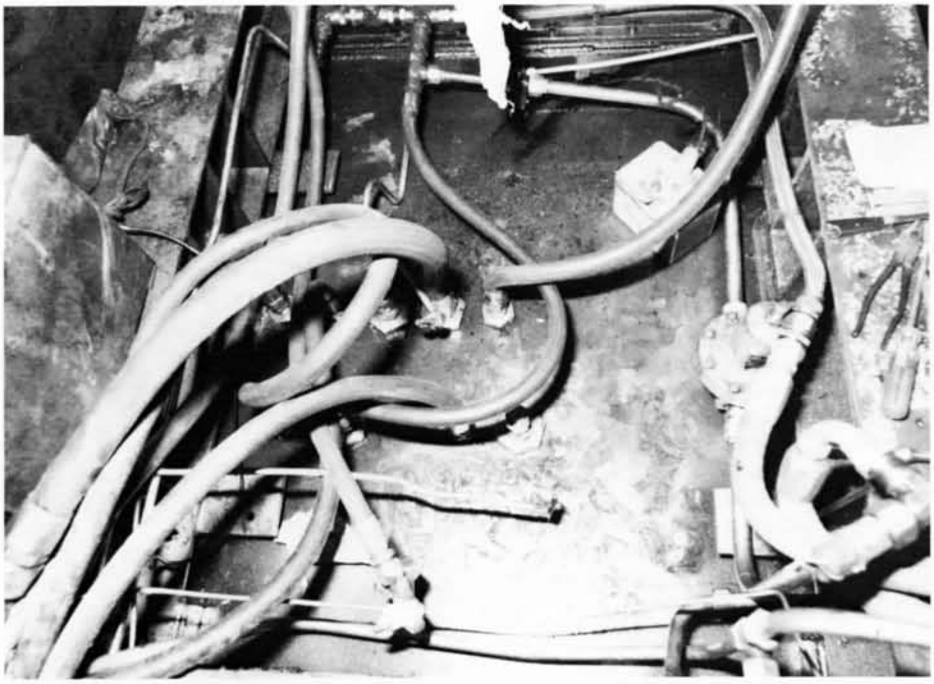


Figure 1. Plan view of the connections beneath the Solar gas turbine revealed on removal of the engine.

Figure 2. The existing acoustic enclosure in the Tribal-class destroyers.

access to the gas turbines and rendered maintenance and fault prediction difficult operations to perform. The SHIPALT-package enclosure, in which the top section is removable, provides good access as depicted in Figures 3 and 4. Upon releasing the spring retaining clips, the top section can be lifted two inches by a pneumatic hoist on an overhead trolley and then moved forward along a 16-ft beam. The engine and its accessories are thus fully exposed for inspection and maintenance.

During the evaluation process the need for a number of additional refinements became apparent, some of which will be incorporated in the final shipboard version. Among these are:

a. a hand-hydraulic hoist to obviate the need for low-pressure air;

b. a shorter and lighter removable section with two windows, one of which may be hinged; and

c. guides to restrain movement of the lifted section when the ship is in a seaway.

Measurements at NETE have shown that the principal requirements of the SHIPALT acoustic enclosure, those of noise reduction and freedom of access, have been satisfactorily achieved. Sound-attenuation characteristics were determined at various engine loads by comparing sound-pressure-level measurements taken at four locations around the enclosure, both with and without the removal section in position. The exact position of the microphones is shown in Figure 5, while Figure 6 depicts the octave-band, sound-pressure-level measurements. Attenuations of 50% and 75% were recorded in the audible and high-frequency ranges, respectively.

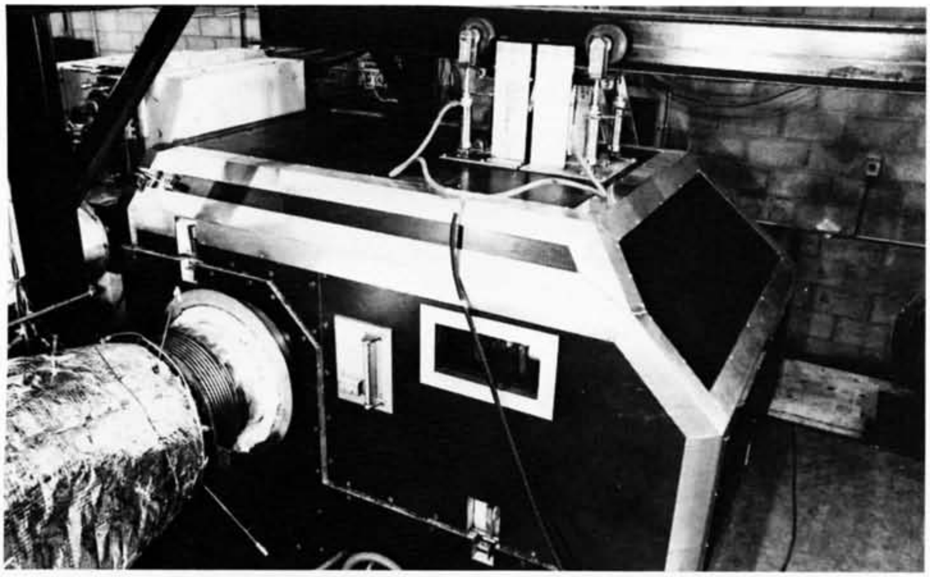


Figure 3. The SHIPALT acoustic enclosure in place. Note the overhead hoist and trolley.

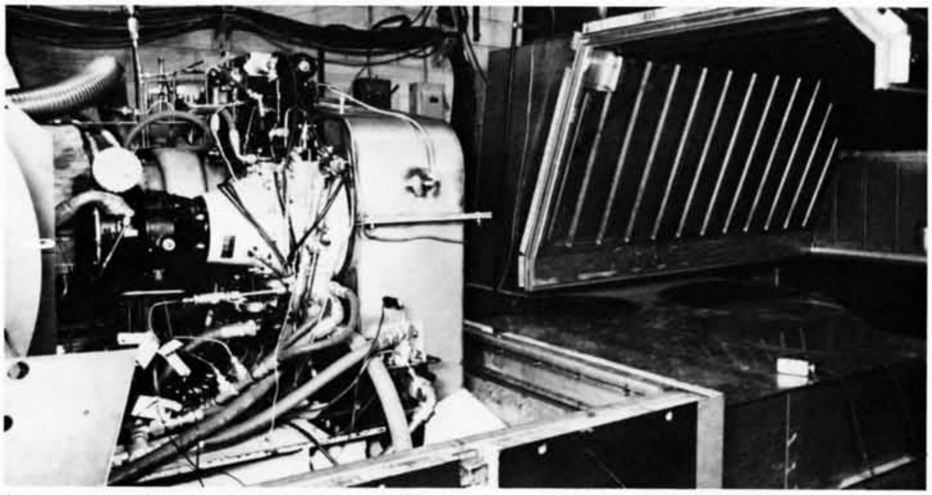


Figure 4. The top half of the SHIPALT acoustic enclosure moved forward on its hoist to give access to the engine and its accessories.

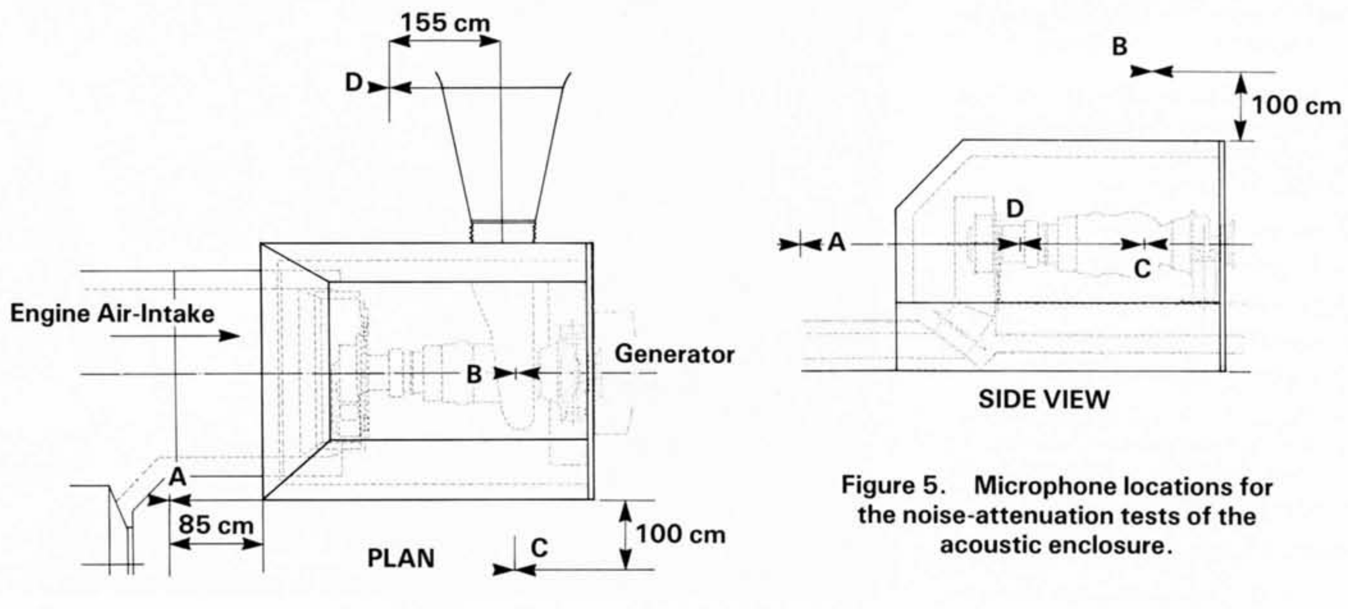


Figure 5. Microphone locations for the noise-attenuation tests of the acoustic enclosure.

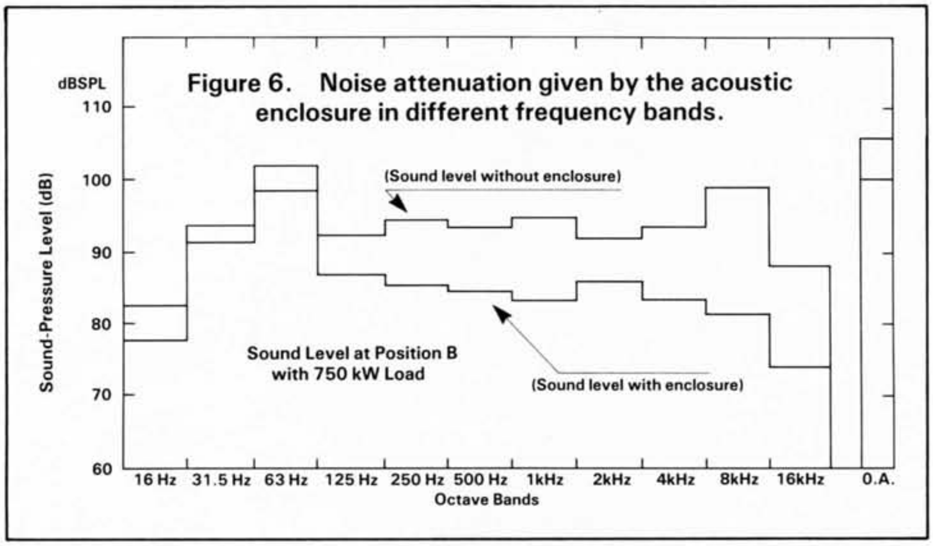


Figure 6. Noise attenuation given by the acoustic enclosure in different frequency bands.

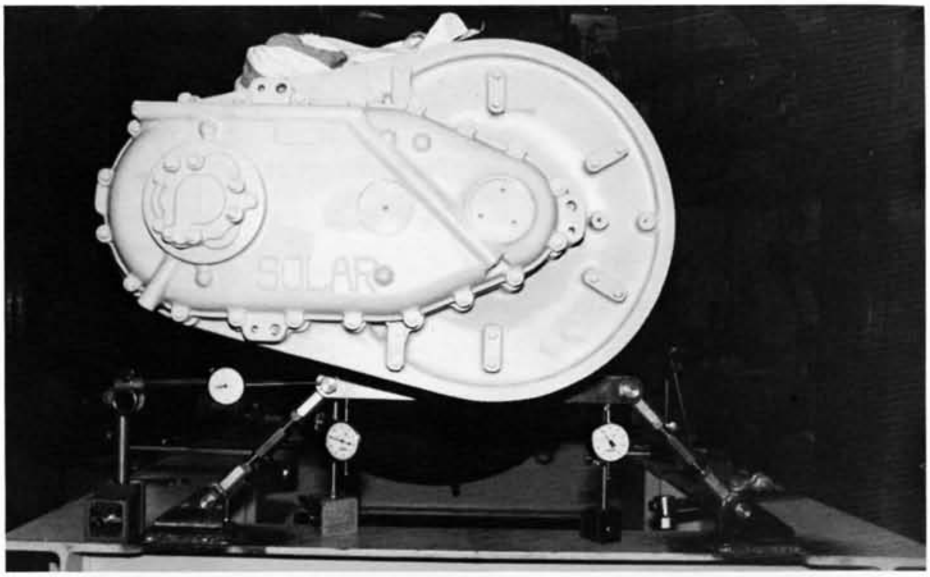


Figure 7. Turnbuckles on the forward engine-mounts permit easy correction of angular misalignment.

Engine-Mounting Arrangements

The design of the engine mounts was changed to facilitate engine/alternator alignment and to reduce the possibility of misalignment due to thermal distortion of the engine casing. New mounts, fabricated at NETE in general conformity to the SHIPALT design (Figs. 7 and 8), were fitted and successfully tested. Angular misalignment can now be corrected in minutes rather than hours by the adjustment of turnbuckles at the forward end of the turbine. Engine adjustments are now directly related to turns of the turnbuckle nuts.

Air-Intake Ducting

The compressors of the naval Solar Saturn engines which were returned to the manufacturer for overhaul all exhibited severe fouling with oil, soot and salt. The extent of the fouling, illustrated in Figure 9, was thought to be due in part to oil and exhaust gases leaking into the acoustic enclosure and then being aspirated into the air-intake ducting. In the new design of the air-intake ducting, the engine intake-air is kept separate from the cooling air. A section of the redesigned ducting was installed and satisfactorily tested at NETE. A few minor deficiencies were identified, but these will be rectified in the shipboard version.

