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Cover: This is an unofficial MARE crest which originated in the DGMEM organization. Your are encouraged to comment on this crest, suggest improvements, and/or submit a completely new design. All input will be considered and an official MARE crest will be completed and submitted for approval.

Le Journal du Génie maritime est une publication autorisée des ingénieurs maritimes des Forces canadiennes, à caractère non officiel. Édité 2 fois par an par le Quartier général de la Défense nationale, il bénéficie d'une large diffusion dans les milieux du Génie maritime. Les opinions qui y sont exprimées n'engagent que la responsabilité de leurs auteurs et ne reflètent pas nécessairement le point de vue officiel. Le courrier doit être adressé au rédacteur du journal du Génie maritime, Directeur — Génie maritime et maintenance (DMGE 5), Quartier général de la Défense nationale, Ottawa (Ontario), K1A 0K2.

Couverture: Représente un projet non officiel d'écusson du G Mar, crée par le DGGMM. Les lecteurs sont vivement encouragés à exprimer leurs commentaire sur ce projet d'écusson, à suggérer toute amélioration ou nouvelle formule qui leur semblerait souhaitable. Il sera tenu compte de tous les avis et, pour finir, un écusson officiel sera retenu et soumis à approbation.

CONTENTS

Editor's Notes

MARITIME ENGINEERING JOURNAL
WINTER EDITION, 1984

In this edition you will find the first of a series of articles on the CPF. The current article is by LCdr R.F. Archer and describes the operational capability of the Canadian Patrol Frigate. Future articles will describe in detail the various systems that will allow the ship to meet her operational requirements.

On behalf of all those associated with the Maritime Engineering Journal, I would like to congratulate Commander Marc Garneau on his selection as one of Canada's first six astronauts. An interview with Commander Garneau is contained as a special feature in this edition.

In past issues of the Journal, I have stressed the importance of participation by the MARE Community. We have had a good start and I believe we have a Journal in which we can all take pride. However, your Editional Committee cannot do it alone to make the Journal grow. We need your letters to the Editor and we need you to write articles for publication. This is your Journal and it is a document in which you can express your options.

We have not received any papers or letters for publication from our brethern on the coasts. Hopefully, there will be enough stimulation in this edition (the first with articles by a seaman <u>and</u> a pusser!) to produce some dialogue. Comments and articles for the next edition should be submitted by May 1984.

Letters to the Editor

I have just finished reading the summer 1983 edition of your excellent Journal. I happened on this copy by accident when I noticed the attractive cover on the desk of one of my staff Engineer Officers.

In view of the many personnel studies concerning the MARE Classification and the Sea Technical Trades which my Branch is involved with, it is apparent to me that we would benefit from regular receipt of your journal. Keeping our finger on-the-pulse at a time of so many real changes is a challenge to me and my staff.

You have established a standard of excellence in the Maritime Engineering Journal which I know comes only through much personal effort and professional pride. My staff and I wish you every success in future editions.

Captain (N) B.P. Moore
COSP&T
Maritime Command

Chairman's Notes

MARITIME ENGINEERING JOURNAL
WINTER EDITION, 1984

MARE SEMINAR '84

Not everything works out the way we would like! The MARE SEMINAR '84 is one of them. You will recall we gave a warning order to all MARE's about six months ago. We had a multi-purpose informative and professional development seminar in mind. However, when the submission went forward, the professional development aspect was turned down, citing the government's current restraint order on conferences. However, we were given authority to conduct regional seminars on the output from the "MARE" Get-Well" project. As a consequence we will work up a good short seminar format for three locations - Halifax, Esquimalt and Ottawa - to be held in the May/June '84 time frame. Expect to hear more later.

WHITHER THE MARE JOURNAL

The Commodore's Corner for this issue caused us as publishers of the journal, to ask ourselves "What kind of a publication is the MARE Journal going to be?". Commodore Ross' contribution contained some opinions which were not universally shared. There were some who felt that publication might cause reaction unhelpful to the MARE community. Others - in particular your editorial staff - spoke up strongly for a journal that had the integrity to print informed opinion and accept the possibility of controversy. In the event, Commodore Ross' original draft was reviewed by several Admirals and ADM(MAT) and, after changes by the author, is published herein. Commodore Ross will not mind my emphasizing here that the Commodore's Corner contains personal opinions and is intended to focus our attention on important longer term considerations related to our careers and directions for the Navy as a whole. With regard to editorial policy, we come down solidly somewhere between that of PRAVDA and the NATIONAL ENQUIRER with a slight tendency to the former!

Commodore's Corner

BY COMMODORE E. RAYMOND ROSS, CD, CF
CHIEF OF STAFF MATERIEL, MARITIME COMMAND

Commodore Ross joined the Royal Canadian Navy as a Cadet in 1947. He spent five years training as first a Marine Engineer and then as an Ordnance Engineer at sea with the Royal Navy and at the Royal Naval Engineering College. During this period he served in HMCS NEWCASTLE in Korea. Returning to Canada in 1954, he became Inspector of Naval Ordnance on the West Coast and later Ordnance Officer of HMCS MICMAC on the East Coast.

From 1957 to 1960, Commodore Ross attended the USN Postgraduate School. He specialized in Guided Missile Engineering and received an MSc in Electrical Engineering.

From 1960 to 1971 he had several appointments in Ottawa. The first of these was with the Joint Staff in the Joint Ballistic Missile Defence Staff and later the Directorate of Strategic Studies. This was followed by a period with the Program Manager Missile Systems and on the staff of the Director of Weapon Systems. In 1965 he became head of the Surface and Air Weapons Section and in 1966 head of the Maritime Systems Concepts Section. In August 1969, he became Director of Maritime Combat Systems.

Commodore Ross attended the Royal College of Defence Studies in London during 1972.

Posted to Halifax in January 1973, he was Base Administration Officer, CFB Halifax; Deputy Chief of Staff for Technical Readiness in Maritime Command Headquarters, and from August 1973 to 1976 Commanding Officer, Canadian Forces Ship Repair Unit (Atlantic).

In July 1976, Commodore Ross was posted to Ottawa as Director, Program Analysis. He was promoted to Commodore in August 1977 and became Director General, Maritime Engineering and Maintenance.

Commodore Ross was appointed Senior Liaison Officer Maritime and Canadian Forces Naval Attaché (Washington) in August 1980.

He was posted to Maritime Command Halifax as Chief of Staff, Materiel in August 1982.

THE CHANGING CIRCUMSTANCES OF THE NAVAL ENGINEER

As I reach the end of my career in the navy I can't help but reflect on the many changes that have been wrought upon the engineering branch during the past 37 years. Allow me to review some of these changes, and I ask for your indulgence if I sometimes resort to hyperbole to make a point.

Let's start off with an academic view of the impact of advancing technology. The increasing technical character of modern warfare has demanded a vast increase in the technical competence required of military personnel. Even direct combat requires a degree of technical competence today. Those who embody traditionalism and glory, whilst recognizing the need for technological change, often see concentration on technology and technical management as detrimental, since they tend to derogate normal military customs and authority and make it more difficult to motivate the fighting man and retain the traditional military ethos. They often also see the new operational doctrines arising from new technology as a challenge to their hard-earned professional expertise. Many traditional officers see their careers threatened.

The complexity and variation in ships and their systems require a much higher degree of initiative now more than ever before, by not only the users but by the designers and maintainers of the equipment as well. The greatest military leaders have always demonstrated a high innovative capability, but paradoxically have usually been loath to accept the same trait in others and have often checkmated the advice of the scientist and technologist. It has been said, for example, that "of the twenty major technological developments which lie between the first marine engine and the Polaris submarine, the Admiralty discouraged, delayed, obstructed or positively rejected seventeen". I believe that we have outgrown this phase and our senior review boards are now constrained more by shortages of funds than by antipathy to innovation.

Technological developments necessitate more professionalization and a greater need for training in the engineering fields. Many of the best officers are likely to be attracted to, and selected for, specialized graduate and post-graduate education. This tends to exacerbate the strain between the traditionalist and the technologist, particularly when it is perceived that the super-trained technologist can find attractive employment opportunities outside the services and will often leave the military at an early age.

Engineers are often uncharitably viewed as being too narrow-minded and too lacking in office-like virtues to ever be allowed command of a ship. It is not so much that MARE officers will never get to prove their worth as ship COs that many MARS officers take as a lack of leadership drive, but that MAREs have deliberately chosen a career that does not provide an opportunity for ship command. MARE officers resent this. Despite not always being as extroverted as their MARS brothers, MAREs still want to be recognized for their leadership capability. The false and unfair image of the unread, unwashed, inarticulate engineer seems to be gradually disappearing, but the image of the engineer lacking in leadership skills persists in spite of strong evidence to the contrary.

Despite public acclaim of individual military heroes, officership is generally considered a low-status occupation. The high entrance standards ensure that officers are in the top intelligence level, higher than most other professional groups, yet in public opinion polls they are generally placed well below the average. And in comparison with other professions the military is still not financially well rewarded. Officers generally have little opportunity to develop local attachments because of constant moves; their family obligations are difficult to meet, their occupation is frequently hazardous, strenuous, unpredictable and at times irksome. Military life is adventuresome, non-routine and offers good comradeship. But above all, particularly as they get older, it has been pride in the sense of mission, the desire to contribute and the reluctance to change that has allowed the officers to accept personal sacrifices to stay even when they may have grown disenchanted with the practical applications of the Forces. Now, however, the availability of challenging civilian jobs, the persistent wooing by contractors and the opportunity to receive a pension at the 20/40 point seem to be conspiring to overcome the reluctance of officers to leave early. Young officers today contemplate their future careers much more than they used to. It's like divorce: once unacceptable, now commonplace.

Stringency of funds for Defence has led to increasing levels of approval, a proliferation of decision-making committees, the need for greater accountability, the requirement for inordinately large program management staffs and a lengthening of the decision-making process. The inevitable result has been a resurgence of conservatism, a sparsity of innovation and initiative, the inability of any one officer to see a project through the entire approval cycle, and staffs dedicated to project administration rather than engineering. There has been an associated increasing tendency to have much of the engineering done by contract, or to buy off-the-shelf equipment. The CPF program is a prime example. Thus, we frustrate those MAREs who wish to do design engineering, we tempt them out of the navy with job opportunities that we created with the contractors, and we can look forward to a new generation of MAREs who will have little or no design experience. It may be unrealistic to continue to expect to design our own ships and equipment when our requirements are not necessarily all that unique and when our acquisition programs are few and far between. Even an original design like that done by Canadian Industry for the CPF may be beyond our means in the future.

The Management Review Group in the early 70s made some sweeping recommendations regarding the relative positions of the civilians and the military in the Department. Perhaps the most important result as far as engineers were concerned was the decision to establish the position of ADM(Mat) (the Group Principal responsible for engineering, supply, and research and development) as a civilian, and to have the engineering senior echelon organized functionally rather than environmentally. This change meant that there were no longer any hard military 3-star engineer positions, and no hard 2-star position for the naval, air or land engineers in their own environments; this, as opposed to the operational side of the organization where no civilians are interlaced at the senior levels, and where an NDHQ hierarchy of a 4-star, two 3-stars and three environmental 2-stars was created, together with an equally impressive galaxy of stars in the Commands and out of the country. This meant that the military engineering community in general would be represented in the highest courts by a civilian who, no matter how knowledgeable, dedicated or fair-minded, could not be expected to fully understand and be entirely sympathetic towards the needs and the frustrations of the military engineering professions. In fact his perception of the organization might well be, with some justification, that the presence of the military in key middle management positions has frustrated the career progression of many ADM(Mat) civilians. A further complication is that civilian engineers in DND are generally paid at a level beyond their military counterpart. The optimum background needed for many of these civilian engineering positions is generally obtainable only through military training experience, hence it should be no surprise that there is a continual migration of MARE officers to civilian engineering jobs in the Department.

The duties of a naval officer now transcend the walking of the quarterdeck or of the plates. Naval assignments today include responsibility not simply in the field of combat, but also in the vast areas of procurement, design, maintenance, logistics, management, mobilization, strategic planning and even international diplomatic and economy policy. In modern warfare generals and admirals are rarely, if ever, seen by the vast majority of their men. Under such circumstances heroic leadership must count for rather less than managerial and technical ability. The ideal military leader is still, of course, one who manages to combine excellence as a task-specialist with an equal flair for the social or heroic aspects of leadership. The need for strong leadership during and between wars is as important as ever. Unfortunately, MAREs have limited opportunities to publicly demonstrate the leadership skills they employ in their dealings with sailors. The abilities they show in dealing with civilians, contractors and in project management jobs are not readily recognized as equally important leadership skills.

There will always be a conflict between the desire to make everyone a generalist to ease the career management problems and to give everyone an equal opportunity to attain senior command, and the need to have specialists sufficiently trained and experienced in their fields to cope with the complexities that modern technology has imposed. Time and cost limitations of course do not permit the creation of a master of all trades.

The controversial Rear-Admiral Jeffry V. Brock in his latest book said, "Ambitious and clever officers of the supply and engineering branches began to question why they should not be trained as seamen and compete with executive branch officers, **not** only for senior commands ashore, but command at sea. These attempts at personal self-aggrandizement and the pressures to obtain executive control were, I believe, handled ineptly by those responsible for advising on personnel matters. I would go as far as to say that lack of foresight and a sort of weakness in successive Chiefs of Naval Staff and their Naval Boards led to a gradual 'homogenizing' of the officer corps within our Navy. Education and training programs were revised, regulations concerning physical fitness for qualifying for the various branches were revamped to accommodate those who had not hitherto been considered fit for executive command positions at sea. Morale and efficiency tended to decline when efforts were made to ensure that all officers were 'jacks of all trades but masters of none'. I believed then, as I do now, that a high degree of specialization is needed to make a successful and efficient modern Navy. Without a dedicated and enthusiastic effort to become fully qualified at each one of the many specialized trades within the Navy, the efficiency of the whole tends to suffer. It is just not possible within one man's lifetime to master all the intricacies and complexities of a modern warship and its highly technical equipments." Brock's chauvinism always manages to show through, but his arguments regarding specialists are perhaps even more valid today.

It is difficult enough to train all MAREs to be both operating engineers at sea and useful design and/or maintenance engineers ashore, particularly when almost every job ashore requires a thorough knowledge of project management. The typical professional officer already spends one-quarter of his career in school or in training situations. We spend an inordinate amount of time training MARE officers for a too-short sea tour, and when they are just becoming acclimatized to it they are put ashore - generally for the rest of their careers. Even in that limited period at sea we have alienated some who would prefer to spend their entire careers in design engineering or project management jobs. We promote many engineers to become managers when they would prefer to remain at their desks. There is currently no face-saving mechanism that would allow them to reject promotion and stay at engineering. There are many "non-degree" MAREs who are most comfortable and useful at sea or in closely related activities. But they must be moved along to provide experience for the mainstream officers. Ship and weapon costs are so great, and the approval process so complex, that acquisition programs require the most talented officers available - those with specialized training and experience. Is it possible to meet all of these often conflicting requirements, and in the process provide challenging career opportunities for everyone in the classification?

An adequate level of prestige and a clear sense of self-purpose are needed if we are to prevent the outflow of MAREs from the CF. We must develop roles for MAREs within the navy that recognize the changing circumstances, clearly define purposeful tasks to perform and then provide acceptable paths of career progression. This must be done in conjunction with our MARS colleagues and must attempt to pull both sides of the Naval Operations Branch much closer together.

