National Defence Défense nationale

Maritime Engineering Journal

CANADA'S NAVAL TECHNICAL FORUM

June 1999

CNTHA News Inside!

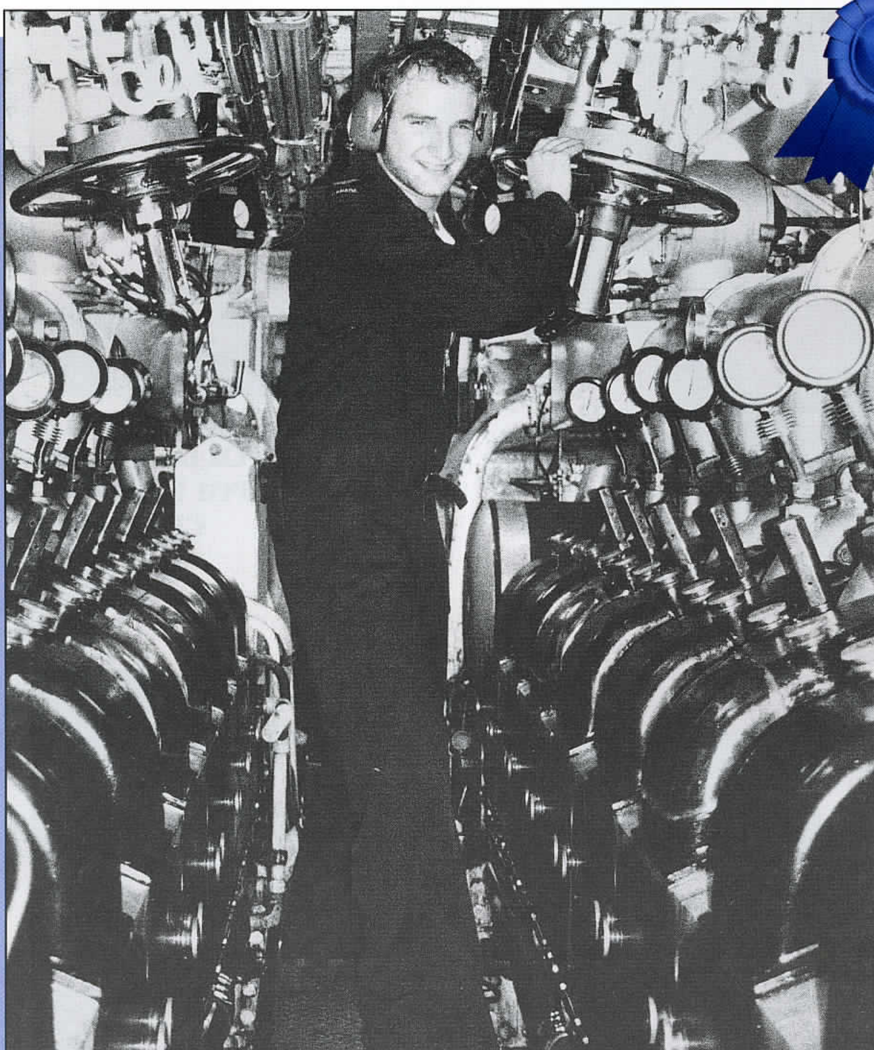


Photo Contest Winner!

Leading Seaman Gary Drainville of Halifax, N.S. snapped this winning portrait of LS J.B.Y. Menard "putting on a snort" for the last time before HMCS *Ojibwa*'s final sailpast in May 1998. *(First Place $150)*

Our photo contest brought in 50 great photo submissions. Turn the page to see the rest of the winning entries.

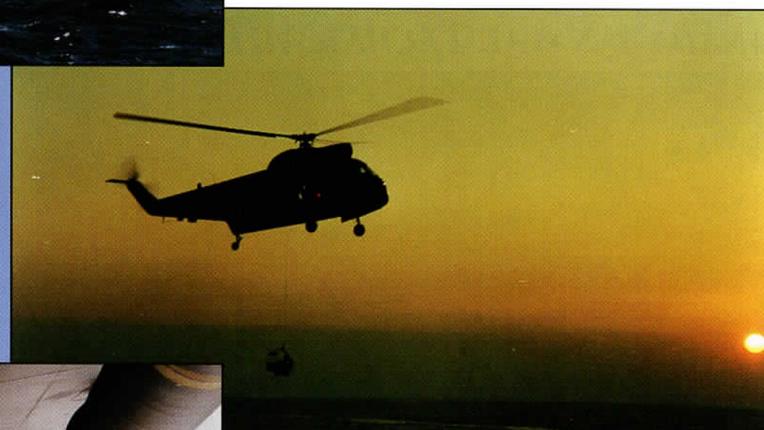
Also:

- *Converting TSRVs into Diving Tenders*
- *Forum: How important is the Divisional System to morale?*

Canada

The Rest of our Photo Contest Winning Entries

"HMCS *Edmonton*" *(Second Place $75)*
by CPO2 Ken Levert, HMCS *Protecteur*



"Medevac" *(Third Place $25)*
by CPO2 Doug Morris
(Submitted by PO1 David Ross, CFB Borden)

"HMCS *Calgary* in Drydock"
(Category: Equipment $25)
by PO1 David Ross, CFB Borden

"HMCS *Ontario*"
(Category: Ship/Vessel $25)
by Cmdre (ret.) W.J. Broughton, Ottawa

"Damage Control School Esquimalt"
(Category: People $25)
by MBdr Jon O'Connor, LFCA Headquarters

Maritime Engineering Journal

JUNE 1999

Vol. 18, No. 2 *(Established 1982)*

The *Journal* is available on the DGMEPM website located on the DND DIN intranet at http://dgmepm.d-ndhq.dnd.ca/

DEPARTMENTS

FEATURES

The *Maritime Engineering Journal* (ISSN 0713-0058) is an unofficial publication of the Maritime Engineers of the Canadian Forces, published three times a year by the Director General Maritime Equipment Program Management. Views expressed are those of the writers and do not necessarily reflect official opinion or policy. Mail can be sent to: **The Editor, Maritime Engineering Journal, DMMS, NDHQ, MGen Pearkes Building, 101 Colonel By Drive, Ottawa, Ontario Canada K1A 0K2**. The editor reserves the right to reject or edit any editorial material. While every effort is made to return artwork and photos in good condition, the *Journal* can assume no responsibility for this. Unless otherwise stated, *Journal* articles may be reprinted with proper credit. A courtesy copy of the reprinted article would be appreciated.

Guest Editorial

A Change of the Watch

A personal retrospective by Captain(N) Gerry Humby, CD

Looking back, it seems quite amazing to me that more than 37 years have whizzed by, seemingly at the speed of light, since I began my naval career as a mere teenage ordinary seaman at HMCS *Cornwallis*. In those salad days in what was then the Royal Canadian Navy, when kit musters, boot polish and parade grounds were my daily fare, it would have been quite impossible to imagine that at the end of this great adventure I would be a full naval captain, leading a huge and complex organization such as Fleet Maintenance Facility *Cape Scott*. I have been privileged to share the journey with some truly wonderful people — some of the finest people this country has ever produced — and it has been great fun, too (which is why, I suppose, the 37 years have passed so very quickly). I am happy and contented, and now that I am at this end of my career I can confidently report that the marvellous and extraordinary journey has been worthwhile.

The navy I joined in 1961 was a smaller representation of that which saw us through the Second World War, but the people who were training us had served in the North Atlantic convoys, and were passing on the fruits of their hard-won experiences. In those days most of the sailors in our ships still slept in hammocks, not bunks, and our pay was handed to us on top of our doffed caps. Technology (especially in the field of electronics) was a crawling infant, and even though Sir Frank Whittle had patented his gas turbine in 1930, the idea of propelling a warship with an airplane engine was still only in gestation. Over the years I have witnessed enormous change in the navy, and as a sailor, engineer and officer have even been instrumental in part of it.

Some of the biggest changes have been cultural. As an AB sonarman "maintainer/operator" in the three-year old HMCS *Gatineau* in 1962, the chances of me seeing an officer in the course of my daily work were zero. Officers would only be spoken to if they troubled to address you, and as a general rule they didn't. They were in the main unpleasantly snobbish, and in some cases unpopular with the ship's company — distinctly *un*-Canadian. Clearly this had to change, and of course it did — radically. By the time I was commissioned in 1973, the transition to the wardroom was very pleasant and easy because of the much improved social attitude.

The sixties brought many other significant changes to the navy. On board HMCS *Columbia* in 1965, we were halfway across the Atlantic on our way to join our NATO cousins in the first Standing Naval Force Atlantic squadron when we hoisted the new maple leaf ensign for the first time. Unification of the Forces followed, and as a navy we gradually distanced ourselves from our Royal Navy roots. By the late sixties we were moving from vacuum tube technology to solid-state and digital electronics, and I was in the thick of it with such uniquely Canadian development projects as hydrofoil VDS, ASROC, and AN/SQS-505 digital display sonar.

Throughout the 1970s and early 80s my career on the waterfront progressed first at sea and then ashore through UCS and ADLIPS, after which I went to Ottawa to join the Canadian Patrol Frigate Project in 1983. Dealing with the captains of industry was indeed an education. I followed this with a three-year stint as DMCS 2 (Surface and Air Weapons) during which time we were prime movers in NATO Sea Sparrow, and then it was back to the Coast in August of 1990, just in time for Op Friction. Shortly afterward, the pace began to get really exciting as our long-awaited new patrol frigates and maritime coastal defence vessels started arriving at a breathtaking rate. Not only that, but the navy began a major restructuring ashore which saw my own organization shrink from 2,200 people to 1,100 during my five-year tenure. Even more exciting times lie ahead as we anticipate the arrival of the first two *Victoria*-class submarines from the U.K. next year.

As I close out my own naval career, the message I would like to leave our junior personnel is that your future can be just as full of adventure, opportunity and enjoyable challenges as mine has been. But you must always remember that "*your attitude is the only difference between an ordeal and an adventure.*" In my estimation our navy has the finest calibre people, sound leadership, and a fleet of world-class warships.

The other day when someone asked me if I had any regrets, I hastily replied, "No." On reflection, however, as I prepare for the change of the watch, I do have one regret — that I cannot do it all again.

You have the watch!

[On behalf of the entire military and civilian naval support community, we wish Gerry Humby fair winds and a following sea. You stood a good watch! — Editor]

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

Commodore's Corner

Prefacilitated Contracts — Navy is Proceeding with Caution

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

Last April's MARLANT Technical Support Seminar included a lively debate on the subject of prefacilitated contracts (PFCs), now the preferred support method of the Materiel Group. Two concerns were tabled: first that we, the technical community, are "contracting-out our bread and butter;" and, second, that PFCs represent alternate service delivery (ASD) without consultation or process.

On the first concern, we must accept that the world, industry and government policy have all changed. The Canadian government "built" this country's first railway, the St. Lawrence Seaway, and so on, but contrast this with the recent construction of PEI's Confederation Bridge and Ontario's highway 407. The trend is clear: nowadays, if industry has the resources and expertise, *industry* should do the work. Government should be as small as possible, and should "steer, not row." DND and the CF are no exception. Since our downsizing, we no longer have the human resources to do as much ourselves, which means we *must* continue to contract-out work that is economically and effectively delivered by private industry.

In-house we now focus on the "warrior" aspects of the military role, and on the "smart customer" activities — design authority, planning, contract management, unique services, etc. — which have to be done in-house. Of course, it would be false economy and frustrating if our contract administration were to absorb much of the time saved, and this is where prefacilitated contracts come in. By bundling contract work into larger packages than in the past (e.g. one PFC to cover hitherto separate contracts for R&O, TIES/FSR, spares, data warehousing, and so on), PFCs should reduce both the amount and cost of contract administration.

The issue, therefore, is not with PFC philosophy, but with the volume and type of work to be included in a prefacilitated contract. A number of you have suggested that downsizing and future contracting-out will render us incapable of being a smart customer, meaning that experience in *doing* some work is a prerequisite to proper specification and analysis of contract deliverables. I fully agree there is a limit beyond which we must not go if we are to remain capable of offering knowledgeable analysis and independent advice to our navy and our government. I am very conscious of this responsibility and we will proceed with caution.

On the second issue — PFCs as alternate service delivery — it is not our intent to bypass the ASD policy if a PFC affects work currently conducted in-house. In most cases, we are simply consolidating R&O, supply arrangements, FSR support and documentation services that have already been contracted to industry, but in many separate vehicles. Where a PFC is to include work currently done in-house, consultation will take place. For incremental new equipment, and even ships like the MCDV, we have utilized large omnibus support contracts from the outset because it made sense to do so as part of a new procurement.

With all of this in mind, I remind you that the overall objective is to provide the maximum amount of support for every budget dollar we receive. I simply will not recommend to CMS or ADM(Mat) prefacilitated contracts, or any other contracts for that matter, which do not achieve value for money.

Letters

HMAS Westralia *Fire:* *Board of Inquiry report available on Internet*

I was reading the *Maritime Engineering Journal* today and started thinking about Cmdre Mack's comments about the fire on board HMAS *Westralia* (Commodore's Corner, Feb. 1999). On reading the *Westralia* Board of Inquiry report, I concluded that a) it was the best BOI report I'd ever seen, and b) there were a lot of great lessons in it about engineering practice, and mistakes that arise from making assumptions (pretty much what the commodore said).

I think it would be a real service to the Mar Eng community to publicize the report and its website: http://www.navy.gov.au/9_sites/o195/boi/report.htm — **Sue Dickout, DMSS 2-4, Ottawa.**

Letters

Francis in the Navy?

I have just been reading the February 1999 edition of the *Journal*, and have noticed what I believe to be an incorrectly captioned photo. In the Hedgehog article on page 20, I think the ship depicted is one of the ex-American "four-stackers" named after Canadian cities and rivers: HMC ships *Niagara*, *Annapolis*, *Hamilton*, etc. Definitely not *Fort Frances*, which was an Algerine-class minesweeper.

I do enjoy the *Journal* very much. Is there a chance of getting excess copies sent to the Warfare Centre? **— LCdr Doug Thomas, Editor of Maritime Warfare Bulletin, etc., Halifax.**

I can now confirm, after consulting MacPherson's *"Ships of Canada's Naval Forces*" that it is definitely *not* the Algerine-class minesweeper HMCS *"Fort Francis"* (sic) in the Hedgehog article photo. It is definitely one of the Town-class destroyers, as evidenced by its very distinctive bridge superstructure. The lower portion is the configuration as per the original build of these ships, and the upper portion is as modified in Canada in WWII.

The Town class in RCN service numbered eight (among them being HMCS "*St.*" *Francis*). These ships were a portion of the 50 ships transferred from the United States to the United Kingdom during the fall of 1940 in the "destroyers for bases" deal (Argentia, Bermuda, etc.) to help the RN close the gap in escort ship numbers until sufficient corvettes (and later, frigates) could be brought into service. Perhaps the most famous of these "four-stackers" was HMS *Campbeltown* which, loaded with explosives and modified to look like a German vessel, rammed the drydock gates at St. Nazaire, thus precluding the use of the dock as an Atlantic docking facility for German capital ships such as *Tirpitz*.

Given the evidence, I think it is safe to presume the ship in the photo is HMCS *St. Francis.* Regards, **— Pat Barnhouse, DSTM 3, Ottawa.**

[*A good eye, gentlemen – the four-stacker HMCS* St. Francis *it is indeed! A case of mistaken identity on the part of your production editor. My apologies to Dr. Douglas, and also to the Directorate of History and Heritage who had correctly identified the photo in the first place! — B. McC.*]

Forum

Engineering Recognition

Article by Cmdre W.J. Broughton (ret.)

I continue to enjoy reading the *Maritime Engineering Journal* and appreciate being kept on the mailing list. I was particularly interested in Lt(N) M.D. Wood's open letter in the October 1998 issue. Engineering recognition is, of course, a long-standing debate and perhaps your readers would be interested in some personal recollections from what is becoming the distant past!

Maritime engineers have come a long way since 1964. That was just two years after I completed my naval architectural degrees at M.I.T. You can imagine my consternation when the navy considered establishing a restricted duty list on the recommendation of the Tisdale Report, according to which any officer with a PG degree would be too specialized to rise above the rank of commander! I submitted my concerns and a rebuttal quoting the M.I.T. calendar which specifically stated that the purpose of postgraduate studies was to *broaden* (and deepen) the student. If integration had not come along, the intended policy would have gone into effect. And, on reflection, I am sure that I would not have stayed in the navy for 37 years.

When I was sent on Course II of the newly integrated Staff College in Toronto in 1967, I pursued my interest in the status of engineering within the service by selecting, "Dual-professionalism in the Canadian Armed Forces" as my major paper. Three particular groups were examined. It is important for clarity to know that I applied the term "specialty/specialist" to all officers (i.e. we are all officers first and then have a particular specialty).

I concluded that the first group, consisting of doctors, dentists, lawyers and chaplains, enjoyed a civilian view of their dual-professionalism in the CF, which was valid considering they were almost completely divorced from the prime warrior function of integrating available manpower and equipment into an effective fighting system. Hence, the policies of the time — particularly with respect to professional pay for doctors —were considered to be valid. Little has changed for them since then, other than to put them on the three-phase career employment scheme.

The second group I examined was air force officers. At the time they received extra pay throughout the rank structure even if they were flying a desk and only putting in minimum hours to maintain their flying qualification. (Needless to say I took a dim view of this.) I concluded that their dual-professionalism was *dipolar*, in that they received most of the benefits of both the civilian and warrior approaches to dual-professionalism. Hence, I wrote, "Both pilots and navigators must come under similar approaches to their professionalism as do engineers ...flying pay must be eliminated except as a risk pay when on flying duty, and status and career opportunities must be equalized between pilots and navigators and between aircrew and other specialists." In effect, I was saying that their professional obligation to be professional in the warrior role was no different from the obligation of engineers in theirs. As an aside, I drew attention to my discovery that navigators were even worse off than engineers in terms of rank status. Strength figures showed 73 percent as many navigators as pilots overall, but only 10 percent as many generals.