Control System

NDHQ is studying the possibility of replacing the present gas-turbine alternator controller with a more compact, programmable microprocessor-based unit made by Gem Data Inc. The proposed controller will not only control engine-starting and protect

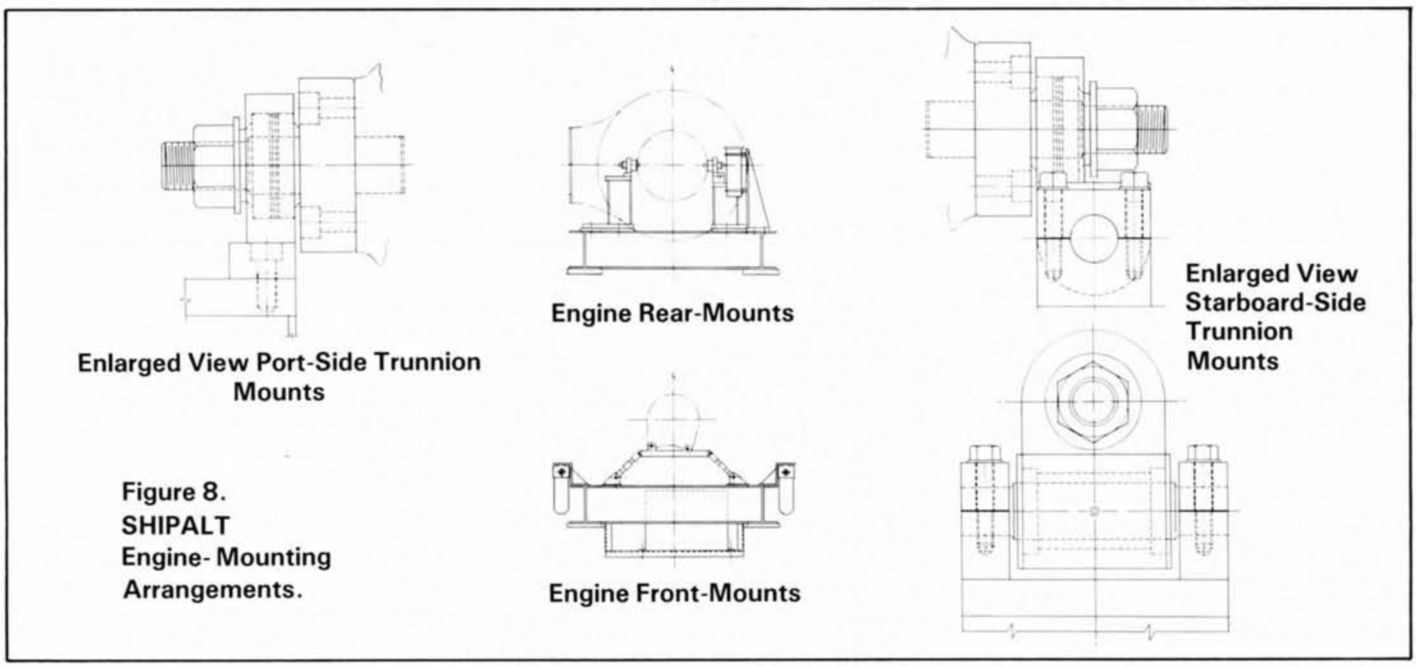


Figure 8. SHIPALT Engine-Mounting Arrangements.

the engine while running, but will also acquire and manipulate operational data on-line. Eventually, it is intended to interface the controller with the Shipboard Integrated Machinery Control System (SHINMACS).

The prototype controller consists of three modules: the control, transducer and display modules. The first two are mounted inside the enclosure, but the display module (which is linked to the control module) is a standard video monitor. The engine-operating parameters are thus readily available to shipboard personnel, and if any parameter deviates beyond the programmed safe limits a warning appears on the monitor. In the event the engine trips, the controller holds and displays the condition just prior to the malfunction. The controller also measures the engine and starter run-down time and is programmed to conduct water-washinhg and load-shedding.

During the initial evaluation phase, a mishap occurred when the engine was first started. A distorted speed signal caused starting-air to continue to be supplied above 70% shaft speed, and due to a software error the engine tripped above 90% speed. Consequently, the starter suffered severe damage and testing was delayed. A careful examination of the controller software was conducted, and after appropriate corrections were introduced the controller functioned satisfactorily. This was a vivid reminder that simulation tests are no substitute for real-life testing.

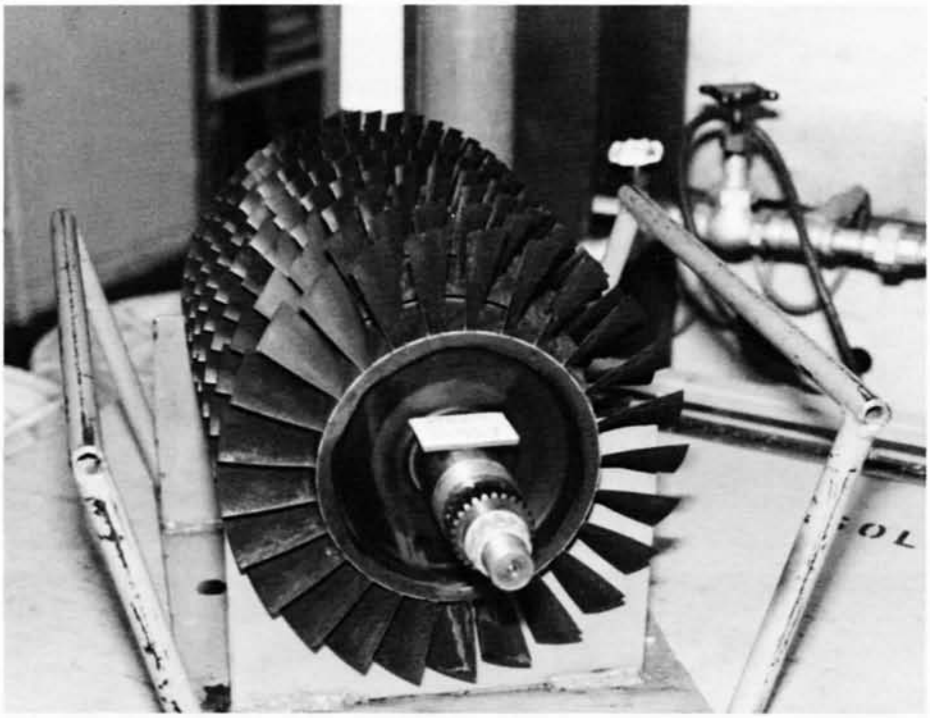


Figure 9. A turbine compressor rotor contaminated by soot, oil and salt deposits.

Exhaust Ducting

In the Tribal-class ships, the existing gas-turbine exhaust trunking from the turbine collector to the waste-heat-boiler inlet flange comprises the following components:

a. an 18-inch-diameter bellows piece;

b. a diffuser section, transitioning from an 18-inch-diameter circular inlet to a 30-inch square outlet; followed by,

c. a 90° square-sectioned elbow.

These items are shown in Figure 10.

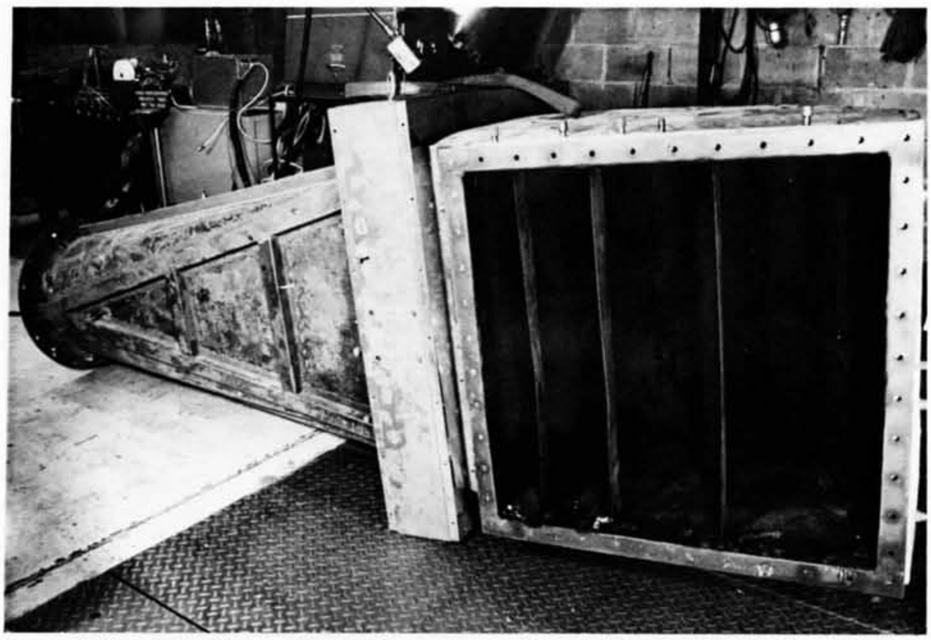


Figure 10. The diffuser and elbow piece of the original exhaust ducting.

The elbow was originally fitted with vanes welded to the top and bottom of the duct, but after short periods of service the vanes would break away and carry into the waste-heat boilers. Consequently, ship's staff removed the vanes and operated the system without them. After several years of service, cracks appeared in the walls of the diffuser transition section. These were repaired as they occurred.

Bristol Aerospace Ltd. was contracted to look into these problems and recommend solutions. Following an investigation on board HMCS *Athabaskan* in December 1984, it was recommended that additional stiffeners be fitted to the four side-panels of the diffuser, and that a means of straightening the flow be provided. Bristol Aerospace manufactured two flow-straighteners (Fig. 11) which were delivered to NETE for fitting within the exhaust bellows and diffuser of the set under test. Measurements revealed that the degree of swirl and turbulence in the exhaust gases was too great for the effective operation of the diffuser, and that the straighteners only compounded the problem. Furthermore, it was found that the diffuser side-panels were the source of low-frequency (70 Hz) noise that had been encountered in the shipboard installation. A new exhaust system was therefore developed, built and tested.

In the redesigned system, shown in Figure 12, a short diffuser of circular cross-section is preceded by a straight, circular-sectioned duct about three feet long. By changing the ducting from square to round cross-section, and eliminating the stiffeners, it is believed that thermal stresses will be reduced and that cracking of the panels will be alleviated. A further advantage of circular ducting is that low-

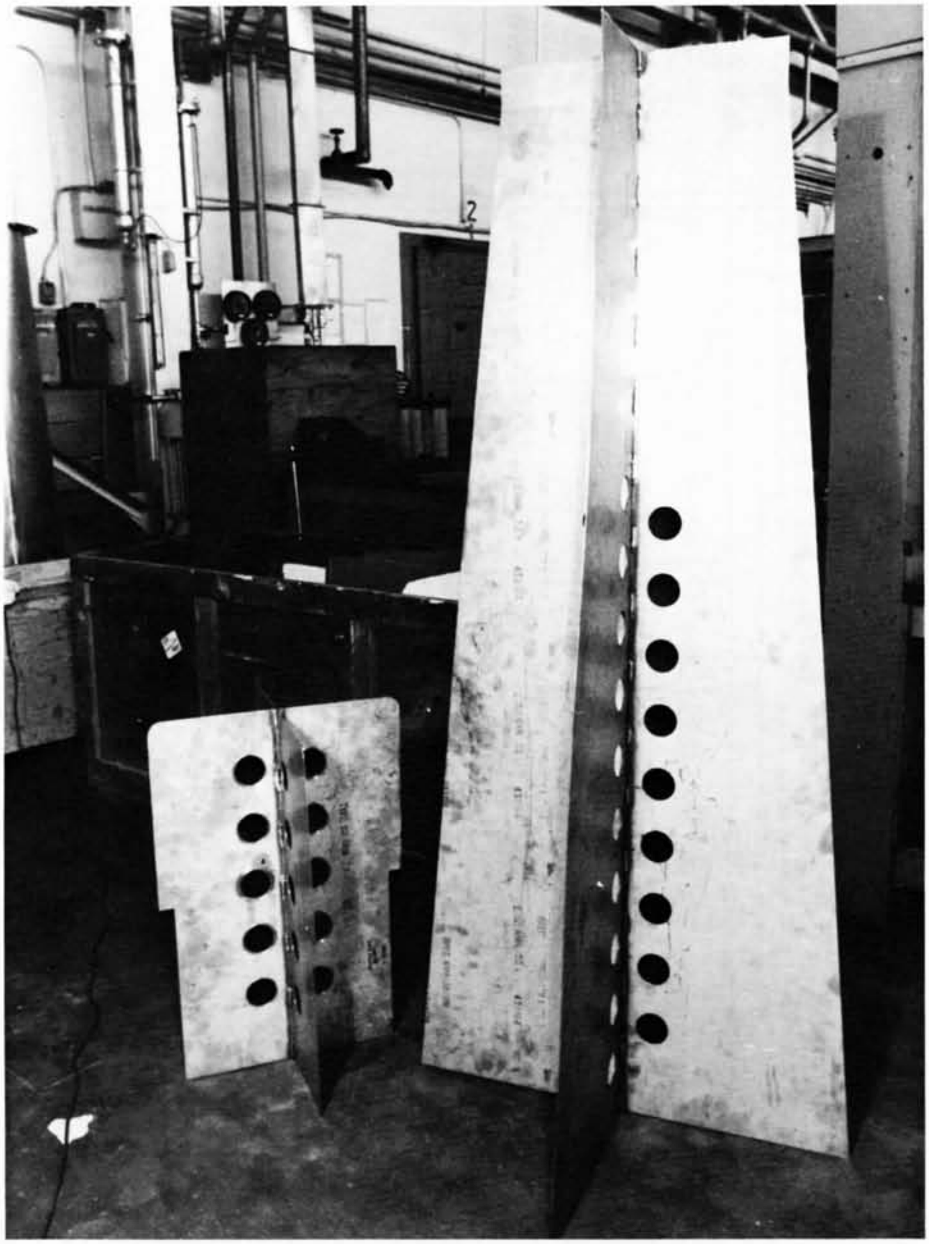


Figure 11. Flow straighteners for the exhaust system.