Let me try to summarize the problems of the MARE classification as I perceive them.

a. We are not represented as a classification at a senior enough military level. DGMEM as Naval Operations Branch co-adviser for MAREs can never have sufficient influence no matter how dedicated and articulate he is. His other duties are overwhelming and allow little time for Branch matters.

b. We do not get a fair and reasonable allocation of senior promotions, awards and prime postings. For example, MAREs represent 40% of the Naval Operations Branch but MARS have seven times as many admirals, over six times as many recipients of the OMM, and fifteen holders of the CMM against none for MAREs. Key positions such as those held by Base Commanders on the coasts, Commandants of the Fleet Schools, and senior MARE career managers are invariably filled by MARS officers. This is unlikely to evoke much sympathy or even empathy from our MARS colleagues who are more likely to feel that, since we elected to play in the support cast, we shouldn't expect the goodies due to the principal actors. There is some logic to that viewpoint.

c. There is an underlying friction between MARS and MARE officers, primarily because of their different perceptions of the MARE role, and because of a territorial delineation that is seen to be threatened. The inexorable advance of technology has exacerbated this problem.

d. The prestige of the military is low; as are the financial rewards of being in the military. The compensatory factors that once kept officers in the services are disappearing. Many MAREs are thus becoming disenchanted and, attracted by civilian job opportunities, are leaving.

e. There is an increased tendency to put much of the interesting and challenging engineering work out to contract, and the role of the MARE is leaning more toward project management and maintenance.

f. The inherent in-house design experience is disappearing.

g. The intermixing of civilian engineers and MAREs who are paid differently for similar responsibilities is an additional cause of friction. MAREs are regularly leaving to fill these civilian engineering positions as they become vacant.

h. The duties of a MARE are encompassing more fields, and managerial ability is becoming a vital component of all aspects of engineering. The need to specialize is increasing in importance, but the rewards for so doing are illusory.

j. The career aspirations of MAREs differ greatly, and it is difficult to devise a classification structure sufficiently flexible to accommodate these differences.

k. The future of the MARE, his roles, tasks and career prospects are clouded in ambiguity. They must be clearly defined and stabilized if the classification is to regenerate and prosper.

I wish I had the answers. I believe that for starters we need a Chief of Naval Engineering position at the Rear-Admiral level. I don't think there can be any question but that we wish to be full members of the Naval Operations Branch, of the Navy if you like, but we must be given greater access to those jobs where our skills, talents, and experiences make us as qualified as our MARS colleagues. We must define roles for the MARE that are supported and respected by our MARS brethren. The Navy must decide whether to buy "off-the-shelf" or design equipment to meet our unique requirements, and whether the design is to be "in-house" or contracted-out. If the latter is the case do we need to continue to develop new breeds of MARE and MARS officers specialized in program management and equipment acquisition, data processing and software development, and other such evolving fields. Should we develop a separate breed of operating engineers who spend their careers at sea or in closely relateed work, and should we allow some engineers/naval architects to remain at the drawing boards throughout their careers but with some form of progressive recognition? Should we recognize that transferring from MARE to civilian engineer in DND is a normal and useful career step for some, and that early departures at, say, the 20/40 point are both normal and acceptable, particularly if DND and DND contractors are the beneficiaries of such a move? Many problems could lose their sting if they were anticipated and catered for as part of the total MARE system rather than "played by ear".

Having said all that I still believe that the career of a naval engineer is second to none. It may have varied in style and importance from time to time, but it has never failed to be challenging and interesting for me. I see the future as being potentially even more exciting and I certainly hope that nothing I have written has shaken any of your beliefs in that. One of the challenges facing you is to ensure that your career prospects are as good as they can be, and that your expectations are not unrealistic. If this paper has engendered a little thought along those lines it has served its purpose. I recognize that much work will be needed to develop any significantly changed structure. I am optimistic that the MARE Study in hand by DGMEM, Capt(N) Broughton's concentration on the "MARE Get Well Program", the current MARS Officer Classification Review and the numerous other NPPP initiatives will produce recommendations that will set things right. My fervent wish is that these deliberations reach to the roots of the problems as I've tried to outline them. Unless the basic premises are exposed and questioned openly and honestly, an understanding across the Naval Operations Branch will not be reached and we'll be building a new structure on very shaky footings. It isn't enough to be habitually hopeful. We must keep the issues "front and centre" until they are resolved.

R.C. Ross

SHIPBOARD INTEGRATED MACHINERY CONTROL SYSTEM

(SHINMACS)

AUTHOR MR. P.V. PENNY

Mr. Penny graduated from the University of Toronto with a B.A. Sc (Electrical) in 1971. After working as an electrical engineer for an iron ore mining company in Labrador and as an electrical design engineer for the Nova Scotia Power Corporation he joined DGMEM in 1977. Mr. Penny has held various positions in DMEE and is currently a senior engineer in DMEE 7 responsible for propulsion machinery control systems and instrumentation.

ABSTRACT

The Canadian Forces has recognized the tremendous impact that digital electronics will eventually have on machinery control systems, particularly those in gas turbine driven ships. To extract the maximum benefit from this burgeoning technology, the machinery control section under the Director Marine and Electrical Engineering (DMEE) has proposed the SHINMACS concept. Essentially, the SHINMACS concept is a digital processor-based distributed control system. It will consist of intelligent hardware (referred to as Digital Propulsion Controllers and Digital General Controllers) and operator/supervisor consoles; all interconnected by a triple redundant serial data bus. The operator/supervisor consoles will be a radical departure from current naval practice in that the man-machine interfaces will be video display units. The operator console, referred to as the standard machinery control console, has been designed, built and tested and is currently about to enter an extensive evaluation phase. Responses to the SHINMACS Request for Proposal have been received from three companies. The anticipated contract let date is Dec 1983 with a deliverable Advanced Development Model due in June 1985. This paper will deal with the rationale for the concept, the system architecture, progress to date, and applications.

INTRODUCTION

Why bother with distributed digital processor based machinery control systems for warships? The Canadian Navy's answer to this question is directly related to its experience with the DDH 280 class ships.

The DDH 280 class main propulsion machinery consists of two shaft lines per ship, each with one Pratt and Whitney FT4 and FT12 driving through a non-reversing reduction gearbox and controllable pitch propeller. The prime controls subcontractor received the tender for this machinery arrangement in 1966. At that time gas turbine driven warships and electronic/digital machinery control systems were, for all practical purposes, in their infancy. The first-of-class, HMCS IROQUOIS, was commissioned in 1972. It is interesting to note that the first-of-class microprocessor, the INTEL 4004, made its debut in 1971.

A simplified representation of the DDH 280 class machinery control system (MCS) is depicted in Figure 1. The MCS incorporates pneumatic controls, discrete transistor logic circuits and solid state systems. The propulsion controller for example provides pneumatic control of propeller shaft speed in accordance with demand input while the automatic sequencing system is composed of discrete transistor logic circuits. By the mid-seventies the various elements of the MCS were beginning to show the effects of a design based on a technology that was approximately 15 years old. Problems associated with maintenance, obsolescent electronics, connectors, overheating, reconfiguration, etc. were becoming more frequent.

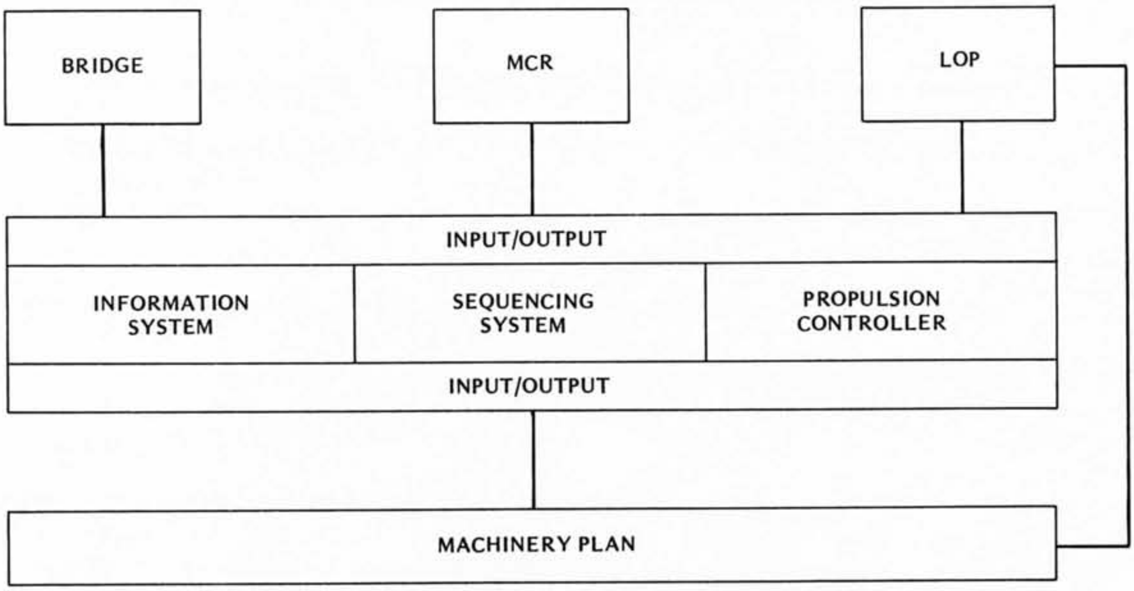


Figure 1. **ELEMENTS OF DDH 280 CLASS MCS**

For example in the area of reconfiguration the MCS had, and still has, no flexibility to adapt to changing requirements. This state of affairs arose because the MCS was designed with a specific operating mode in mind and, as such, hardware was interconnected to provide only one set of sequencing steps and analog control functions.

Coincident with these identified shortcomings and problems, digital processor-based devices/systems were beginning to invade the market-place. These systems presented viable alternatives. The DDH 280 class machinery control requirements (control algorithms, sequencing logic and information processing) could quite easily be handled by microprocessor-based systems with their powerful instruction sets and memory addressing capabilities. These systems are very tolerant to changing system requirements and have the additional advantage of not being real estate intensive. Once it was realized that digital systems had an attractive set of attributes, the SHINMACS concept began to evolve. Early in-house taskings were directed at the man-machine interface (MMI) and, eventually, these results were incorporated in an overall SHINMACS Statement of Requirement (SOR). For an in-depth treatment of the SHINMACS concept and the MMI, the reader is referred to Baxter et al (1) and Gorrel (2), (3).

SHINMACS PROGRAM

The evolution of the SHINMACS concept has culminated in an SOR that defines the requirements for the design, development, building and concept demonstration of an Advanced Development Model. The ADM, as it is called, is defined as "a model of the system which can be used for experimentation or tests to:

a. demonstrate the technical feasibility of the design;

b. determine its ability to meet existing performance requirements;

c. secure engineering data for use in further development; and, when appropriate,

d. establish the technical requirements for contract definition."

An additional requirement for an ADM is that serious consideration should be given to reliabiity, maintainability, human factors and environmental conditions.

It is important to understand that what follows are the major points of the SOR, and that a final design has not been decided upon. The contractors that responded to the SHINMACS RFP were aware of a preferred system architecture, however they were given freedom to propose variations or alternate systems.

System Architecture

To aid the contractor in formulating a desirable system several objectives were defined as follows:

a. Survivability: Any single failure in the system should not catastrophically affect or interrupt the control and monitoring functions. The design should strive to minimize catastrophic failure modes and maximize graceful degradation properties.

b. Reliability: The system should be structured to prevent inadvertent data modification, service interruption or system malfunction due to hardware or software failure.

c. Modularity: The system should be designed with maximum software and hardware modularity to provide system expansibility and maintainability.

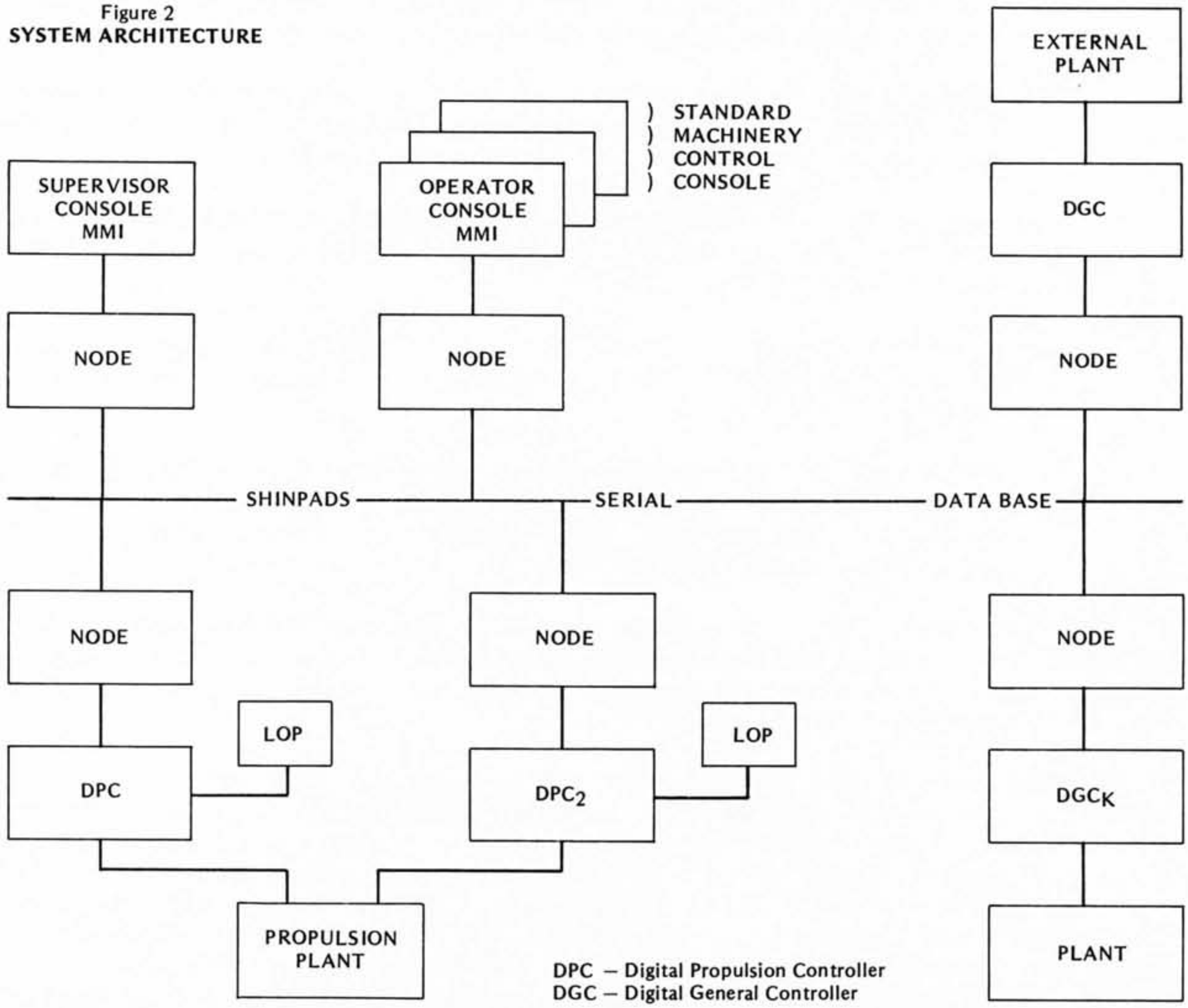
d. Standardization: Standard bus interfaces and physical connections should be implemented for maximum interchange-ability.

e. Flexibility: The system should have the capability of being easily changed, expanded, reconfigured and updated to meet additional operational requirements or future changes with minimum hardware modification.

It is hoped that these objectives coupled with the system architecture depicted in Figure 2 will provide a fundamental basis for the eventual SHINMACS ADM. It is stressed that the architecture shown in Figure 2 is not intended to be the final design.