But what about engineers? First, I argued against the then recent thinking within the navy to train all officers (including engineers) for command at sea. For most, I said, it was "an unattainable myth and an unnecessary requirement. Dual-professionalism of all specialists must be based on professional ability in only one specialty, be it engineering or the management of violence, coupled with an underlying professionalism in terms of motivation to the service." As far as treatment was concerned, I noted that engineers fell into two subgroups — "the traditional military engineers and gunnery specialists who had a consistent warrior treatment of their dual-professionalism based on their long history and their intimate association and training for the conduct of battle," and "the variety of new engineers which have emerged in the twentieth century...whose status, employment and career opportunities failed to reenforce either a warrior view or a civilian view. The result was considered to be a neutral view in that the new engineers derive few of the benefits and most of the disadvantages of both the warrior and civilian approaches to dual-professionalism." Again you will notice that I called the warrior group a specialty, too, in an effort to seek more parallel treatment in personnel policies. Such an approach, I stated, meant unprejudiced personnel policies, including the following for the engineering group in particular:

a. no extra pay;

b. equal opportunity for promotion to all billets not requiring a warrior expert;

c. realistic job requirement specifications and posting opportunity, particularly with respect to opening up certain traditional warrior billets which need not be restricted to the warrior group (personnel being an outstanding example);

d. promotion percentages in terms of numbers and time-in-rank on par with the warrior group; and

e. staff training percentages on par with the warrior group.

Although at the time I thought I was "whistling Dixie," I think it is fair to say that much was redressed, not that I had anything to do with it. The navy in its wisdom adopted a "Best Sailor" approach, largely due to the foresight of vice-admirals Jock Allan and Chuck Thomas, and Cmdre Ray Ross. Flying pay was changed, although probably more for budgetary reasons than for considerations of sound personnel policies, and "any" positions were worked into the preferred manning lists of engineering classifications. I myself enjoyed my five years in personnel almost as much my time in engineering, and it certainly aided my career. I hardly see "purple jobs" (we used to call them "green jobs") as diluting one's engineering professionalism as Lt(N) Wood suggests. The question of extra pay will always reappear, but I still believe MAREs would lose far more than they would gain by taking that route. The *quid pro quo* would undoubtedly be limitations on both job and promotion opportunities.

Finally, I see the question of professional registration as a matter of personal choice. In my experience we were always encouraged to join appropriate professional associations such as the Society of Naval Architects and Marine Engineers, the Engineering Institute of Canada, the Association of Professional Engineers of Ontario, etc. Senior officers, military and civilian, were always willing to endorse our qualifications. Lt(N) Wood's letter brought back many memories. It is good to see junior officers taking their MARE role and their professionalism seriously, and being prepared to speak out on such an important and personal topic.

Cmdre W.J. Broughton retired from the navy as DGMEM in 1990.

The Naval Divisional System and its Fundamental Importance to Morale in the Navy

Article by Lt(N) Keith Coffen

I have chosen this moment to write an article for the *Maritime Engineering Journal* because the navy has begun to encounter significant difficulty in retaining properly qualified and experienced CSE technicians. As I understand it, last year there were 36 unplanned releases of NE Techs and 13 unplanned releases of NW Techs from the West Coast alone. At the Eastern Region Naval Technical Support Seminar held at the end of April, Cmdre Davidson and Cdr Bell of DGNP presented a bleak outlook for all technical trades on both coasts, as manning shortages are expected to continue throughout the next five to, possibly, ten years. Manning problems are not unique to the combat systems MOCs, and work is needed virtually everywhere in the navy to ensure these occupations do not become more critical than they already are. Certainly, the recent pay raises and the proposed cost of living allowance will help to resolve some of the problems, but there is more to do than simply throw money at the problem.

It is my belief, confirmed to some extent by discussions with the sailors in *Huron*, that more important to our sailors than pay — is leadership. Our leadership, especially at the junior officer level, needs to improve. The divisional system is a key leadership tool, yet in my opinion it is suffering as a result of inattention from the officers who are supposed to lead it.

I will preface my remarks by saying that my views have been formed from a relatively short, four-year period of observation, and it may be that many of you who have the benefit of greater experience will disagree with my point of view. So be it. My intent is less to convince everyone that the navy is in dire straits than it is to prompt discussion about the divisional system among the officers charged with its upkeep.

The Divisional System

I recently read a book by historian David Bercuson, entitled "*Significant Incident*" [McClelland and Stewart, 1996]. While his book focuses primarily on the army and its leadership challenges, something he said struck me as appropriate to the navy also:

> Problems with family life, difficulties with career management systems, complaints about poor equipment, and gripes about officers and NCOs…are a normal part of army life. When soldiers believe that their leaders...care about them and appreciate their sacrifices, the complaints mean little.

It is my view that the divisional system is of paramount importance to the navy because it is our demonstration of such care and appreciation. The purpose of the divisional system is to foster loyalty to the navy and to build the morale of our sailors by seeing to it that their concerns as individuals are met. In the absence of a proper measure of care applied to the welfare of our sailors, morale begins to degrade. The ultimate manifestation of such degradation would be mutiny, like those which prompted Admiral Mainguy to recommend that the navy institute the current formalized system for the welfare of our sailors. Today, however, it is much more likely that degraded morale will result in sailors simply walking away from the navy, or taking on an "eight to four" attitude, both of which are essentially what we are seeing. For those of us who would blame that on the sailors, I offer these words from Gen. Jacques Dextraze (CDS, 1972-77) who once said, "*There are no bad soldiers — only bad officers.*"

Reduced morale degrades our capability as a navy to accomplish any given mission by robbing us of people, or by reducing the willingness of people to work to their full potential. Morale must be a fundamental concern for any leader with a mission to accomplish, and the divisional system is the naval leader's tool for building morale.

As I see it, there are three key elements to the proper application of the divisional system:

a. Being available at all times to hear the concerns of our sailors;

b. Allowing the sailors to speak, and listening carefully to what they have to say; and,

c. Acting in their best interest, regardless of the burden we assume by doing so.

I have observed officers fail to meet one or more of these general principles regularly throughout my brief career. We are busy people, and it often seems undesirable to take time out to deal with problems that seem to have no immediate import. We need to remember that failure to deal promptly and satisfactorily with such concerns will have a cost in terms of the regard our sailors hold for us. There is always off-duty time to catch up on work that may have shifted to the right as a result of a divisional matter. Officers should be prepared and expected to spend that time.

The proper application of the divisional system is more important to us than any technical issue we might ever face. It has, however, been my observation that many divisional officers have a tendency to hold the divisional system as a subordinate concern to "their real job," which is viewed as strictly technical, or in the case of our MARS brethren, strictly operational. I think it should go without saying that no matter how good an engineer or tactician we may be individually, we run the risk of being unable to accomplish our mission by not demonstrating strong leadership. Strong leadership builds morale and a genuine desire to accomplish the mission in the hearts and minds of our sailors. There is more to leadership than simple technical or operational skill. Certainly to win the respect and trust of a sailor, an officer must excel in his or her area of expertise, but this is not enough. Officers must also concern themselves with, and be very visibly seen to be concerning themselves with, the well-being of the teams they lead, without whom the mission would either not be accomplished, or would be accomplished at greater fiscal or human cost than necessary.

I have attended three of the so-called "junior officer" symposia, now, and while each meeting was more than three hours long, not one minute of that time was spent discussing issues that affect our sailors. Instead, we tended to focus inward on a steady stream of complaints about promotions, pay, and ORO or HOD selection. I am as guilty as anyone else in this matter, having rationalized that the forum was really for junior officer issues and that it would not have been appropriate to raise other concerns. Lately, however, I have begun to ask myself how often, as junior officers, we get access to DGNP or any other element of the Personnel system. In reality, we have in those meetings an ideal forum in which to air some of our concerns for our sailors. We have an obligation as officers to focus more of our attention on our sailors and less on ourselves, whatever the perceived personal costs may be. While the concerns are raised by and for junior officers during these meetings do have validity, I question whether the voices complaining most loudly about promotions and so-called "deep" selection are in fact those most deserving of either promotion or selection. By complaining so loudly about our own problems, we demonstrate a certain blindness to the basics of leadership and our responsibilities as officers — our ships, our men, ourselves, isn't it?

Conclusion

The divisional system is one of the things makes the navy unique. It is not found in private industry, and the reason for this, mutinies aside, is that the navy is (or is at least supposed to be) comprised of better leaders than would be found in the average private company. The divisional system is a formal demonstration of our concern for our sailors and our commitment to their well-being. It is a guarantee that we will put their concerns ahead of our own. The divisional system, when properly applied, will win loyalty and build morale, which is of course what it was designed to do.

Junior officers have a vital role to play in upholding the divisional system and using it to serve the needs of their sailors, thereby setting a positive tone in the day-to-day working environment in the fleet. We are, in an era of scarce resources and increasing workload, as pressed for time as anyone, and it does indeed require a great deal of effort to make time available to every member of our division. The fact remains, however, that this is our duty. Officers are officers not because of their education and training, so much as because of their greater commitment to duty and their ability to lead. We need to ask ourselves regularly whether or not we are doing the best job we can for our sailors, and act according to the honest response.

Lt(N) Coffen was, until recently, the Assistant Combat Systems Engineer in HMCS Huron.

The Canadian Navy's Solution to Simulation-based Command Team Training

Article by LCdr Steven Yankowich

With the introduction of 12 *Halifax*-class frigates into the fleet, the Canadian navy's operational capability has undergone a significant revitalization. To fully realize the potential of the technology employed by this class of ship, a comprehensive and modern training system must be established. The core of an effective naval training system is command team training, and the Canadian navy's Operations Room Team Trainer (ORTT) is designed to fulfill this critical role. This paper describes the unique and cost-effective approach through which the ORTT is being designed and implemented.

Background

Canada's *Halifax*-class frigates employ a fully integrated combat systems architecture in which all shipborne control, sensor, weapon and communication systems are interfaced to the central command and control system (CCS). The CCS is comprised of 22 AN/UYK-507 digital computers, executing compiled CMS-2 software in an SDX real-time operating system environment. The computers are deployed in a distributed configuration and networked together via a triple-redundant, four-channel serial data bus. The integrated system performs the functions of navigation, target detection, acquisition, tracking, classification, threat analysis and evaluation, localization and engagement. The system is capable of automatic threat response up to and including weapon firing.

The command information organization (CIO), or operations room team, is comprised of 11 operator positions (including the bridge officer of the watch) which interface to the CCS through multifunction display consoles. The displays provide the principle operator-combat system interface and facilitate command of the ship, compilation of the tactical picture and control of the ship's sensors and weapons.

The ORTT is required to provide CIO team training in command, control, communications and intelligence for anti-submarine, anti-surface and anti-air warfare operations in a realistically simulated multithreat, multiplatform time-stressed environment. It must present dynamic simulations of tactical engagements to exercise the team in picture compilation, procedures, operations and the execution of tactics in a variety of simulated scenarios which may occur during peace or wartime conditions. To satisfy the training requirement, the ORTT must be capable of providing simulated natural and tactical environments necessary to support operator interaction with high-fidelity communication, sensor and weapon systems (*Fig. 1*).

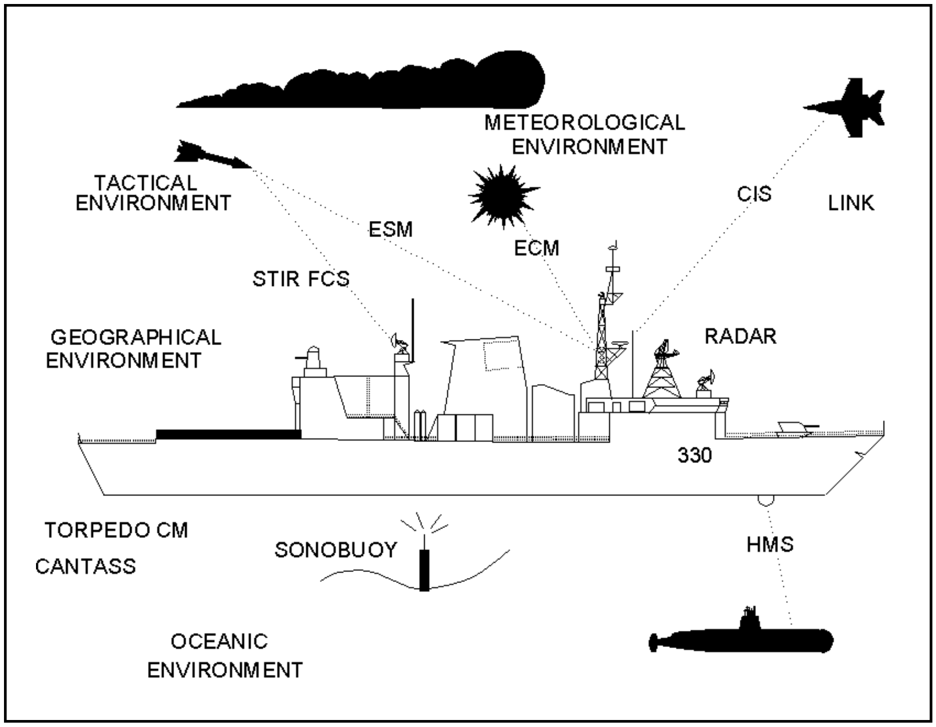


Fig. 1. Simulated Ship's Tactical Environment

Simulation Requirements

The ORTT must provide a realistic training environment in which the full CIO teams for two independent *Halifax*-class ships (herein referred to as "cubicles"), accessing a common scenario, perform their individual and collective processes through interaction with simulation-driven equipment systems which accurately reflect actual shipborne command and control system functionality. Specific systems requiring high-fidelity simulation include:

- Radar video — mode dependent rendering of contacts, coastline, chaff, jamming and environmental clutter;
- Interrogation Friend or Foe (IFF);
- Link-11;
- Weapon, electronic warfare (EW) and acoustic systems interface and control;
- Fire-control (FC) system interface and control;
- Navigation system interface and cubicle simulated ship (ownship) control;
- All operations room panels and displays;
- Integrated internal/external communications system, including all transceivers; and
- Visual rendering of the simulated external environment to the OOW, including visual display of contacts, coastline, sea state and other environmental conditions.

Trainer Control Requirements

Trainer control is required to support scenario generation and execution, operational environment simulation, and real time monitoring of the CIO team performance in each cubicle. Trainer control functionality is comprised of three roles: instructor, support station operator, and gamepiece operator.

Instructors must have the ability to monitor the actions of all CIO members in both cubicles, with any four positions being monitored simultaneously. Instructors will use this monitoring function to listen in real-time on any communication circuit; view in real time the tactical picture compiled at each CIO member station; and witness in real time each member's interactions with panels and displays. In addition, instructors must have the capability to dynamically interact with, control and change the scenario being executed. Prior to a training exercise, instructors must be able to script a scenario, allocating roles, tasks and event-dependent behaviour to selected gamepieces.

Support station operators fulfill the role of the ships' fire-control, electronic warfare, acoustic warfare, and ship control subteams. They must exchange information with the CIO team via the internal ship communication nets, configure the simulated weapon and sensor systems in accordance with the direction of the CIO team; and with the aid of semi-automatic detection models, input track data to the appropriate cubicle CCS.

Gamepiece operators control the movements and actions of individual simulated gamepieces. They must have the capability to participate in external cubicle communication nets and dynamically interact with the cubicles' CIO teams as either a neutral, friendly or hostile element. Gamepieces not specifically controlled by gamepiece operators must behave in accordance with scripted, event-driven behaviour.

Debrief Requirements

Selected portions of monitored data (both voice and visual) must, at the instructor's discretion, be recorded during the execution of a training session. At the conclusion of the training session, the instructor must be able to compile and execute an integrated debrief whereby all the recorded data is played back in a formal instructional setting.