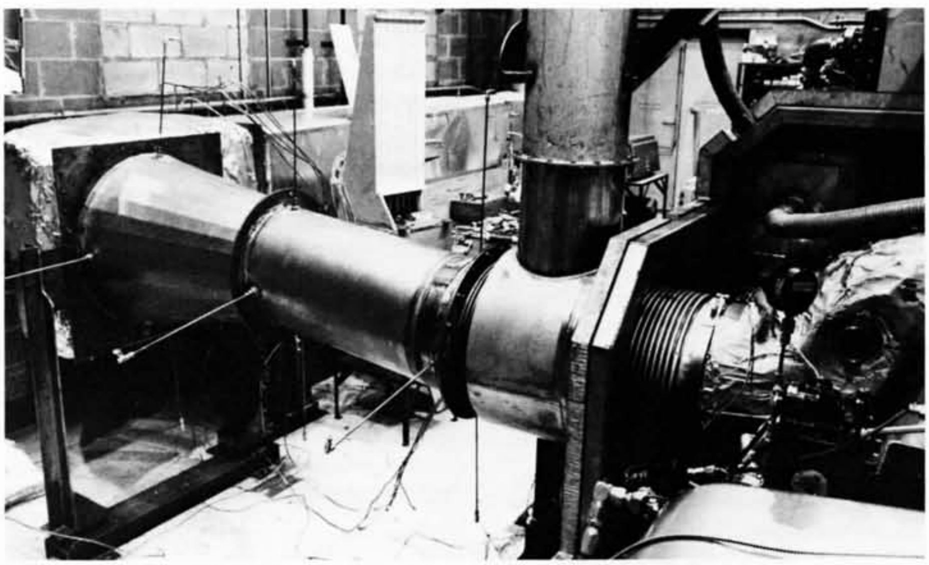


Figure 12. The SHIPALT exhaust ducting.

frequency vibratory amplitudes can be decreased by using heavier-gauge material. This remedy would not have been possible with the original square ducting which incorporated external stiffeners.

Measurements during trials at NETE showed the flow at the end of the straight section to be uniform enough for a reasonable conversion of dynamic to static head in the diffuser. A marine version of the diffuser has been designed; this will be manufactured by Flexonics Incorporated and tested at NETE. The outcome of these tests will determine to a large extent the configuration of the exhaust ducting for the SHIPALT package.

Lubricating-Oil System

Numerous problems were encountered with the Solar Saturn lubricating-oil system, including:

a. a very high lubricating-oil consumption due mainly to the high rate of venting of oil mist through the breathing system. Part of this loss is drawn back into the air intake and leads to clogging of the demisters, fouling of the compressor and reduction of engine output;

b. an installation with five feet of suction head from the oil tank. This is suspended under No. 3 deck where it is poorly located for maintenance;

c. overheating of No. 3 bearing after turbine shut-down by the residual heat of the combustion chamber;

d. possible skidding of No. 1 bearing due to its location in the cold-air intake at the forward end of the engine; and finally,

e. foaming of the oil due to the aspiration of air into the lubricating-oil pump. This pump scavenges the generator pedestal bearing from which the oil flow is only a fraction of a gallon per minute.

The system first proposed to overcome these problems consisted of eductors to scavenge oil from various engine locations, and a motor-driven pump to cool the bearings after shut-down. This proposal however did not meet its design specifications. The lubricating-oil system was extensively redesigned with input from DMEE 2 and NETE. The salient features of the current version are:

a. The tank was redesigned to reduce foaming and provide ease of maintenance. It was also fitted with an electrical heater.

b. The operating temperature of the oil was raised from 130°F to 180°F in order to counter the skidding of No. 1 bearing and also to help rid the oil of moisture.

c. A post-shut-down cooling cycle was developed to improve the cooling of the engine bearings. The procedure entails motoring the engine with L.P. air for five minutes while the compressor delivers air to the combustion chamber. This allows oil at 70°F to cool the engine bearings, No. 3 bearing in particular. The gradual cooling of the engine bearings which results from this procedure is shown in Figure 13.

d. An eductor is utilized to scavenge oil from the generator pedestal bearing. In addition, one of the original pump chambers was dedicated to scavenge oil from the gearbox. This arrangement eliminates foaming of the lubricant by mitigating the ingress of air.

e. The high rate of oil consumption was a serious concern and became the subject of an independent investigation. Sight-glass flow indicators were fitted in the drain-line from the gearbox breather pipe and the gearbox scavenge line. Sealing-air and lubricating-oil flows to the gearbox were varied while taking pressure and flow readings. The heavy loss of lubricating oil through the breathing system was found to be due to excessive gearbox sealing air; it was also demonstrated that lubricating oil could be made to flow up through the breathing pipe by increasing seal-air pressure above a certain limit. This problem was solved by simply reducing the seal-air pressure from 40 p.s.i.g. to 5 p.s.i.g. At this pressure, which provides an adequate flow of air for sealing, there is no undue foaming or loss of oil through the breather system.

A number of other minor modifications were made to the lubricating-oil system.

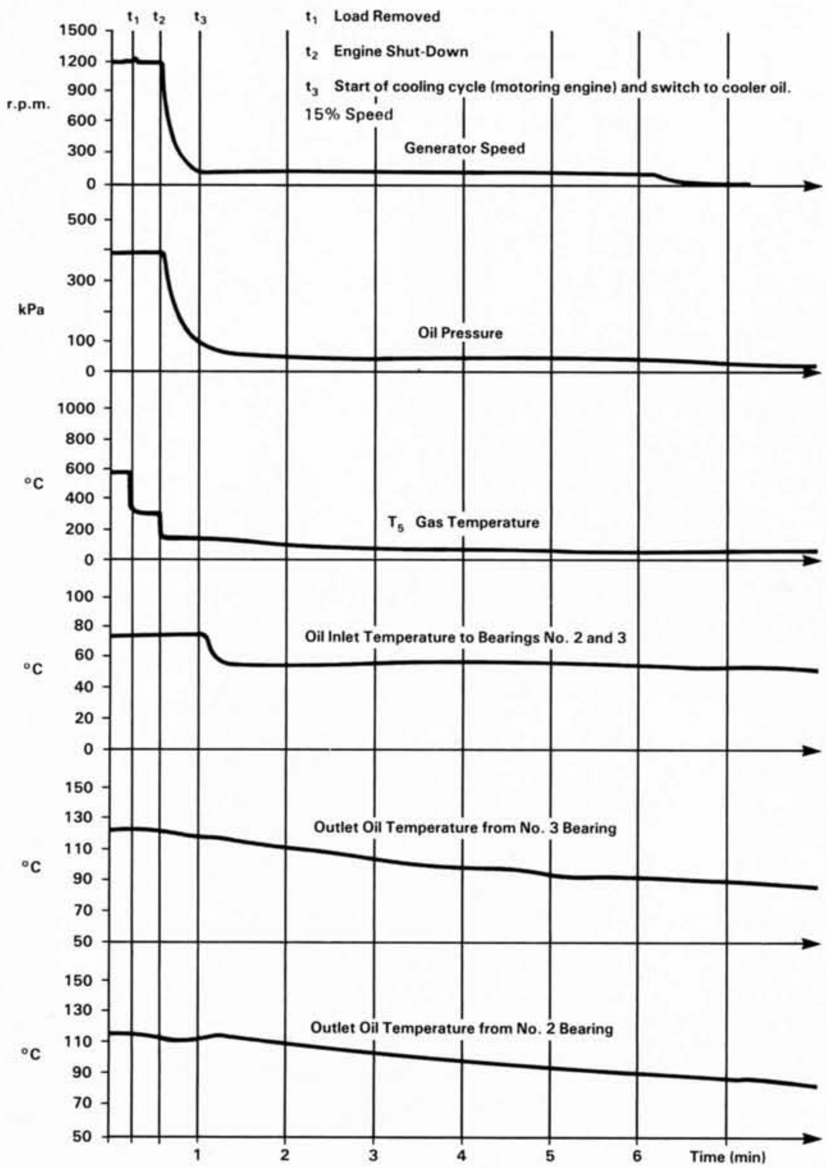


Figure 13. Post-Shut-Down Cooling Cycle

Summary

As a result of the unsatisfactory performance of the Solar Saturn gas-turbine alternator sets in the Tribal-class destroyers, a SHIPALT package was prepared. This involved redesign of the acoustic enclosure, engine mounts and air-intake ducting, and the control, exhaust-duct and lubricating-oil systems. NETE has evaluated this package and made a number of changes to the design to ensure its satisfactory service at sea. While some of the observed deficiencies involved minor changes, others entailed radical redesign.

The numerous problems encountered in the course of this work clearly delineate the need to conduct full-scale evaluations of all major engineering systems considered for shipboard installation. This commitment must be made a prerequisite of both new and SHIPALT proposals if NDHQ is to ensure their satisfactory performance in the fleet.

It is considered that the experience gained during these tests will pay valuable dividends in supporting gas-turbine testing for current and future ships. In view of the exhaustive and rigorous testing undertaken, it is expected that this SHIPALT package, with the appropriate logistic support, will ensure ease of maintenance and improve the reliability of the Solar Saturn gas turbines on board the Tribal-class destroyers.

Acknowledgements

The author wishes to express his thanks to Peter Cheney (DMEE 2) for his numerous contributions and his assistance with the evaluation of this package, and to Peter Sharp and Real Richard of NETE for their invaluable contributions during the conduct of the trials. Thanks are also due to LCdr J. Lavallee, Commanding Officer, NETE, for his encouragement and advice in the preparation of this article.

Ahmed Abdelrazik obtained his B.Sc. in Mechanical Engineering from Cairo University in 1973. Before emigrating to Canada he spent time in the merchant marine where he acquired extensive experience with diesel and steam-turbine propulsion systems. He was admitted to the order of Engineers of Quebec in 1977, and in 1979 joined NETE where he has concentrated on project work in the fields of gas turbines, diesels and dynamic balancing methods. Mr. Abdelrazik is currently responsible for the operation of the NETE gas-turbine/diesel-engine test facility.

Software Production Chaos

by LCdr Roger Cyr

Introduction

In the Canadian navy, software production is still being done the traditional way, using old established methods, without due consideration for more innovative approaches dealing with software transportability and system testing. The advent of two very large and complex software oriented shipbuilding projects, namely the Canadian Patrol Frigate and the Tribal Class Update, has provided a timely opportunity to discard some of the obsolescent methods, yet the more progressive software production techniques are being totally ignored. Software for these projects is being produced using traditional, suboptimal methods.

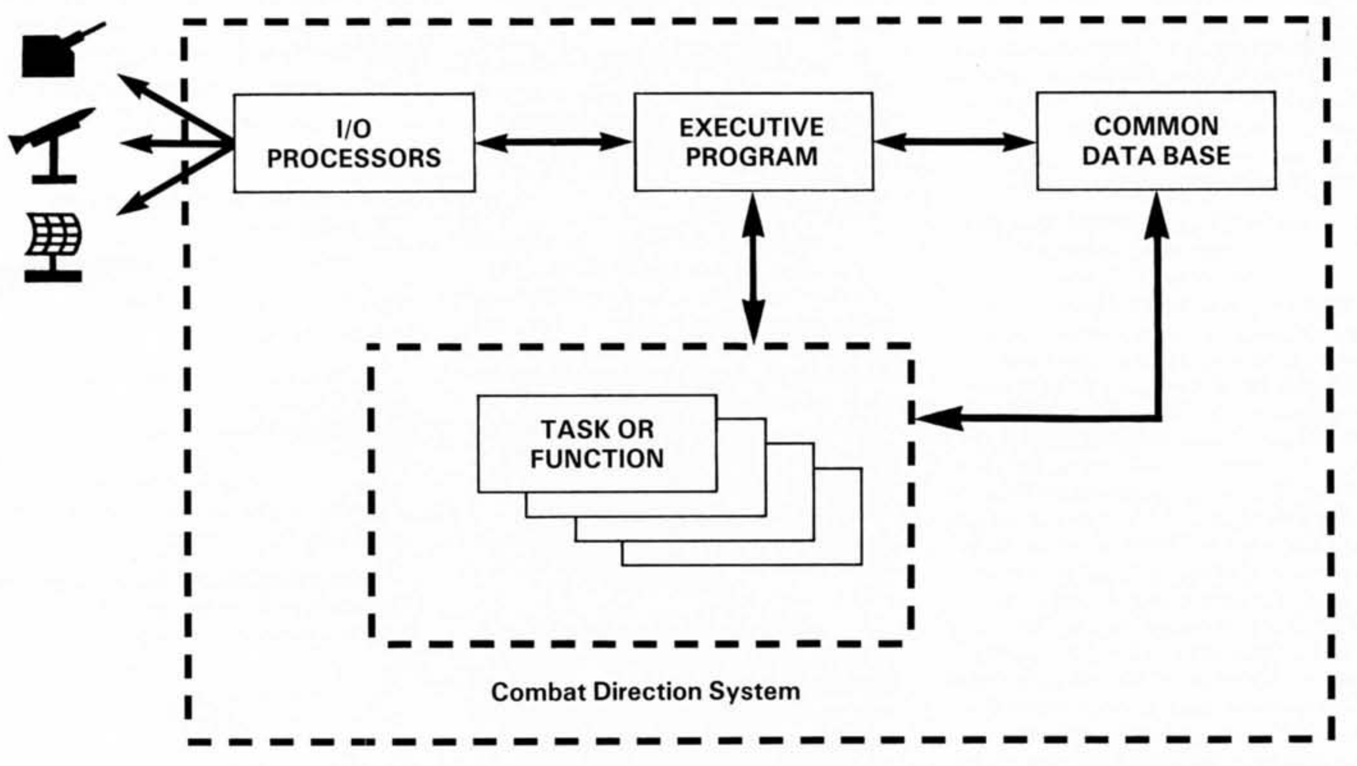
Background

Modern combat systems have become increasingly dependent on software, and as this dependency has evolved so has the complexity of the software. Two resultant factors have emerged: the production cost of software has increased drastically; and, since the sheer volume of software in typical combat system programs has grown exponentially, the testing requirements have also magnified proportionately.