With respect to Figure 2, the serial data bus that will provide the communication medium between the various hardware entities will be the SHINPADS bus. This choice, as well as that associated with computers and displays, is the result of an in-house policy regarding standard digital equipment. The Digital Propulsion Controller (DPC) will be a microcomputer-based device (AN/UYK502) that will provide the basic functions of serial bus interface, propulsion plant applications and input/output. The DPC will be responsible for executing the propulsion control algorithms and processing input/output data related to control and monitoring of the engines and local auxiliaries. Depending on the final configuration a DPC could control a shaft line or the entire propulsion plant. In the case where redundant DPCs are utilized an arbiter will be used to detect a faulty DPC, declare it inactive and assign, in a transparent manner, responsibility for control to the remaining DPC. The Digital General Controller (DGC) will also be a microcomputer-based device (AN/UYK502) that will reside anywhere in a ship performing a full slate of tasks from mundane (starting and monitoring of pumps) to closed-loop control of a variable pitch propeller. Operator/supervisor consoles will provide active interfaces that will permit personnel to command, interrogate and respond to the system through visual display units. Information will be presented in alphanumeric and/or graphic form.

Figure 2
SYSTEM ARCHITECTURE



Inherent Features

In addition to the hardware/software/firmware associated with a design based on the architecture depicted in Figure 2, the SHINMACS ADM will incorporate several features that are worthy of note. For example, a maintenance interface will be an integral part of each DPC and DGC. This interface will permit a maintainer to request information from, and to exercise, each DPC and DGC with the view to verifying that they are capable of performing the tasks for which they were designed. A security feature in the form of a keylock and/or password will prevent unauthorized access. A diagnostic feature, that will isolate any fault to board level, will provide the operator/supervisor consoles with a visual indication of the health and condition of the DPC and DGC. For each diagnostic, the type of fault, probable cause, implications and a suggested method of repair will be presented on one of the visual display units.

A unique feature is that a resident simulation of the propulsion plant will be used for operator training. A typical scenario would have the supervisor, via his console, load the simulation, notify the operator that the simulation is ready to run and, finally, perform the interactive instructor role. During the simulation mode station-in-control will have been passed to the bridge. The major advantages of shipboard simulations are that the requirement to cycle personnel through shore based facilities is substantially reduced, and the ship environment injects a degree of realism that is not available ashore.

Standard Digital Equipment (SDE)

The Department of National Defence has initiated a policy for standardization and maintenance of shipboard computers and peripheral equipment. This means that the navy must use SDE and standard software languages (CMS-2 and eventually ADA) for shipboard digital processor-based systems. The standard computers, displays, etc. require their own hardware/software support structures. Thus, systems such as SHINMACS will be able to use the existing support structures, both during development and while in service. Contrast this with non-standard systems which would have to build their own support structures thereby losing the benefits of commonality with the naval support facilities. There are also long-term life cycle benefits from conforming to the SDE policy. As individual standard computers become obsolete they will be replaced with more modern computers, and in most cases the existing system software will be usable in the newer equipment. Thus, a system developed with SDE can remain technologically current into the foreseeable future.

SDE, as it applies to the SHINMACS ADM, comprises the AN/UYK-502(V) computer, the AN/UYQ-502 SHINPADS standard display, and the AN/UYC-501(V) SHINPADS serial data bus.

PROGRESS

Responses to the SHINMACS Request for Proposal have been received from three companies. It is anticipated that a contract will be let in December 1983 with delivery of a SHINMACS ADM scheduled to follow 18 months later. With the view to ensuring that the ergonomically designed consoles could progress as a stand-alone development DMEE initiated two minor R&D projects: the first, for the development of a standard machinery control console; and, the second, for the development of DDH 280 class propulsion control algorithms and a computer simulation of the current propulsion plant. Any documentation related to these two projects will be supplied to the successful contractor as it becomes available. The standard machinery control console is currently in contract with the final deliverables expected in December 1983. Commencing January 1984, the standard console will enter an extensive evaluation phase. During this phase operators currently serving in DDH 280s will be exposed to the console under the direction of human engineering personnel. The contract for the control algorithms was let in February 1983 and will run for a total of 10 months.

The potential deliverables to SHINMACS from these two minor R&D projects are quite extensive. For example, the standard machinery control console contract will furnish the following:

a. a technical statement of requirement for the console;

b. simulation software;

c. a computer code; and

d. manuals.

The actual console itself will not be supplied to the SHINMACS contractor. It will be retained for its marketing potential and, ultimately, as a training device. The second R&D project will furnish the following:

a. control system requirements definition document;

b. computer model (simulation) documents;

c. a control system functional definition document which will specify the control functions in detail; and

d. a control system evaluation test plan.

Both minor R&D projects are defined explicitly for the DDH 280 class, which is consistent with the SHINMACS ADM test program since it will also employ the DDH 280 class as the baseline ship.

APPLICATIONS

Originally it was intended to develop SHINMACS using the normal stages of ADM, EDM, pre-production and production. The production versions were scheduled for installation in the Canadian Patrol Frigate (CPF) and as a replacement machinery control system for the DDH 280 Class Modernization Program - TRUMP. However, as invariably happens during major development programs, events overtook the original plan. The inevitable delays that came with defining a fairly rigorous statement of requirement and statement of work took their toll. Eventually a request for proposal for a SHINMACS EDM was released that resulted in a sole response which far exceeded the approved funding level. The SHINMACS documents were subsequently rewritten consistent with the definition of an ADM, and a request for proposal was released once again. As noted earlier, responses to this latest proposal have been received from three companies. The evaluation of these proposals has been completed and a recommendation forwarded to Supply and Services Canada.

From the foregoing it is obvious that the evolution of SHINMACS has been rather slow, and as such its identification as a candidate system for the CPF and TRUMP has become somewhat tarnished. However, at the time of writing, SHINMACS has been identified as the replacement machinery control system for TRUMP with a distinct possibility that it may eventually be in CPF also. With respect to the proposed machinery control system for CPF, it is interesting to note that, while not SHINMACS by name, it is certainly flexible enough to incorporate some or all of the SHINMACS features. What then is the real purpose of the SHINMACS ADM? From the beginning, the intent has been to first demonstrate the concept; this intent has not changed. It is felt that the SHINMACS ADM will significantly enhance the acceptability in warships of digital distributed control systems and operator/supervisor consoles that employ visual display units as the fundamental interface with machinery systems.

In the long term, SHINMACS has the potential to be applied in whole or in part (eg. standard console only) to follow on patrol frigates, replenishment ships, new 150-ft patrol boats, the new submarine acquisition program, the Arctic ice-breaker program and the commercial marine.

CONCLUSIONS

The SHINMACS concept has come a long way since its inception in 1976. It has survived a rather lengthy evolution, two request-for-proposal stages and the uncertainty of not being identified with a specific ship program or mid-life refit. It is fully expected that a contract for the development of a SHINMACS ADM will be let December 1983. With unique features such as the consoles described by Gorrel (2) and resident simulations integrated as a functioning system, SHINMACS will undoubtedly be an exciting system to see in operation.

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THE MARE CLASSIFICATION SPECIFICATION

AUTHOR COMMANDER J.R. SCHOLEY

Commander Scholey joined the RCN in 1966 as an ROTP cadet. He graduated from Acadia University in 1970, received a BWK in 1971, an EOOWK in 1973, and a Certificate of Competency in Engineering in 1975. His experience in HMC Ships includes 3 years in PROTECTEUR, five months in NIPIGON, a further two years in PROTECTEUR and 2 years in ASSINIBOINE. His staff appointments include 2 years as AOR Class Officer in NEU(A) and 2 years as exchange officer at the Royal Naval Engineering College, Plymouth, England. He was promoted to Cdr in July 1983 at which time he assumed his current position as Section Head, DMEE 4 in NDHQ.

ABSTRACT

The draft MARE classification specification is reviewed and evaluated for its contribution to the MARE evolution as it applies to the MSE subclassification.

INTRODUCTION

One of the strengths of the military is that, unlike much of industry, it provides an explanation and a road map for its members to view their intended career progress. It also gives them the opportunity to provide input into their own career pattern and development. A review of the road map, necessary at periodic intervals, is currently in progress at the moment. In the last edition of the Journal, Captain (N) Barrett wrote about the process of writing classification specifications. The Board sat in March and produced a commendable document. The proposed specifications have not been seen by everyone, and the changes from the old have not themselves been widely disseminated. However, it is incumbent on all of us to be aware of the fundamental changes, and to have our own views clearly in focus in order to be ready to provide reasoned input to the MARE evolution now occurring. What follows is a review of the new draft classification specifications from an MSE's perspective, and an attempt to identify any improvement or deficiency contained therein.

THE NEW CLASSIFICATION SPECIFICATION

The new classification specification is divided into 7 sections as follows:

a. Section 1 - General;

b. Section 2 - Career Patterns;

c. Section 3 - Basic Specifications;

d. Section 4 - Marine Systems Subclassification Basic Specification;

e. Section 5 - Combat Systems Subclassification Basic Specification;

f. Section 6 - Naval Constructor Subclassification Basic Specification; and,

g. Section 7 - Naval Architecture Subclassification Basic Specification.

Only Sections 1 - 4 will be considered further since sections 5-7 would more appropriately be reviewed by officers in those subclassifications.

THE GENERAL SECTION

The General Section is 7 pages long and contains generic information relevant to all MARE subclassifications. It begins by describing, in general terms, how MAREs are employed. It then enumerates the wide spectrum of activities associated with the operation, maintenance, design, acquisition and improvement of the many shipboard systems. In addition, it mentions the non-engineering jobs that the MARE could be required to.

A large portion of the General Section is devoted to describing working conditions. The physical conditions described largely reflect the arduous conditions at sea in surface and sub-surface combatants.

Special factors associated with being a MARE are also described. These, again, are largely relevant to the sea jobs and include such things as displaying judgement, ingenuity, analytical ability, and leadership when dealing with large numbers of complex equipment, systems, and personnel. MAREs at sea must be thoroughly trained and decisive since there is no recourse to more senior technical officers. Other special factors include the sociological and psychological effects of close quarters living conditions.

The MARE is subject to stresses, and closely aligned with stress is the consequence of error. The highest levels of stress identified are those associated with the seagoing jobs and result from the requirement to make sound decisions in emergency situations. Error could result in prejudice to the mission, injury, loss of life, or loss of ship.

The description of working conditions concludes with an enumeration of occupational hazards. The hazards as described, again, are those associated with the sea jobs. These include injury from burns, falls, electrical shock, electromagnetic radiation, contact with moving machinery, and possible injury resulting from ordnance disposal and helicopter operations. Other hazards are the result of toxic gases, contact with chemicals and hydrocarbons, and, exposure to noise and high vibration levels.

Other topics discussed in the General Section of the specification are career progression requirements, educational requirements, medical requirements, security clearance requirements, the MARE subclassifications, and related civilian occupations.

The major thrust of the General Section of the MARE specification is to put into perspective the major broad factors which affect the employment of MAREs in seagoing jobs.

THE CAREER PATTERNS SECTION

This section of the specification defines five development periods in a MARE's career. It further specifies the rank an officer should have and the objectives, employment, and training that should be in evidence in each development period. These development periods form the career spectrum of a MARE and are summarized in Tables 1 and 2 taken directly from the draft specification document.

It is in this section on career patterns that the largest departure from past practice in the development of MSEs is specified. After the first development period, emphasis on development moves away from the operation and maintenance of the fleet in being, and the position of ship's engineer officer is treated as a job just like any other rather than having the traditional elevated status of the past.

THE BASIC SPECIFICATIONS SECTION

This Section specifies the basic duties, skills and knowledge that all MAREs must possess before they can progress subclassification training. Sixteen duties and tasks, which are mostly shipboard oriented, are identified and further defined by specifying the skill level required and the knowledge in order to do each. Over 1/3 of this section is devoted to the duties and tasks associated with being Officer of the Day in harbour.

MARINE SYSTEMS SUBCLASSIFICATION BASIC SPECIFICATION

This section sets out the detailed skills and knowledge that an MSE is required to possess in order to undertake the types of jobs that will be set before him during his career. There are four broad areas of employment identified: Engineering, Operation and Maintenance, Management, and Training. Close examination does not reveal any particular emphasis on one or the other of these categories of activity. This part of the specification defines very well the broad background of experience and training required by an MSE, and is therefore a vast improvement on the specification which we now have. The current specification gives obvious emphasis to the shipboard jobs with little or no mention of second, and third line support knowledge, managerial skills, or training knowledge required. Thus, the strength of the new classification specification lies in its description of the entire spectrum of MSE duties rather than the specifice of the operation and maintenance aspects; however, this strength may, paradoxically, give rise to the development of a downstream weakness.

As would be expected, the training system for the MSE will follow from the first four sections of the new specification should it be adopted. In the past we have been plagued with a number of problems in our training pattern, but in particular the length of time required to train an MSE to Certificate of Competency standard has been seen to be far too long. This problem could be worsened by the new specification because it formally recognizes the diversity of jobs that MSEs undertake. It therefore causes the training requirement to expand while pressure is on to reduce the time allotted. This problem can, to some extent, be reduced by removing ineffeciencies of the existing training pattern. However, this will not provide enough time to give the junior officers the dedicated training they need if they are expected, at their rank level, to perform any of the identified types of duty effectively from the first day on the job. In other words, after training (ie. receipt of Certificate of Competency or its replacement qualification) a fair amount of reading into the job will be necessary before the junior officer can be expected to be fully effective. Therefore, the designer of the training pattern which will follow the new specification will have to strike a balance in training time between the various specified tasks that the officer is being prepared to undertake. This could mean a reduction in training devoted to operation and maintenance, and an an increase in training in other areas.

The decrease of importance attached to the job of ship's Engineer Officer mentioned earlier is now fully specified. It is proposed that it should be treated as a job like any other that an MSE has to perform, and it merits no special mention in the subclassification basic specification. What now requires clarification is whether or not this basic change in philosophy is a good thing.

SHIP'S ENGINEER OFFICER

In the past, the job of ship's Engineer Officer was so highly thought of that it merited special description not only in the classification specification but also in the Naval Engineering Manual. Has the significance of this traditionally honoured position diminished?

There are many reasons why it is appropriate to concentrate officer development on how to operate and maintain a ship as EO. To begin with, the position of ship's EO is the first level of responsible contact with the operational world. Since we are part of the Naval Operations Branch, it is of the utmost importance that the job be done competently and to the complete satisfaction of the operational aurthority (i.e. that the MARS classification is completely satisfied with the EO's performance). Secondly, operation and maintenance are the basic levels of systems engineering, and there is no better way to gain experience in systems engineering than by practicing it at those levels. Thirdly, since the operation and maintenance of a ship is the proving ground for the work of the design engineer, any poor engineering practices used in the ship's design will become blatantly obvious to the ship's EO. This experience will stand the EO in good stead when he is called upon to occupy a design desk. Furthermore, the EO's position carries an enormous amount of responsibility because the EO is virtually on his own in his interaction with first-, second- and third-line support agencies, operational authorities, and training authorities. He is the Captain's marine systems technical expert, and has a large group of highly qualified officers and technicians working for him to whom he is the highest level of visible technical authority. He tests their competence for AMOC and Cert 2, recommends them for Cert 3 and Cert 4, and plays a major role in Fleet School certification boards. He recommends them for promotion, writes their PERs and sets the standards which they are to meet. Next to the Captain he is, to them, the most important person onboard. An MSE will not receive this amount of responsibility again until he is a very senior officer.

Fifth, MSEs have a front-line role to play in a wartime situation, and they must be able to make technically sound decisions when they are required to improvise. It falls to the EO to make things work when support is not close at hand, the importance of which was amply demonstrated in the recent Falklands campaign. This factor is all too easily overlooked in peacetime.

As well, consideration must be given to the type of officer recruited as an MSE. While exact reasons for wanting to be a Naval Engineer cannot be determined, it can be reasonably speculated that, on average, the university student, graduate, or technologist who joins wants to go to sea in a naval ship. If this were not the case, he would take his knowledge and skills somewhere else. Going to sea may not be his reason for staying in the Navy and making naval Engineering his career, but it must have figured prominently in his early thinking.