Scaleability/WAN Requirements

The ORTT must be scaleable to include additional cubicles situated in disparate geographic locations. To expand beyond intracubicle training, it must be

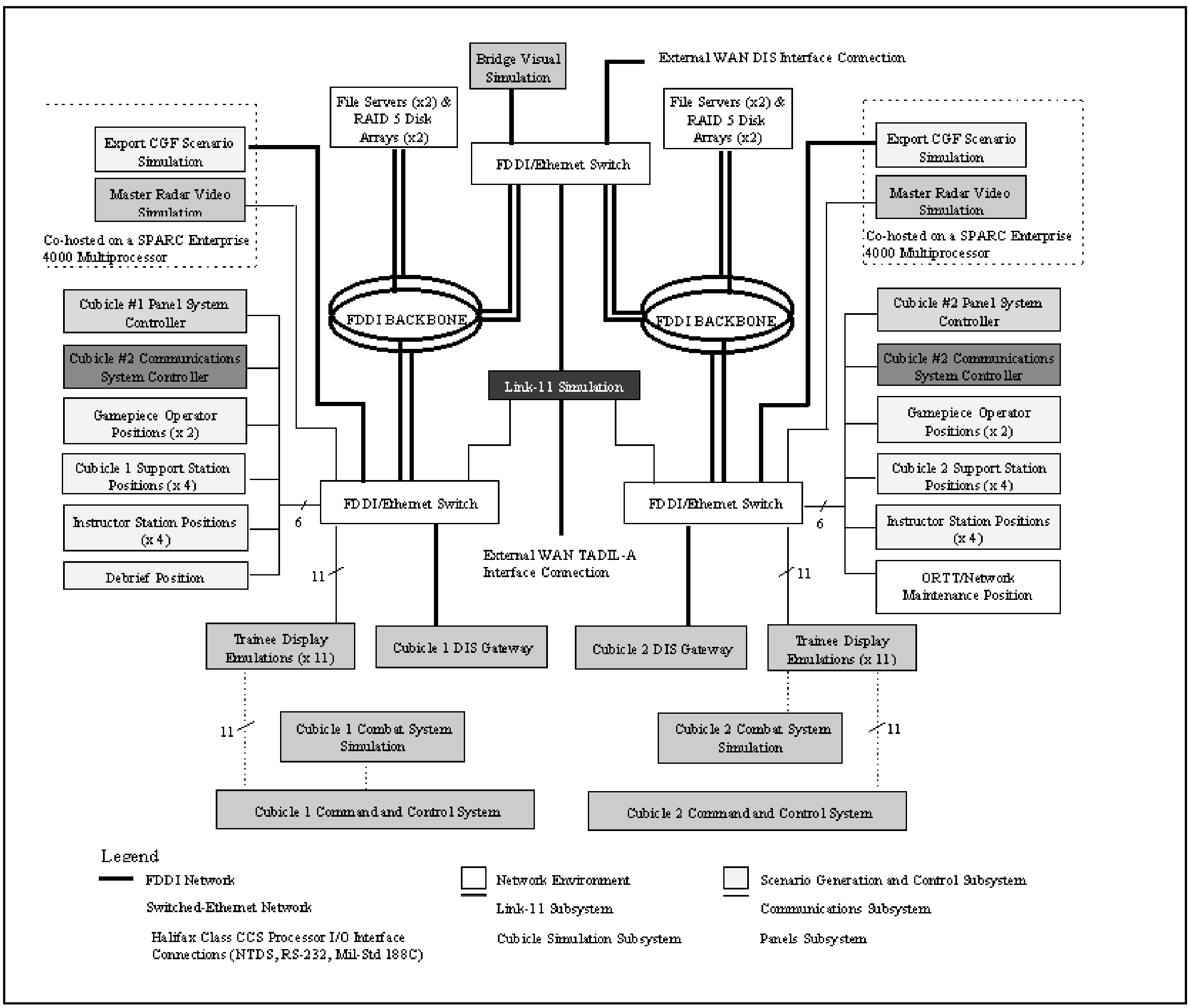


Fig. 2. ORTT Network Topology and System Architecture

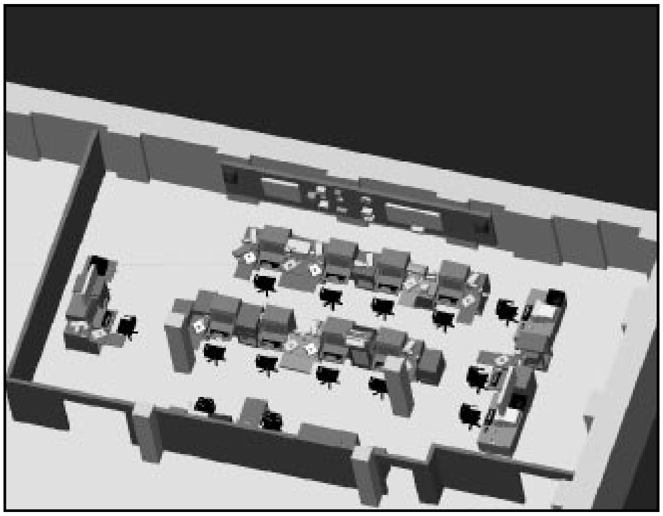


Fig. 3. *Halifax*-class operations room

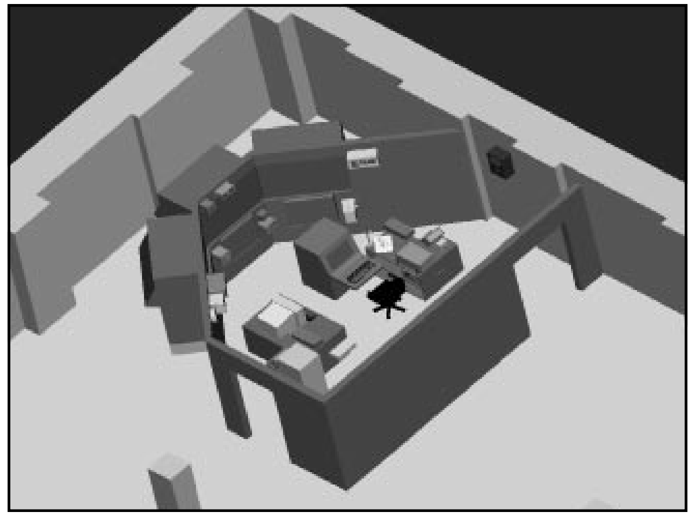


Fig. 4. Bridge station (ORTT)

compatible with other simulation systems employing the Distributed Interactive Simulation (DIS) standard.

ORTT System Design

The ORTT design incorporates a distributed network architecture and core system functionality largely consistent with similar in-service trainers. This functionality is broken down into the following subsystems (*Fig. 2*):

- Cubicle simulation (trainee interface);
- Link simulation;
- Scenario generation and control (SGC); and
- Communication simulation.

In addition to the functional requirements (scope), the ORTT design team was constrained by established parameters of quality, cost and schedule performance. Although cubicle fidelity to the actual ship system was the primary factor in the determination and selection of candidate solutions, more design flexibility was allocated to the scenario generation and instructor interface requirements. Each design choice was ultimately evaluated on the basis of the following criteria:

- Risk (technical, and schedule);
- Cost;
- Reliability, availability and maintainability; and
- Life-cycle support.

Commercial off-the-shelf (COTS) product-driven solutions, integrated in strict accordance with the open architecture methodology, were incorporated into the ORTT system to the maximum extent possible (as dictated by the requirements). This approach facilitated the implementation of a standards-based system with a configuration of software and hardware that was flexible, accessible to a wide range of designers/developers, widely supportable, and more cost-effective to implement than military-standard compliant systems of similar complexity. Wherever possible, new software was developed using POSIX-compliant C++ compiled for execution in a Solaris environment. Network and processing hardware were selected on the basis of cost, performance and proliferation in the commercial marketplace.

Network Architecture

The ORTT network topology (*Fig. 2*) is based on an open and distributed architecture consisting of several interconnected local area networks (LANs). The architecture incorporates the use of heterogeneous platforms, layered communication protocols, high traffic isolation and distributed application software. Increased flexibility and scaleability are facilitated through the use of multiple routing pathways and switching devices equipped with virtual LAN capability.

The ORTT network consists of two independent Fiber Distributed Data Interface (FDDI) timed token rings of Ethernet switches. This topology is symmetrical with two FDDI backbone networks, each supporting the dedicated simulation elements for one cubicle (e.g. DIS Gateway, panel system interface, communication system interface) and distributing the common simulation elements (e.g. SGC, Link-11). The two dual-attach contrarotating FDDI backbones provide redundancy and increase availability of the overall system. The FDDI 100-Mbps bandwidth is sufficient to handle the worst-case backbone traffic congestion with enough surplus bandwidth to enable the addition of a third cubicle. Switched Ethernet provides a mechanism to increase the effective subsystem network bandwidth (subsystem to backbone) to 10 Mbps, while maintaining standard COTS adapter cards in connected hosts. Furthermore, Switched Ethernet provides the means to effectively regulate, monitor and manage LAN operation.

There are three backbone switches in the ORTT architecture. In addition to providing data filtering and routing capabilities between network segments, each switch provides two dual-attach FDDI ports, six single-attach FDDI ports, and 38 Ethernet ports. Each switch provides an integral FDDI concentrator capability with single-attach FDDI connections to the backbone for selected bandwidth critical elements (e.g. DIS Gateway, Link-11 node).

Communication (network and/or transport layer) protocols for distributed applications hosted across the FDDI and Switched Ethernet networks are TCP/IP. Between applications, session layer message communication is achieved using UNIX sockets for real-time critical applications, and remote procedure calls for all other applications.

Network monitoring and ORTT system configuration and maintenance are conducted through a trainer maintenance position executing custom software hosted in a Solaris-based Sun Enterprise 2 station interfaced to the network via a Switched Ethernet connection. Four Dual Ultra-SPARC fileservers, each interfaced to the network via a dedicated FDDI connection, provide the means for file loading, saving, and backing-up the ORTT system to RAID-5 disk arrays.

Cubicle Simulation

The cubicle simulation subsystem provides the CIO team with the high-fidelity operations room (*Fig. 3*) and bridge training environments (*Fig. 4*). It is comprised of the eight segments described below. Each segment is hosted in its own environment and interfaced to the other segments via a switched Ethernet and/or an FDDI network connection.

1. CCS Software and Hardware. The heart of the *Halifax*-class ship is the integrated command and control system (CCS). The stringent fidelity requirements, coupled with the large quantity of unknown combinations and permutations of operator interactions occurring during team training, preclude the ready application of COTS simulation development tools to emulate this system. Consequently, it was decided that the best risk/cost solution was to retain the off-the-shelf CCS unmodified software as a fundamental component of the cubicle simulation subsystem.

The unmodified CCS software necessitated using hardware which identically emulates that deployed in the ship. The risk and cost associated with the emulation of the shipboard UYK-507 computers and serial data bus were substantially reduced by rebuilding the required CCS hardware to commercial standards using commercial power supplies, chip sets, boards, interconnects and chassis. The performance and net saving of employing this “commercialized” hardware was more than 50 percent. Other CCS component emulations, such as the trainee display console, were completely redesigned and built using commercially available tool sets and hardware solutions.

2. Trainee Display Console Emulation. The primary operator interface to the CCS is facilitated through a multifunction display console which supports the display and control of all CCS functions as well as the display of processed radar video. The in-service military-standard display console satisfies the ORTT CCS I/O requirement, but the monitoring and radar video requirements render it difficult to integrate into the cubicle simulation subsystem. Accordingly, a less expensive, wholly COTS derived solution was implemented.

To satisfy the human/machine interface (HMI) fidelity requirements, the trainee display console emulation chassis was built, using commercial standards and products, to replicate the look and feel of the Mil-Std display console. A gateway application hosted in a VME-mounted Power PC processing environment and employing the VxWorks real-time operating system provides the bidirectional interface between the Naval Tactical Data System and the CCS. The gateway is interfaced to a Solaris-based 300-MHz, dual Pentium PC which hosts and executes the graphic generation and the HMI control applications. All HMI events, graphics and radar video are generated using the X-Window Library system. In each trainee display emulation, a local X-server is used to detect HMI events and generate graphic/video in response to X-requests transmitted from a client. Since X-servers can be either local or remote, active or passive, this approach enables remote instructor stations to monitor trainee actions by recreating, using X-requests transmitted over the network, the complete graphic/video picture seen by a given trainee. All X-requests from all display emulation X-servers are transmitted via a Switched Ethernet connection across the ORTT network, enabling any instructor to simultaneously monitor any combination of trainees.

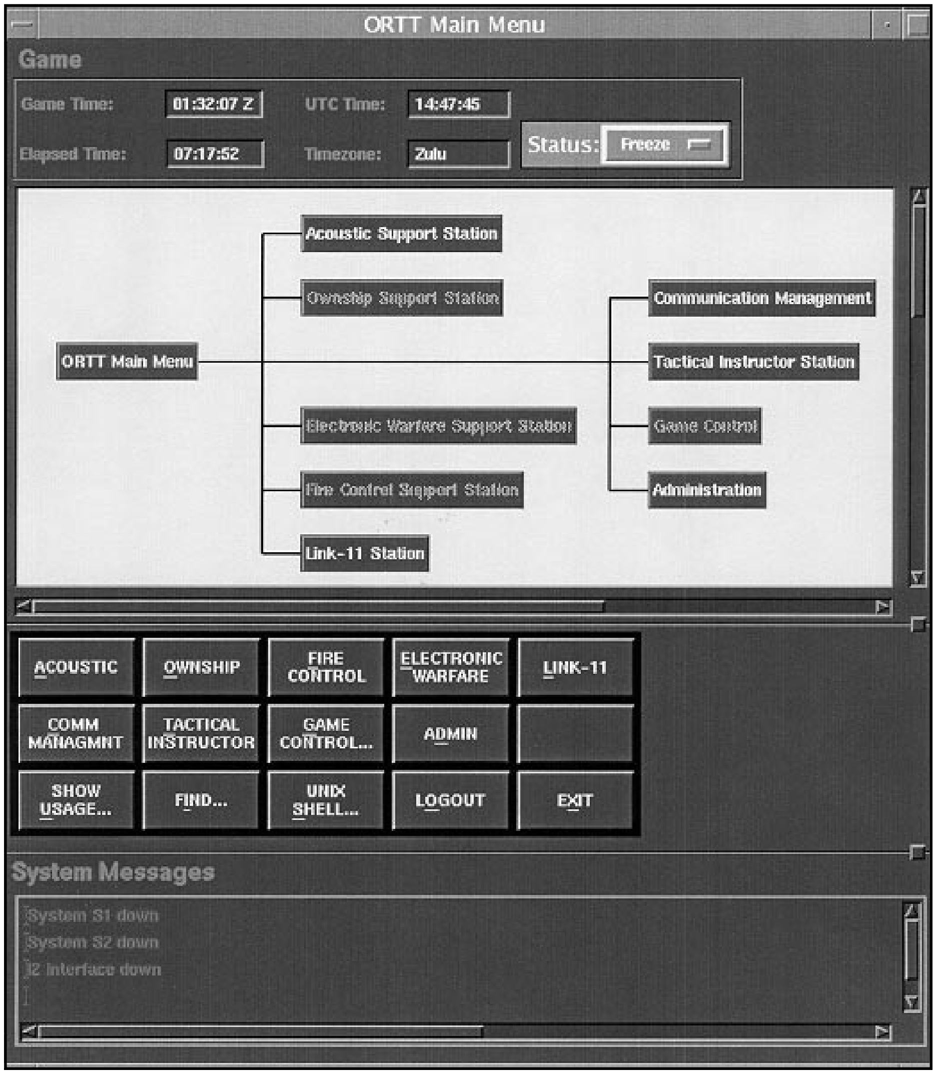


Fig. 5. ORTT main menu HMI

3. Combat System Simulation (CSS). In addition to the 11 display consoles, the *Halifax*-class command and control system has 26 discrete interfaces to the weapons, sensor and operator panel systems comprising the ship’s overall combat system. Providing a new high-fidelity simulation for each of these interfaces would have required substantial software development and cost risk. Fortunately, a proven *Halifax*-class combat system simulation (CSS) software/hardware architecture already exists. Used for CCS software support and lower level team/subteam training, the CSS architecture provides functionality applicable to the ORTT requirement:

• Proven functional I/O to CCS interfaces;

• Models to support simulation of each combat system;

• User interface to control the simulation of the combat system equipment; and

• Management of a simulated target database.

The existing CSS software is compiled and executed in the same processing environment as the operational command and control system software. The substantial modifications required to enable the level of simulation and instructor control specified for the ORTT could not be accommodated within the constraints of this legacy environment. Consequently,

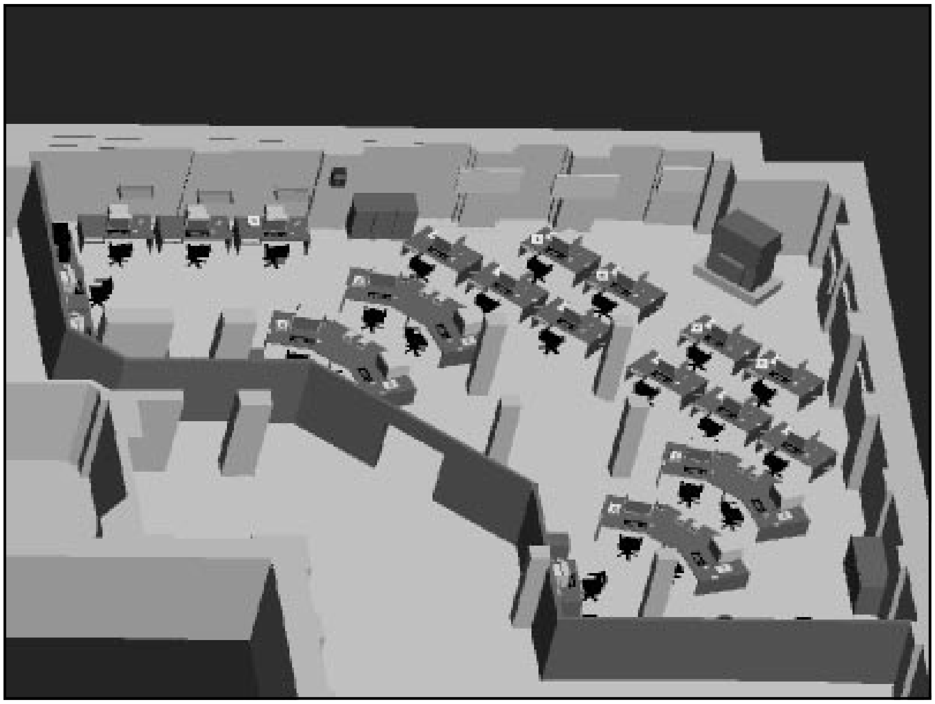


Fig. 6. ORTT trainer control

jection monitors. Land topography (consistent with the area of the world in which the game is situated), environmental effects and a dynamic sea state are displayed in conjunction with the gamepiece models. Each model is updated 30 times per second, creating a realistic visual environment.

Consistent with the open architecture design approach employing COTS technology, the gamepiece model, dynamic sea-state model and land topography (coastline) visual simulations are created using Multigen OpenFlight databases. Real-time rendering software is OpenGL compliant, with simulation extensions provided by IRIS Performer and Paradigm Vega. A Silicon Graphic's ONYX II computer running IRIX 6.2 provides the host environment.