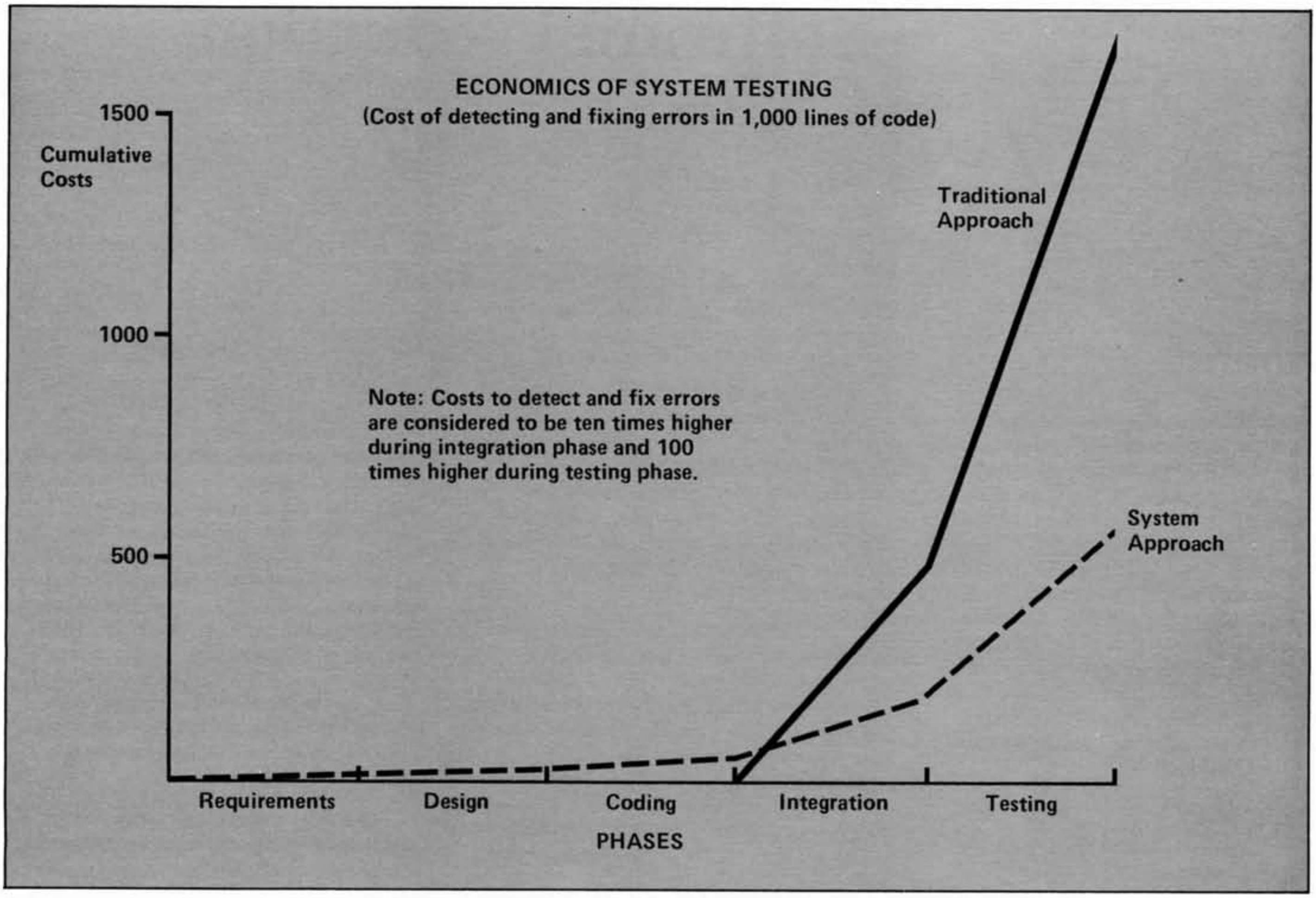
The U.S. Defence Department is committing enormous resources in the effort to make weapon system software error-free. U.S. Forces spent some $10 billion in 1985 on combat system software, and it is estimated that some $30 billion will be expended in 1990. The demand for combat system software in the United States is growing so rapidly that it is believed industry, in the years ahead, will be short some one million programmers and analysts to do the work.

Because of the magnitude of its software requirements, the U.S. Navy is faced with major difficulties associated with software production. Four nuclear submarines have in recent time put to sea without their Tomahawk cruise missiles because of delays in completing the required software. Under Strategic Defence Initiatives (SDI), the United States plans to build the world's most complex software-based system to date, yet the most serious problem envisioned with SDI is the testing of the system which is said to be a nightmare of unequaled proportion.

The U.S. Navy has recognized the difficulties associated with combat system



USN Command and Control Software Structure



software requirements, and in an effort to reduce the volume of software faults, and at the same time drastically reduce its software production costs, is embarking on an ambitious plan to restructure the combat system software for all its ships.

Canadian Software Production

With CPF and TRUMP, the Canadian navy is undertaking shipbuilding projects which are heavily dependent on combat system software. However, the problems regarding large-scale, combat system software production have not been truly recognized. Software for these projects is being produced through a traditional and obsolescent process of first doing design work, then coding, and then testing. The process is considered to be far from optimal since the first formal level of testing is only introduced in the certification phase, after the code has been fully written. It is worthy of note that even this suboptimal process has been circumvented in CPF, where some coding has actually been completed before the software design phase has been done. It is considered that this rush to start the coding will result in an overly large number of software errors which will not be uncovered until late in the testing phase; errors which would not likely have occurred if the software production had followed its contracted, albeit suboptimal plan.

With CPF and TRUMP two particular facets of software production should have been better addressed — software testing, and software commonality.

Software Testing

A report issued to U.S. government departments by the General Accounting Office stresses that a greater emphasis must be placed on testing in order to make computer software more reliable and less costly. It is generally accepted that the earlier an error is detected and fixed, the fewer resources it takes to do so. One reason for this is that as software develops from a concept to an operational program, more stages of that development — such as requirements, design specifications, or program code — may be affected by an error.

This is particularly true for design errors that involve changes to software specifications. One industry study noted that such errors are over seven times more expensive than if detected during design. Furthermore, the cost of correcting a software design error after a system is operational is one hundred times greater than correcting it during design.

Testing has traditionally been looked at as a separate element of the software production process which consists of:

- defining the requirements
- completing system design
- coding
- doing system certification and integration
- completing system testing

The CPF software production plan basically follows this process (see Table 1).

When system testing is concentrated in the last steps of the production process, serious software problems can develop unnoticed. One of the major consequences is that the longer an error exists in a program, the more expensive it becomes first to find, and then correct.

When an error is discovered late in the production process, the cost of that error is incurred several times over. There is:

- the cost incurred developing the system erroneously
- the cost of testing to detect the error
- the cost of rewriting specifications and coding; and
- the cost of retesting the system.

SYSTEM DESIGN:	Activities in this phase include the generation of Subsystem Design Documents (SSDDs), and the conduct of design reviews.
SOFTWARE DESIGN:	This phase begins following preliminary approval of the SSDDs. The primary activity during this period includes the development of the Software Design Documents (SDDs).
CODE AND DEBUG:	The Code and Debug phase begins following preliminary approval of the SDDs. During this phase all codes are developed and written. Some informal testing may take place.
CERTIFICATION:	This phase is the first formal level of software testing. Certification procedures are run to verify that individual software components meet design requirements.
INTEGRATION:	This is the second formal level of testing. Approved integration procedures are used to verify integration and proper functioning of all software and hardware components.
SHIPBOARD TESTING:	This phase begins upon delivery of the software to the ship. Testing begins at the equipment level, progressing to subsystems and culminating with fully integrated tests.

Table 1: Canadian Patrol Frigate Software Production Process

It is emphasized that software errors are not only introduced during the coding process. Many errors, such as misinterpretation of requirements, actual specification errors, or system design errors, are made before the coding even begins. Studies have shown that more than 50% of all detected errors occur prior to the coding phase. This hight level of pre-coding error highlights the need to perform testing activities in parallel with system design.

Software Commonality

As combat systems have evolved, their software has become very complex. Consequently, this software is very costly and difficult to produce, and the production process is prone to the induction of large numbers of errors. Because of this, it makes good sense to re-use software to the largest extent possible in order to reduce production and maintenance costs. The U.S. Navy's practice of developing separate programs for individual ship classes is being abandoned because of the impracticality and excessive workload of this process. In lieu, the USN has embarked on a major restructuring project to make software programs common to all ships. This is considered essential because of the ever-increasing number of different programs required by the various ship classes.

For example, with the Cruiser/Destroyer/Frigate group, some 150 ships, the USN is faced with a requirement to produce and maintain some 22 different programs. Even though many of these ships' weapon and sensor suites vary, they use standard combat system processor hardware. And since tactical doctrine for all ships is standard, the use of common application programs is feasible. The U.S. Navy estimates that about 70% of the required Command and Control software is common to all ships of the fleet, regardless of class. Specific ship tactical functions which depend on a particular ship's role, such as anti-air warfare or anti-submarine warfare only affect about 30% of the total software package. However, when grouping similar ships, even greater commonality of functional areas is being achieved. One program being developed for the Cruiser/Destroyer/Frigate group consists of a software library, containing over 3,500 basic tasks which apply to all ships of the group. As many as 500 supplementary tasks can be added to cover the particular needs of individual ships and ship classes, but the common library alone contains between 80 and 100 per cent of the application software required by each ship.

In the context of Canadian naval software, the small number of functionally very similar ships easily allows for software commonality. With the CPF and TRUMP, transportability of Command and Control software could have been readily achieved. Both classes use Standard Digital Equipment, and their combat systems are distributed via the SHINPADS data bus, but through contractual shortsightedness similar application software is being developed by two different contractors. In essence, the application code is being duplicated, and this will mean unnecessary additional costs not only for the initial procurement, but for the life of these software programs as well. In short, two organizations are producing the same application software which will be used in standard computers and which, for the most part, will perform standard applications. This, at twice the cost.

Conclusion

It is considered that CPF and TRUMP provided a unique opportunity to implement innovative software production principles. But, their use was not made. It is expected that sometime in the future there will be a requirement to replace the command and control processing equipment of CPF and TRUMP with new-generation processors. At that time, consideration should be given to proceeding with common-application software for all ship classes. The software production effort should then also give greater heed to available technology.

LCdr Roger Cyr joined the RCN as an ordinary seaman Radioman (Sea). Following his commissioning from the ranks he was employed as a computer programmer on the CCS-280 and SAMSON systems, and went on to complete his CSE Level II. He later attended Royal Military College as a UTPO student and was awarded a Bachelor of Engineering degree. LCdr Cyr was recently the CPF Detachment Commander at Paramax Electronics Inc., Montreal, before taking up his current posting in the Directorate of Maritime Combat Systems at NDHQ.

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Low-Cost Options for Upgrading the Canadian Navy*

by LCdr Roger Cyr

* *This article first appeared in the Winter 85 edition of the Martime Warfare Bulletin.*

Introduction

The Canadian navy has for some time been primarily an anti-submarine force, and over the years Canadian ASW ships, equipment and tactics have made their mark. Developments such as the variable-depth sonar and the ability to operate ASW helicopters from destroyer flight-decks have been recognized as major contributions to anti-submarine warfare, yet this ASW expertise has been exploited at the expense of anti-air or surface-combat proficiency. Consequently, because of their inadequate self-defence capabilities, Canadian ASW ships have become a liability to the multinational forces with which they operate, and are also proving to be unsuited for territorial regulatory duties.

Modern Fleet Composition and Capability

A balanced fleet should be made up of units with different specialties or roles in order to optimize the capabilities of the fleet. However, regardless of its specialty, it is also imperative that a warship be able to defend itslef. Canadian navy destroyers are at present highly specialized in ASW, but are virtually defenceless against surface or air attacks.

Ship capabilities can be assessed as a proportion of relative importance; first, to its survival, and second, to its effectiveness in performing its tasks at sea. Figure 1 outlines the evaluated breakdown of capabilities for ships with different roles. The percentages shown are based on estimated effective ranges of influence of individual weapon systems.

				PERCENTAGE OF TOTAL CAPABILITY AS A PROPORTION OF RANGE		
				SHIP ROLE		
FUNCTION	COMBAT SYSTEM	EQUIPMENT	RANGE	ASW	AIR DEFENCE	GENERAL PURPOSE
AAW (Self-Defence)	Close-In Defence Point Defence	CIWS (Phalanx) VLSS (Sea Sparrow)	2M 8M	4 16	4 16	6 24
			TOTAL	20%	20%	30%
AAW (Area Defence)	Air Defence	SAM (SM-1)	25M	–	20%	–
SUW	Short Range Long Range	Gun SSM (Harpoon)	5M 60M	2 18	2 18	3 27
			TOTAL	20%	20%	30%
ASW (Defensive)	Short Range Medium Range Long Range	HM Sonar/Torpedo VD Sonar/ASROC Helo	5M 10M 25M	2 5 13	2 5 13	2 5 13
			TOTAL	20%	20%	20%
ASW (Offensive)	Long Range	Towed Array (CANTASS)	75M	20%	–	–
EW	ECM ESM	Chaff/Jammer Detection (CANEWS)	– –	5% 5%	5% 5%	5% 5%
C^3	Command-Control Communication	NTDS (ADLIPS) Satellite Comm	– –	5% 5%	5% 5%	5% 5%
			SHIP TOTALS	100%	100%	100%

Figure 1. Capabilities of a Modern Destroyer/Frigate

Current Naval Programs and their Impact

Various programs are being implemented to either replace the oldest units, the *St. Laurent* class, or to modernize those ships which are expected to remain in service for extended periods of time. These programs include:

a. the Canadian Patrol Frigate Project (CPF);

b. the Destroyer Life-Extension Project (DELEX); and

c. the Tribal-Class Update and Modernization Project (TRUMP).