DEVELOPMENT PERIODS — RANKS — EMPLOYMENTS

FIELD OF ACTIVITY	FIRST OC/A SLT/SLT LT(N)	SECOND SLT/LT(N)	THIRD LCDR	FOURTH CDR	FIFTH CAPT(N)
FIRST LINE	– ASSISTANT CSEO AT SEA – ASSISTANT MSEO AT SEA	– DEPUTY MSEO AT SEA – CSEO OR DEPUTY CSEO AT SEA – LIQUID CARGO OFFICER IN AOR – SQUADRON TECHNICAL STAFF – SUBMARINES	– SHIP CSEO – SHIP MSEO – SQUADRON TECHNICAL OFFICER – SUBMARINES – SQUADRONS TECHNICAL STAFF – SURFACE	– SQUADRON TECHNICAL OFFICER	
SECOND LINE	– NAVAL ARCHITECTURAL PROJECTS – NAVAL CONSTRUCTOR PROJECTS	– DESIGN ENGINEER – PROJECT OFFICER – TECHNICAL STAFF OFFICER – TECHNICAL, SOFTWARE AND DAMAGE CONTROL TRAINING – SOFTWARE PROGRAMMER/ANALYST/ENGINEER	– DESIGN ENGINEER – PROJECT OFFICER – TECHNICAL STAFF OFFICER – SECTION HEAD NEU – SOFTWARE PROGRAMMER/ANALYST/ENGINEER – TRAINING POSITIONS/SECTION/HEAD/DIVISION COMMANDER – PERSONNEL STAFF	– DIVISION HEAD NEU – DIVISION COMMANDER CFFS – CO NEU(P) – TECHNICAL STAFF DUTIES	– CO NEU(A) – MARCOM DEPUTY CHIEF OF STAFF ENGINEERING & MAINTENANCE
THIRD LINE	– NAVAL ARCHTECTURAL PROJECTS – NAVAL CONSTRUCTOR PROJECTS	– DESIGN ENGINEER – PROJECT OFFICER – TECHNICAL STAFF OFFICER – RESEARCH AND DEVELOPMENT – SOFTWARE PROGRAMMER/ANALYST/ENGINEER – SHIP REPAIR/SHIPBUILDING/QA POSITIONS – EXCHANGE/LIAISON POSITION	– DESIGN ENGINEER – PROJECT OFFICER – TECHNICAL STAFF OFFICER – EXCHANGE/LIAISON POSITIONS – RESEARCH AND DEVELOPMENT – SHIP REPAIR/SHIPBUILDING/QA – PERSONNEL STAFF – NATO STAFF – SOFTWARE PROGRAMMER/ANALYST/ENGINEER	– SECTION HEAD NDHQ – CAPITAL PROJECT MANAGER – SHIP REPAIR/SHIPBUILDING/QA – EXCHANGE LIAISON POSITIONS – NATO STAFF	– DIRECTOR NDHQ – CAPITAL PROJECT MANAGER – SHIP REPAIR/SHIPBUILDING/QA

These are at least some of the reasons why emphasis in training and employment should be given to the duties of ship's EO. These reasons also draw out the conclusion that the job of ship's EO is not, in fact, a job like any other. It is a highly visible position, and if it is not done competently and in a professional manner it will be to the detriment of all MAREs. Thus, the significance of the job has not diminished, and it is still logical to continue to concentrate the MSE's early career in the seagoing navy.

One other aspect of MSE employment that requires further consideration is the variety of jobs that MSEs perform. The numbers of different types of employment indicate that an officer cannot be equally prepared to do each of them fully in the limited time available for training. If cursory treatment is given to all aspects of the MSE function, insufficient depth will be given to enable an officer to do any of them competently, and the trained MSE could become a proverbial "jack of all trades, master of none". This occurrence, after a lot of expensive training would be unacceptable. For the reasons already noted, shipboard engineering duties should be the cornerstone of MSE training.

TABLE 2

TRAINING APPLICABLE TO DEVELOPMENT PERIODS

PRIMARY COURSES	FIRST	SECOND	THIRD	FOURTH	FIFTH
BOTC	X				
CLASSIFICATION	X				
SUB-CLASSIFICATION	X				
SUBMARINE TRAINING	X				
OPDP		X	X		
STAFF SCHOOL		X			
UNDER GRADUATE	X	X	X		
POST GRADUATE TRAINING		X	X		
MANAGEMENT TRAINING		X	X	X	
CFCSC			X	X	X
SPECIALTY QUALIFICATIONS		X	X	X	X
PROFESSIONAL DEVELOPMENT (TECHNICAL)		X	X	X	X
LANGUAGE TRAINING	X	X	X	X	X
SOFTWARE PROGRAMMER		X	X		

SUMMARY

The new classification specification is a vast improvement over the old one in that it finally gives us a complete description of all the functions that an MSE is expected to perform in the course of his career. It is apparent, though, that an MSE cannot be equally prepared to do all jobs after the limited time available for training. In addition, the pressure to reduce training time will necessitate a more efficient training pattern, and it may even tempt the designers of the new training scheme to address too many different MSE functions in the one syllabus. This would inevitably mean insufficient depth in all of them. The most responsible job that a junior MSE can have is that of ship's engineer officer. This is the one fundamental duty that brings together the results of all support activity. In a previous article in the Journal it was said of junior officers that they "should be at the 'coal-face' learning their trade for future employment in headquarters roles". It is important that we recognize that necessity, and preserve what depth and breadth of training there is to give future Marine Systems Engineers the most essential basics necessary to effectively practice their profession.

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CPF OPERATIONAL CAPABILITY

AUTHOR LCDR R.F. ARCHER

LCdr Archer joined the RCN under the VENTURE Plan in 1960, transferred to ROTP and graduated from RMC in 1965. He attended the Operations Officers' Course in 1968/69, followed by tours in HMC Ships BONAVENTURE and SASKATCHEWAN. In 1972, he instructed in the Navigation Section of the Fleet School (Halifax), and in 1973 transferred to the Fleet School (Esquimalt) as MARS Training Officer. From 1974-76, he commanded HMC Ships MIRAMICHI, CHALEUR and FUNDY. After RN Staff College in 1977, he was Trainer Officer in the RN's new Cook Trainer at HMS Dryad, a digital trainer giving sophisticated warfare simulation for CAACS, ADAWS 4, ADAWS 5, and manually fitted ships. In 1979, he assumed the duties of Executive Officer of HMCS OTTAWA, and is presently working in the Canadian Patrol Frigate Office in NDHQ.

ABSTRACT

This article describes the raison d'etre, project operational capability and employment of the Canadian Patrol Frigate. This description is a qualitative overview based upon the anticipated operational environment and the CPF's ability to fulfill those requirements.

INTRODUCTION

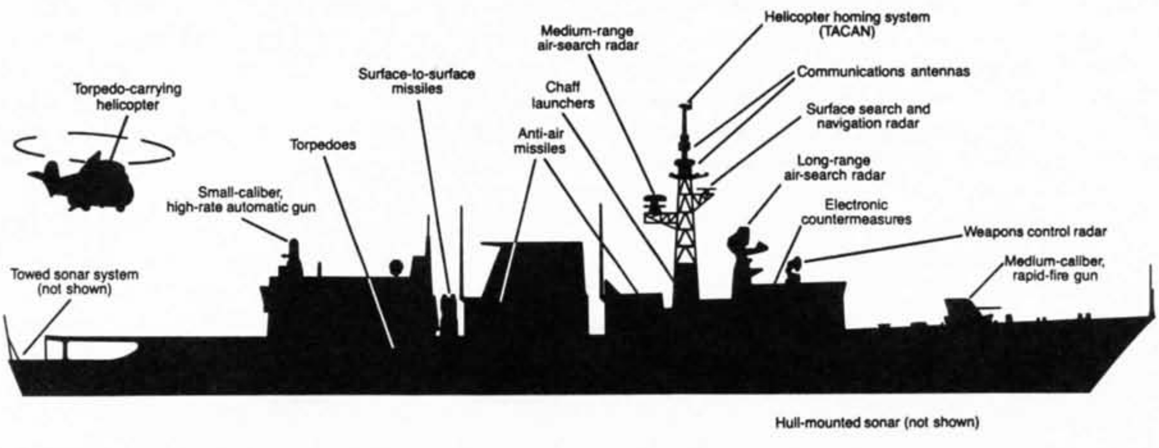
"Speak softly and carry a big stick; you will go far," said Teddy Roosevelt on September 2nd, 1901. With this adage, it is unlikely that Mr. Roosevelt could have foreseen the trepidation with which I as a MARS officer approached the idea of writing for the MARE Journal (he was actually referring to the need to develop the USN in order to put teeth in the Monroe Doctrine), but, as will be seen, it does apply in large measure to the subject of this article, the operational capability of the Canadian Patrol Frigate, the FFH 330 City Class.

CPF OPERATIONAL CAPABILITY

To put things in perspective, let me start at the beginning. When it was decided to commence with the first phase of a fleet renewal program to replace the aging ST LAURENT class, studies were conducted to determine what these new ships should be able to do. Two major missions were identified for any future fleet: anti-submarine warfare and fleet air defence. Further studies showed that it would be more cost-effective to build separate classes of ships to handle these roles rather than build one class of large ships. This is particularly true when considering the unique stationing requirements for ships fitted with tactical towed array sonars (TACTASS) which introduce a new totally passive dimension in surface borne ASW.

ASW was chosen as the role for the first batch of new ships - the CPFs, with the air-defence role, if ever required, relegated to the TRUMPed DDH 280 and to a later class of new construction. Once ASW was chosen, it was decided that the towed array should be the primary ASW sensor system to do "useful work" in contributing to the ASW defence of the fleet. Useful work is a term used to denote capability that goes beyond mere self-defence.

The towed array needs to be deployed far from other surface ships for it to be most effective, and thus it is expected that the CPF will normally be distant from the mutual support of other escorts or of the larger, more powerful ships of other NATO nations. Therefore, the CPF will have to rely on its own comprehensive fit of sensors, weapons and survivability measures to have a reasonable chance of remaining effective against the anticipated threats.



CPF DEFENCE-IN-DEPTH	
THREAT	**DEFENCE**
Aircraft and Anti-ship missiles	• Anti-air missiles • Medium caliber, rapid-fire gun • Small-caliber, high-rate-of-fire automatic gun • High-power electronics jamming • Chaff launcher to divert enemy missiles
Surface Ships	• Anti-ship missiles • Medium-caliber, rapid-fire gun • Helicopter for over-the-horizon attack
Submarines	• Torpedoes for local anti-submarine operations • Torpedoes launched by helicopter for long-range anti-submarine operations • Towed decoy to divert enemy torpedoes

Meeting Canada's sovereignty requirements and NATO commitments.

Preliminary thinking on the CPF's operational employment sees the ship operating normally as passively as possible. An excellent hull and propeller design will help to minimize underwater detection by submarines, as will extensive noise reduction techniques in the mounting of propulsion and auxiliary machinery. Such measures will of course also enhance the detection chances of the passive towed array system and its back-up the passive sonobuoy processing system. Active sonar will only be used as a last resort to direct ship-launched or air-dropped torpedoes against enemy submarines that are unacceptably close. Similarly, the active torpedo-decoy system will only be used if necessary.

The ship will rely a great deal on the extensive capabilities of its helicopter in the deployment of sonobuoys and the use of dipping sonar at a safe distance. The helicopter will provide the only organic means of sufficiently localizing towed array contacts for an attack to be made.

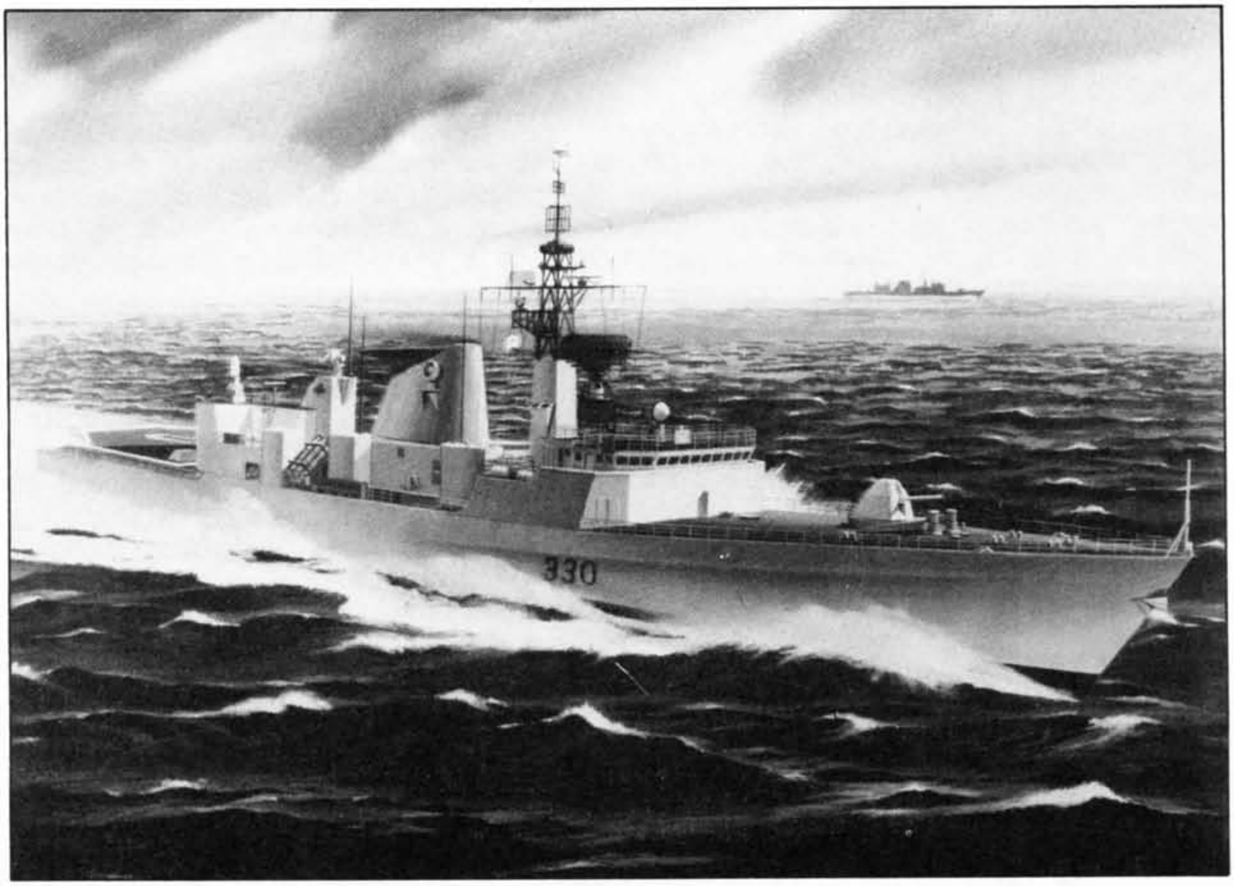
Turning now to above-water warfare, the ship will be designed from the outset to support a primarily passive role similar to that intended in ASW. Techniques for the reduction of radar cross-section and infra-red signature will be employed, and there will be excellent means for the passive surveillance, detection, direction-finding, and analysis of a wide band of the electromagnetic spectrum covering most communications and radar frequencies. These systems will enable the CPF to remain largely undetectable, or at least unidentifiable, while maintaining a very good picture of the surrounding sea surface and airspace. Under certain circumstances it will be possible for the ship to engage surface warships entirely passively. However, should these passive systems indicate that, despite its efforts to remain undetected, the CPF is in fact under direct attack, then the ship's comprehensive active radar and fire-control systems can be brought to bear as necessary.

In the area of communications, as with radar and sonar emitters, the ship will normally attempt to avoid transmitting when it can. Occasions for transmitting UHF voice traffic such as for helicopter control will be minimized. When required, communications and data links with other ships over the horizon will normally be via satcom, providing a low probability of intercept.