8. DIS Gateway. The DIS Gateway is used to connect the cubicle simulation subsystem to the other subsystems. It receives natural and tactical environment information in DIS PDU format and translates the data into intermodule messages which are used to populate and maintain the CSS target database and to control the CSS simulations. Conversely, the DIS Gateway translates the intermodule messages into DIS protocol data units for use by simulations external to the cubicle simulation subsystem. It also provides intermodule message translation services for non-DIS compliant intrasubsystem simulations such as the panel system. Due to the large data throughput requirement, the DIS Gateway is interfaced directly to the ORTT system FDDI backbone. The host processing environment is a VME bus architecture with multiple Power PC processors running the VxWorks real-time operating system.

the off-the-shelf CSS software was modified to enhance individual combat system simulation functionality and increase the track database capacity. Additional simulation and all CSS human/machine interface functionality were offloaded to commercially developed software hosted in COTS processing environments distributed across the ORTT network. The CSS and the CCS are interfaced to the rest of the ORTT system via a purpose-built gateway developed and hosted in a COTS environment and linked to the ORTT network via a dedicated FDDI connection.

4. Panel System. The panel system emulates the required panels and consoles used for team training. Panels are either recreated virtually on a commercial PC, or rebuilt using commercial components with a micro-controller driven Ethernet interface to the ORTT system. The panel simulations accept input from the individual micro-controllers and the CCS (via the DIS Gateway). Depending on the panel, responses to operator input are processed by either the modified CSS or the new CCS interface simulations.

5. Support Station Simulations. Support stations provide functionality to allow the training staff to substitute for *Halifax* CIO members for whom there are no ORTT trainee positions. In the ORTT, support stations are required for ownship manoeuvring and control, fire-control/weapon system operation and control, sonar/torpedo system operation and control, and electronic warfare sensor operation and control. Support stations incorporate semiautomated, system-specific detection and information processing functionality that closely replicates the behaviour of the actual system. Custom HMIs are used to ease the support station operator workload and facilitate efficient transfer of information to the CIO teams. Support station simulation software is hosted by a Pentium PC running the Solaris operating system, and is connected to the ORTT network via a dedicated Switched Ethernet connection.

6. Master Radar Video Simulation. The master radar video simulation synchronizes the associated video contact, land topography and environmental effect databases, and generates the radar video picture for each operating mode of each of the three search radars. The video picture generated by the various sensor simulations is compiled in real-time and transmitted in the form of X-requests via a Switched Ethernet connection to each trainee display emulation and instructor station. The processing environment is a Solaris-based multiprocessor SPARC Enterprise 4000 server (one per cubicle) shared with the SGC subsystem.

7. Officer of the Watch (OOW) Visual Simulation. The OOW visual simulation was developed and implemented by a third party vendor. The system receives DIS protocol data units (PDUs) from the cubicle simulation and SGC subsystems via a Switched Ethernet connection to the ORTT system. Gamepiece-specific entity state PDUs are converted to high-fidelity models and rendered in real-time on three high-resolution 67-inch BARCO rear-pro-

Scenario Generation and Control (SGC)

The SGC subsystem provides the capability to define, script, execute and control simulation scenarios containing both cubicles and up to 300 simulated gamepieces. It is comprised of three distinct components: a user interface for the support station, gamepiece operator and instructor station positions; a customized version of the COTS integrated software system Export Computer Generated Surface Forces; and services for real-time monitoring, recording and debriefing trainee performance in the simulation environment.

Support Station, Gamepiece Operator and Instructor Station Human/Machine Interface (HMI). The HMI pages for each position were designed by navy subject matter experts for efficient and intuitive

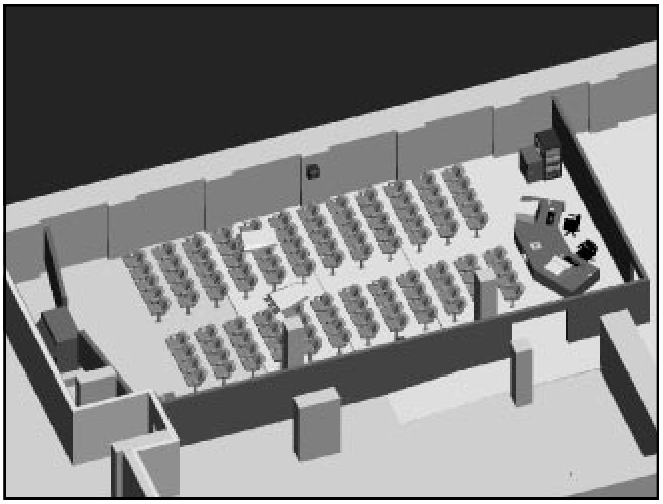


Fig. 7. ORTT Brief/Debrief Theatre

ner, independent of operator control. Predefinable scripts and behavioural rule sets enhance the complexity and realism of large tactical scenarios. Scenarios are created off-line with the operator selecting and configuring the sensor, weapon and behavioural characteristics of constituent entities. This information is stored in a database where it is extracted and used by high-fidelity simulation models to run real-time tactical scenarios. The effectiveness of these predefined scenarios can be validated off-line at accelerated execution speed.

control of information dissemination (*Fig. 5*). Individual pages were built using Motif widgets selected from a customized UIM/X tool kit.

Each support station and gamepiece operator position is configured with one Solaris-based, 166-MHz Pentium PC and one 21-inch monitor. Each instructor station is configured with one Solaris-based Dual 300-MHz Pentium PC with a graphics card driving four 17-inch monitors. This architecture enables the instructor to dynamically configure and change the information displayed on each monitor. Using the previously described X-request technique, the instructor is able to monitor up to four different trainee consoles at any given time.

Information from each ORTT subsystem is made available to the support station, gamepiece operator and instructor stations via a Switched Ethernet connection. Consequently, all positions, depending on the user's access permission, may be configured to enable real-time control of the other ORTT subsystems. Under normal operation, the instructor station positions are granted access to all HMI pages and functions, while the support station and gamepiece operator positions are granted access to a subset of these pages. This architecture provides flexibility and redundancy to the ORTT trainer control organization (*Fig. 6*).

Export Computer Generated Forces (CGF). Export CGF is a COTS integrated software system that configures and runs a synthetic tactical environment. It provides the core functionality through which the instructors create and control a tactical scenario comprised of large numbers of gamepieces. Definable physical, environmental and gamepiece behaviour models enable individual or groups of gamepieces to function in a realistic manner, independent of operator control.

To satisfy the ORTT requirements, Export CGF has been modified to incorporate a custom HMI, as well as more entity models, scripting functionality and behavioural rule sets. The software is hosted on two Solaris-based multiprocessor SPARC Enterprise 4000 servers shared with the Master Radar Video Simulation. Connectivity to other ORTT subsystems is achieved through the transmission and receipt of DIS protocol data units over the ORTT network via a dedicated Fibre Distributed Data Interface connection.

Monitoring, Recording and Debriefing. Through the custom HMI, instructors can monitor and record the true synthetic tactical picture, all trainee display pictures, panel system interactions, and communication circuits. Events within the recorded information can be tagged during game execution for extraction and playback during exercise debrief. All recorded information is stored over the network. Prior to exercise debrief, an instructor selects, extracts over the network, and compiles specific segments of recorded information for synchronized display (on one of three large-screen visual projectors) and audio playback in the ORTT Brief/Debrief theater (*Fig. 7*).

Link-11 Simulation

The Link-11 subsystem provides a tactical data exchange radio link environment to support each cubicle's Link-11 operations. It simulates Link-11 communication between reporting and participating units to produce a consolidated tactical picture. A total of 14 gamepiece participating units, and two *Halifax*-class participating units are supported — any of which can be designated as Net Control Ship. The instructors have the capability to dynamically create and change the Link-11 environment for each cubicle and gamepiece. Trainees interface with the simulation through the CCS and a high-fidelity microcontroller-based panel simulation. The simulation is comprised entirely of new development software hosted on a VME bus with SPARC processors running the Solaris operating system and interfaced directly to each cubicle CCS via a direct point-to-point NTDS connection. A dedicated Switched Ethernet connection is used to interface the simulation with the rest of the ORTT system. Specific synthetic tactical environment information (gamepiece identity, location, emitter information, etc.) is exchanged with the SGC subsystem via the transmission/receipt of DIS protocol data units.

Communications Simulation

The communications simulation subsystem provides the internal and external radio environment through which the cubicle CIO teams and the instructors communicate. The entire communications environment is simulated using a customized COTS solution supplied by a third-party vendor. High-fidelity microcontroller-based panel replicas are used to simulate the actual shipboard communications interface for each trainee position. Instructors interface to the system through a customized HMI, and have the ability to dynamically select and simultaneously monitor/record up to four separate circuits. Radio frequency propagation, communications range filtering and jamming effects are realistically modeled as part of the COTS simulation package. The communications simulation subsystem interfaces with the ORTT network via a Switched Ethernet connection. Intergamepiece range and emitter status data are exchanged with the cubicle simulation and SGC subsystems via the transmission/receipt of DIS protocol data units over the network.

WAN Connectivity

Connectivity with other DIS-compliant simulations is facilitated through a single connection to one of the FDDI/Ethernet switches and a separate connection for each of the communication simulation and Link-11 simulation subsystems. A routing table provides appropriate field of view filtering for the ORTT and distributes DIS data to the appropriate simulation. The customized COTS communication subsystem provides a separate interface for the integration of external communication circuits into a WAN exercise. Similarly, the Link-11 simulation can be integrated into a WAN exercise through a dedicated TADIL-A compliant interface.

Development and Integration Strategy

The ORTT development and integration strategy incorporates the incremental build paradigm. This approach is based on a structured design and development methodology which enables design issues to be identified and corrected early in the development cycle. A necessary prerequisite for the incremental build approach is a firm validated requirements specification. In the ORTT this specification is comprised of two substantial documents: the customer system specification and the ORTT detailed design data package. The system specification is a high-level text document enumerating 600 specific requirements. Its focus is what functionality the ORTT shall provide. The design data package focuses on *how* the ORTT system will provide the specified functionality. The system design is comprised of eight computer software configuration items and five hardware configuration items. The computer software configuration items are comprised of comprehensive software requirement specifications developed using the Rumbaugh Object-Oriented design approach. The hardware configuration items provide detailed hardware system product specifications.

In the ORTT adaptation of the incremental build paradigm, timing and execution of the system development, test and integration, qualification and delivery tasks are addressed based upon capability precedence and risk priorities. Using the information provided by the system specification and the detailed design data package, the ORTT system is subdivided into six manageable increments (builds) with each successive build adding functionality to the system as a whole. Each build is defined by its functional traceability to the system specification, and is described with a statement of functional objectives which may be directly associated with the ORTT high-level system requirements. In general, the ORTT incremental build approach achieves two objectives. First, it mitigates risk by enabling high-risk system elements to be developed early in the program cycle. Second, it compresses the project schedule by facilitating and synchronizing parallel development and integration of system components.

Builds 1 and 2 provide the entire network and message communication infrastructure. Builds 3, 4 and 5 integrate the COTS simulation applications and vendor supplied subsystems. Build 6 is reserved for the resolution of outstanding software deficiency reports. At the time of writing, Build 4 has been successfully closed out, Build 5 is 10 percent complete and Build 6 is scheduled for completion by summer 1999. The Canadian navy expects final acceptance of the ORTT in early 2000.

Conclusion

The Canadian navy's *Halifax*-class frigate Operations Room Team Trainer combines the integration of legacy software solutions with hardware emulation and developmental COTS-based solutions to create a cost-effective multiplatform, multithreat high-fidelity simulated command team training environment. Its powerful simulation applications and scenario generation and control subsystem enable the creation and dynamic interactive execution of realistic complex virtual exercises situated anywhere in the world. Its open architecture and Distributed Interactive Simulation compliance facilitate reduced life-cycle costs and flexible expansion to incorporate additional cubicle simulations and/or participation in a networked exercise comprising other DIS-compliant simulations.

LCdr Yankowich is the former project manager for the ORTT and MPT projects. He is now on exchange with the Royal Navy in England.

Maritime Engineering Journal Objectives

- To promote professionalism among maritime engineers and technicians.
- To provide an open forum where topics of interest to the maritime engineering community can be presented and discussed, even if they might be controversial.
- To present practical maritime engineering articles.
- To present historical perspectives on current programs, situations and events.
- To provide announcements of programs concerning maritime engineering personnel.
- To provide personnel news not covered by official publications.

Submission Formats

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

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

Extended Work Period Management — Principles for Success

Article by Irek J. Kotecki and David B. Jones

When the scheduled refits for HMCS *Athabaskan* (DDH-282) and HMCS *Iroquois* (DDH-280) had to be postponed until after the ships returned from their 1999 deployment with NATO's Standing Naval Force Atlantic, it was deemed prudent in the interim to schedule shorter duration extended work periods (EWPs) to handle essential maintenance and implement certain design configuration changes. The EWPs were relatively brief (17 weeks), but very intense, with configuration change being the predominant work. Both EWPs were highly successful, with all scheduled work being completed on time and to a satisfactory quality standard. By reviewing the conduct of these two work periods (*Athabaskan*'s in 1997; *Iroquois'* in 1998), certain common denominators can be identified as critical success factors for EWP management. The same principles and criteria would apply to any refit or other work period conducted in a commercial shipyard.

Normally, the EWP project is initiated several months prior to the actual commencement of work and does not terminate until some time after completion of work on the ship. Although extended work periods must be treated as stand-alone projects, each EWP should build upon the lessons learned from previous efforts — an especially important consideration in the implementation of large configuration changes throughout a ship class.

The overall success of the EWP depends on a series of linked activities, and on the actions and interactions of four groups: the project manager and his on-site team; the parent organization (NDHQ); the customer organization (formation/ship) and the contractor. The project manager can improve the probability of success through careful planning and execution of the project, and by being mindful of certain critical success factors. This paper sets out some of these key factors.

EWP Preparation

Planning

The importance of EWP preparation cannot be overemphasized. The average preparation time is approximately nine months, and many of the activities carried out in this period will directly affect the conduct of the EWP. Any errors in judgement or failure to effectively carry out certain tasks at this stage can jeopardize the successful completion of the work in the contract yard.

Preparation begins with the establishment of realistic milestones for the EWP. The milestones leading to contract award and commencement of the EWP are identified and initiated by the Dynamic Deliverable List letter, and should include the following principal events and minimum recommended lead times (longer in the case of a refit):

- 36 weeks prior to EWP start – Maintenance and Repair Specification List (MRSL) and configuration change specification preparation commences; shipboard MRSL review meeting;
- 22 weeks prior – MRSL approval;
- 20 weeks – MRSL distribution; MRSL review and revision;
- 17 weeks – Request for Proposal issue;
- 12 weeks – bidders conference;
- 9 weeks – bid closing;
- 6 weeks – contract award;
- 3 weeks – Ship preparations (destoring, deammunitioning, etc.); and
- 0 weeks – EWP start

The project manager prepares and implements a detailed activities plan to meet the set milestones.

Cost and Duration

Several months before the Dynamic Deliverable List letter is issued, the project's budget and duration must be established. The project manager estimates the level of effort required (work scope, duration and proposed schedule) based on the ship's maintenance history, condition, the backlog of configuration changes and the anticipated post-EWP deployment of the ship, and seeks project approval from the Director General Maritime Equipment Program Management in conjunction with the Director Maritime Policy and Project Development and the formation. Once the work scope and duration have been agreed upon and the corresponding project budget has been approved, detail planning commences. It should be noted that the cost and duration may vary depending on a contractor's geographical location and commercial market workload. It is important that all factors be fully analyzed and that a realistic budget and schedule be established.

Critical Path and Risk Management

A contracted work period has its critical risk areas. Properly assessing these areas and developing risk management strategies to deal with them should be one of the most important activities of the project manager during the preparation phase. The risk assessment must consider such issues as:

- *Is the proposed work achievable in the specified time frame?* Assume that the implementation schedule is based on a single shift, working weekdays.
- *Will material be available?* Consider the assembly and delivery schedule for government-supplied material, and the availability of contractor-furnished material, long-lead items, substitute material, etc.
- *What are the technical risk areas?* Produce risk notes to identify potential problems and propose solutions.
- *Does the on-site team fully appreciate the risk issues?* This requires on-site team involvement in the preparations.

During implementation — be prepared for the unexpected. Take a proactive approach and work *with* the contractor to anticipate and resolve problems.