CPF

The CPF project provides for the construction of six frigates to replace the six *St. Laurent*-class destroyers over the period 1989-1992.

DELEX

The DELEX project has already provided some improvements to the 16 steam destroyers.

The overall principle of DELEX was that the oldest ships, the *St. Laurent*-class, would receive only that funding necessary to ensure their safe operation until they are replaced by the CPF. The scope of DELEX refits varied according to the ages of the ships, with those ships scheduled to remain in service beyond the 1990s receiving more equipment. However, DELEX has not significantly increased the overall capabilities of the steam destroyers. The areas in which they are most vulnerable, anti-air and surface warfare, have not been improved.

As illustrated in Figure 2, even with the DELEX modifications, the overall capability of the *Annapolis* class is assessed at only 36%, and the *St. Laurent* class at 12%. Moreover, since the *Annapolis* class could be in service well beyond the year 2000, it points to the obvious need to further upgrade these ships.

TRUMP

The four Tribal-class, gas-turbine-driven destroyers are Canada's newest, having entered service in the early 1970s. They carry two Sea King helicopters, and have both the hull-mounted and variable-depth versions of the AN/SQS-505(V) sonar. For point defence the ships are

FUNCTION	COMBAT SYSTEM	ANNAPOLIS				RESTIGOUCHE				MACKENZIE				ST LAURENT				
		DELEX	PERCENT CAPABILITY	AGE FACTOR	FACTORED PERCENT	DELEX	PERCENT CAPABILITY	AGE FACTOR	FACTORED PERCENT	DELEX	PERCENT CAPABILITY	AGE FACTOR	FACTORED PERCENT	DELEX	PERCENT CAPABILITY	AGE FACTOR	FACTORED PERCENT	
AAW Self-Defence	CIWS																	
	Point Defence																	
AAW Area Defence	SAM																	
SUW	Gun		2	1/8	0.25		2	1/8	0.25		2	1/8	0.25		2	1/8	0.25	
	SSM																	
ASW Defensive	HMS/Torpedo	•	2	1	2.0		2	1/2	1.0	•	2	1	2.0		2	1/8	0.25	
	VDS/ASROC						5	1/2	2.50						5	1/4	1.25	
	Helo		13	1/4	3.25										13	1/4	3.25	
ASW Offensive	Towed Array	•	20	1	20.0													
EW ECM	Chaff/Jammer					•	5	1	5.0									
EW ESM	Detection	•	5	1	5.0	•	5	1	5.0		5	1/2	2.50		5	1/2	2.50	
Command-Control	NTDS	•	5	1	5.0	•	5	1	5.0	•	5	1	5.0	•	5	1	5.0	**
Communication	SATCOM						5	1	5.0									
TOTAL CAPABILITY EACH CLASS					36%				24%				10%	with NTDS			12%	**
														without NTDS			7%	**

Figure 2. Capabilities of Canadian Destroyer Classes

NOTE: ** Only 3 of the 6 ST. LAURENT CLASS will receive the NTDS Equipment

FUNCTION	ZONES OF INFLUENCE	COMBAT SYSTEMS	PERCENTAGE PER ZONE	AGE FACTOR	FACTORED PERCENTAGE
AAW (40%)	CLOSE IN POINT DEFENCE AIR DEFENCE	CIWS (Phalanx) V.L. Sea Sparrow V.L. SM-1	4 16 20	1 1 1	* 4 * 16 * 20
SUW (20%)	SHORT RANGE LONG RANGE	Gun SSM (Harpoon)	2 18	1/2 1	1 * 18
ASW (20%)	SHORT RANGE MEDIUM RANGE LONG RANGE	HM Sonar/Torpedo VD Sonar/ASROC Helo	2 5 13	1 1 1/2	2 5 6.5
EW (10%)	ECM ESM	Chaff(SRBOC)/Jammer CANEWS	5 5	1 1	* 5 * 5
C^3 (10%)	C^2 COMM	TDS SATCOM	5 5	1 1	* 5 5
			TOTAL CAPABILITY		93%

NOTE: * Includes TRUMP Mods.

Figure 3. Capabilities of Tribal Class * (Air-Defence Role)

armed with the Canadian Sea Sparrow missile. The Tribals are the largest and most complex destroyers ever to have been built in Canada, and feature a flexible design that has high endurance and a rapid response capability.

However, there are areas where improvements and updating must be carried out if these ships are to remain effective fighting units. With TRUMP, the intent is to address the particular need to improve the air-defence capability of the fleet. The USN Standard Missile has been selected as the air-defence missile system; self-defence and surface-combat systems similar to those for the CPF have also been selected. After their TRUMP refits, the overall effectiveness of the Tribals is estimated to be 94%, as outlined in Figure 3.

Destroyer Classes — Combat System Capabilities

The estimated combat capabilities of Canadian destroyer classes, including the modifications made under DELEX and projected for TRUMP, are summarized in Figure 4. An overview of the fleet capabilities is also depicted in chart form in Figure 5 which specifically highlights the deficiencies of the *Annapolis, Improved Restigouche, MacKenzie* and *St. Laurent* classes with respect to anti-air, surface and electronic warfare.

Considering their limited remaining life span, any form of capability upgrading for the *St. Laurents* can only be of little value. However, the length of service remaining for the other three steam-destroyer classes is rather substantial. Even with follow-on construction programs to the CPF, some of the steam destroyers will be around well beyond the year 2000. Therefore, since DELEX modifications have done little to make these ships more combat capable, it is imperative that drastic steps be taken immediately to upgrade them.

Proposed Fleet Upgrading

Basically, this article proposes options for upgrading the Canadian navy by retrofitting combat systems for various classes of ships as outlined in Figure 6. It further proposes that the *St. Laurent* class, which is scheduled for imminent replacement by the CPF, be removed from service at an earlier date, and that the ensuing savings in operations and maintenance (O&M) costs be applied to cover some of the upgrading costs for the remaining classes of steam destroyers.

The upgrading options deemed essential for each of the steam destroyer classes are described in the following paragraphs. The proposal addresses the need to fit these ships with anti-air and surface weapons, along with the necessary fire-control, communications and navigation equipment.

Annapolis-Class Upgrading

The two *Annapolis*-class ships are the newest of the steam destroyers and, accordingly, have the longest remaining life span. Scheduled to receive the CANTASS towed array and the modernized AN/SQS-510 hull-mounted sonar under the auspices of DELEX, the *Annapolis* class will actually have a slightly better ASW capability than the new CPF; but they will continue to be largely ineffective in all other combat areas. Therefore, to upgrade their overall capability to that of modern warships, they should be retrofitted with the systems noted in Figure 6. A possible arrangement and location of weapon systems is shown in Figure 7.

A study was undertaken regarding the feasibility of modifying the present stern configuration of this class in order to fit the Harpoon system. The study concluded that Harpoon could be fitted in the

CLASS	ROLE	MOD PROGRAM	CAPABILITY BEFORE MODS	CAPABILITY AFTER MODS
TRIBAL (4)	AIR DEFENCE *	TRUMP	30%	93%
ANNAPOLIS (2)	ASW	DELEX	7%	36%
RESTIGOUCHE (4)	ASW	DELEX	13%	24%
MACKENZIE (4)	ASW	DELEX	3%	10%
ST-LAURENT (6)	ASW	DELEX	7%	12%

NOTE: (*) ROLE AFTER TRUMP MODS

Figure 4. Summary of Destroyer Capabilities

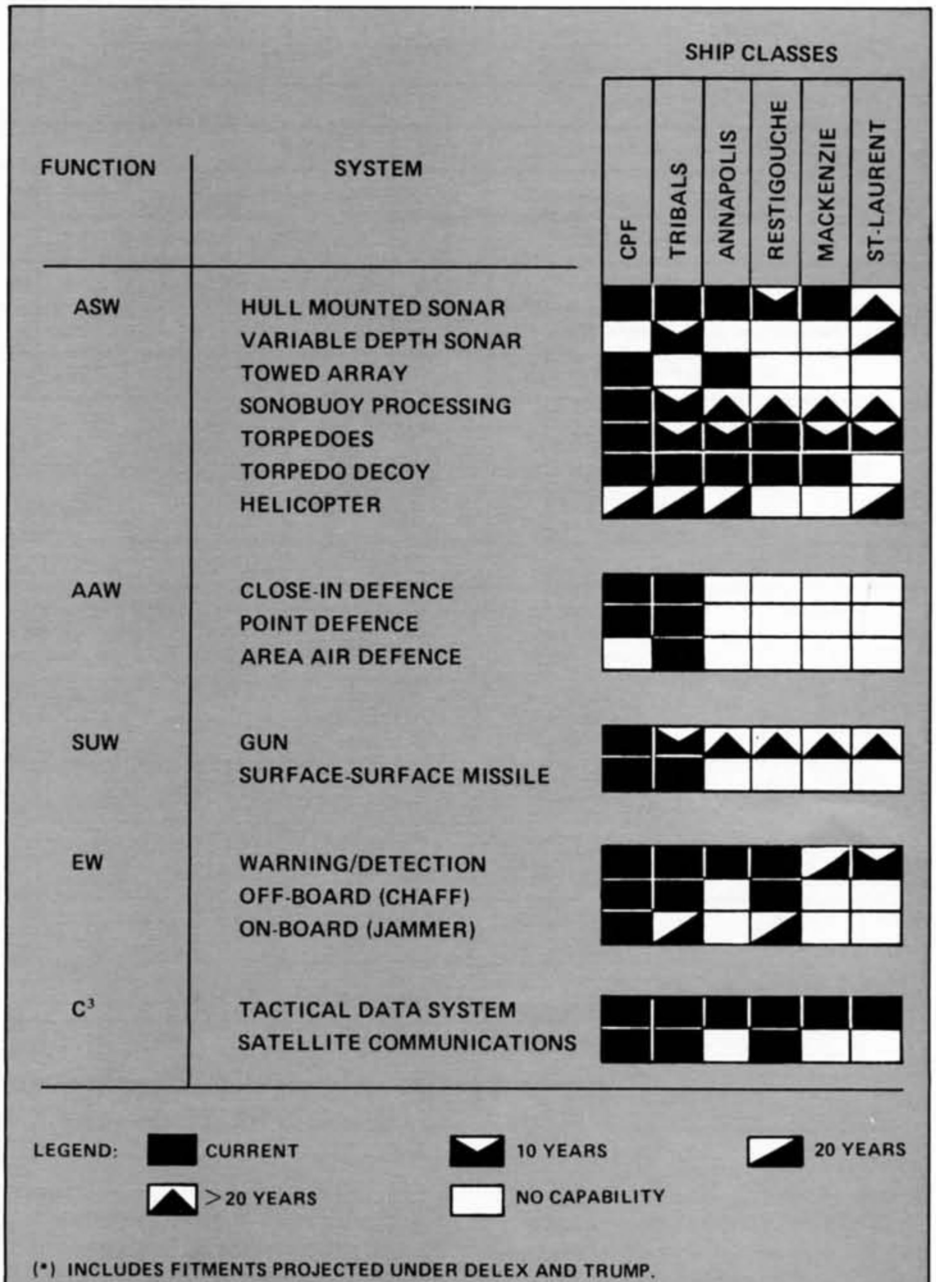

Figure 5. Ship Combat Systems (*)

System	Ship Classes ANS	IRE	MCK
STIR Fire-Control System	2	2	1
Continuous-Wave Illumination System	2	2	1
Vertical Launch Sea Sparrow Launchers	8	8	8
Vertical Launch Sea Sparrow Missiles	4	4	4
Close-In Weapon System, Phalanx	1	1	1
MK-32 Torpedo Tubes	F	F	6
SRBOC Chaff Launchers	4	F	4
CANEWS ESM System	F	F	1
Harpoon Launchers	8	A	8
Harpoon Missiles	2	2	2
WSC-3 Satellite Communications	1	F	1
MK-29 Intertial Navigator	2	2	2

Notes: F = Already Fitted
A = ASROC; with mod kits, Harpoon could be loaded in ASROC launcher.

Figure 6. Fleet Upgrade Proposal (No. of Systems)

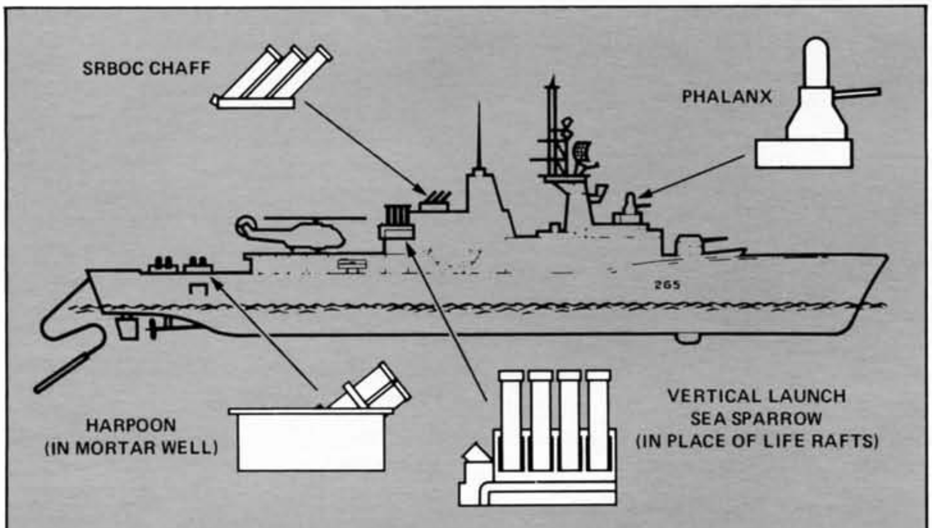

Figure 7. Proposed Upgrading *Annapolis* Class

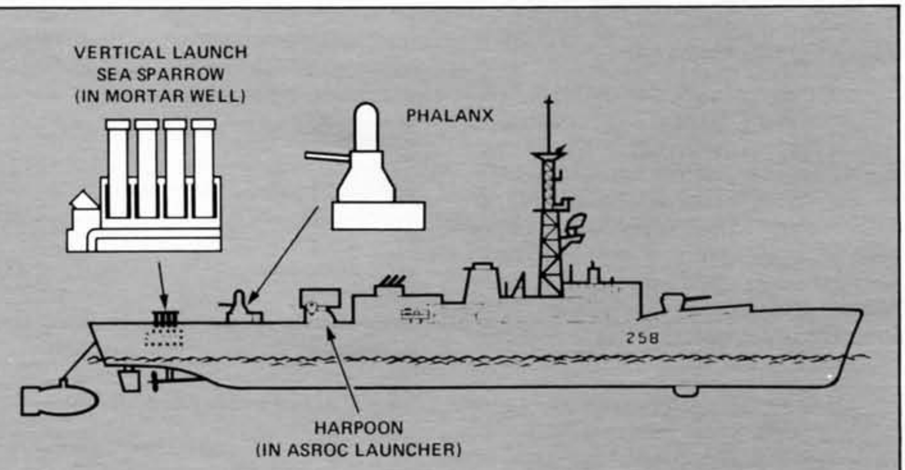

Figure 8. Proposed Upgrading *Restigouche* Class

existing mortar well, replacing the obsolete mortar launcher. The installation could consist of two, quadruple canister/launcher mountings set in a tub-like arrangement in the mortar well. Cutouts in the hull would be required for the missile blast to exit on firing.