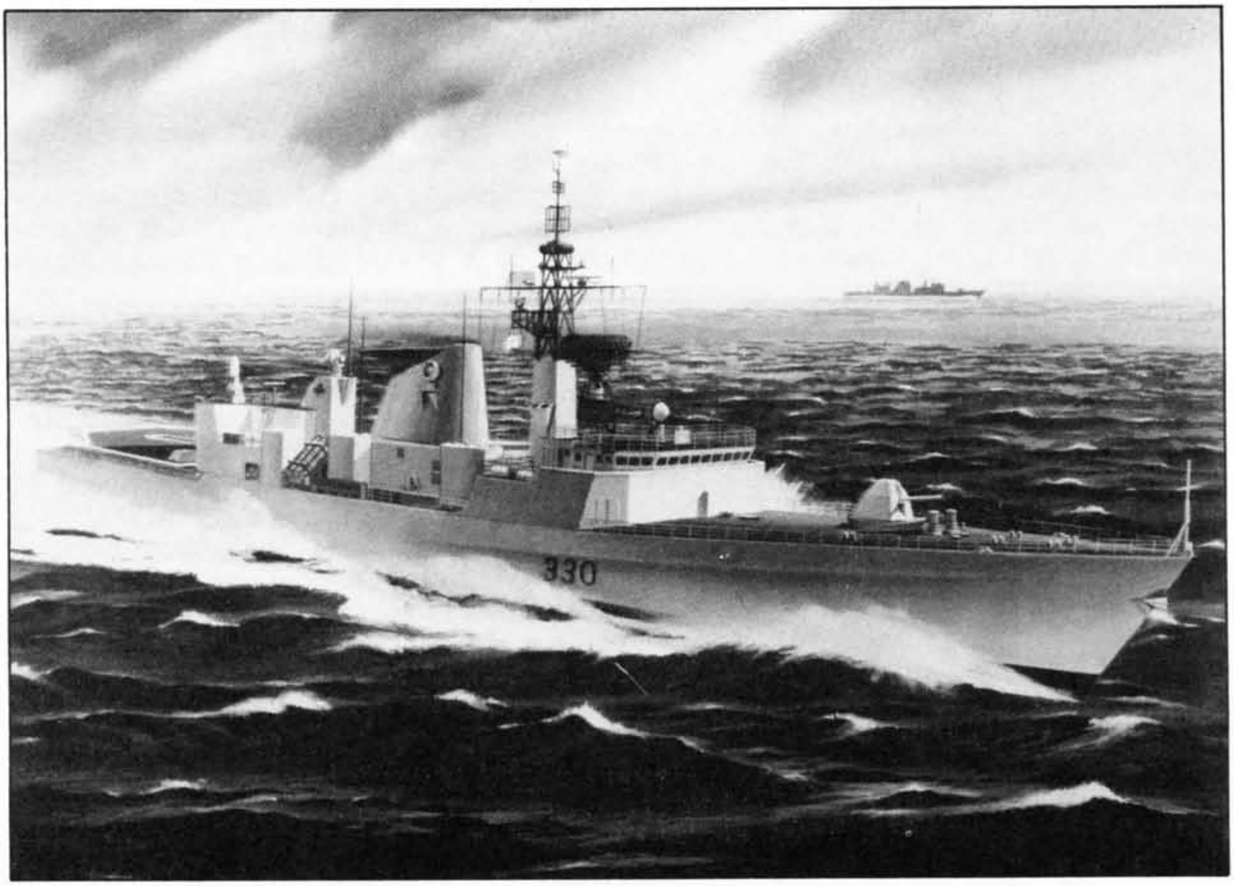
So the passive nature of the CPF's operations will satisfy the first part of Mr. Roosevelt's aphorism: it will definitely "speak softly", if indeed it speaks at all.

Now on to the "big stick". Countermeasures to air, surface and sub-surface attack will be dealt with in turn.

Analysis shows that the bulk of any concerted attack would be directed at the group being escorted and at other higher-value ships, rather than at the CPF on its solitary patrol. However, the CPF itself would still be subjected to a level of threat, particularly that of the anti-surface-ship missile, that would require modern defensive systems.



Rather than depend on a single type of weapon system for shipboard air defence, the CPF will employ the "defence-in-depth" concept. In this concept the ship will have its long-range passive and above-water active sensors backed up by two layers of weaponry. The outer layer will be provided by a surface-to-air missile system, and the inner layer will be provided by a close-in weapon system and, to a certain extent, by a medium-calibre gun. Electronic jamming equipment and radar decoys similar to those used in the Falklands, along with infra-red decoys, will also be fitted to further enhance the ship's air defence. Extensive analysis and computer simulation of the CPF's systems against modern air threats of multiple attacks indicates that the ship will have a good capability in this area.



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Furthermore, in shallow waters where the towed array is perhaps less effective, it may be best for the CPF to act as a close escort to the ships being protected. In this case, the flexibility of the anti-air warfare systems on board will allow the surface-to-air missiles to be used against certain crossing air targets so as to provide a small measure of supportive air defence for the group.

The CPF is also well equipped to deal with threatening surface vessels. Since the CPF will normally be out on its towed array station it is likely that it will be the first to contact the enemy. As in the air-defence scenario it will have to rely on its own systems for protection. It will carry a medium range anti-surface-ship missile which can be directed at targets well over the horizon, and, for occasions when a heavy missile is inappropriate, it will have the gun. For targets at long range the CPF will have its own sensors, particularly the communications ESM, to provide "bearing-only" information, or it can use bearing and range information passed by its helicopter or other assisting aircraft. At shorter ranges it can use all of its fitted ESM systems, and if necessary it can use its radar and fire-control systems. The jammer will also be effective against enemy surveillance and fire-control systems at these shorter ranges.

Finally, and most importantly, there is the "useful work" in ASW, referred to earlier, which is the prime reason for the CPF. Although the full capabilities of towed array systems are still being investigated, it is fully expected that the CPF will markedly improve the fleet's capability to detect submarines at relatively long ranges. This capability, supported by the sonobuoy processing system, the organic helicopter and other maritime aircraft, will provide the ability to detect, localize and destroy nuclear attack submarines carrying torpedoes and the shorter range anti-ship missiles. The ship will be able to prosecute these submarines when they are outside their normal weapon range from the high-value units being protected. This will be possible even though the submarines are not directly threatening the CPF itself. That is, the CPF will be able to go beyond ASW self-defence and will be able to contribute significantly to the overall ASW defence of the fleet and escorted vessels.

When this ability to do useful ASW work is combined with the ship's effective self-defence in AAW and SSW, and with its ability to operate more or less independently, the CPF will be employable in other roles besides distant escort of high value units. Area sanitization, choke-point, barrier, and anti-SLBM operations come to mind.

This, then, briefly outlines the current thinking on the CPF's projected operational capability and on the operational employment that flows from that capability. I will leave it up to the Project Management Office's resident Nav Arcs, MSEs, CSEs, software-smiths and others to describe in detail the various systems that allow the ship to meet the foregoing operational considerations.

REVERSE OSMOSIS DESALINATION PLANTS

Development and Potential Use in Naval Ships

AUTHOR COMMANDER B. BLATTMANN

Commander B. Blattmann received his B Sc in mechanical engineering in 1969 from Ecole Polytechnique of Montreal. On completion of four successive sea duty appointments, he joined 201 CFTSD as the Senior Marine Engineering Officer overseeing the Multi-Ship (Two) refit. He then moved on to the Naval Engineering Test Establishment located in Ville LaSalle, Quebec in the capacity of Commanding Officer. Upon promotion to commander in 1980, he was assigned Section Head duties in the Directorate of Marine and Electrical Engineering in National Defence Headquarters, Ottawa. Cdr Blattmann is a member of the Institute of Marine Engineers.

ABSTRACT

During the last decade important scientific and technological breakthroughs were achieved in the research and development of reverse osmosis as a viable method for generating potable and boiler-feed quality water for marine applications. Recently, reverse osmosis desalination techniques have caught the attention and interest of naval ship designers, and serious consideration is currently being given to determine its potential for naval application.

The aim of this paper is to review the research and development phases associated with reverse osmosis technology, and to assess its future potential as a desalination method in marine and, more specifically, naval applications.

INTRODUCTION

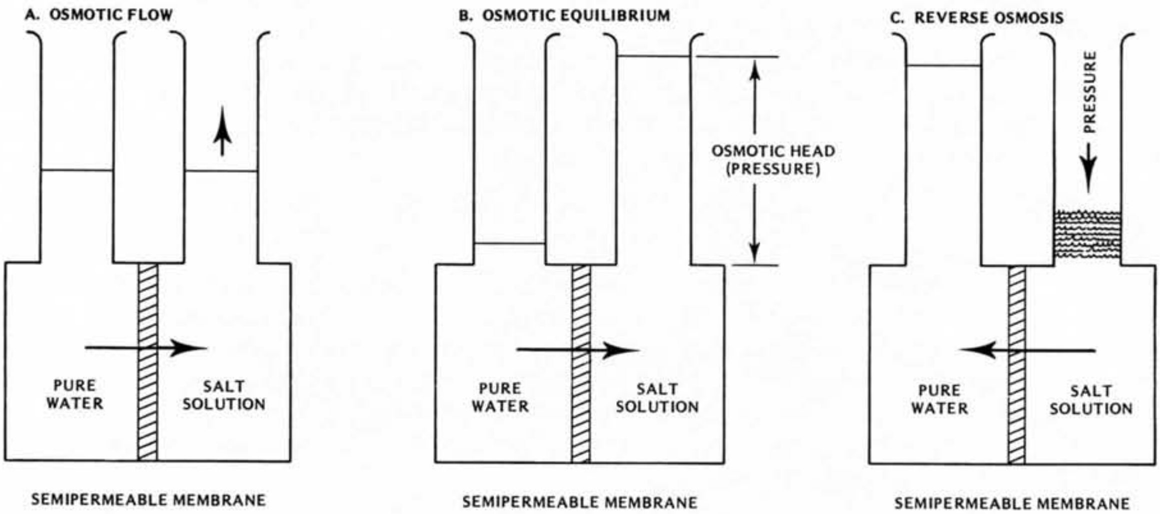
The natural phenomenon of osmosis is a process by which a dilute solution will pass through a semi-permeable barrier to dilute a more concentrated solution. The process continues until the two solutions are of equal strength. The pressure represented by the differences in levels between the solutions in equilibrium is called osmotic pressure.

In reverse osmosis, a pressure in excess of the osmotic pressure is applied to the concentrated solution as shown in Figure 1, forcing essentially pure water through the semi-permeable membrane, leaving behind the dissolved solids. The result is a pure, essentially mineral-free stream of water.

The distinct advantage over other desalination methods is that no phase change is required. Hence, very low energy consumption is required. The process occurs at ambient temperatures, requiring only high feed pressure as the driving force. In practice, it was found that the pressure required to force seawater through a semi-permeable membrane is in the order of 900 psi. The pressure required must be sufficient to overcome the osmotic pressure of salt water (350 psi) as well as provide a suitable flow-rate through the membrane and associated piping work.

FIGURE 1

BASICS OF REVERSE OSMOSIS



DESCRIPTION OF REVERSE OSMOSIS DESALINATION (ROD) PLANT

In the reverse osmosis process, filtered saline water is pumped to a working pressure, well in excess of its osmotic pressure, and fed into pressure vessels containing arrays of semi-permeable membranes. Potable water permeates the membranes which can reject 99% of dissolved salts and 100% (1) of suspended matter including all bacterial and viral contamination. The concentrated brine remaining behind the membranes at nearly full working pressure must be exhausted to prevent excessive salt concentrations. A typical schematic of the reverse osmosis desalination plant is shown at Figure 2.

Three components are necessary for a successful ROD plant:

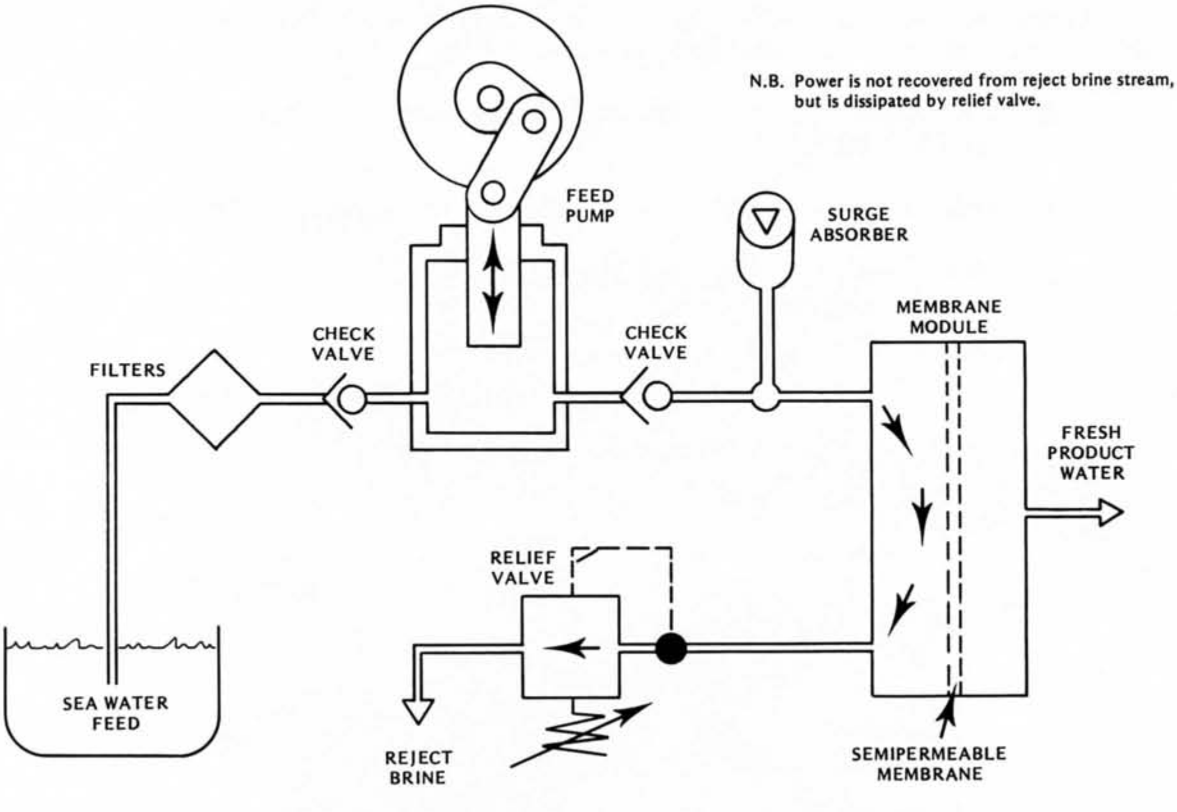
a. semi-permeable membranes capable of withstanding pressures up to 1000 psi;

b. an adequate seawater filtration system; and

c. a high-pressure pump.

FIGURE 2

BASIC REVERSE OSMOSIS DESALINATION SCHEMATIC



SEMI-PERMEABLE MEMBRANES

The development achieved in the manufacturing process of the semi-permeable membranes permitted, in turn, the development of a salt water reverse osmosis system. The semi-permeable membranes employed in reverse osmosis are based on cellulose acetate, nylon or thin film composite polyamide/polynilphonate formulations having rejection characteristics.

The membranes found on the market are normally of the hollow-fibre or spiral-wound types. The spiral-wound membrane, Figure 3, consists of a synthetic sheet spirally wound onto a porous support tube with a flow-spacer dividing each layer. The high-pressure seawater passes over the membrane and potable water passes through and is collected. The concentrated brine flushes by the membrane and is rejected. The hollow-fibre membrane, Figure 4, consists of a bundle of hollow hair-like fibres (50 micro metres OD) sealed at one end in epoxy and held in an epoxy tube sheet at the other end. The high-pressure seawater passes over the fibres, water permeates the fibres and is collected as potable water.