The On-site Team

The composition and capability of the on-site team is the most instrumental factor in the success of the EWP. During implementation, it is this team that manages the day-to-day EWP activities on behalf of the project manager. Since the project manager must have complete faith in the on-site team and trust their judgement, he must have the right to select key team members. Due to the complexity and intensity of the EWP, there is no time for a learning curve for the on-site team. To be effective from day one, the core team members must have proven track records

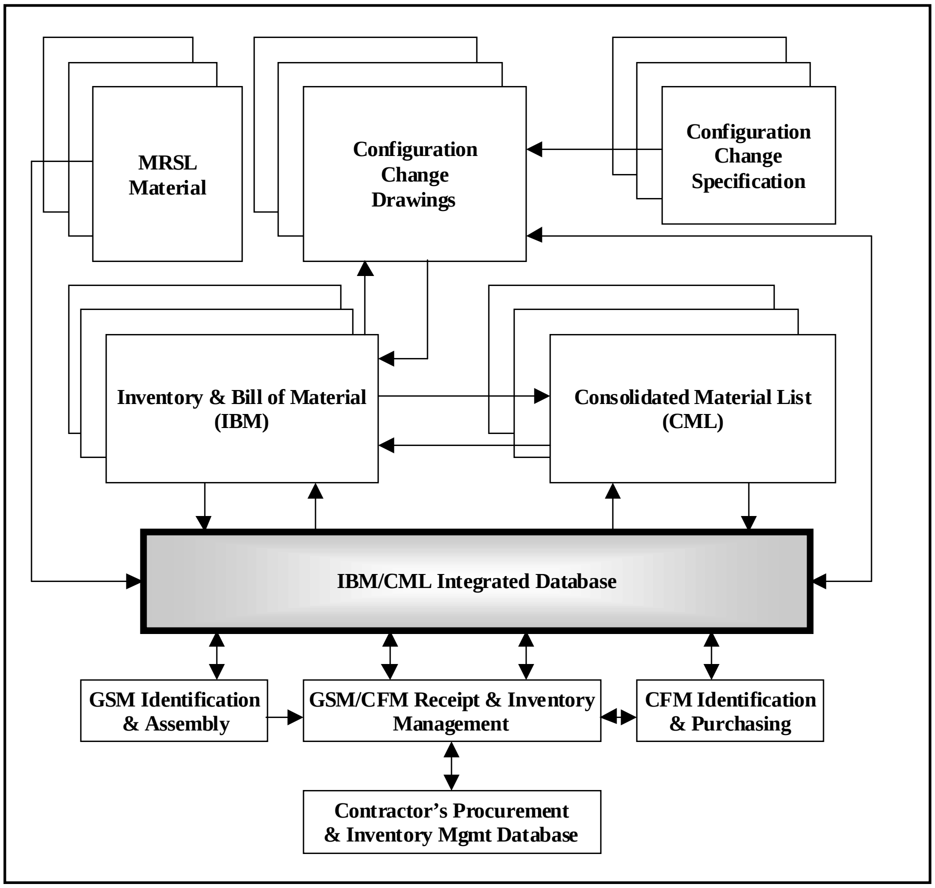


Fig. 1. Material Identification and Control

in their field, know the ship and its systems, and have engineering capabilities. The project manager can further stimulate the probability of success by:

• developing the commitment and sense of mission from the start;

• generating an attitude of co-operation and mutual respect and support; and

• having key team members participate in the decision-making and problem-solving.

Specification Review

Another critical factor for a successful EWP is the detailed review of specifications and drawings for Maintenance and Repair Specification List (MRSL) work, and configuration change work by key members of the on-site team and by the life-cycle material managers (LCMMs). This review serves several purposes in that it:

• familiarizes the on-site team members with the work requirements;

• permits an assessment of areas where one specification affects another, thus eliminating conflicts, contradictions and duplications;

• permits an understanding of the interconnection of work items in the same work zone;

• permits identification of material deficiencies;

• provides time to incorporate necessary changes to a specification (including lessons learned from a previous installation); and

• permits comparison of the installation drawings against the ship's configuration, and identification of interference points or other areas of conflict.

Government-supplied Material

When confronted with schedule constraints imposed by a short time frame and highly labour-intensive work periods, it is vital that government-supplied material be organized and available at the contract yard when work commences. Material is identified in the configuration change specification and drawings through the Inventory and Bill of Material. From this, a Consolidated Material List (CML) is generated and included with the specification to combine like items such as cable or piping in a single line item. Columns are added to the CML so that the LCMM and supply managers can indicate whether an item is government- or contractor-supplied. Thus, the Consolidated Material List becomes the primary document for material procurement. However, because the CML items reflect the requirements of more than one drawing item, it is not possible to determine the details of the item's end use without going back through the Inventory and Bill of Material to the drawing. This is an unwieldy process and is prone to errors.

When technical and logistics personnel encountered problems identifying and pre-staging government-supplied material for the *Iroquois* EWP in 1996, the on-site team generated a database in *Microsoft Access*™ to correlate the drawings, the Inventory and Bill of Material, and the Consolidated Material List (*Fig. 1*). The database proved to be invaluable as incoming material could now be readily identified by item, by the applicable configuration change, by drawing number and title, by drawing item number and by the MRSL specification number. In other words, the *end use* of each item was identified.

There were more than 7000 line items of government- and contractor-furnished material in the database for both the *Athabaskan* EWP at Port Weller Dry Docks in St. Catharines, Ont., and the *Iroquois* EWP at Davie Industries in Levis, P.Q. To reinforce the spirit of co-operation, DND provided the contractors with a copy of the integrated database created by the on-site team. In both cases, the contractors found the database to be an extremely useful and time-saving tool as it allowed them to combine the procurement of like items required for more than one configuration change (e.g. cables, valves, etc.) rather than have to order material separately for each configuration change. This resulted in significant economy of scale when purchasing.

At Davie Industries, the unexpected provision of the database by DND showed that the on-site team was sympathetic to the contractor's procurement problems, and went a long way toward establishing a team approach to the conduct of the EWP. What's more, a software interface established between the material database and Davie's procurement and inventory control system simplified and expedited the contractor's procurement and inventory control processes. And since virtually all of the government-supplied material was assembled prior to the commencement of the EWP, there were no schedule delays attributed to any late supply of material by the government. Taken together, these factors played a major part in the contractor's ability to deliver the required product on schedule.

Ship Preparation Plan

A comprehensive and widely promulgated ship preparation plan is an important factor in the successful commencement of the EWP. The plan is prepared by the EWP project manager, reviewed by the responsible authority in the formation and by the ship's commanding officer, and promulgated as a joint planning document. The plan sets out the responsibilities for the various players in the EWP, including the on-site team, and details the ship preparation requirements. There are many potentially conflicting activities that require co-ordination, such as deammunitioning, removing radar antennas and weapons, defuelling the water displaced fuel tanks, destoring, and starting the compartment turnover process. The successful commencement of the EWPs in both *Athabaskan* and *Iroquois* were the result of commendable effort by the ship's crew, the fleet maintenance facility, formation personnel and the on-site team, guided overall by a jointly developed, detailed plan.

EWP Implementation

Setting the Tone

As soon as possible after contract award, a "kick-off" meeting should be arranged with the contractor. This meeting is extremely useful for a number of reasons. First, it permits the key players from the contractor's staff to meet with the contract officer from Public Works and Government Services Canada (PWGSC), the DND project manager and key members of the on-site team. An important aspect of the meeting is to cultivate a "team" approach so that the contractor can be assured that the PWGSC/DND team understands the pressures faced by the contractor and will deal fairly with issues faced by both sides. The meeting also sets the stage for the delivery and turnover of the ship to the contract yard by dealing with such aspects as compartment turnover, berthing, jetty services, security, safety, defuelling and destoring assistance.

The short duration and highly labour-intensive nature of the work period make it absolutely crucial that the contractor be able to ramp up resources very quickly and begin meaningful work as soon as possible after the vessel has arrived at the yard. This means that several critical activities first have to be completed. For instance:

• The compartment turnover effort should begin prior to the vessel's transit to the contractor's yard, continue throughout the transit and be completed within two or three days after arrival.

• The initial work phase in the EWP involves stripping-out redundant equipment and systems as required by the various configuration change specifications. All of this material — the piping, cables, valves, panels, equipment, etc. — has to be tagged to indicate whether it will be scrapped, saved for re-use, or returned to stores. An offer should be made to the contractor to begin this work at the same time as the compartment turnover and continue it during the transit.

• It is also important that the ship be gas-freed as soon as possible after arriving in the yard — but it has to be defuelled first. *Iroquois*-class vessels have a water-displaced fuel system which requires special procedures for removing the fuel and effluent. Since the procedures are somewhat risky and should not be undertaken by inexperienced personnel, it was judged prudent in the case of the *Athabaskan* and *Iroquois* EWPs to have the ship's upper-deck stoker work with the on-site team to provide guidance to the contractor's staff on the defuelling. This DND assistance not only contributed to the safe and prompt defuelling of the ships, it also set the tone for co-operation with the contractor.

• Destoring ship is an all-hands activity, with labour provided by the ship, and cranes, forklifts and warehouse space provided by the contractor. This usually takes three to four days to complete.

• And finally, all government-supplied material should be delivered to the contract yard immediately after the ship arrives in the yard. Any discrepancies or shortfalls at this point should be aggressively pursued and resolved.

Procedures

On arrival at the contract yard, the on-site team should set up in the designated office area and establish smooth administrative procedures for handling work arisings, deviations, requests for technical information and government-supplied material, technical inspection requirements, etc. To facilitate this, the team prepares process flow charts which should be discussed with the contractor, amended as required, agreed to by the contractor, and promulgated to all concerned parties.

At the same time, the on-site team develops a responsibility assignment matrix to designate which member of the on-site team is responsible for each element of the work and for each technical discipline associated with that work. The matrix is then passed to the contractor to identify his counterpart staff responsible for each

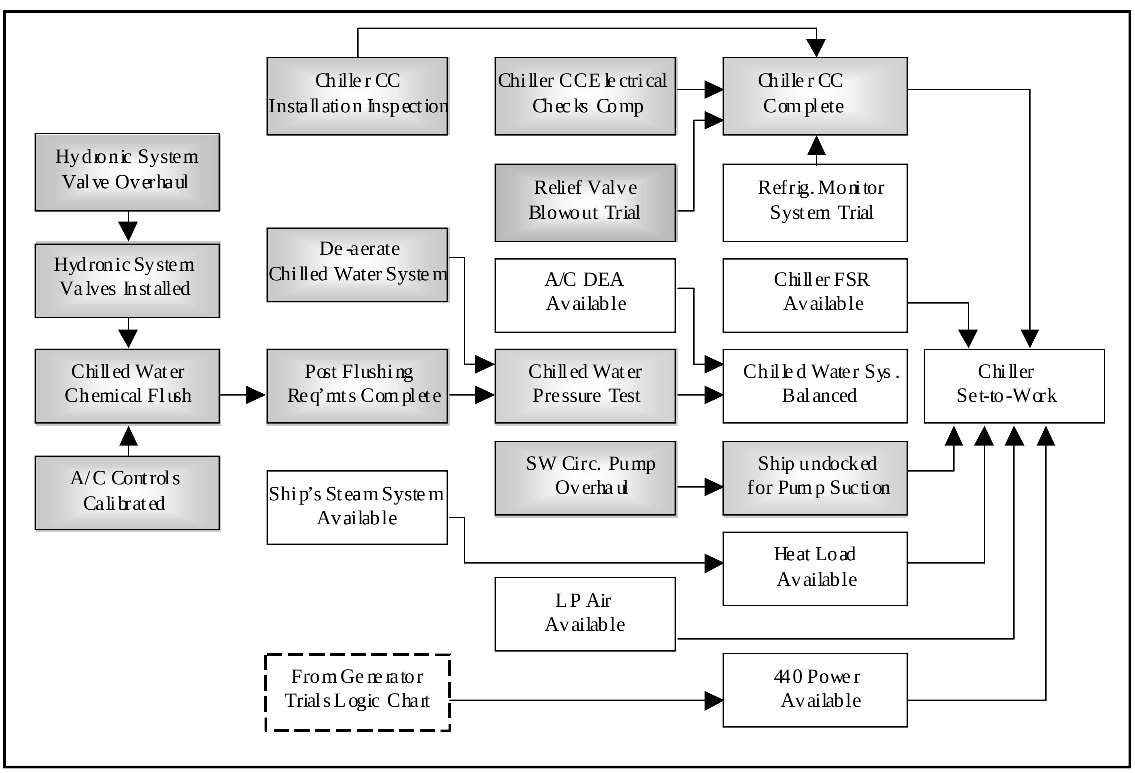


Fig. 2. Logic Chart for Chiller Set-to-Work

work item. In this way, personnel on both sides can meet at the commencement of the EWP and begin to establish a smooth and co-operative working relationship.

In the case of the *Athabaskan* and *Iroquois* EWPs, a large portion of the work entailed implementing large-scale, technically complex configuration changes. It was imperative, therefore, that the on-site team have sufficient technical knowledge of the configuration changes (including how the new systems integrated with other related ship systems) to be able to respond quickly and professionally to contractor requests for detailed technical clarification *right down to the subtiers of referenced specifications called up by the configuration change specification*. Individual members of the on-site team also had to be aware of how the implementation of certain configuration changes affected the implementation of other changes, and what impact that had on the EWP schedule. They also had to know when to go to the LCMM, or other engineering authority for technical advice.

Contractor's Master Schedule

One of the most important factors in the success of the EWP is the integrity of the master schedule that is developed and followed by the contractor. Because these schedules are largely generic, they do not always logically integrate work items nor take into account the need to reactivate systems in an orderly and achievable fashion. Thus, with a view to providing constructive suggestions for improvement to the contractor, the on-site team must undertake a detailed review of the master schedule.

To do this effectively the team must first fully understand the highly complex interconnection of work items. Consider an example from HMCS *Iroquois*' 1998 EWP. At one point the critical path work involved stripping-out four 75-ton chiller units and installing three 125-ton units in a new configuration. Completing this work was an essential habitability prerequisite to remanning the ship, yet the chiller reconfiguration work was itself affected by other related work items, including the overhaul of 67 chilled water system valves, the removal of 300 Measure-flo valve diaphragms, a chemical and freshwater flush of the hydronics system, reassembly and reactivation of the system, and a complete balancing of the chilled water system. It also incorporated a new requirement to install a refrigerant monitoring system for two of the chillers.

To demonstrate the logical sequence of events, the on-site team developed a colour-coded logic diagram (*Fig. 2*), identifying both contractor and DND activities. But note in *Fig. 2* that a key requirement is 440 electrical power. Since jetty power was insufficient, it was necessary to ensure that at least one of the ship's generators was available for the chiller set-to-work. This in turn required its own sequence of events (and another logic diagram).

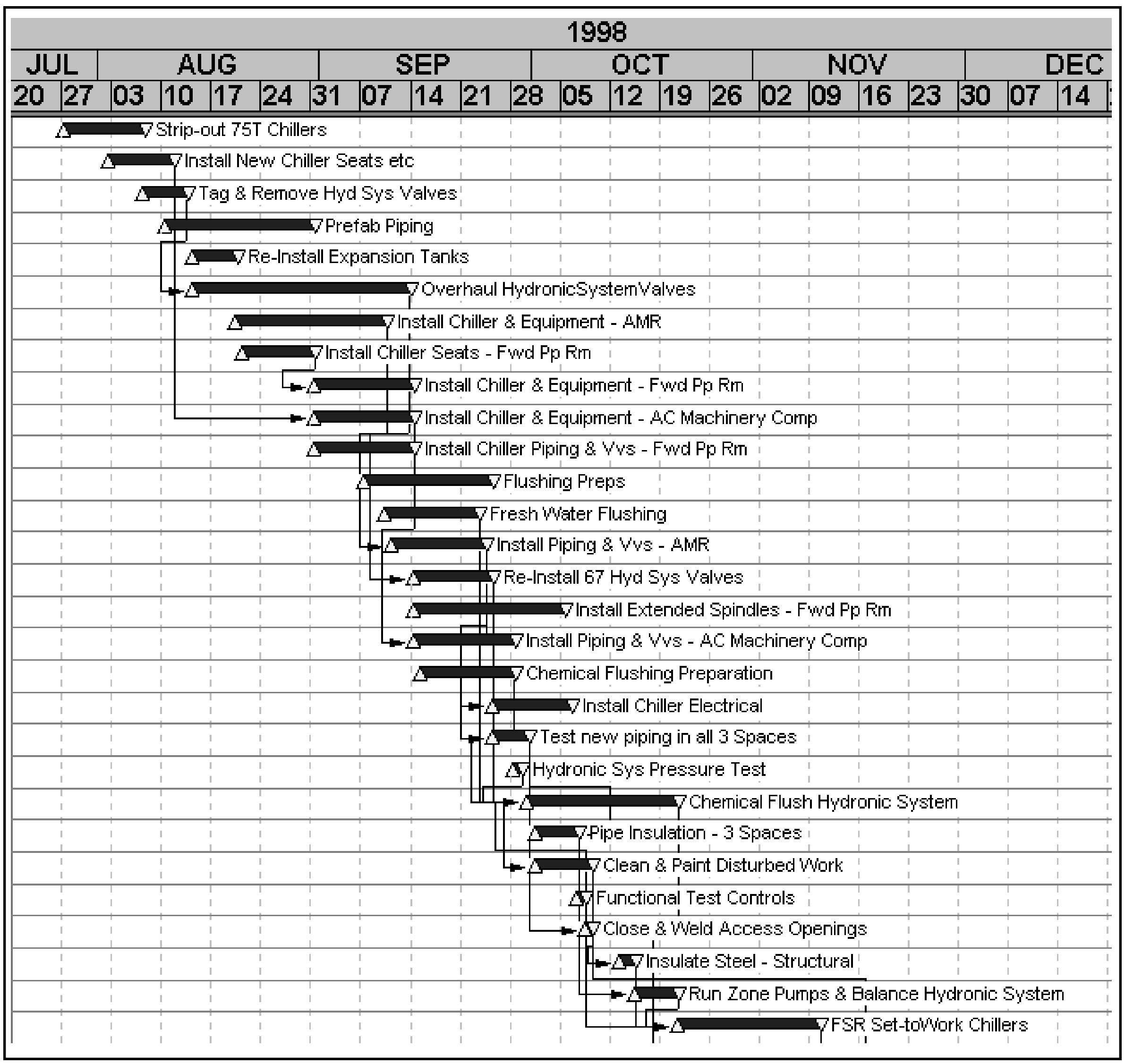


Fig. 3. Sample of detailed schedule for the integrated hydronics and chiller work

Using the logic in the charts, the on-site team was able to develop a detailed schedule for the integrated hydronics and chiller work (*Fig. 3*). Both charts illustrate the degree of interdependence of various work items and the need to consider these linkages when scheduling the work. These logic charts were developed for a number of linked work items and were used by the contractors in both Port Weller and Davie to revise the master schedule. Each week, the schedule was reviewed and, where slippage occurred, the contractor amended the schedule to reflect the revised dates. The willingness of both contractors to adopt and adhere to the revised