The vertical-launch Sea Sparrow (VLSS) missile launchers could be installed in a configuration of four launchers, with a plenum chamber conducting the efflux away from the ship, fitted on each side of the hangar above the two flight-deck fire-fighting compartments.

The Phalanx system, being self-contained, could be readily mounted atop the bridge with minimal structural modifications.

The full SRBOC chaff system, consisting of four launcher platforms of six tubes each, could be fitted on top of the hangar since it does not require an excessively large surface area.

Improved Restigouche-Class Upgrading

The four *Improved Restigouche*-class ships received a major update of their ASW suite during the period 1970-74. They carry both the hull-mounted and variable-depth configurations of the AN/SQS-505(V) sonar, as well as ASROC anti-submarine rockets, giving them a rather effective ASW package.

Of the three classes of steam destroyers being evaluated for upgrading, the *IRE*s require the least improvement since they were fitted with a considerable array of new equipment under DELEX. The new fittings include SRBOC chaff, WSC-3 Satcom, CANEWS electronic support measures, and MK-32 torpedo tubes. These ships should be additionally fitted with the anti-air and surface weapons already outlined for the *Annapolis* class: Harpoon, VLSS and Phalanx (see Figure 8).

The VLSS could be readily installed in the mortar well. The existing Limbo MK-10 mortar, which is now considered obsolete as an ASW weapon, could be removed and replaced by two side-by-side VLSS systems in the normal configuration of four launchers plus one plenum chamber per system. The mortar well could then be permanently covered around the protruding launchers with relatively little structural modification.

The Harpoon anti-ship missiles could be loaded in the existing ASROC launcher. Two of the eight ASROC cells could be easily converted to Harppon cells with modification kits presently available at low cost. The Phalanx mounting could be located between the ASROC launcher and the mortar well.

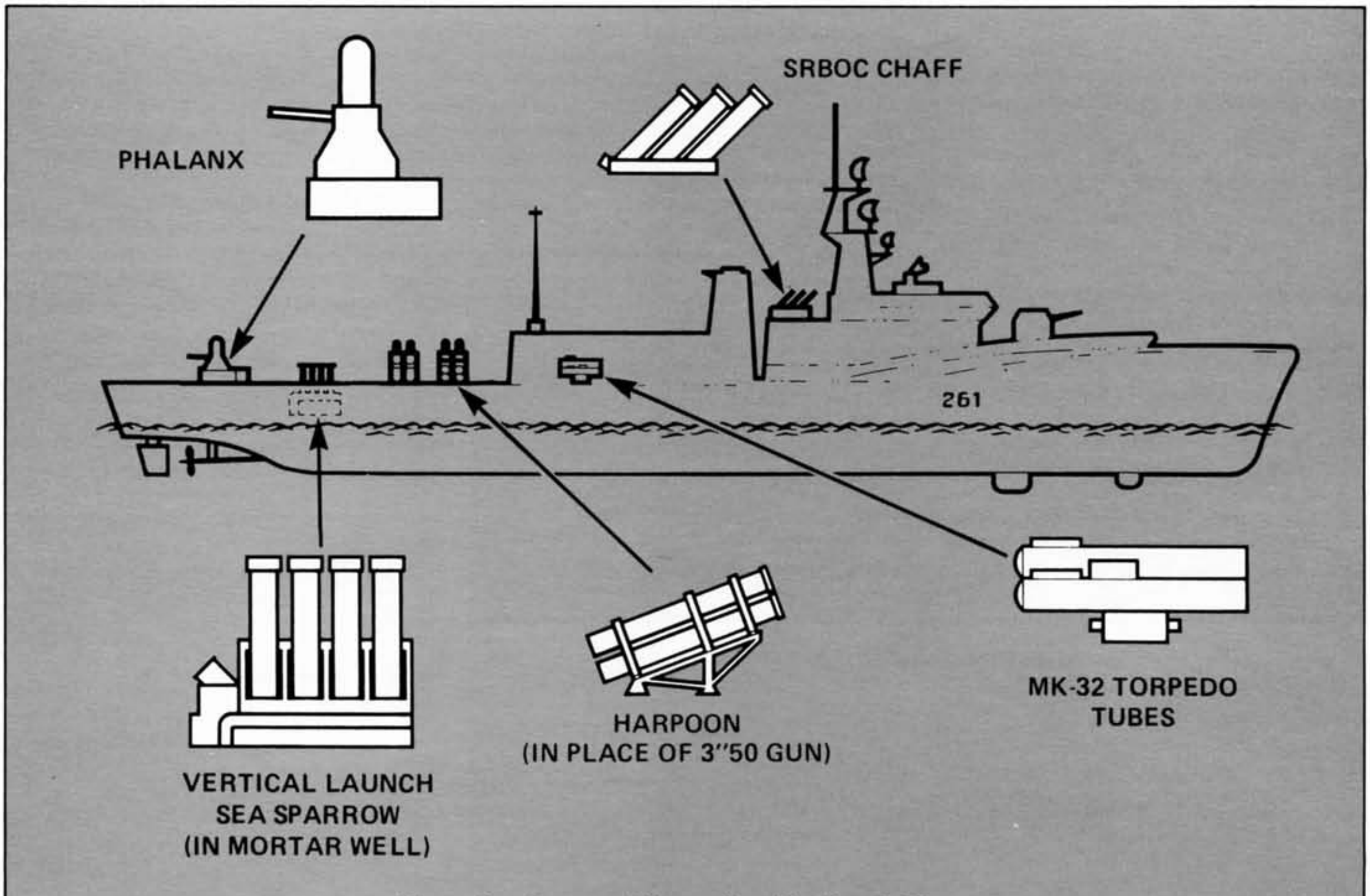

Figure 9. Proposed Upgrading *MacKenzie* Class

MacKenzie-Class Upgrading

The four *MacKenzie*-class ships have been the most neglected over the years. Relegated exclusively to a training role, they have received little or no new equipment since they were commissioned in the 1960s and have suffered much degradation of combat capability. As a consequence, of the twenty surface-combat units in the Canadian navy, four are now virtually unsuitable for modern combat roles; a situation that can be ill-afforded.

The *MacKenzie* class will likely be operational at least until 1995/1996, and possibly well beyond then. Their minimum projected life span is nine years, provided CPF follow-on ship construction is approved. Under DELEX they received the updated AN/SQS-505(V) and new ADLIPS tactical data system, but did not show a marked increase in overall capability. Moreover, given the need to maintain the *MacKenzies* at a level of effectiveness deemed minimal for any warship, it is imperative that they be upgraded with the combat systems noted in Figure 9. Again, these systems are primarily meant as a means of correcting gross deficiencies in the anti-air and surface-warfare spheres, and include Phalanx, SRBOC chaff, VLSS, Harpoon, MK-32 torpedo tubes, WSC-3 Satcom, and a single STIR fire-control system.

The anti-air and surface packages are similar to those proposed for the other classes except that only one STIR and CWI system are included to control the VLSS. Because of the relatively small improvements made to this class under DELEX, the *MacKenzies* require additional weapons such as the MK-32 torpedo tubes.

For the *MacKenzies*, the Harpoon launchers could be fitted on the quarterdeck in place of the present 3"50 gun mounting. This gun, developed during World War II, is considered to be of little value in today's context and has long since been discarded by most navies. The Harpoon launchers could be installed in their original configuration of four tubes per system, with one system pointing to port and the other to starboard.

The Sea Sparrow (VLSS) could again be fitted in the mortar well to replace the Limbo MK-10 mortars, as per the *Restigouche*-class installation.

Steam Destroyers — Capabilities with Proposed Upgrading

The weapon systems indicated for the *Annapolis, Improved Restigouche* and *MacKenzie* classes are primarily intended as a means of increasing their effectiveness in areas of almost total vulnerability. Their estimated increases in capability as a result of the upgradings are calculated in Figure 10. The level of capability of these ships would then increase to 82%, a level considered essential to the useful employment (and survival) of a surface combatant at sea today.

It should be noted that with the upgraded weapon systems, the *IRE*s and *MacKenzies* could be classed as general-purpose ships rather than as strictly ASW units as they are at present. Indeed, the systems outlined would provide these ships with the necessary tools to function effectively as units of a small but versatile, well balanced force.

Disposal of the *St. Laurent* Class

The six *St. Laurent*-class ships are scheduled for replacement in 1989. Their maintenance costs have soared because of their age and state of disrepair, and the fre-

	Ship Classes		
	ANS	IRE	MCK
Capability with DELEX	36	24	10
Additional Capabilities with Proposed Upgrading:			
AAW Close-In Defence	4	6	6
AAW Point Defence	16	24	24
SUW Missile	18	28	28
ASW Torpedoes			2
ECM Chaff	3		3
ESM CANEWS			5
SATCOM	5		5
Total *Upgraded Capability (%)*	82	82	83

Figure 10. Steam-Destroyer Capabilities with Proposed Upgrading (%)

System	System Cost	Program Cost Factor	Total System Cost
STIR (one system)	2.5	2.0	5.0
CWI (one system)	1.3	2.0	2.6
VLSS (8 launchers)	3.0	2.0	6.0
VLSS (one missile)	0.3	1.2	0.36
CIWS (one system)	5.0	2.0	10.0
MK-32 (6 tubes)	1.0	1.5	1.5
SRBOC (4 launchers)	0.4	1.5	0.6
CANEWS (one system)	2.0	2.0	4.0
Harpoon (8 launchers)	4.0	2.0	8.0
Harpoon (one missile)	1.0	1.2	1.2
SATCOM (one system)	0.4	1.5	0.6
MK-29 (one system)	0.4	1.5	0.6

Figure 11. Estimates of Systems Costs ($M)

quency and unpredictability of breakdowns has made them highly unreliable.

Therefore, given the condition of these six ships, the cost of maintaining them, and their relatively low capability of 7 to 12%, it is suggested that the *St. Laurent*-class ships be scrapped in advance of their current phase-out date. Savings in operations and maintenance of $117M could then be achieved. This amount is based on an estimated yearly cost of $7.5M for each of the six ships, calculated using DND cost factors adjusted for inflation. It is further suggested that the savings realized from the early retirement of these ships be applied to the cost of upgrading the remaining steam destroyers.

Estimates of System Costs

Figure 11 outlines the estimated cost for each system. The program cost is obtained by multiplying the system cost by the program factor. The program costs are applied to account for additional costs which would result from accompanying requirements for such items as spares, training, ship-integration installation, set-to-work, initial field service, federal sales tax and duty. Because of the commonality of equipment with the CPF, program costs could be lower than shown.

Upgrading Costs by Ship Class

Upgrading costs for one ship of each class are described in Figure 12, and include both equipment and program costs. For example, to upgrade one *Annapolis*-class ship would cost $45.44M. It should be noted that costs shown for Harpoon are for eight launchers and only two missiles; and for VLSS, eight launchers and four missiles. This arrangement of including only a

	ANS		IRE		MCK	
System	No.	Cost	No.	Cost	No.	Cost
STIR System	2	10.0	2	10.0	1	5.0
CWI System	2	5.2	2	5.2	1	2.6
VLSS (8 launchers)	1	6.0	1	6.0	1	6.0
VLSS Missiles	4	1.44	4	1.44	4	1.44
CIWS System	1	10.0	1	10.0	1	10.0
MK-32 (6 tubes)					1	1.5
SRBOC (4 launchers)	1	0.6			1	0.6
CANEWS System					1	4.0
Harpoon (8 launchers)	1	8.0	A	2.0	1	8.0
Harpoon Missiles	2	2.4	2	2.4	2	2.4
SATCOM System	1	0.6			1	0.6
MK-29 System	2	1.2	2	1.2	2	1.2
TOTAL ($M)		45.44		38.24		43.34

Note: A = Harpoon in the ASROC launcher. Cost is for Mod kits, integration.

Figure 12. Upgrading Costs by Ship Class ($M)

limited number of missiles in the initial procurement is similar to that for CPF where sailaway cost is based on eight Harpoon launchers and only four missiles.

Net Cost of Upgrading

Figure 13 compares the actual upgrading costs for the *Annapolis, IRE* and *MacKenzie* classes with the total net costs resulting from introducing the $117M in O & M savings realized from the early disposal of the *St. Laurents*. As shown, the total cost of upgrading could be reduced from $424M to $307M. (Projected shiprefit dates were used to determine the years in which the upgradings could take place. Six months were then added to each ship refit to complete the proposed upgrading.)