During the development of the ROD plants at the Defence Research Establishment Pacific (DREP) it was discovered that, for adequate membrane performance, several precautions must be taken:

a. the operating pressure across the membrane should not exceed 1000 to 1100 psi;

b. the seawater feed inlet should be adequately filtered, and

c. some chemical pre-treatment may be necessary to prevent scaling of the membranes.

FIGURE 3

SPIRAL-WOUND MEMBRANE MODULE

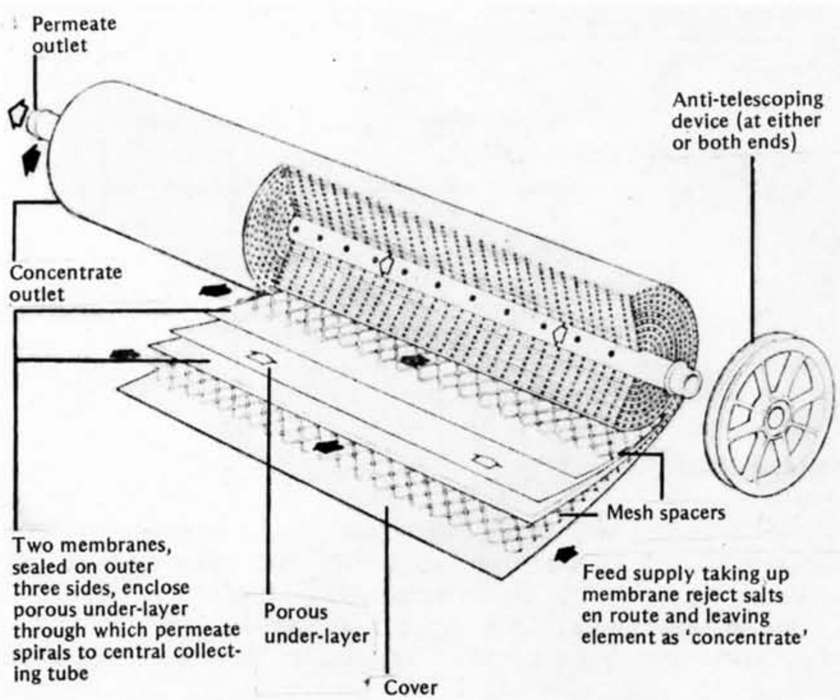
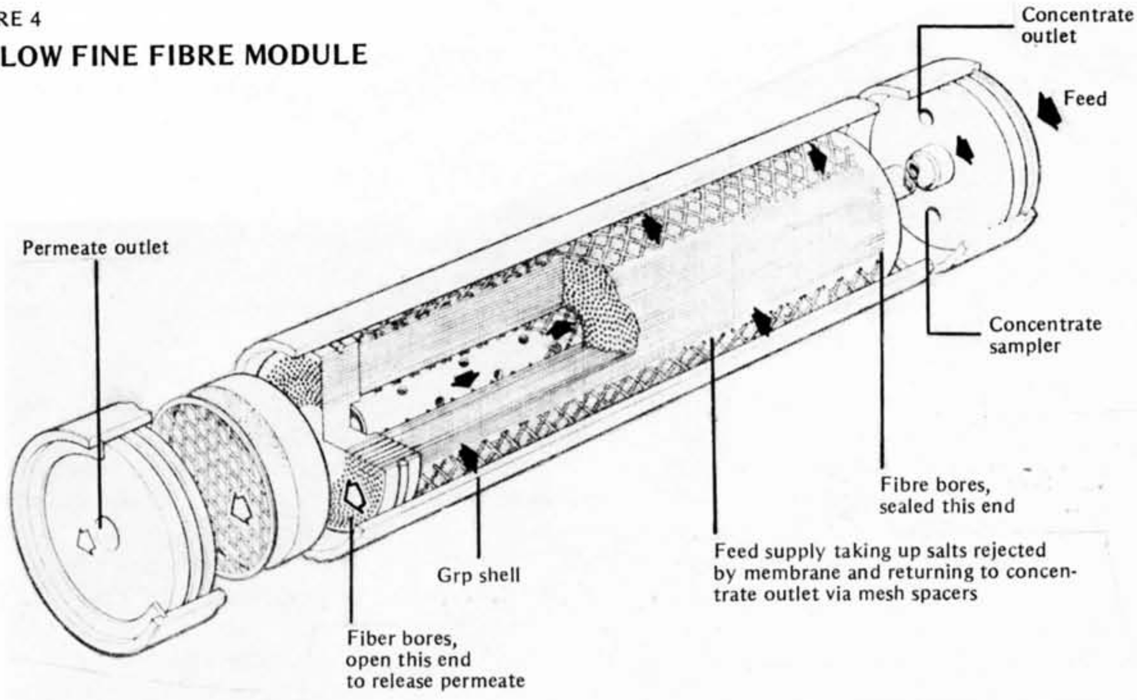


FIGURE 4

HOLLOW FINE FIBRE MODULE



FILTRATION

Filtration is a vital process in any ROD system since two of its primary components, the high-pressure pump and RO membranes, require maximum protection from fouling. Several modes of filtration were evaluated during the course of the DREP trials.

Initially an ultrafiltration (UF) system was tested. UF is a membrane process that uses a more porous membrane than RO. Unlike RO, UF mainly removes particulate matter rather than dissolved ions. The UF unit performed only marginally as a filter as it suffered from a high rate of erosion and was prone to blockage of the filter media.

The next modification of the test plant incorporated a series of cartridge filters: a 50-micron unit followed by a 5-micron unit acting as a polisher filter. These filters were of a disposable type and had to be replaced after 60 to 70 hours of operation. Due to the inconvenience of replacing the cartridges whenever they became blocked, a sand filter was later used in place of the 50-micron cartridge filter in the above series. The 5-micron filter was retained to keep any particles of sand from entering the high-pressure pump components. Initially the sand filter required flushing after 80 hours of water flow, but after only 200 hours of operation back-flushing was required every 25 to 30 hours. Inspection of the sand filter revealed that even after back-flushing for one hour, considerable amounts of algae were retained by the medium which resulted in the reduction of the time between back-flushings. Worse, after four months of use, barnacles were found growing on the inside walls and internal plumbing of the filter tank.

A multi-media, anthracite/sand filter, which requires back-flushing every 50 to 60 hours, proved more convenient than the sand filter. The 5-micron polisher filter was now replaced every time the multi-media filter was back-flushed. Mixing the media gave a much coarser filter which increased the period between back-flushings, but increased the amount of particulate matter reaching the cartridge filters.

A diatomaceous earth (DE) filter was recently evaluated on a 10,000-gallon-per-day ROD unit. DE is an extremely fine, sand-like material composed of the remains of crustaceous sea animals, and when seawater is passed through a DE filter the particulates are retained at the surface of the DE. Although the DE filter gave very high quality water, equivalent to that filtered through a one micron cartridge, it needed cleaning and replenishing every eight hours. The DE filter also required a constant flow of seawater to keep the filter material on the support bags. Overall, this was not a very convenient type of filter for shipboard operation.

It should be taken into consideration that all the above filter types were evaluated at DREP in Esquimalt, BC with seawater taken near the surface and within ten feet of the shoreline. Seawater from this environment has a much higher concentration of suspended particules than that found in the open ocean where ROD units are intended to operate. It was estimated that the amount of suspended matter was approximately 150 times greater by mass than open ocean seawater [2]. For example the DE filter was operated for 2.4 hours in a port facility and 113 hours while at sea for the same pressure drop [3].

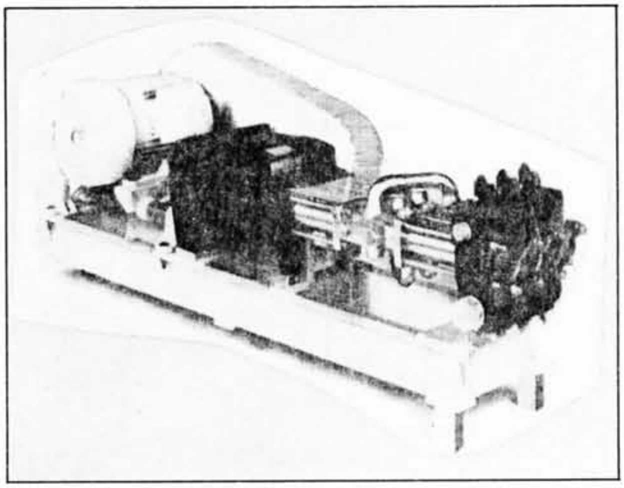
HIGH-PRESSURE PUMPS

As mentioned previously, the pump working pressure must be considerably higher than the osmotic pressure in order to achieve the reasonable water fluxes and adequate salt rejection at the RO membrane. The effective osmotic pressure seen by the membranes is itself increased by concentration polarization effects. Another large part of the extra power demand is attributable to mechanical and hyrodynamic friction losses in pumps, intake filters and system piping.

Either rotodynamic or positive displacement type high pressure pumps must be carefully considered for the fairly severe conditions encountered in seawater ROD plants. The pumps may be positive displacement piston or plunger pumps, or multi-stage centrifugal pumps. Centrifugal pumps, however, are not as efficient as positive displacement pumps in smaller, shipboard applications such as are intended here.

All conventional ROD plants use a throttling or relief valve to depressurize the brine concentrate after it has passed over the membranes and before it is returned to the sea. However, some of the pumping energy can be recovered in the form of mechnical work if the reject brine is depressurized through an energy recovery device. Two energy recovery pumps which are presently being trialled in HMC Ships are the result of a research and development program with the B.C. Research Ocean Engineering design group. In 1978, Seagold Industries, also located in B.C., was incorporated to commercialize this unique pump. The Energy Recovery Triplex (ERT) pump shown at Figure 5 is manufactured by Seagold Industries (4) and is currently being evaluated onboard two naval vessels.

FIGURE 5
ENERGY RECOVERY TRIPLEX
PUMP – BY SEAGOLD INDUSTRIES



ENERGY RECYCLING PISTON PUMP

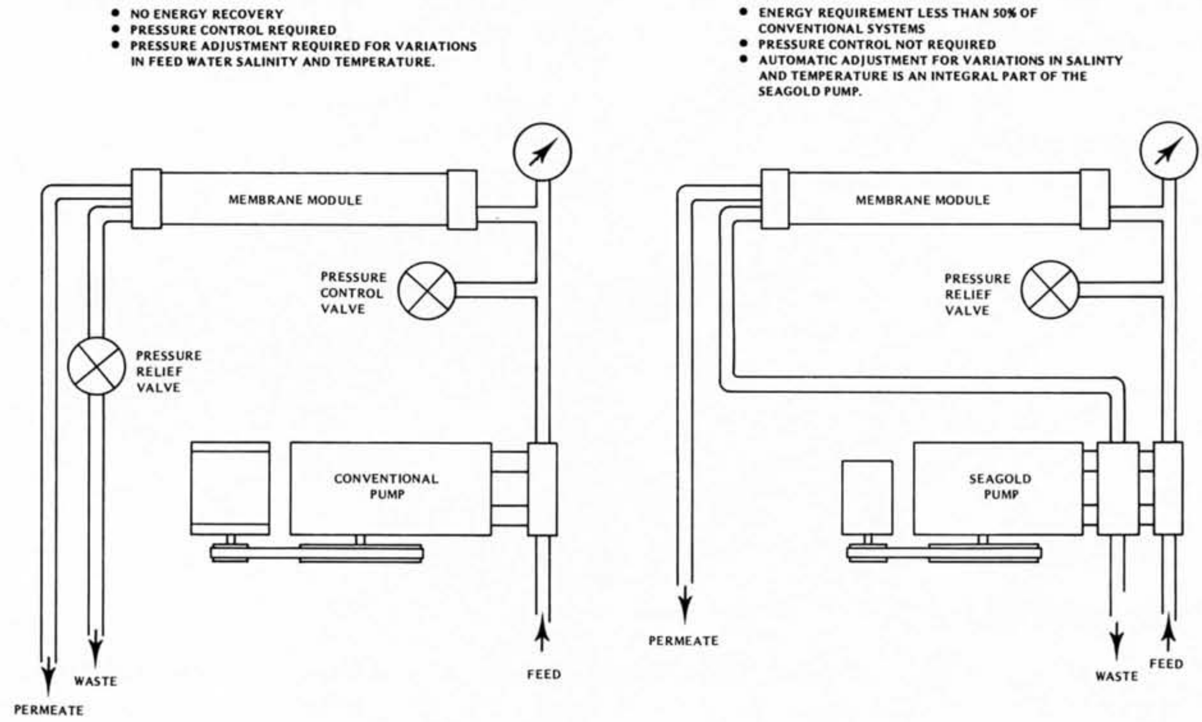
Briefly, the ERT pump is adapted to use the crankcase and fluid end-sections of a conventional triplex pump, with the energy recovery module bolted between the two sections as shown in Figure 6. Because the pistons are driven almost entirely by the reject brine, power and pumping-force loads on the crankcase are little more than those required by the pistons sized for pumping the product water alone. This intimate combination of functions enables the achievement of very favourable overall efficiency, particularly on the brine loop where crankcase and seal friction losses are largely avoided.

A schematic diagram of a ROD plant using this type of pump is shown in Figure 7. The schematic is simplified in that only one pump cylinder is shown while, in general, each pump would have three cylinders phased to smooth both torque and flow.

Note, in Figure 7, that the feed water is pressurized to working pressure in the upper part of the cylinder, by the piston, and is forced into the membrane module. The reject brine, still at high pressure, then passes to the lower part of the cylinder. In the lower part of the cylinder the reject brine exerts its remaining pressure on the underside of the piston to assist in the pumping stroke and energy is thereby recovered. Note also that the volume of permeate produced by each pump stroke is equivalent to the cross-sectional area of the piston rod times the length of the stroke.

FIGURE 6

CONVENTIONAL SYSTEM — ENERGY RECOVERY SYSTEM



The following advantages of the energy recycling pump can be readily deduced by comparing figures 1 and 7:

a. a significant amount of energy is recovered from the reject brine as it exerts its pressure on the underside of the piston;

b. the water circulated through the brine loop, from the upper part of the cylinder, through the membrane module and to the lower part of the cylinder, suffers only very small pumping losses;

c. seal friction associated with the piston is very low because the differential pressure above and below it is small;

d. the recovered energy is not loaded back into the pump crankcase so that crankcase friction losses are reduced;

e. the crank mechanism and prime mover now need to be sized for the product-water fraction alone, plus an allowance for the pressure-drop losses on the brine side; and

f. the resultant reduction in size of machinery will provide a corresponding capital cost reduction in a working plant.

In both cases the piston rod gland seals are pressurized to the full working-pressure and impose equivalent friction losses.

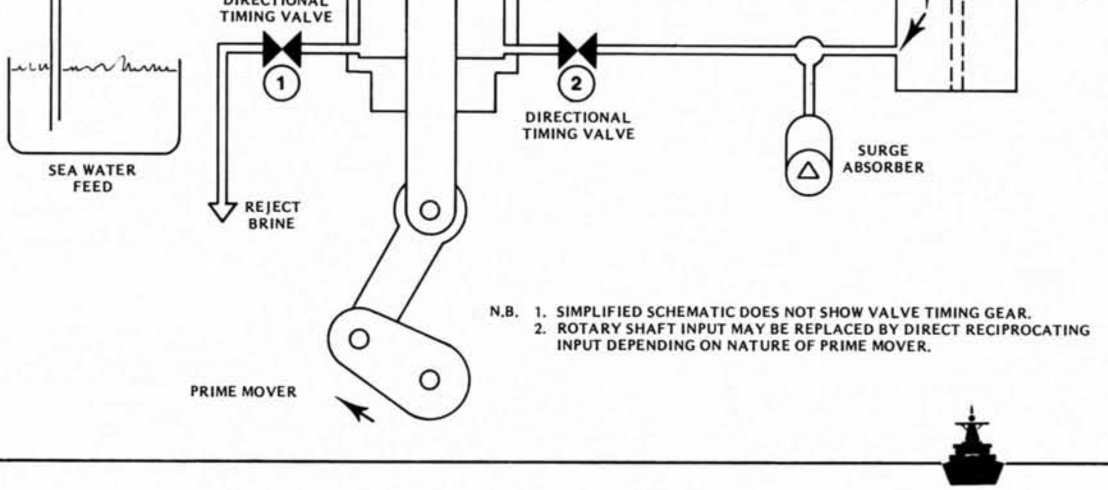
An important aspect of the energy recycling piston pump is the inherently fixed conversion ratio which is defined by the ratio of piston areas. System pressure is determined by membrane permeability, the effective osmotic pressure of feed, and the operating speed of the pump.