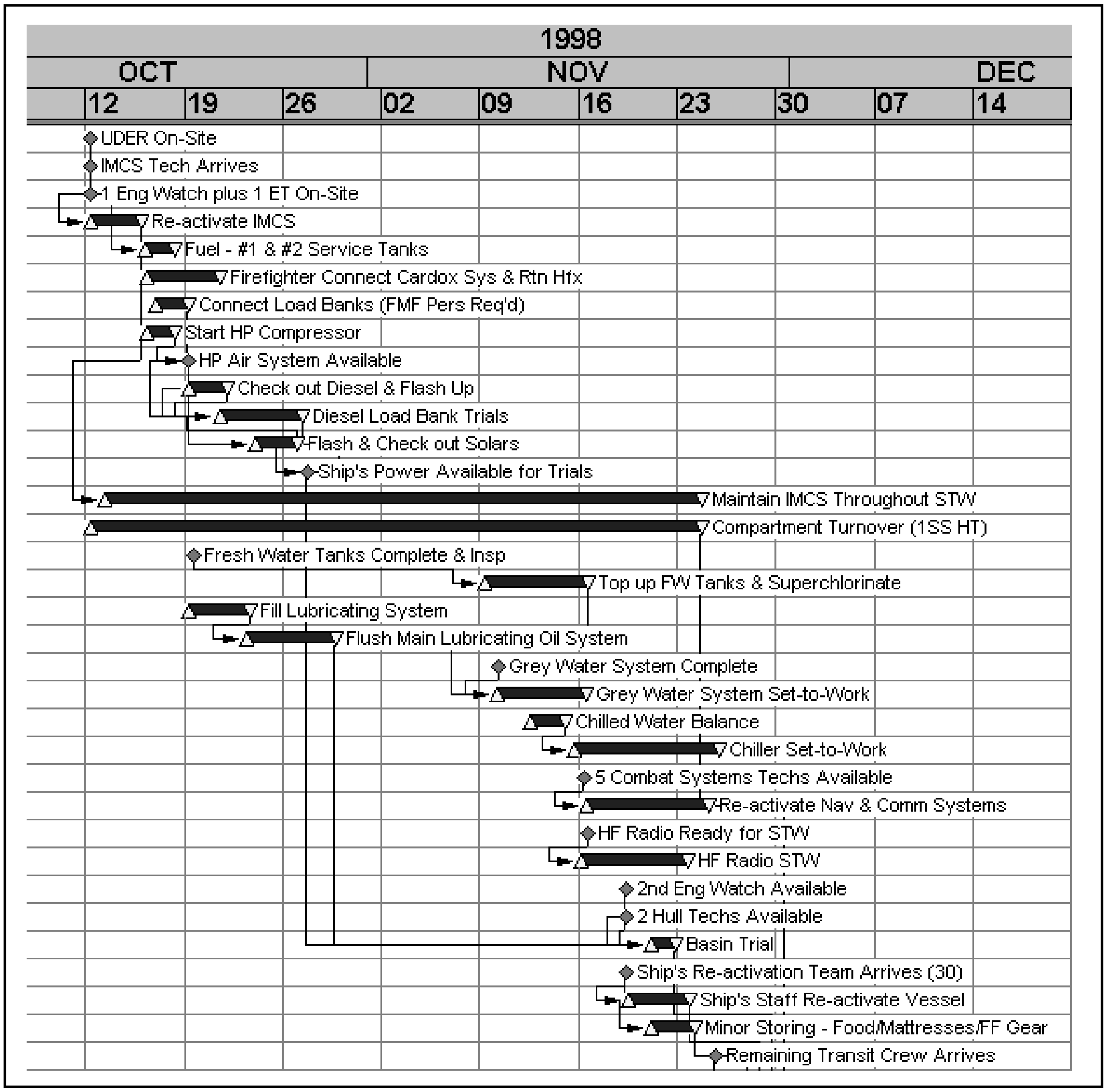


Fig. 4. EWP Integrated Completion Schedule

schedule was a very important factor in successfully meeting project milestones.

Final Phase

One of the most difficult challenges in managing an extended work period involves the co-ordination of work, trials, set-to-work and compartment acceptance in the last few weeks leading to delivery. The contractor's production supervisors are often competing for time and resources and are hard-pressed to complete assigned tasks on schedule. Subcontractors such as flooring, insulation and sheet metal workers are trying to complete their work. Refuelling is required for set-to-work activities. Attendance by field service representatives, LCMMs and designated engineering authorities must be planned in advance for set-to-work of configuration changes and related systems. Compartment by compartment, the ship must be cleaned, inspected and accepted by the Crown. The ship must also be made ready for the return transit as soon as possible after the EWP is complete.

With such a complex series of interlinked activities under way the potential is there for many conflicts and problems, yet there is little or no margin for slippage. This is one of the most critical management areas with potentially serious schedule consequences if errors are made. As problems arise, they must be dealt with and resolved quickly. Thus, management experience in the DND on-site team is an extremely important risk control factor in meeting the vessel completion schedule. To ensure appropriate management visibility, all of the final EWP work and certain non-EWP activities must be integrated into the contractor's work schedule for the final portion of the work period.

In the case of the EWPs for *Athabaskan* and *Iroquois*, an integrated completion schedule covering the last four or five weeks of the EWP was prepared by the on-site team (*Fig. 4*). This schedule co-ordinated set-to-work, trials and vessel reactivation activities by ship's staff and field service representatives with the contractor's own activities and completion dates as laid out in the master schedule. A draft of the integrated schedule was discussed at length with the contractor, PWGSC, DND staff and the ship, and was finally adopted by all concerned as the plan for completion and delivery of the vessel. Daily meetings were held throughout the set-to-work period to review progress, plan events for the coming week, and fine-tune the schedule to resolve conflicts and meet the target dates. The integrated completion plan showed its worth to management on both sides by making problems readily visible and by making it easier to determine the impact of late completion of any one activity on subsequent activities. Thus, the contractor was able to sensibly arrange his priorities and plan for shift work or overtime when required.

Set-to-work of new systems and equipment installed as configuration changes requires careful planning. Most new systems are set-to-work and trialled by DND using LCMMs, field service representatives and ship's staff, with assistance as required from the contractor. Prior to any set-to-work activity, a configuration change installation must be thoroughly inspected by the responsible member(s) of the on-site team together with contractor's staff to ensure compliance with the relevant specifications and drawings. Deficiencies are noted and (as far as possible) the parties agree on whether correction of the deficiency is the responsibility of the contractor or DND. The deficiency list is processed by the contractor's organization into a preliminary CF1148 Report of Inspection document. The deficiencies that affect the set-to-work of equipment change items (ECs) are identified and marked for immediate action by the contractor.

Prior to the set-to-work activity, the contractor is expected to provide the Provisional Acceptance Certificate (PAC) file for review and approval by the DND on-site team. This file contains inspection reports, certificates and other relevant documentation to provide evidence that the work has been completed in accordance with the specifications and drawings. A designated DND trial conducting authority then leads each set-to-work activity, noting any defects resulting from the trial in the preliminary CF1148. It is the responsibility of the conducting authority to ensure that the necessary trial documentation is complete and that the critical parameters have been met.

As the EWP contract work nears completion, the contractor is required to restore the vessel to an agreed-upon level of cleanliness. The physical condition of the vessel is documented at the commencement of the EWP by a joint contractor/DND team using deficiency forms and photographs of each compartment. This process is repeated throughout the final few weeks of the EWP and requires very careful planning by the contractor to ensure that a compartment, once accepted, can be secured to prevent unauthorized access. There is frequently a conflict between this activity and the need to enter a compartment to inspect a system installed as a result of an equipment change.

An essential prerequisite to the delivery and remanning the vessel is that basic habitability requirements be in place. This involves the reactivation and set-to-work of many systems, some of which had no work responsibility by the contractor. The reactivation of these systems is carried out at the same time as the contractor's work is being completed and set-to-work and trial activities are under way. For example:

- the heating, ventilation and air conditioning system must be operational;
- certain auxiliary machinery must be available;
- the fire-main and pumping systems must be functional;
- the ship's generators must be proven and available in the event of an emergency;
- the main refrigerators and galley must be functional;
- fixed and portable fire-fighting systems must be in place;
- accommodation areas such as messdecks, heads, washplaces and dining areas must be completed and accepted;
- internal communications need to be functional; etc.

All of these activities must be completed prior to acceptance for a successful turnover.

Post EWP Activities

EC Certificates of Compliance

At the completion of the contract, the members of the on-site team return to offices in the navy dockyard. An immediate priority is to assemble and check all of the redlined drawings resulting from the installation of equipment change items during the EWP. For each equipment change the arisings, technical information requests and EWP notebooks are reviewed to identify any specification deficiencies. All such deficiencies are recorded on Specification Deficiency Reports (SDRs), and a brief report is also prepared outlining any major problem areas and summarizing the installation costs. A package containing the summary report, redlined drawings, SDRs and a certificate of compliance is then submitted to the appropriate DMCM refit manager at NDHQ. The priority in preparing this package is put on ECs that are likely to be included in the contract requirements for a follow-on ship. This allows a clean-up of the specification and drawing package to be done to reduce the incidence of work arising, thereby reducing the EC installation cost in subsequent vessels.

Lessons Learned

A lessons learned report is prepared for discussion at a wash-up meeting some time after the EWP is completed. The contractor should be consulted as to how the Crown can improve EWP management processes and procedures. Where significant improvements can be achieved through changes in processes and procedures, the DMCM class desk should undertake to document and implement the changes. (The EWPs for *Athabaskan* and *Iroquois* prompted a reevaluation of the current maintenance policy for refits of *Iroquois*-class ships. As a result, a modified, more cost-effective, *Iroquois*-class maintenance profile has been proposed based on cyclic EWPs.)

Summary and Conclusions

As demonstrated throughout the paper, the success of any work period depends on several key factors. Although some factors are more crucial than others, to maximize the chance of success all elements must be included in the management plan. In summation, the "not negotiable" factors required for a successful work period or refit are:

- An EWP preparation plan must be developed and promulgated.
- A risk management plan must be prepared.
- The project manager must have the right to select key on-site team members;
- Key on-site team members must participate in preparations by:
  - reviewing the technical data package; and
  - pre-staging government-supplied material.
- A co-operative and mutually supportive team approach must be fostered with the contractor.
- Constructive input must be provided to the contractor's master schedule.
- Set-to-work and trials must be planned and conducted by the Crown.
- The ship reactivation plan must be developed and integrated with contractor's activities.
- The project manager must ensure that lessons learned, SDRs and redlined drawings are promptly produced and incorporated into the technical data package for the next EWP.

The project manager is ultimately responsible for the success or failure of the EWP and the results depend on his ability to incorporate the "critical success factors."

Acknowledgements

The importance of the Public Works and Government Services Canada contract officer's contribution to the success of the EWP cannot be overestimated. Michael O'Connor represented PWGSC during both EWPs. At Davie, he was aided by Mr. Paul Lachance. Mr. O'Connor's contribution to the success of the EWPs is acknowledged and his professionalism and support to the "team" approach are greatly appreciated.

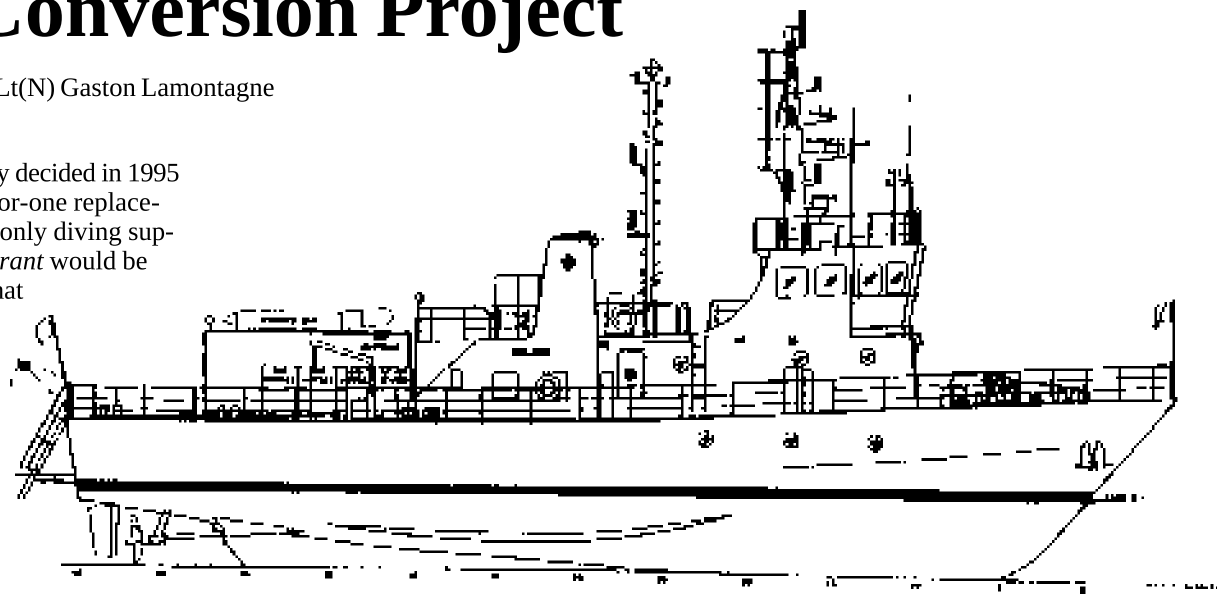
Irek Kotecki is the DGMEPM Iroquois-class refit manager at NDHQ.

David Jones is the president of LAL Marine Technical Services, which provided key members to the on-site teams.

Auxiliary Vessels:

Yard Diving Tenders — A Successful Vessel Conversion Project

Article by Ed Chan and Lt(N) Gaston Lamontagne



When the navy decided in 1995 that a one-for-one replacement of its only diving support ship HMCS *Cormorant* would be unaffordable, it meant that manned submersibles would no longer be part of the Canadian diving inventory after 1998. Instead, the navy chose to meet its deep-diving requirement through the acquisition of an unmanned ROV — the 1,000-metre capable Deep Seabed Intervention System — and a containerized system of diving workshops and recompression chambers. While the single ROV would have to be shuttled from one coast to another as required and fitted on one of the maritime coastal defence vessels (or other medium-sized vessel of opportunity), the workshop and recompression containers on each coast could be carried on much smaller platforms. The question was — Which ones?

Two of the navy's yard diving tenders (the wooden-hulled YDTs 8 and 9) were due to be replaced…and, as luck would have it, two other vessels in the Canadian auxiliary fleet — the torpedo and ship ranging vessels (TSRV) *Sechelt* and *Sooke* — had been declared surplus on March 31, 1996. (Could the TSRVs possibly be converted into diving tenders?)

Four of the 33-metre TSRVs had been delivered to the Canadian Forces Maritime Experimental and Test Ranges (CFMETR) at Nanoose, B.C. in 1990-91. Built by West Coast Manly Shipyard in Vancouver, the steel-hulled vessels were designed to carry a containerized scientific package during operations. A study was made to determine whether they could accept the 20-foot ISO containers for the diving workshop and recompression chamber, and meet all the other requirements of a YDT replacement vessel including sufficient stowage to support mine countermeasure operations, surface-supply diving, explosive ordnance disposal and battle damage repair diving ops.

Surveys indicated there was insufficient deck space on the TSRVs to accommodate both 20-foot containers simultaneously, but a decision was made to proceed with a conversion package that would fit the recompression container on deck and build a new deckhouse on No.1 deck between the funnels for the workshop and diving equipment stowage. This arrangement would give the new YDTs the capability to deploy any ISO containerized package, and the flexibility of having space available on the open deck. [*Even though the converted YDTs would have a built-in diving workshop, a separate containerized diving workshop was also acquired for each coast so that the maritime coastal defence vessels could, if required, transport a full diving payload of a containerized workshop and a recompression chamber.*]

TSRVs into YDTs

The torpedo and ship ranging vessels were designed and built in accordance with Canada Shipping Act regulations and American Bureau of Shipping classification standards, and also to comply with DND stability and buoyancy requirements. It was essential that these requirements be maintained during the conversion. In addition, since the TSRVs were designed to operate on the West Coast, and the converted ships would be required to operate on the East Coast and on the Great Lakes as well, changes would have to be made to the heating, ventilation and air-conditioning systems and to the insulation of some compartments to allow for the different environmental conditions.

The TSRVs had also been designed as day boats, but as YDTs they would be required to operate unsupported for periods of up to five days. Their current fuel capacity was adequate, but the blackwater, freshwater and ration storage capacities needed to be increased. As a result, new black and greywater holding tanks would be built in the pump room, a new reverse osmosis desalination unit installed in the auxiliary machinery room, and a new dry provision locker and freezer installed.

The accommodation arrangements also required upgrading. The TSRVs had only been designed to accommodate a crew of four, plus two scientists, but the new requirement included accommodations for a crew of 12, which necessitated adding extra bunks and lockers to all cabins, rearranging the lounge and eating area, and enlarging the pantry. The numbers of life rafts and life-jackets would also have to be increased accordingly.

To allow the new YDTs to navigate in restricted visibility, a Furuno 1831 collision avoidance radar capable of accepting input from the global positioning system, speed-log and gyro would be installed. The communication system was also upgraded to include a UHF transceiver, one ship-mounted and two hand held VHF units, along with a Spectra A4 VHF/FM transceiver. An internal communication system would be installed between the new workshop and the recompression module, and a seating made for side-scan sonar equipment such as the AN/SQQ-505(V). A third anchor and anchor winch installed on the quarterdeck would enable the vessel to carry out precise, three-point anchoring.