Effects of Upgrading on Destroyer Capabilities

It must now be determined whether or not removing six destroyers from the fleet and increasing the effectiveness of the ten remaining ships would actually increase the overall capabilities of the surface force. Figure 14 describes the capabilities of all the destroyers, based on the evaluations previously outlined in Figures 2 and 3, before and after modifications performed under DELEX and TRUMP. For example, the capability of HMCS *Restigouche* prior to DELEX is calculated to be 13%, whereas after DELEX it is considered to be 24%. The lower capability of 13% is shown up to 1986, the scheduled DELEX refit date.

The improved capabilities resulting from retiring the *St. Laurents* and upgrading the remaining ten steam destroyers are tabled in Figure 15. Using the same example, *Restigouche*'s capabilities would climb from 13% before DELEX, to 82% after both DELEX and the proposed upgrading.

Additional Factors

The repair agencies' maintenance man-hours which would become available as a result of the disposal of the *St. Laurent* class could be used to perform some of the proposed upgrading work. Furthermore, since there is apparently a shortage of some 200 personnel in the sea trades at this time, early disposal of the *St. Laurents* would serve to alleviate this problem.

	85	86	87	88	89	TOTAL
O&M Savings from Disposal of *St. Laurents*	23	45	30	17	2	117
Cost of Upgrading:						
Restigouche	39					
Terra Nova	39					
Saskatchewan	44					
Yukon	44					
Annapolis		46				
Gatineau			39			
Kootenay			39			
MacKenzie			44			
Nipigon				46		
Qu'Appelle				44		
Upgrading Costs	166	46	122	90		424
Net Costs ($M)	143	1	92	73	(2)	307

Figure 13. Cost of Upgrading Destroyers ($M).

SHIP	84	85	86	87	88	89	90	91	92	93	94	CPF
Assiniboine	7	12	12	–	–	–	100	100	100	100	100	Halifax
Saguenay	7	7	12	12	–	–	–	100	100	100	100	Vancouver
Margaree	7	7	12	12	–	–	–	100	100	100	100	Quebec
Skeena	7	7	7	12	12	–	–	–	100	100	100	Toronto
Fraser	7	7	7	12	12	–	–	–	100	100	100	Regina
Ottawa	7	7	7	7	12	12	–	–	–	100	100	Calgary
Annapolis	7	7	7	36	36	36	36	36	36	36	36	
Nipigon	7	7	7	7	7	7	36	36	36	36	36	
Terra Nova	13	24	24	24	24	24	24	24	24	24	24	
Restigouche	13	13	24	24	24	24	24	24	24	24	24	
Gatineau	13	13	13	24	24	24	24	24	24	24	24	
Kootenay	13	13	13	13	24	24	24	24	24	24	24	
Saskatchewan	3	3	3	10	10	10	10	10	10	10	10	
MacKenzie	3	3	3	3	10	10	10	10	10	10	10	
Qu'Appelle	3	3	3	3	3	10	10	10	10	10	10	
Yukon	3	3	10	10	10	10	10	10	10	10	10	
Iroquois	30	30	30	30	30	30	93	93	93	93	93	
Athabaskan	30	30	30	30	30	30	30	93	93	93	93	
Huron	30	30	30	30	30	30	30	30	93	93	93	
Algonquin	30	30	30	30	30	30	30	30	30	93	93	
TOTAL	240	256	284	329	328	311	491	754	1017	1180	1180	
FLEET PERCENTAGE	12	13	14	16	16	16	25	38	51	59	59	

Figure 14. Destroyer Capabilities with DELEX and TRUMP

The training of personnel for the upgraded ships could present some difficulties because an imposing array of modern, high-technology systems would be introduced to the fleet. However, the training burden would be somewhat reduced because all of the proposed systems are either already fitted in some units, or are scheduled for the new CPFs.

As the CPFs are commissioned, the present standard fleet training will have to be amended to reflect the presence of the CPF weaponry. The proposed upgrading options will result in a broader distribution of the new weapons around the fleet. Consequently, with the larger numbers of systems available to tradesmen, the transition of training programs will be easier to achieve.

Conclusions

Canada has considerable and varied maritime interests including fishing, commerce and seabed resources' exploitation. Yet Canada's navy, through decades of neglect, has lost its capability to effectively respond to any territorial challenge. Although Canadian naval ships have maintained a fairly adequate level of capability in ASW, they are now considered virtually defenceless against surface or air threats.

The Falklands Campaign proved that it is of paramount importance that a naval force be well balanced in all areas of modern sea warfare. It also demonstrated the vital need for all naval combatants to possess the necessary self-defence systems if they are to survive in a conflict.

The six aging *St. Laurent*-class destroyers should be retired at an accelerated rate, and the ensuing savings in maintenance costs should be applied to the upgrading of the ten remaining steam destroyers, specifically in the areas of anti-air and surface warfare.

Even though the total upgrading cost of $307M for ten steam destroyers would still be significant, it is but a fraction of the amount which would be required to acquire ten new ships in the same time frame. This upgrading would result in a significant increase in overall capability and effectiveness for the Canadian navy.

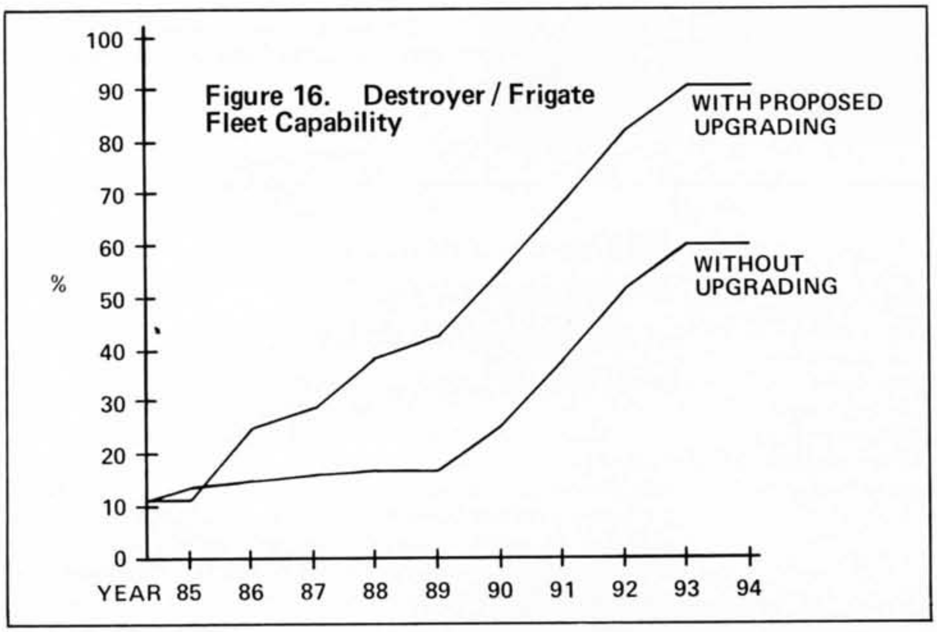

Figure 16. Destroyer / Frigate Fleet Capability

SHIP	84	85	86	87	88	89	90	91	92	93	94	CPF
Assiniboine	7	–	–	–	–	–	100	100	100	100	100	Halifax
Saguenay	7	–	–	–	–	–	–	100	100	100	100	Vancouver
Margaree	7	–	–	–	–	–	–	100	100	100	100	Quebec
Skeena	7	7	–	–	–	–	–	–	100	100	100	Toronto
Fraser	7	7	–	–	–	–	–	–	100	100	100	Regina
Ottawa	7	7	–	–	–	–	–	–	–	100	100	Calgary
Annapolis	7	7	7	82	82	82	82	82	82	82	82	
Nipigon	7	7	7	7	7	7	82	82	82	82	82	
Terra Nova	13	13	82	82	82	82	82	82	82	82	82	
Restigouche	13	13	82	82	82	82	82	82	82	82	82	
Gatineau	13	13	13	13	82	82	82	82	82	82	82	
Kootenay	13	13	13	13	82	82	82	82	82	82	82	
Saskatchewan	3	3	83	83	83	83	83	83	83	83	83	
MacKenzie	3	3	3	3	83	83	83	83	83	83	83	
Qu'Appelle	3	3	3	3	3	83	83	83	83	83	83	
Yukon	3	3	83	83	83	83	83	83	83	83	83	
Iroquois	30	30	30	30	30	30	93	93	93	93	93	
Athabaskan	30	30	30	30	30	30	30	93	93	93	93	
Huron	30	30	30	30	30	30	30	30	93	93	93	
Algonquin	30	30	30	30	30	30	30	30	30	93	93	
TOTAL	240	219	499	574	789	869	1107	1370	1633	1796	1976	
FLEET PERCENTAGE	12	11	25	29	39	43	55	69	82	90	90	

Figure 15. Destroyer Capabilities with Proposed Upgrading

News Briefs

Associate Minister of National Defence, the Honourable Paul Dick, right, recently joined Leigh Instruments Ltd. President and Chief Executive Officer Barry Flower for the signing of a contract to modernize Canadian navy warships. The $15.2-million contract will replace aging shipborne remote-control radio systems with a secure system so that classified information can be sent from ships without risk of interference or interception.

Bulletin d'information

Le ministre associé de la Défense nationale, l'honorable Paul Dick, à droite, en compagnie de Barry Flower, président et chef de la direction de Leigh Instruments Ltd., ont signé récemment un contrat pour la modernisation des navires de guerre canadiens. Le marché de 15,2 millions de dollars vise le remplacement de l'ancien système de téléradiocommunications embarqué par un système assurant la discrétion des communications classifiées.

Thumbs Up for TSRV

Treasury Board gave its approval last December for the acquisition of four, purpose-built Torpedo and Ship Ranging Vessels (TSRV) for the Canadian Forces Maritime Experimental and Test Ranges at Nanoose, B.C. The 30-metre steel-hulled vessels, replacements for four aging support vessels, will carry a payload container fitted with state-of-the-art acoustic monitoring and processing equipment. The TSRVs will be used at CFMETR to conduct tests of underwater weapons, sonobuoys and other equipment.

Bâtiments d'essais et de mesure de torpilles et de dispositifs de détection (TSVR)

En décembre dernier, le Conseil du Trésor a approuvé l'acquisition de quatre bâtiments d'essais et de mesure de torpilles et de dispositifs de détection pour les Centres d'expérimentation et d'essais maritimes des Forces canadiennes (CEEMFC). Ces navires de 30 mètres, à coque d'acier, qui remplaceront de vieux bâtiments de soutien, seront dotés d'un conteneur modulaire équipé de matériel de mesure et de traitement de données acoustiques. Les CEEMFC utiliseront les TSRV pour tester les armes sous-marines, les bouées et autres matériels.

Canada to Provide Portugal with Sonars

The Associate Minister of National Defence, the Honourable Paul Dick, announced in December a project to provide a gift of three sonar systems to Portugal.

In 1980, as part of a NATO Military Assistance Program, Canada agreed to provide an appropriate sonar system for the Portuguese Frigate Program. At that time, the government approved the project at a maximum cost of $11 million ($1980) to Canada. This assistance program was developed to help member countries of the southern flank to fulfil their assigned roles in the collective defence of the alliance.

"This project will contribute to the alliance and at the same time will provide significant opportunities for Canadian industry," said Dick.

"State-of-the-art Canadian technology aboard Portuguese warships will improve the total military capabilities of the alliance. It will also result in greater NATO standardization and interoperability because Canadian warships will have this equipment," he added.

A contract to provide the sonar systems to Portugal is expected to be awarded to a Canadian company in 1987.

Le Canada Fournira des Sonars au Portugal

Le ministre associé de la Défense nationale, l'Honorable Paul Dick, a annoncé en décembre que le Canada projetait de faire cadeau de trois systèmes sonar au Portugal.

En 1980, dans le cadre d'un programme d'aide militaire de l'OTAN, le Canada a convenu de fournir un système sonar approprié au programme de frégates du Portugal. A cette époque, le gouvernement a approuvé le projet, qui ne devait pas coûter plus de 11 million de dollars (en dollars de 1980). Ce programme d'aide a été mis sur pied dans le but d'aider les pays membres de l'OTAN situés sur le flanc sud à remplir les tâches qui leur ont été confiées dans le but d'assurer la défense collective de l'alliance.

"Grâce à ce projet, nous viendrons en aide à l'alliance tout en offrant à l'industrie canadienne des grandes possibilités", a déclaré M. Dick.

Le Ministre associé a ajouté que "la présence d'équipements canadiens des plus modernes à bord des navires de guerre portugais augmentera les capacités militaires de l'ensemble de l'alliance. De plus, cet équipement contribuera à assurer une plus grande uniformité et interopérabilité au sein de l'OTAN puisque les navires de guerre canadiens en seront aussi dotés".

Le contrat, afin de fournir au Portugal un système sonar, devrait être accordé à une compagnie canadienne en 1987.

Beatty Announces Fleet Restructuring

The Honourable Perrin Beatty, Minister of National Defence, announced in January the transfer of HMCS *Huron*, a Tribal-class DDH-280 destroyer, and two detachments of two CH-124 Sea King helicopters from the Atlantic Coast to Maritime Forces Pacific (MARPAC). At the same time, an *Improved Restigouche* class destroyer escort, HMCS *Gatineau*, whose home port is Esquimalt, B.C., will be transferred to Halifax. The moves are scheduled to take place this summer, and are designed to give more balance to the anti-submarine capability on both coasts.

"This reallocation of our maritime resources reflects the government's recognition of the increasingly important role of the Pacific region," said Beatty.

The transfers are designed to respond to the increasing Soviet fleet and submarine presence in the North East Pacific, particularly that of the Victor class and nuclear-powered, guided missile submarines, as well as the increased level of operations of intelligence gathering vessels.

The much greater anti-submarine capability provided by the helicopters on the DDH-280 will improve the capability of our West Coast fleet. One detachment of two helicopters will be in HMCS *Huron*, and the second detachment will be embarked in HMCS *Provider*. The transfer of HMCS *Gatineau* to Halifax will provide a vessel-launched anti-submarine rocket (ASROC) capability to our Atlantic fleet.

The transfer of HMCS *Huron* to the West Coast will also provide valuable training to Maritime Forces Pacific in helicopter operations at sea, preparing for the eventual arrival of the new Canadian Patrol Frigate. As well, *Huron*'s presence in the Pacific fleet will provide a previously unavailable command and control ship, allowing an independent Canadian task force to be created, when required, from Canadian resources on the West Coast.