The membrane must permeate the fixed product-fraction of the pump-feed flow, and the pressure results from membrane resistance to the imposed flow. Feed pressure will gradually increase under fixed flow conditions as the membranes age and lose permeability. This slow pressure increase is a means of monitoring membrane performance and eventually indicates the need for replacement.

Again referring to Figure 7, valves 1 and 2 are timed to open and close at the top and bottom dead-centre positions of the piston. Valve 1 is open and valve 2 is closed when the piston is drawing feed water into the upper part of the cylinder on its down-stroke. Accordingly, valve 1 is

FIGURE 7

B.C. RESEARCH ENERGY RECYCLING PISTON PUMP



closed and valve 2 is open when the piston is assisted by pressurized reject brine to drive feed water toward the membrane on its up-stroke. The valves may be separate two-way valves or may be combined as a closed-centre three-way valve.

The valve application is severe because of the low lubricity, relative incompressibility and corrosiveness of salt water. After an engineering study of several timing-valve concepts, it became apparent that conventional valve systems could not be adapted to this application. The crucial problem arises from fluid incompressibility and the consequent necessity for very exact timing. Referring to Figure 7, it is clear that valves 1 and 2 must never be open simultaneously or the system will lose pressure. They also must never be closed while the piston is in motion or exceedingly high pressures will develop. Even though the quasi-harmonic piston motion is helpful, since the valves would be in motion only when the flow is virtually stopped, it was realized that the simple configuration of Figure 4 would be quite impracticable.

To circumvent the valve timing problem a dwell interval was designed into Seagold's commercialized energy recovery pumps, such that during a certain percentage of a piston's stroke no fluid could be pumped. At any time during this interval, valves 1 and 2 could be simultaneously closed and their timing became non-critical.

Indications of the ERT pump reliability to date have been quite favourable. One pump presently fitted on the hydrological research vessel CFAV ENDEAVOUR performed successfully for more than 3800 hours. The only problem which eventually developed, corrosion of the valve spools due to improper material selection, was alleviated by a material change. The second ERT pump under evaluation, a prototype 120-gpm unit, was trialled for about 2000 hours at DREP and only minor problems were experienced. The unit was then installed in the operational support ship HMCS PROVIDER in the fall of 1982 and insufficient time has been available to obtain further reliability data.

POST-TREATMENT

Fresh water produced in HMC Ships by both evaporator and flash-distillation units do not require any means of post-treatment unless the distillate is produced from water in harbours, inlets, bays, inland water-ways, or coastal waters within ten miles of the entrance to such waters. This is because distillation plants treat the water by boiling it. Reverse osmosis desalination (ROD), on the other hand, does not boil or treat the water in any of the aforementioned acceptable ways. Hence, post-treatment with the maintenance of a residual treatment level is deemed necessary by the Surgeon General.

ROD is capable of producing product water pure enough for human consumption under the terms of agreement of NATO STANAG 2136, and the World

Health Organization which stipulates that the maximum of Total Dissolved Solids (T.D.S.) allowed in product water for human consumption is 500 ppm of T.D.S. To date, ROD plants under evaluation have proven to be capable of producing potable water with a T.D.S. level below the 500 ppm maximum. Notwithstanding, the Directorate of Marine and Electrical Engineering has requested the Directorate of Preventive Medicine to coordinate multiple biological testing of ROD product water samples. In this way it is hoped that sufficient evidence will be obtained to confidently determine whether or not a ROD system must continue to incorporate post-treatment of the product water.

SHIPBOARD OPERATING EXPERIENCE

There are three reverse osmosis desalination (ROD) plants presently in shipboard service in the Canadian Armed Forces:

a. a 3,800-litre-per-day (LPD) unit is installed with an Energy Recovery Triplex Pump in the hydrological research vessel CFAV ENDEAVOUR;

b. a conventional (non-energy recovery) 3,800-LPD unit is installed in the Oberon class submarine HMCS OJIBWA; and

c. a 38,000-LPD unit with an Energy Recovery Triplex Pump is installed in the operational support ship HMCS PROVIDER.

All of the ROD plants are single-stage units that were built by Seagold Industries Corporation located in Vancouver, Canada. Seagold is the only manufacturer of this unique energy recovery pump.

None of these ROD plants were manufactured to military specifications for shock, noise and vibration since they are still undergoing Developmental Evaluations (DEVALs).

CFAV ENDEAVOUR

The first ROD plant procured by the Canadian Forces was a prototype 3,800-LPD unit with the unique Energy Recovery Triplex Pump. The unit was trialled for 1,800 hours at the Canadian Forces Defence Research Establishment Pacific (DREP). Several types of filters were trialled and it was determined that the cartridge filter system would be suitable for shipboard installation. The only problem which eventually developed during the trial was severe corrosion of the spool valves, parts peculiar only to energy recovery pumps. The problem arose due to an improper material selection, and the spool valve material was changed before the unit was installed in ENDEAVOUR.

During the testing at DREP, the plant was found to consume, on the average, 3.0 watt-hours of energy per pound of permeate produced. This is approximately 33% lower than conventional ROD plants of comparable size. After more than 2,000 operating hours in ENDEAVOUR, the ROD plant operated consistently well.

HMCS OJIBWA

A 3,800-LPD ROD plant was installed in HMCS OJIBWA in the spring of 1982 during refit, and set-to-work in the fall. A schematic is shown in Figure 8. Due to severe space limitations in the submarine, the Caird and Rayner Type "D" Distiller had to be removed to allow sufficient space for the installation of the ROD unit. The ROD unit has therefore been the only means of producing potable water in the boat.

Due to installation problems and operator inexperience, several difficulties were encountered setting the plant to work. Due to an imposing deployment schedule, the plant had to be set-to-work alongside Halifax harbour. It produced water at a rate of 200 litres per hour (equivalent rate of 4,800 LPD) with an impurity level of 620 ppm T.D.S. in excess of the allowable maximum of 500 ppm. Because the unit was set-to-work alongside, the membranes deteriorated to such an extent that they could not produce water of acceptable quality, and new membranes had to be fitted. Also, upon learning that the bromine cartridge of the product water bromination unit had been accidentally punctured, and realizing that this was a personnel

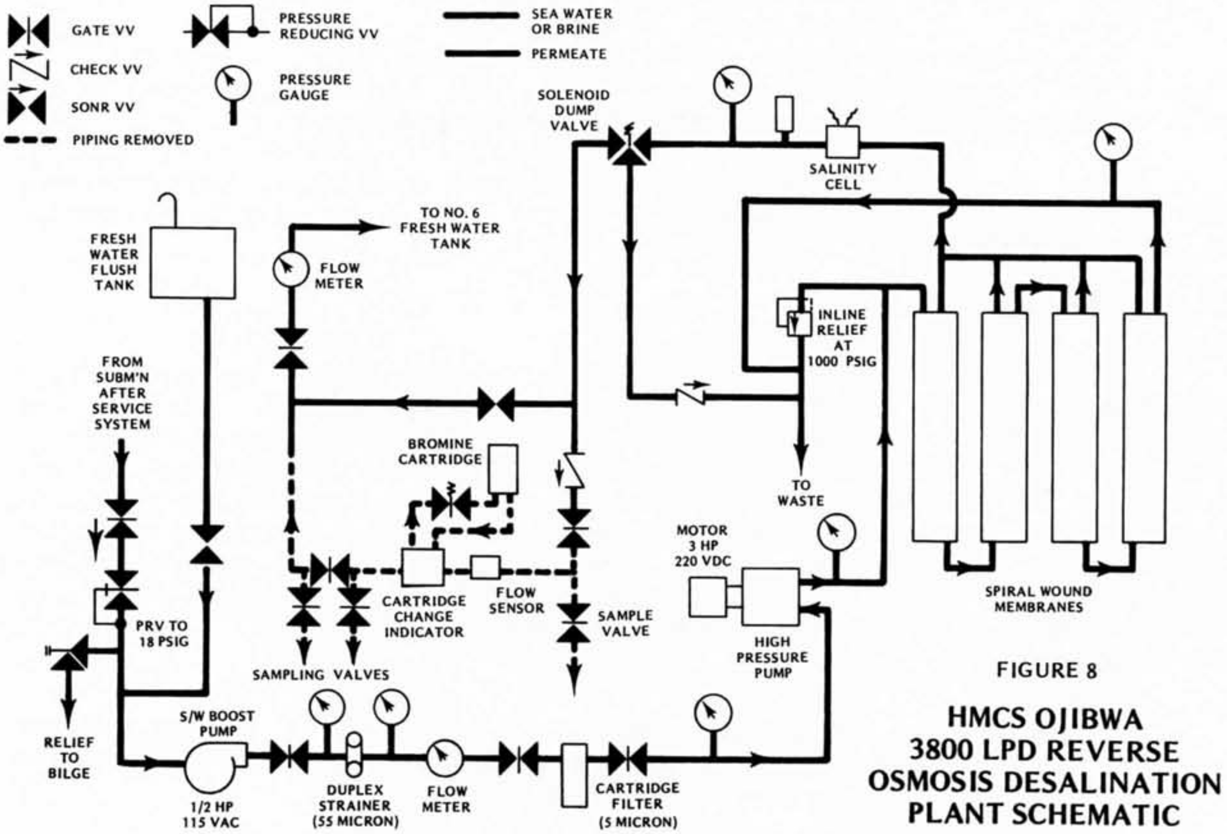


FIGURE 8

HMCS OJIBWA 3800 LPD REVERSE OSMOSIS DESALINATION PLANT SCHEMATIC

safety hazard because of the closed environment of the submarine, it was decided to terminate post-treatment by bromination. Water post-treatment is now carried out by manual injection of 12% sodium hypochlorite to maintain a residual chlorine of 0.2 ppm.

The initial problems have now been resolved and recent operating experience has been very favourable. The unit is now producing on an average 3,050 LPD with a consistent impurity level below 500 ppm T.D.S. It produces considerably more potable water per day than the Caird and Rayner Type "D" distiller, which produces 2180 LPD, and takes much less space. The crew is very pleased with the ROD plant performance.

HMCS PROVIDER

The 38,000-LPD ROD plant in PROVIDER is the largest one in the Canadian Armed Forces. This plant is also fitted with the Energy Recovery Triplex Pump. The plant was trialled at DREP for approximately 2000 hours and proved quite satisfactory with only minor problems encountered. It was subsequently installed in PROVIDER in September, 1982. Since PROVIDER is a steam powered ship and fresh water is produced by two flash evaporators, the intent of the installation was not to assess the plant's suitability to PROVIDER. PROVIDER was chosen because, unlike frigates and destroyers, extra space was readily available. Sufficient operating experience could then be obtained to determine if a ROD plant should be installed in a diesel or gas-turbine powered ship.

Since installation in PROVIDER, operating problems have been relatively few, with the exception of a required membrane change. The requirement to post-treat the product water to ensure 0.2 ppm residual chlorine has, however, given rise to considerable difficulties because PROVIDER has only one freshwater storage tank - a 60 tonne tank also supplied by the two flash evaporators.

ADVANTAGES OF ROD PLANTS

The trend, at least in naval ship design, is towards non-steam-powered ships where the main requirement for high quality water is limited to auxiliary oil-fired boilers and waste-heat boilers. ROD units appear to be well suited for such applications.

One of the main advantages of a ROD plant over the commonly known distillers is that the RO process, as explained above, is dependent upon the use of pumping power to desalinate seawater rather than thermal energy from steam. The actual energy consumption, per pound of permeate produced by the RO process, is only in the vicinity of 7 B.t.u.s compared to 1,015 for the flash-type distiller. The advantages of a ROD unit for shipboard application are more readily apparent when a typical ROD plant is compared with the flash-type distiller found on the DDH 280 Tribal class ship, a gas-turbine powered vessel.

TABLE 1

COMPARISON OF A 10,000-GAL/DAY REVERSE OSMOSIS DESALINATION PLANT AND AN 8,000-GAL/DAY FLASH-TYPE DISTILLING PLANT

	Flash (6)	ROD (7)
Water production rate (gal/day)	8000	10000
Water quality (ppm)	4pp	500*
Wet operating weight (pounds)	8750	4200
Operating Volume (cu ft)	325	250
Energy Required (B.t.u.s.)	1015	7
Potential degree of automation	limited	full
Safety consideration	low steam pressure	high water pressure

*If permeate produced is passed through a second-stage RO process this figure can be reduced to below 8 ppm (8).

Manpower requirements for the ROD plant are less than those for the flash evaporator. Once the ROD plant is in operation, it can essentially run unattended. Since the RO membrane is of modular concept it can easily be replaced when fouled up, whereas the flash evaporator requires more elaborate acid cleaning or replacement of feed-heater and condenser tubes, not to mention maintenance of its numerous ancillary pumps.

THE WAY AHEAD

Short-Term Plans. The Canadian Forces has recently initiated procurement action for a 33,300-litre-per-day, two-stage ROD plant. The plant is expected to be installed in place of a flash-distillation plant in a DDH 280 class ship in the spring of 1984. The unit will be different from those already in service in that it will be a fully militarized plant meeting shock, vibration and noise-borne MIL standards. It is anticipated that the unit will be trialled under a technical evaluation for a one-year period, after which a decision made about its suitability. During this period any faults and deficiencies in the system will be identified and corrected.

Long-Term Plans. Upon successful termination of the technical evaluation, it is anticipated that additional units of the same design will be procured and fitted in place of each flash-distillation plant in each of the four DDH 280s.

HOW NOT TO GET THINGS DONE

A SUPPLY OFFICER'S PERSPECTIVE

AUTHOR – COMMANDER C.H. LIONAIS

Commander Lionais graduated from St Francis Xavier University in 1964 and trained in frigates and destroyers on both coasts. He completed the supply officer's course at HMCS HOCHELAGA in 1966 and was subsequently supply officer of HMCS ALGONQUIN, HMCS ASSINIBOINE and Helicopter Squadron 50. He has served as comptroller at CFS MOISIE and has filled several finance and logistics positions in CFB Halifax and Maritime Command. After attending the RN Staff College, Greenwich, Cdr Lionais was posted to Director Procurement and Supply Common User in NDHQ until 1981 when he took up duties in the NDHQ Secretariat. Commander Lionais was promoted in July 1982 and moved to Director Procurement and Supply Maritime where he is responsible for national procurement of maritime spares, miscellaneous recurring capital (marine items) and equipment for ship alterations.

INTRODUCTION

Those of us in the supply specialty of the logistics branch (your standard pusser) often hear how the supply system failed to support a particular piece of equipment. I'm not out to refute that, on occasion, the reasons for the lack of support lie completely within the supply world. But, equally often the reason for the lack of support is because the engineer (among others) has shot himself in the foot by trying to short-circut the supply system. The following true examples illustrate how good intentions can, and often will, do you in.

BACK DOOR

A ship required certain nuts to effect repairs on one of her boilers. Since the EO and his staff could not identify the item they called the life cycle materiel manager in NDHQ. The LCMM was able to identify the nut, and called the manufacturer to find that, indeed, the item was available. He then requested DP Sup M to purchase the item.