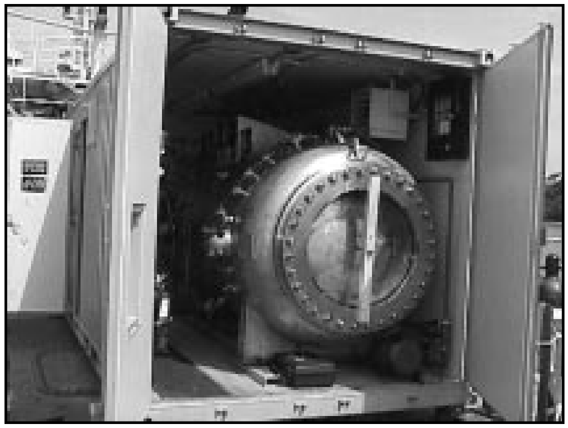
The greatest changes to the TSRV related to the vessel's new diving equipment systems. Securing points had to be fitted on No.1 deck to accept the 20-foot ISO standard recompression container, and the new deckhouse had to be fabricated. This deckhouse contains the diving workshop for conducting first-line maintenance, storing dive equipment, calibrating pre-dive set-ups and charging diving sets. The workshop's dedicated calibration bench allows up to three divers at a time to set up, test or calibrate their rebreather sets. A full system of high-pressure air compressors and gas banks leading to the calibration panel lets the divers charge their sets with the required mixture of gases. There is even a water bath for immersing the diving bottles during charging. Low-pressure air banks will supply power to operate underwater air tools. To facilitate getting divers into and out of the water, a diving platform would be installed at the stern. The existing deck crane would be relocated to support diving operations and lower the rigid-hull inflatable boat.

The contract for developing the TSRV conversion engineering change specifications and drawings went to competition and was eventually awarded to MIL Systems Engineering Inc. in February, 1996. Ed Chan (DMSS 2-7) managed this contract, while various life-cycle material managers reviewed the final design. The conversion packages for *Sechelt* and *Sooke* were incorporated with other necessary periodic refit work, and on Aug.1, 1996 an invitation to tender was issued for a single contract to refit and convert both TSRVs. The contract was limited to suppliers in Western Canada and stipulated that the award of contract would be based on the lowest priced responsive tender. To be considered responsive, contractors were required to:

- demonstrate they have completed at least one previous ship refit for a vessel of this size (length 33.07 m; breadth 8.45 m; draft 2.47 m; displacement 275 tonnes) with a contract value exceeding $0.5M;
- demonstrate a capability to dock these vessels, and include a docking certificate for their own facility along with the name of the dockmaster; and
- provide a performance bond, along with a labour and material payment bond.

Contractors were also required to:

- commence/complete work as follows:
  Sechelt: Oct. 23, 1996 – Feb. 6, 1997
  Sooke: Nov. 13, 1996 – Feb. 27, 1997
- use an electronic planning and work scheduling system to plan and manage the project; and
- use an ISO 9002 compliant quality assurance system during the implementation of the project (proven to have been in place and used in similar projects).



The recompression chamber in its container *(DND Photo)*

Three bid proposals were received, but when the lowest was disallowed after the contractor's quality control system was examined and found to be non-compliant, the contract for the refit and conversion of the two TSRVs was awarded to Nanaimo Shipyards Ltd. on Oct. 28, 1996. The delay in having to evaluate two shipyards meant that *Sechelt* would commence refit almost three weeks later than expected, and *Sooke* approximately one week later than originally scheduled.

A "virtual" project management team was established to conduct the refit and conversion. The team was "virtual" in the sense that the individual members continued to carry out their primary functions with their parent organizations. The team comprised: Project Manager Lt(N) Gaston Lamontagne (DMCM/AUX 4); Procurement Officer Ken Black (PWGSC, Pacific Region); Financial Manager Kathy Pope (DMMS 5-3-5); Regional Quality Assurance Manager Al Carter (8 CFQAR); On-Site Refit Manager and Quality Assurance Representative for YDT 610 *Sechelt* — CPO2 Bob Bourdage (8 CFQAR); QA Rep for YDT 612 *Sooke* — CPO2 Kevin Gates (8 CFQAR); and TSRV Conversion Specification Project Manager Ed Chan (DMSS 2-7).

The conversion of the two TSRVs into yard diving tenders was successful on a number of fronts. To begin with, the total cost of the project came in under budget. Even though a total of 331 work arisings were accepted, they accounted for only 15 percent of the contract price, a very low figure compared to other navy refits. While it is true that the YDTs were delivered somewhat later than expected (on May 12, 1997), Fleet Diving Unit Atlantic was still able to conduct a ship readiness inspection of YDT 610 *Sechelt* and make the long transit to Halifax prior to the onset of the hurricane season in the Caribbean. The transit itself was completed without any mechanical difficulties.

Both vessels have continued to perform well with their respective East and West Coast diving units since coming out of refit, and have been well tested in a variety of naval exercises and operations. Last fall, YDT 610 *Sechelt* was deployed as the main diving platform during Operation Persistence — the Swiss Air Flight 111 crash recovery effort off Nova Scotia. During this operation *Sechelt* logged 10,121 manhours on site, 108 dives in total, without a vessel-related failure of any kind.

The current chief of *Sechelt*, CPO2 Kevin McNamara (a member of the original transit crew), has described the new diving tenders as "the best thing that has ever happened to the trade." As he told *Trident*, he now "likes his job but *loves* his boat." Coming from one of the navy's most senior divers, this accolade speaks volumes about the success of the conversion. It should also put the Canadian Forces Maritime Experimental and Test Ranges on alert. As the two remaining wooden-hull diving tenders (YDTs 10 and 11) move ever closer to retirement, CF METR had better keep a close eye on *its* remaining two range vessels — YPT 611 *Sikanni* and YPT 613 *Stikine* — lest the fleet diving units come up with any long-range plans for diving operations that could benefit from another couple of steel-hulls!

Ed Chan is the DMSS 2-7 project manager responsible for the TSRV conversion specification.

Lt(N) Lamontagne is now the DMSS 2 project officer for the navy's Afloat Logistics and Sealift Capability Project.

Protecting the Oceans in the Future

Article by LCdr Mark Tinney

Regular readers of Greenspace will be familiar with initiatives underway to make Canada's warships compliant with existing environmental regulations. For example, in response to the International Maritime Organization's call for a complete ban on the disposal of waste plastic at sea, many of our ships are being outfitted with plastic waste processing systems. The equipment illustrated is designed to shred, melt and compress all of a ship's waste plastic into pizza-size disks which can be conveniently retained on board until the ship reaches its next port of call. This is a typical example of technology being developed specifically to enable ships to comply with regulations currently on the books. Since regulations continue to evolve, however, so must our navy's response. In this article I intend to provide an opinion on where it's all heading.

HMCS *Fredericton*'s plastic waste processors. *(CFB Halifax photo by Pte. Kent)*

Protection of the oceans affects every facet of naval operations and will continue to do so to an even greater extent in future. Navy ships, as well as all other forms of vessels, will be obliged to treat the world's oceans with the utmost care and respect. To that end, adherence to environmental doctrine will be an essential element in planning naval operations. Non-compliant vessels will be severely restricted in the type of operations that they can perform.

Today's effluent standards for oily water, black & grey water, and solid wastes can be fairly easily met using existing technology. The standards apply only to certain areas, and generally are not policed outside of territorial waters. This will change. Effluent standards of the future will be challenging to meet, and extend to greater areas of the oceans. Furthermore, the international community is generally starting to accept that it is not good enough merely to adopt regulations without having an established means for enforcing the rules. Thus, policing of ship activities will become a fact of life, and penalties will be severe.

In the same incremental manner being used to force cigarette smokers into extinction, environmental regulators are leading the world's navies toward zero-discharge regulations. Within the foreseeable future, the discharge of any non-biodegradable solid or liquid waste at sea will be prohibited. Ships will be obliged to retain all forms of non-biodegradable waste on board for offloading in port, and ship operators will be held fully accountable for any breach of the rules. All products brought on board a ship will have to be accounted for when they leave the ship. Ship operators won't be able to arrive in port with the announcement that they have no waste to offload; the waste miraculously having disappeared in the middle of the ocean. And in the true spirit of "Big Brother is Watching," satellites will be used to a much greater extent to monitor ship activities, watching for signs of illegal dumping of any waste stream.

Even today, it is very expensive for ship operators to comply with environmental regulations. As regulations move closer and closer to zero discharge it will become prohibitively expensive to operate in an environmentally conscientious manner. As long as port authorities charge huge levies to offload waste, the incentive will remain for ships to try to minimize the amount of waste requiring offloading (through illegal dumping). So a couple of things need to happen. First, industry is going to have to develop the necessary technology, which is cost-effective and easy to operate, to enable ship operators to process waste streams in accordance with the law. Second, port authorities are going to have to supply the necessary waste handling facilities to make it easier and less expensive to offload waste products in port.

To comply with stricter regulations, ships will need equipment which can process solid and liquid waste streams to the higher standards. Research and development on technologies which can make this practical are under way. Several countries, including Canada, are developing plasma arc incinerators which can reduce all manner of waste to an inert slag. The waste by-products can then be conveniently retained on board until they can be off loaded in port. Technology and processes being developed to recycle fluids on manned spacecraft which one day will be deployed to the farthest reaches of the solar system and beyond (without the benefit of a replenishment in space), will also be prime candidates for use in shipboard systems.

In the near term we can see changes coming which will have a significant impact on the design of liquid waste treatment systems. Probably within five years new regulations will require food waste and grey water to be treated prior to discharge. This will have a huge impact on the size of shipboard liquid waste treatment systems which are already heavily challenged dealing with black water alone.

The requirements for pollution abatement equipment will be enormous. Warships, commercial ships and cruise ships will all need systems which can process large volumes of solid and liquid waste products efficiently and cost-effectively. As the regulations evolve, so will the technology and procedures that we employ to process waste at sea. With the right equipment it doesn't need to become an increased burden on ship's crews, beyond the level that it is now. But one thing is certain. As regulations become stricter, it is imperative that we do not falter in our resolve to comply.

LCdr Mark Tinney is the project manager of the navy's Maritime Environmental Protection Project.

HMCS *Fredericton* Joins the Solid Waste Management Fleet

Article by Sean Gill

HMCS *Fredericton* (FFH-337) is the most recent *Halifax*-class frigate to be outfitted with the solid waste management equipment selected by the Maritime Environmental Protection Project (MEPP). Project staff members Mario Gingras and George Power will install a USN plastic waste processor and shredder, and a Hobart pulper on each of the 12 patrol frigates by the end of 2001. Fleet oilers have already received a plastic waste processor, pulper and Strahan and Henshaw shredder compactor unit, while the *Iroquois* class will be outfitted with a trash compactor and pulper only. This equipment will allow each class to effectively process solid waste for discharge/storage in accordance with discharge regulations.

Aboard the *Halifax* class the pulper is used to process approximately 70 percent of shipboard generated waste — paper, cardboard and food — which can then be discharged beyond the three-mile limit. The plastic waste processor is composed of two distinct machines — a compress melt unit, or CMU, that turns plastic waste into 20-inch-diameter plastic disks, and a solid waste shredder that serves several roles: preprocessing plastic waste prior to loading it into the CMU; and shredding metal and glass for discharge beyond 200 nautical miles. (As plastic discharge into the oceans is prohibited at all times, the plastic disks must be offloaded ashore.)

The MEPP team visited HMCS *Fredericton* in Halifax last February, following the fit of new solid waste equipment by Saint John Shipbuilding Ltd. As with all new installations, MEPP personnel and their FSRs were on hand for the set-to-work to ensure the equipment was installed and operating properly, and to train the ship's company in how to operate and maintain the equipment. Interestingly, *Fredericton* accepted our offer to train the crew while the ship was at sea.

Making sure the equipment works is easy, but providing the best training opportunity to the crew can be a difficult task if not taught in the right classroom. We have found that an underway ship, in its at-sea routine, actively generating waste, is the teacher's best forum. It is here that the sailors can observe and use the equipment under real-life operating conditions. They get to experience actual waste flow "battle problems" while operating *all* the equipment under various scenarios, including the failures we simulate to teach the maintainers their troubleshooting techniques. Another big advantage to conducting the training while the ship is under way (apart from our having a captive audience) is that we are able to offer much more individual instruction than we might otherwise be able to provide. And, we get to watch the newly trained operators in action for the rest of the time we are on board!

During the three days we were embarked in the ship, we encountered some of our most enthusiastic students to date. We trained a total of 32 people — including six maintainers — who will surely be able to handle any problems they come up against with the equipment.

The set-to-work on board HMCS *Fredericton* was an unqualified success. Top-down support combined with a receptive, interested crew made for a very rewarding visit. The ship now joins a growing list of vessels in the Canadian fleet having the tools to better protect the marine environment by managing their solid waste in accordance with discharge regulations.

To the crew of *Fredericton*, the MEPP team says, Thank You for your enthusiasm, support and friendship. And to LS Chisholm — Thanks for the ride home!

Sean Gill is the field service representative for Geo-Centers Inc., of Pittsburgh, PA.

"Freddie" Goes Green — the View from the Ship

Overall, the training was very well received; it was exceedingly beneficial to have the experts at hand to answer questions as they arose.

Having completed formal waste-processing training, the crew will now turn its attention to waste collection. During the brief training period, it became obvious that sorting garbage at the source will greatly reduce the workload of the waste processing watch. An efficient waste management program will therefore depend upon the proper education of the ship's company, the key (as always) being the three R's of Reduce, Reuse and Recycle. **— Lt(N) Clark Patterson, Deck Officer, HMCS *Fredericton*.**

Ship Signature Reduction in the Canadian Navy — A Balancing Act

Article by Mike Belcher and Ping K. Kwok

Throughout history, the most successful hunters have tracked their prey using keen senses of sight, hearing, smell and touch. This holds true even in today's high-tech arena of naval operations. Among the world's navies, the "prey" is as well armed as the hunter, and the "victor" is often the one who detects the other first.

We all instinctively know that invisibility equates to invincibility; if you can't be seen, you can't be hurt. This is the basic premise of naval stealth technology, which aims to improve survivability by reducing detectability. Modern sensors operate above and below the ocean's surface throughout the electromagnetic spectrum, searching for signals that can find, identify and provide guidance to a target. This task is made easier if the target can be remotely monitored and reliably analyzed as to identity, location, speed and direction — characteristics broadly referred to as the target signature.

A signature can be regarded as an emission of acoustic or electromagnetic energy (either transmitted or reflected), usually with spectral (i.e. frequency), temporal (time-dependent) or spatial (shape or directional) content. While the power level of the energy can sometimes be used to determine range, it is the other variables which serve to identify and classify the target. In the case of weapon triggering mechanisms, the identifiable aspects of a ship's signature are used to determine whether the physical phenomenon the mechanism is monitoring is natural (and can therefore be ignored), or is a hostile warship that should be destroyed.

To counter the widespread availability of sophisticated detection and surveillance sensors among other maritime forces, navies everywhere are turning to stealth and information denial techniques to tip the balance in their favour. This article will address some of the issues relating to signature reduction in Canadian naval ships.

The funnels show up as hot spots in this normal IR image of the now decommissioned HMCS *Skeena* (DDH-207). *(Photo courtesy W.R. Davis Engineering, Ltd.)*

Sensors

The threats to modern warships are weapons launched from aircraft, land-based sites, other surface ships or submarines, and mines. In the majority of cases the weapon originates out of visual range of the ship, and the decision to launch and subsequent guidance to the target are based on sensor input. Remote sensors are used for surveillance, detection, tracking and classification of targets, ground-mapping and weapon-homing guidance.

Sensor systems are divided into two broad categories: *active* sensors, such as radar and "pinging" sonar which radiate energy to detect a target, and *passive* sensors (i.e. sensors in quiet mode) which detect, either directly or indirectly, the energy emanating from a target. Sensors are also categorized by their operational environment as either *above-water* systems (e.g. radar, infrared, optical sensors), or *underwater* systems (e.g. sonar, pressure sensors, magnetic field detectors). For each type of sensor there is a corresponding signature, the primary ones being acoustic, underwater magnetic and electric, radar and infrared (*see sidebar articles*).

Signatures and the Changing Role of the Canadian Navy

The Canadian navy developed its expertise as a major antisubmarine force during convoy escort operations in the Second World War, a role that was reinforced later during the Cold War. Not surprisingly, Canada optimized its fleet for this function over the years in terms of training, sensors, weapons and acoustic signature reduction. As our ships incorporated many quietening features such as gas turbine propulsion, air-emission systems and effective vibration isolation of machinery, the operational community developed a good awareness of the importance of acoustics.

Following the collapse of the Soviet Union and the subsequent reduction of the submarine threat, the navy's operational focus shifted away from transatlantic ASW escort duties to a broader combat role in support of NATO littoral operations worldwide. And although our long-standing attention to *acoustic* signature reduction continues to serve us well, we must now turn our attention to other areas of signature reduction that have assumed greater importance in the threat scenarios associated with coastal operations. Shallower coastal waters are fertile fields for mines (turn to p. 3 of the enclosed issue of *CNTHA News* to see the result of USS *Tripoli*'s encounter with a mine off Kuwait in 1991), and ships are within easy striking distance of land-based aircraft, missiles and, in some cases, even coastal artillery. Increased emphasis on above-water signatures, including visual components, therefore needs to be considered. The key lies in a balanced approach to signature management.

Signatures and the Evolving Threat

As sensors become more sophisticated and are incorporated into weapon systems, the need to update the signature management of naval ships becomes increasingly important. But because signatures are not always well understood within the naval community, there is a tendency to rely on information that may be outdated. For example, when magnetic mines were first developed they could only sense variation in the vertical magnetic field. Initial degaussing systems, therefore, were configured to deal with that threat using horizontal M coils. Unfortunately, the NATO standards for degaussing still refer primarily to vertical field limits, even though the majority of mines inventoried around the world today use multi-axis sensors and trigger on horizontal fields. It is important to recognize that weapon development is a constantly evolving field, and that countermeasures designed for last decade's threat may not be effective on today's battlefield.