Mr. Beatty went on to say that, "This transfer of ships is an example of our determination to make the very best use of our existing defence resources".

The four Sea King helicopters will also enhance the capability of the Commander Maritime Forces Pacific to respond to search and rescue needs. The CH-124 Sea King anti-submarine helicopter is the Canadian Forces's only sea-going helicopter. It is an all-weather, day or night aircraft with detection, navigation and weapon systems that enable it to search for, locate and destroy any submarine. It carries a crew of two pilots, a tactical navigator and an airborne electronics sensor operator.

The DDH-280 is designed primarily as an anti-submarine warfare vessel with a good self-defence and command and control capability. The ship has a complement of 285 officers and men and can accommodate up to 30 trainees.

The destroyer escorts of the *Restigouche* class such as HMCS *Gatineau* have been modernized to incorporate improved sensors and improved electronic warfare capability, as well as a medium-range and quick reaction anti-submarine weapon system (ASROC). The ship has a complement of 214 officers and men.

Beatty Annonce la Restructuration de la Flotte

L'honorable Perrin Beatty, ministre de la Défense nationale, a annoncé en janvier que le NCSM *Huron*, un destroyer de classe Tribal DDH-280, et deux détachements de deux hélicoptères Sea King CH-124 chacun, seront prélevés de la côte Est pour être confiés aux Forces maritimes du Pacifique, sur la côte Ouest. Par ailleurs, le NCSM *Gatineau*, un destroyer d'escorte modernisé de classe *Restigouche*, dont le port d'attache est Esquimalt (C.-B.), sera transféré à Halifax (N.-É.). Ces mouvements, prévus pour l'été prochain, visent à équilibrer les ressources anti-sous-marines sur les deux côtes canadiennes.

"En réaffectant ces ressources navales, le gouvernement reconnaît l'importance croissante de la région du Pacifique", a déclaré M. Beatty.

Les déplacements ont pour but de répondre à la recrudescence des activités d'espionnage naval ainsi qu'à la présence de plus en plus fréquente de navires et de sous-marins de flotte soviétique dans le nord-est du Pacifique (et plus particulièrement les sous-marins à propulsion nucléaire et ceux dotés de missiles guidés).

Les capacités accrues de lutte anti-sous-marine des hélicoptères Sea King, embarquées sur les navires DDH-280, amélioreront sensiblement le potentiel de la flotte du Pacifique. Deux appareils seront embarqués sur le *Huron* tandis que les deux autres seront affectés au *Provider*. Par ailleurs, avec le *Gatineau*, la flotte de l'Atlantique disposera d'un navire doté d'un système de lance-grenades anti-sous-marines (ASROC).

Le rattachement du *Huron* à la côte Ouest vise également à permettre au personnel des Forces maritimes du Pacifique d'acquérir une expérience de l'utilisation des hélicoptères en mer, préparant le terrain à l'entrée en service des nouvelles frégates de patrouille. En outre, au sein de la flotte du Pacifique, le *Huron* servira de navire de commandement et de contrôle, permettant, au besoin, la création d'un groupe naval d'intervention entièrement canadien.

M. Beatty a également déclaré que cette décision reflète la détermination du Canada de faire le meilleur usage possible de ses ressources de défense.

Outre leur rôle de lutte anti-sous-marine, les hélicoptères Sea King s'ajouteront aux ressources de recherche et de sauvetage des Forces maritimes du Pacifique. Le Sea King est actuellement le seul hélicoptère embarqué des Forces canadiennes. Il peut opérer de jour comme de nuit, par tout temps et est équipé de systèmes de navigation, de détection et d'armement qui lui permettent de chercher, de localiser et de détruire les sous-marins. Son équipage comprend deux pilotes, un navigateur tactique et un opérateur de détecteur électronique aéroporté.

Les destroyers porte-hélicoptères de classe Tribal DDH-280 sont conçus avant tout pour la guerre anti-sous-marine; ils sont dotés de moyens modernes d'auto-défense et de dispositifs de commandement et de contrôle. L'équipage d'un navire de ce type compte habituellement 285 officiers et non-officiers, et peut comprendre 30 recrues.

Les destroyers d'escorte modernisés de classe *Restigouche*, dont fait partie le *Gatineau*, ont été dotés de dispositifs modernes de détection et de guerre électronique, ainsi que d'un système lance-grenades anti-sous-marines à moyenne portée et à tir rapide (ASROC). L'équipage de ce destroyer compte 214 officiers et non-officiers.

Militarized Reconfigurable Microcomputer

In a move away from military computers having unique architectures and programming languages, DY-4 Systems Inc. of Ottawa has been awarded a contract for the first-stage development of a militarized reconfigurable microcomputer (MRM). The MRM is based on the Motorola 68020 32-bit microprocessor and will use the industry standard VME (Versa Europa Modula) backplane.

Under development are a state-of-the-art central processor board and two I/O boards for NATO serial and parallel interfaces which will be compatible with a wide range of commercially available products. Such compatibility would mean reduced costs for hardware and software system development, and would allow commercial enhancements of these products to be captured by DND. A number of Ada compilers and program generation systems, as well as a wide variety of VME products, are available for the 68020, giving prospective DND contractors multiple sources from which to select their systems.

The contract for the MRM will run for 18 months, with an estimated completion date of June 1988.

Micro-ordinateurs reconfigurables militaires

S'écartant de la tradition d'utilisation d'ordinateurs militaires à architecture et programmation unique, le MDN a adjugé un contrat à DY-4 Systems Inc., d'Ottawa, pour le développement d'un prototype de micro-ordinateurs reconfigurables militaires (MRM). Cet appareil est basé sur le micro-processeur de 32 bits Motorola 68020; il sera doté d'un fond de panier suivant la norme VME (Versa Europa Modula).

Une carte de processeur central et deux cartes E/S destinées aux interfaces série et parallèle de l'OTAN sont en voie d'élaboration; elles seront compatibles avec un grand nombre de produits que l'on trouve dans le commerce. Une telle compatibilité se traduira par une réduction des coûts de développement du matériel et des programmes et permettra au MDN de mettre la main sur les améliorations de ces produits lorsqu'ils arrivent sur le marché. Un certain nombre de compilateurs Ada et de systèmes de génération de programmes, ainsi qu'un grand choix de produits suivant la norme VME sont compatibles avec le 68020, ce qui donne aux entrepreneurs éventuels du MDN de multiples choix de systèmes.

La durée du contrat pour les MRM est de 18 mois; la date prévue de parachèvement des travaux est juin 1988.

ASP Contract Awarded

Computing Devices Company of Ottawa has been awarded a contract for the Full-Scale Engineering Development (FSED) of the Airborne Signal Processor (ASP) for the Synthetic Aperture Radar (SAR) being developed for the CP-140 Aurora aircraft.

Design of the ASP is based on the AN/UYS-501 Signal Processor that Computing Devices is developing for the Canadian navy's shipboard acoustic processing system (see Jan 87 issue of the *Journal*). Thus circuit cards, software and documentation will be common to the airborne and shipborne versions of the UYS-501. For the ASP a new airborne chassis will be developed.

Adjudication du contrat de PSRB

Computing Devices Company of Ottawa a obtenu le contrat de développement et de mise au point du Processeur de signaux radars de bord (PSRB) destiné au Radar à antenne synthétique actuellement en développement dont sera doté le Aurora CP-140.

La conception du PSRB s'inspire du Processeur de signaux AN/UYS-501 que Computing Devices est à développer pour le Système de traitement des signaux acoustiques à bord des navires de la Marine canadienne (voir le *Journal* de janvier 1987). Dès lors, les cartes de circuit imprimé, les programmes et la documentation seront les mêmes pour les deux versions du UYS-501. Un nouveau chassis sera développé pour la version aéronef.

Commodore Ross dies at 56

Commodore E. Raymond Ross (RCN Ret.) passed away suddenly at home in Victoria, B.C. on February 28, 1987. He is survived by his wife Patricia, his daughter Sheila of Chilliwack, B.C., and his son Patrick of London, England.

Born in Deal, England in 1930, Commodore Ross spent his early years in England and North Vancouver B.C. He joined the Royal Canadian Navy as a cadet at Royal Roads Military College in 1947, and did his early training in ships and establishments of the Royal Navy, seeing action in the Korean war. In 1960 he graduated with distinction with an M.Sc. degree from the USN Post-Graduate School, Monterey, California. After a series of technical appointments in 1972 he spent one year at the Royal College of Defence Studies (England) and was promoted Commodore in 1977. As Commodore he served in Ottawa as Director General Maritime Engineering and Maintenance; in Washington as Naval Attache; and in Halifax as Chief of Staff, Materiel, Maritime Command. He retired to Victoria in 1985 where in partnership he operated the Leafhill Galleries, which gave him the opportunity to work in an artistic environment and develop his considerable talents as an artist.

Funeral services for Commodore Ross were held in St. Andrew's Chapel, Naden (Victoria) on March 5th.

Commodore Ross meurt à 56 ans

Le Commodore E. Raymond Ross (à la retraite) est décédé soudainement, chez lui, à Victoria (C.-B.), le 28 février, 1987. Il laisse dans le deuil sa femme Patricia, sa fille Sheila de Chilliwack (C.-B.), ainsi que son fils Patrick de Londres, Angleterre.

Né à Deal, Angleterre, le Commodore Ross a grandi en Angleterre et à Vancouver-Nord (C.-B.). Il s'est enrôlé dans la Marine Royale Canadienne, comme élève-officier du *Royal Roads Military College*, en 1947, et entreprit sa formation d'officier à bord de bateaux et bases de la *Royal Navy*. Il participa alors à la guerre de Corée. En 1960, on lui décerna une maîtrise en Sciences de la *USN Post-Graduate School*, Monterey, Californie. Après avoir occupé plusieurs postes en génie, il a passé un an au *Royal College of Defence Studies* (Angleterre) et fut promu au rang de commodore en 1977. En tant que commodore, il a rempli les fonctions de Directeur-général génie maritime et maintenance à Ottawa; Attaché naval à Washington; et Chef d'état-major, matériel, Commandement maritime. Il a pris sa retraite à Victoria en 1985, où il était partenaire dans l'entreprise *Leafhill Galleries*, lui donnant ainsi l'occasion de développer ses talents d'artiste.

Le service funéraire du Commodore Ross a eu lieu à la chapelle St-Andrew de Naden, Victoria, le 5 mars, 1987.

Survey Results

What you thought about us!

Résultats du questionnaire

Votre opinion de notre journal!

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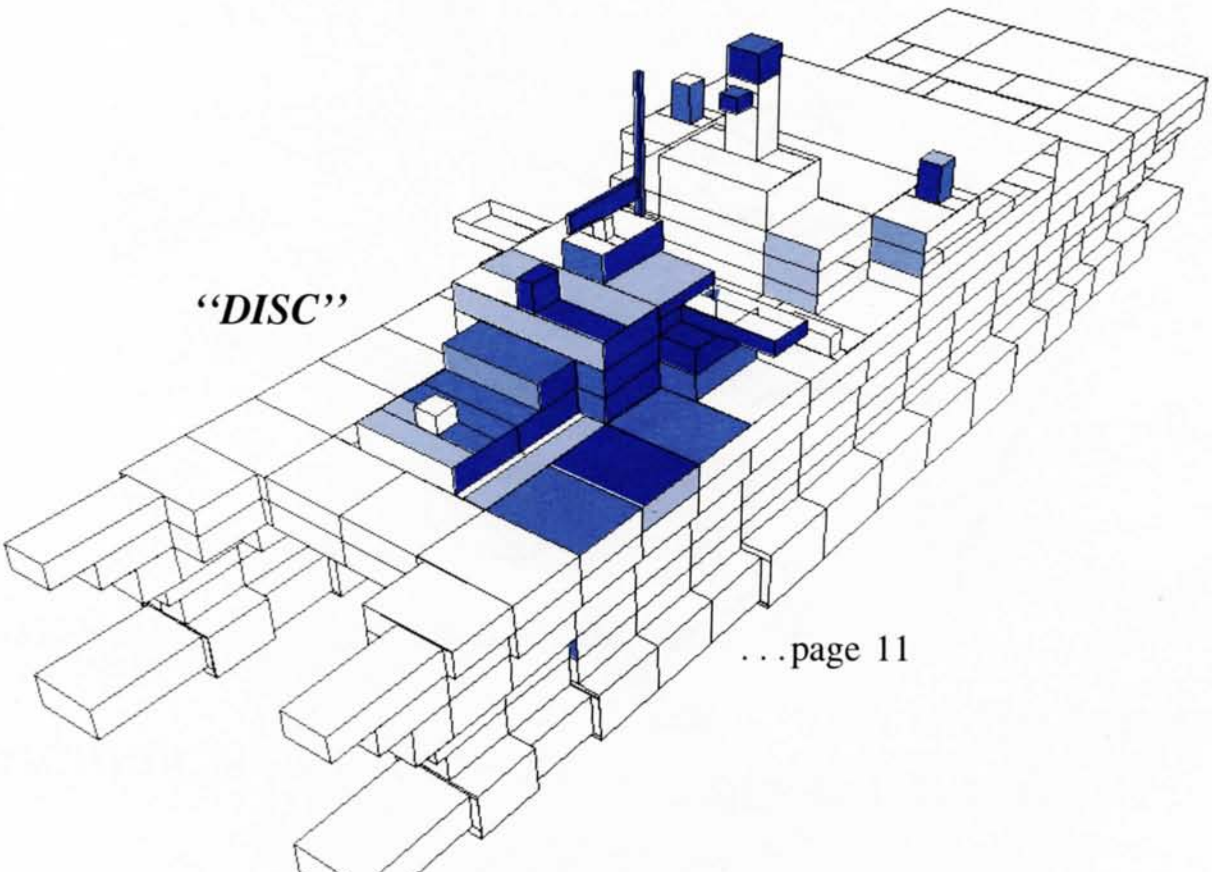
À venir en septembre...

MARE



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