The item did not have a NATO stock number so there were no central stocks. As DP Sup M does not have a local procurement facility the LCMM was told to tell the ship to go through base supply. Not only had base supply not been contacted but neither had the ship's supply department. Base supply was able to obtain the item locally from the manufacturer's representative. Much time would have been saved by going through the front door, the ship's supply department.

SIDE DOOR

This example is very similar to the previous one, but in this instance the item had a NATO stock number and was centrally (NDHQ) managed. Again, the Engineering Department did not go through the ship's supply department but went directly to the LCMM at NDHQ. The LCMM contacted the supply manager who initiated procurement action. As frequently happens with urgent procurements the item arrived at the base supply receipts section before a copy of the contract was received by base supply. Because the supply system had been circumvented at the local level (which should have been picked up at NDHQ) base supply did not know who the item was for and shelved it.

NO DOOR

This category is for the repairable item, whether so designated or not. Even though the practice has decreased significantly of late, items are sometimes taken from the ship to a dockyard workshop where repairs are made, off the record, by an old friend

The engineer has done his thing. He has returned his equipment to serviceable condition in quick order. The fault is that supply does not know of the problem and cannot prepare for future occurrences. In addition, the LCMM at NDHQ is not aware of the problem and the same piece of equipment might be repaired repeatedly in the same manner. This relates to another problem area - that of not submitting an unsatisfactory condition report (UCR) when warranted. If the engineering specialist at NDHQ, the LCMM, is not made aware of unsatisfactory equipment he lives with the belief that all is well and takes no corrrective action. In short, the LCMM must be in the know as it is he who enventually gets the better item into the supply systems through the supply manager.

ONE LAST SELF-INFLICTED WOUND

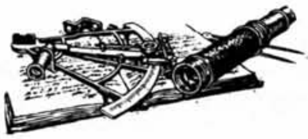
This last problem area (the last addressed here - there are many others) has to do with specifications for a desired item. Very often the initiator of the requirement has seen something that he wants or needs. The need or desire may be valid, but what often happens is that the specification for the end item is written up around the known item. To a certain extent this is natural. The specification, however, is frequently written up too tightly. And when suppliers offer to provide their item in response to a request for proposal from Supply and Services (even though their item may be capable of doing the job and is available at a good price) the bid is not responsive because the specifications of the item requested are not fully met. The supplier, then, who offers the equipment around which the original specification was written, wins the contract even though his might not necessarily be the best price.

Had the specification been written up as a performance specification, then any item capable of doing the job required would have been acceptable and that with the best value for the dollar could have been accepted. Of course where there are valid grounds for a specific item on the market to be provided because of commonality of spares or training requirements, and the case for sole source or no substitute can be substantiated, it is quite an acceptable route to follow.

The above examples are just a few of the types of problems good intentions sometimes create. The common thread in all of these examples, which is common to many other problems, is that of communications; or, more correctly, the lack thereof.

The CFSS is a bit of an historian in that it gathers history in order to predict future supply support requirements. If usage is not recorded the shelves, bins or five empty boxes will not be filled on time. Also, since the CFSS attempts to purge itself of excess stock items which are validly required but show no usage could be recalled for redistribution or disposal.

To summarize, you will do yourself and your ship or establishment well to go through your supply department. Even where the non-standard procedures (through other than the front door) seem to be the most expedient method, at least let the supply department know what you are up to. They very often can save you time and at the same time provide better support in the future.



Note Book

IF THE CAP FITS......

The following is quoted verbatim from the USN Engineering Duty Newsletter No. 54, Summer 83 edition. Of course as MAREs we are all fully aware of our duties and responsibilities and could never be faulted for laxness! Or could we? I thoroughly endorse Admiral Fowler's closing sentence and enjoin you to continued standards of excellence in the conduct of your duty.

E.C. Ball
Commodore

FROM THE COMMANDER:

USS SARATOGA has experienced excessive leaks in the superheater tubes since completion of the Service Life Extension Program at Philadelphia Naval Shipyard in January of this year. Investigation revealed in late June that it would be necessary to replace all 256 superheater tubes in all eight boilers to achieve reliable operation. This effort will cost between two and three million dollars and take over two months to complete. This unfortunate situation is the consequence of poor work by the Philadelphia Naval Shipyard and poor technical direction and oversight by NAVSSES and NAVSEA Headquarters. It is particularly disappointing to me because it is the largest single failure of the NAVSEA organization to perform properly since I have been Commander. Administrative and disciplinary actions are being taken against those accountable and actions will be taken to provide the proper direction and control to minimize the possibility of future failures.

I enjoin all Engineering Duty Officers to ensure that sound and logical methods are in place so that technical repair procedures for important ship components or weapons are carefully thought out and properly reviewed. Good technical repair procedures are needed to make our work control and discipline adequate. Shipyard personnel must be fully trained and properly supervised to accomplish the work in accordance with approved procedures. Tight quality control and inspection standards must be implemented to ensure the job is accomplished correctly and thoroughly tested. I continue to be amazed at the degree of serendipity, which is another word for laxness, we permit and accept as normal. During my career experience I have found several cultures that follow a logical, structured, formal and disciplined approach. These include space technology, deep submergence, strategic missiles and nuclear propulsion. I do not understand why we cannot adopt these methods throughout all aspects of our organization. Slovenliness by engineers and workers is simply unacceptable. Logic and discipline are fundamental to engineering. I think it is time that every Engineering Duty Officer search his own or her own soul and ask what contributions he or she is making to a better understanding of engineering responsibility and accountability and its implementation.

E.B. Fowler
Vice Admiral, USN

CORRECTION

A number of officers have questioned the statement in the Summer 1983 Note Book concerning OPDP for MAREs. Commodore Ball wishes to apologize for the misconception created and have it noted that;

a. current regulations state that as part of the NOC, MARE officers write equivalent OPDP exams and could be granted credit for OPDP 2, 3, 4 and 5; and

b. those MARE officers who pre-dated the NOC are still required to complete all OPDP.

PROMOTIONS

The Journal would like to acknowledge the promotions of the following MARE's to the ranks indicated:

a. Captain R.L. Preston

b. Captain H.W. Schaumburgh

c. Commander J.R. Scholey

d. Commander F.B. Smith

e. Commander C.F. Varen

f. Commander J.R.Y. Deblois

g. Commander D.F. McCracken

h. Commander R.V. Hattin

j. Commander G.M. Pollock

k. Lieutenant Commander G.B. Mandy

m. Lieutenant Commander A.S. Davis

n. Lieutenant Commander J.G.D.G. Moineau

p. Lieutenant Commander E.R. Paquette

q. Lieutenant Commander E.S. Koshman

r. Lieutenant Commander N.N. Blanchford

s. Lieutenant Commander R. Gebbie

t. Lieutenant Commander R.J. Kerwin

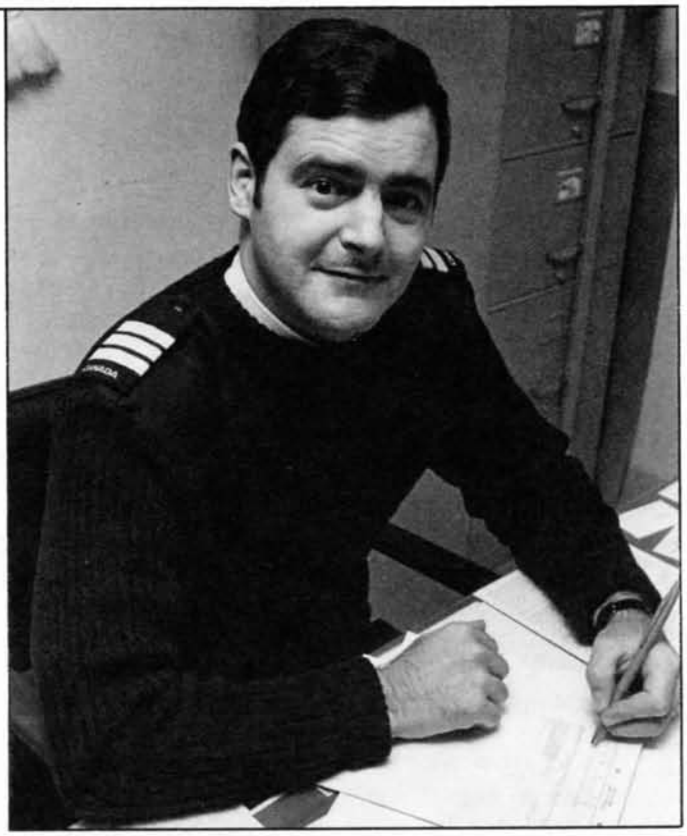
u. Lieutenant Commander H.V. Archibald

v. Lieutenant Commander D.S. Kolba

w. Lieutenant Commander B.J. Spanik

Good luck in your new positions and ranks.

An Interview with Commander Marc Garneau



Q. Within the next three years two Canadians will get the opportunity for space flight. We would like to congatulate you, Cdr Garneau, for your selection as one of Canada's first six astronauts. How did you first get interested in the astronaut programme and what got you started on the road to final selection?

A. Well, actually I was sitting in my backyard last summer after work reading the newspaper and I saw this ad in the Careers and Opportunities section of the local paper that stated that they were looking for Canadian astronauts and the only prerequisites were that you had to be either an engineer or a doctor and that it was desirable to have flying experience and to be bilingual. Well, when I saw the ad I just had to make my application. It's not the sort of thing you run into very often in the newspaper. It's indeed an opportunity of a lifetime that I just couldn't resist so I put in my application. Thereafter followed a four month period during which they whittled the applicants down to the final six.

Q. We understand that the nationwide competition attracted over 4,000 applicants and MacLean's magazine (with tongue in cheek) suggested that education and fitness replaced appearance and personality as the judging criteria. It is considered an honour by the MARE community that one of our fraternity has been selected for such a programme. Notwithstanding your many qualifications the situation begs the question: Did your MARE background provide you with an edge in the competition?

A. Well, I personally think that it was very useful for a number of reasons. I think the Board was looking for someone who had real life experience out in the field, working with equipment, and had experience with evaluating new equipment in an environment that, as we all know in the Navy can sometimes be difficult, where good planning is required , where real time decisions have to be made on the spot and be followed up by careful analysis. Usually such trials on new equipment are expensive and one shot only. In the last 10 years I've been involved in a number of these new equipment trials while working in the naval environment. I think all those things were a great asset in putting forward my application as well as the fact that naval life varies from one posting to the next. My experience instructing in the Fleet School, maintenance and troubleshooting in the Naval Engineering Unit, the project management experience in Ottawa, and of course the CSE experience onboard a ship were all assets that helped me in my application.

Q. Could you briefly describe for our readers the type of training you are about to undertake, as well as the major milestones which may result in your being chosen for a space voyage.

A. Yes, certainly. At this stage, as you know, there are six astronauts for two experiments; that is, three applicants for each experiment. For each experiment only one astronaut will be chosen to actually go up into space. As I understand it at the moment, the two chosen astronauts will be notified about a year from now. That is, a year before the actual shuttle missions which are scheduled to occur in late 1985, early 1986. All of us, however, will carry on for a second year when two backups will be nominated and the third person in each of the two groups will be released from the National Research Council. Because I'm concerned with the space vision system experiment, I will be involved in helping to finalize the design of the equipment. We have a prototype lab version but we have to finalize its design, get it built by industry and design the test procedures that we will actually use when we're up in space. These things have to be finalized so that we accomplish our objectives up there in a very limited amount of time. There will also be a public relations side to the job whereby we will keep the Canadian public informed about what we are doing. In the midst of all that, there will be some introductory training to become an astronaut and I suspect the final intensive training for the astronaut program will be reserved for the two finalists but I think we will all go through a certain amount of basic astronaut orientation. We will also meet the remainder of the crews that will be flying the actual shuttle missions. So basically during the next two years we have a lot of technical work to do as well as some PR work and some astronaut work. As it stands now, I anticipate that I'll begin work towards mid-January 1984.

Q. We are all aware of the problems (or inconveniences) created by the demands of the Service on our families and yet you are voluntarily entering into a seemingly intense program. Could you comment on the changes, if any, that your family life will undergo as a result of your selection to the astronaut program?

A. Well fortunately in my case, since the work will take place in Ottawa at the National Research Council, I don't have to move and, therefore, that part of it is out of the way. Since we're talking about a basic two year program, about one-third of that time will be on the road, which I guess for some people in Headquarters is really no different from usual, and I'm used to going on trips in my present position. So I don't think there will be any special disruption from that point of view. Naturally, my wife is aware that I'm doing something that is a little out of the ordinary and she has the normal concerns. She thinks that there is some danger involved in becoming an astronaut. I've tried to reassure her and I think I've been partly successful but certainly not totally successful. However, she has resigned herself to the fact that this is a personal dream of mine and basically supports me a hundred percent. My children are really a little bit too young to fully appreciate what's going on. They think it's rather fun but they don't think it's anything special.

Q. Of all the imaginable ways which MARE officers have devised to influence their career manager's posting plan, yours certainly ranks amongst the most original to date. Could you please expand on the mechanics involved, and the implications if any, on your terms of Service as a result of your employment in this program?

A. Well, I will be seconded to the National Research Council of Canada from the Canadian Forces. I will continue to receive medical and dental benefits; I will be assessed on a yearly basis by PER, just like everybody else; and I will be paid my Naval salary and any additional allowances which would normally occur in a situation judged to be equivalent. While I realize that I'm not going to be working in the Naval environment for the next two years, I think it's pretty much business as usual as far as my career is concerned. When I return to the navy on completion of this work, I will probably go back into a job where I can get my feet wet fairly fast, again just in case I've forgotten some of the things I've learned. So I don't think that there will be that much disruption to my career. I hope when I return that I won't be out of date. Obviously I will be to some extent, but I hope that my usefulness as a Naval Officer will not have suffered in any important way.

Q. Is the program on which you are now embarking an exclusively "one time only" evaluation, or do you foresee a continuing participation on the part of Canada in the space program and hence a new career opportunity in that field?

A. Strictly speaking, the only thing that is formed up at the moment between the National Research Council of Canada and NASA are the two space shuttle missions; the one I'm involved with, the Space vision System experiment, and the Space Adaptation Syndrome experiment. However, I know that the National Research Council of Canada and the Interdepartmental Committee on Space are certainly planning for the future. There are a number of future endeavours that the National Research Council would like to become involved in cooperation with NASA. These endeavours are being considered by Government and so this may be literally the first step on the way to greater Canadian participation in manned space. In the non-manned side, Canada is very active and has been for at least twenty years and is in fact in the forefront in terms of space technology. So, it's quite possible that this will be just the beginning. How big future manned space

programs will be will depend on a number of factors but if the National Research Council is successful in promoting its proposals then there will definitely be further programs.

Q. How do you feel personally about what's in the future?

A. Well, this has been without any doubt a tremendously exciting experience for me. Words fail me when I try to describe how I do feel. The next two years will be an absolutely great adventure. It's a dream come true for me. I look forward to every aspect of it. I can't think of a single drawback. It's just going to be great fun and I look forward to working with my other five fellow astronauts. We've had a chance to meet each other. They're all very nice people. I think we're going to do a good job and I think that we're going to have great fun doing it. I've had to make certain changes in my life obviously. I'm not used to some of the attention I've been receiving in the last few weeks. I have to tell you that I don't mind it at all; in fact, I quite enjoy it. In some ways it's a bit funny. I get the feeling that since being chosen, people expect me to be more intelligent than I was before, more courageous than I was before, and of course I wasn't transformed in any way over night by being selected as an astronaut. I'm the same person as I was a month ago and I hope that people will remember that and not treat me in any special way. However, as I say, this is going to be a great two years, hopefully a great three years if I'm selected to be the one who goes up into space.