The technology has advanced on all fronts. Underwater sensors are now capable of detecting changes in AC or DC electric fields, but it is the above-water threat that requires special vigilance. The advent of radar-guided anti-ship missiles have prompted some drastic changes in ship configurations to incorporate "stealth" technologies such as shaping and radar absorbent materials. However, these measures cannot completely hide the target ship, and some missiles are able to use multiple sensors to couple radar and IR for targeting. Active countermeasures like chaff and flares can be effective (the common wisdom being that these measures must be able to project a more attractive signature than the platform itself), but imaging IR sensors negate some of the utility of flares. In the end, above-water threats are best countered through a combination of signature reduction and active countermeasures integrated with weapons.

Interestingly, the visual component of warship signature is front and centre once again. Prior to the Second World War when ships had to close to within visual range to identify a target, visual camouflage was a key factor in remaining undetected. The advent of radar during the war seemed to make camouflage an anachronism, but is enjoying something of a resurgence among today's navies. Heavier reliance on passive sensors which do not give away an attacker's position, the use of electro-optical seekers on weapons, the employment of stealthy remotely piloted vehicles (RPVs) for airborne reconnaissance, and the increased likelihood of littoral operations have all combined to make the denial of ship visual identification by other forces important once again. While the garish stripes painted on the sides of ships to confuse optical rangefinders during the First World War are probably gone for good, more navies are considering some scheme of colour and/or pattern camouflage for reducing the visual impact of their vessels.

Signature Measurement

The first step in reducing ship signatures is to identify the areas of the ship that are contributing to the signature, and this calls for accurate measurement. Because of the various physical processes involved, each signature is measured in a different manner, using highly sensitive sensors under controlled conditions.

The Canadian navy operates several test ranges for dealing with signature management. There are two facilities on the East Coast — the Ferguson's Cove Influence Range and the Bedford Basin Degaussing Range. Ferguson's Cove is a multi-use facility incorporating a deep-draught degaussing facility for ships with beams greater than 55 feet (16.8 m), and both static and dynamic sound ranges. The Bedford Basin range is strictly a de-

Underwater Signatures

Magnetic

Steel ships develop individual magnetic fields through their interaction with the earth's magnetic field. During construction the structure develops a *permanent* magnetic orientation in alignment with the earth's field at that location. Furthermore, moving a ferromagnetic object (such as a steel-hulled ship) within a magnetic field will cause the field of the object to change as it attempts to reorient to the local field. Such *induced* magnetism is determined by the ship's global position and heading, and also leads to the formation of eddy currents within the structure. Any electrical machinery operating on board the ship will also generate its own *electromagnetic* field. Altogether, these effects make up the ship's magnetic signature, normally described in units of field strength (nanoTesla) at some distance below the ship's keel.

Magnetic signature reduction aims at reducing a ship's field to a level which will allow the ship to pass at some predetermined stand-off distance from mines which trigger on detecting a change in the earth's magnetic field. The most effective way to reduce the signature is to minimize it during design. Modern minesweepers are typically constructed with GRP or wooden hulls, and the machinery is made primarily of non-magnetic metals, but for the vast majority of warships other methods are required.

Deperming reduces the permanent field by temporarily wrapping the ship with a series of coils which are then energized with strong currents applied in alternating polarities. In addition, *degaussing* coils permanently installed in the ship generate opposite fields to counteract any remaining permanent and induced fields. A horizontal degaussing loop (the M coil) generates a vertical field, while fore and aft loops (A coils) generate an athwartships field. The longitudinal field is controlled by horizontal coils of opposite polarity on the foredeck (F coil) and quarterdeck (Q coil), or by a series of circumferential loops (L coils). By altering both the number of turns in these coils and the power applied to each, it is possible to vary the field strength in the coils to manipulate the ship's signature. Changes due to ship's heading are controlled by a link to the gyro compass. All Canadian warships, including *Kingston*-class MCDVs, are fitted with degaussing systems.

Electric

Ships also emit underwater electric fields, which are a combination of electric machinery AC signals and a static-electric field resulting from galvanic currents. The static-electric field can in turn generate an extremely low-frequency electric (ELFE) AC signal caused by the modulation of the static-electric field by shaft rotation. *Halifax*-class ships are now fitted with a Canadian-developed active shaft grounding system to counter the ELFE signature.

gaussing facility for ships up to 55 feet in the beam. It has both east-west and north-south magnetometer arrays to allow calibration in vertical, longitudinal and athwartship directions. Mooring buoys and a deperming barge in Bedford Basin are available for deperming/wiping.

Both ranges have shore facilities where range data is gathered and processed, and offer secure voice communication with ships on the ranges. These facilities use either visual or laser tracking systems, and are now being augmented with a digital global positioning satellite (DGPS) tracking system. This will improve the accuracy of ship tracking, provide track feedback to ships and allow all-weather operation.

On the West Coast, facilities include equipment at the entrance to Esquimalt Harbour which incorporates a magnetic check ranging capability, a degaussing range at Coburg Spit where a north-south magnetometer array is situated, and the Parry Bay dynamic sound range. A trial acoustic range was recently established at Pat Bay to take advantage of better ambient noise conditions. The West Coast ranges are also being updated with DGPS tracking systems.

Sound-Ranging

To measure underwater radiated noise, a warship must conduct static and dynamic sound ranging trials on an instrumented range employing sensitive hydrophones and accurate positional tracking. The profile of the ship's underwater noise signature can then be used to predict acoustic detection and counterdetection ranges, and determine the ship's vulnerability to acoustic weapons. Sound-ranging can also detect individual ship and class defects so that corrective action can be taken. Typically, rangings are done before and after a refit, and following repairs or changes to major machinery, the hull or propellers. Tactical sound rangings are conducted before any major deployment.

Magnetic Ranging

Determining the coil effects and initial optimization of the magnetic signature require the use of a magnetic range. The range consists of an array of highly sensitive magnetometers fixed on the seabed which measure the ship's magnetic field strength as it passes over. Accurate position measurement of the ship during this pass allows the field strength to be plotted against the ship's keel position, allowing the effects of the various coils to be evaluated. A complete ranging is an iterative process, combining range data with knowledge of the ship's magnetic characteristics. The result is a ship with its degaussing coils set so that the magnetic signature is minimized.

Defence Research Establishment Valcartier's trailer-mounted infrared imaging spectrometer has been used to measure IR signatures of Canadian warships. The imaging spectrometer produces a series of multidimensional graphed outputs of a ship's IR intensity mapped against different variables.

Infrared (IR) Signature

All objects emit a characteristic pattern of wavelengths in the infrared (IR) region of the electromagnetic spectrum, with intensities proportional to the temperature and surface optical characteristics. IR signatures include spectral signature (intensities of the emitted radiation at specific wavelengths), spatial signature (a pattern of the image with the relative intensity defining the target shape), and temporal signature (the fluctuation of the target signal over time).

Infrared signature can be controlled by reducing the contrast of the radiant power with the backgrounds against which the ship is viewed and by eliminating any direct line-of-sight to the heat source. Since background radiance varies with time of day, weather, and geographic location, IR signature management should consist of a passive system designed to keep the IR signature as low as possible against a standard environmental condition, and an active system to vary the ship's radiance to account for different conditions.

Halifax-class frigate gas turbine uptakes are fitted with the "DRES Ball" fan-cooled exhaust diffuser, while simpler diffusers are used for all other exhausts.*Iroquois*-class ships have exhaust diffusers on all exhausts. Ship's internal heat emission is controlled by insulation fitted throughout the ship, especially around the exhaust pipes and ducts, and by special ventilation in the funnel. All Canadian major combatants are fitted with an NBC defence pre-wetting system which can be used to alter the IR signature in the 8-14mm wavelength band.

Defence Research Establishment Valcartier, in conjunction with W.R. Davis Engineering Ltd., has developed the Naval Threat/Countermeasures Simulator (NCTS) software to model the IR signature of naval ships. It can be used to study the impact of engineering changes on the infrared signature and on the ship's susceptibility to antisurface missile IR seekers under a wide range of operational and maritime conditions.

Infrared Imaging

IR imaging systems measure the differential radiance produced by a target and its immediate background. The image recorded depends on the spectral radiance of the target and background, the transmittance of the atmosphere and the spectral response of the imaging system. Canadian warship IR imagery has been recorded by Defence Research Establishment Valcartier (DREV) using a portable IR imaging system from a Sea King helicopter. In addition, a DREV IR imaging spectrometer operating in the 2-5mm waveband (*see sidebar*) has measured ship signatures from Osborne Head near Halifax. Further development is required to establish a permanent shore-based IR imaging system with quick-look analysis capability to support fleet deployment.

Radar Cross-section

Measurement of Canadian warship radar cross-section has been conducted by Defence Research Establishment Ottawa (DREO). Their I/J-band measurement radar (*see sidebar*) can collect coherent data and includes a high-resolution mode that will resolve one-dimensional RCS "hot spots." Naval Electronic System Test Range Atlantic (NESTRA) and Pacific (NESTRP) both have RCS measurement systems.

Fig. 1. The ever-diminishing "design spiral" for control over a ship's threshold signature shows an iterative process of measurement and improvement.

Signature Reduction — A Balancing Act

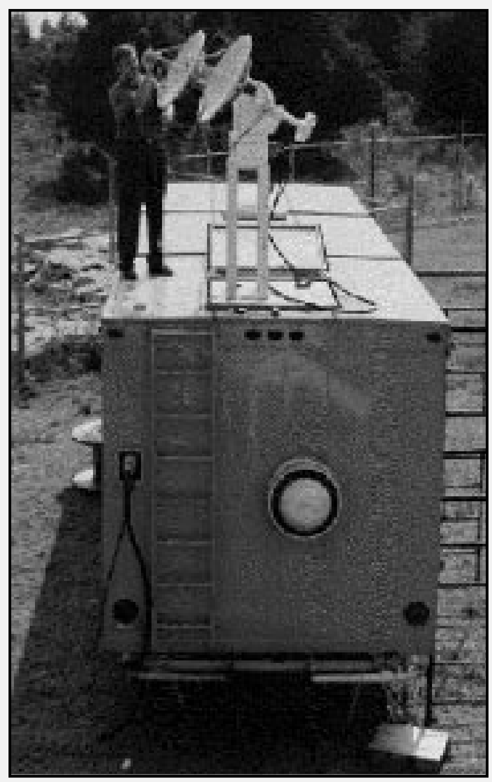
A ship's signature reduction measures must be in line with the relevant sensor characteristics and the associated signal processing systems. When multispectral threat systems exist, signature reduction

Radar Signature

The radar signature of a vessel is a measure of its ability to reflect radar energy back to a transceiver. It is typically expressed as radar cross-section (RCS) in square metres, or in decibels relative to one square metre. RCS bears little relation to the actual physical size of a target. A complex object such as a ship contains many significant "scattering centres," and its radar cross-section varies as a function of radar frequency, polarization, elevation and azimuth angle.

Radar waves are only reflected from conductive materials. GRP materials are essentially transparent to electromagnetic radiation, but internal metal structures would be visible. The intersection of three orthogonal planes, called a trihedral reflector, is the most efficient design of reflector and should be avoided through careful attention to "shaping." Similarly, vertical planes in the upper superstructure can combine with the deck to form reflectors, and so should be inclined slightly — 10 degrees or less is sufficient — to reflect radar energy away from the transceiver. Reflective deck equipment such as boat davits, capstans and even stanchions can also contribute to the radar cross-section, and some navies have taken drastic steps to remove these items or hide them behind screens. Further RCS reduction can be achieved by fitting radar absorbent material either as sheet material permanently attached to the structure, or as flexible panels that can be rigged as required. In all cases, effective use of hull and superstructure shaping, as in the *Halifax*-class ships, requires rigorous adherence to design principles.

The radar cross-section of a ship can be determined through scale-model testing, computer simulation and full-scale range testing. (Scale-model tests of the *Halifax*-class were conducted to verify the design and to identify the major scattering sources.) Defence Research Establishment Ottawa (DREO) has analysis codes to predict the RCS of various targets with complex geometries. However, full-scale ship testing on an instrumented range remains the most accurate method for establishing the radar cross-section of a ship.



DREO's I/J-band mobile RCS measurement system.

Acoustic Signature

The acoustic signature is the underwater noise generated by a ship, expressed in decibels (dB) relative to a reference sound pressure level of 1 mPa (micropascal) one metre from the hull. It is a complex spectrum of sounds, dominated by narrowband machinery and propeller tonal components at slower ship speeds, and by broadband propeller cavitation noise at higher speeds. Noise radiated by a ship can be detected at great distances, and can also degrade the performance of the ship's own sonars.

Machinery vibration is transmitted through seatings and piping systems to the hull, then radiated into the water. Airborne acoustic energy can also be radiated directly to the hull. Machinery noise is reduced by minimizing vibration at the source through accurate balancing and alignment of rotating parts, and by keeping machines in good repair. Interrupting the vibration coupling path is accomplished by resiliently mounting machinery, fitting fluid and acoustic mufflers, installing acoustic enclosures, and avoiding rigid connections to the hull. Air-emission systems distribute a layer of bubbles in the water near the machinery spaces to create an acoustic impedance mismatch, thus reducing the transfer of machinery noise to the water. Acoustic decoupling tiles attached externally to the hull around the machinery spaces also prove effective. Although such tiling is more common on submarines, and rarely used on surface ships, they are currently fitted on HMCS *Montreal*.

Hydrodynamic noise results from a combination of propeller cavitation and flow noises. Flow noise can be controlled through careful design of the hull and its appendages. The cavitation inception speed can be increased by good propeller design and by smoothing the flow of water into the propeller. To reduce the effect of cavitation, operators can keep the ship's speed below the cavitation inception speed, or run propeller air-emission systems above that speed, accelerate gradually and use minimum rudder and stabilizer angles where practicable.

must be applied to *all* signatures for it to be tactically effective, although measures to reduce one signature may increase another. For example, screens to reduce the IR signature on deck may increase the radar cross-section of the ship. *Figure 1* provides an overview of the dynamic, sequential and iterative process of the threshold signature management spiral. Once an acceptable ship self-protection system effectiveness has been achieved, the threshold signatures must be maintained to ensure the ship can accomplish its mission effectively against a set of threat sensors under a given set of environmental conditions.

It is important to remember that ship signatures be considered together with the available countermeasures and with the defined threats. There is a common misconception that stealth technology can make objects invisible to radar. This is no more true than saying special paints can make an object invisible to the eye. The aim of stealth technologies is to reduce the signatures in specific areas below the sensor acuity in a given set of environmental conditions. In certain cases, the signature need only be reduced below the level at which decoys are effective. By the same token, it makes no sense to reduce signatures to levels below which sensors cannot detect at normal engagement ranges.

While there are often palliative means to improve ship signatures, the most cost-effective method of ensuring low signature levels is to build these features in at the design stage. This can be accomplished through proper selection of materials, equipment and structural design details. In many cases, the cost of building a stealthy structure is not significantly more than building a non-stealthy one. In other cases, as in the case of modern minesweepers, the requirements for low signature levels will dominate the design.

The methods for controlling and reducing signatures are for the most part well understood. Because the threat is constantly evolving, and because many elements of ship signature are dependent on the maintenance of existing design features, it is desirable that a signature management organization monitor the "stealth health" of the fleet. The goal of this organization should be to review signature control efforts on a ship-level focus, to ensure that these efforts are balanced and congruent.

To address these issues, a Naval Signature Management Committee has been established with representation from headquarters, the research community and both coasts. This allows open discussion of policy, provides input for the development of new and current facilities, and ensures that naval signature management retains high visibility. An Atlantic Signature Management Working Group also exists in MARLANT to deal with issues relating specifically to the East Coast fleet. West Coast fleet survivability issues are the responsibility of MARPAC/N34. In DGMEPM, technical responsibility for signature management falls within the Passive Protection section (DMSS 2-5), which has unique experience in underwater noise, vibration, magnetics, above-water signatures and survivability. This section is also responsible for maintaining the navy's various signature test ranges.

Way Ahead

Signature reduction is a passive protection system, an integral part of the ship's defensive system, and cannot be treated in isolation. The effectiveness of countermeasures will be improved with signature reduction. Underwater signature management, both acoustic and magnetic, is well established. Although not all the components required for radar cross-section and IR signature management are in place, requirements to address these issues have been identified. With the advance of new sensors such as millimetre microwave (MMW) radar, imaging infrared, and laser detection and ranging (LADAR), there will be a need to deal with the threat from new missile seekers. Each new threat will pose unique signature control challenges, and the battle between measure and countermeasure can be expected to continue. However, with an effective method for understanding the effect of signatures and dealing with these issues, the Canadian navy is well prepared to respond to these challenges.

Mike Belcher is a survivability analyst in DMSS 2.

Ping K. Kwok is the DMSS 2 engineer for above-water signature management.

Year 2000 Ship Readiness

Article by LCdr Richard Gravel and Lt(N) Erick DeOliveira

The year 2000 computer problem anticipates a number of computer failures that could occur should computers misinterpret key dates in their internal calculations. The basis for the problem lies in the ambiguity of the two-digit year indicator "00" (Is that year 1900 or year 2000?), and in the confusing logic presented by certain dates (such as April 9, 1999 — the 99th day of the 99th year — which some computers might read as a 9999 "end-of-file" date field). Two of these key dates, Jan. 1st (the first appearance of "99") and April 9th, have already passed seemingly without incident for the Canadian navy, but there is concern that the effects of some of these events might manifest themselves only later. For instance, one concern with routine business processes is that the bugs might not show up until software is invoked to perform quarterly roll-ups.

Y2K bugs are likely to affect various systems differently, and operators could see their systems react with anything from quirky behaviour, to a refusal to perform certain activities and outright failure and shutdown. Errors in performing date interval calculations could affect database archives, such as those used in message handling systems, by reporting that no messages had been received between, say, December 99 and February 00 — the year 00 having been logically assumed to have occurred *before* the year 99. (In a combat system, this type of error could produce ludicrous target information.) A database with a memory optimization feature could even end up deleting "stale" data from the year 00 (i.e. 2000) if the computer misinterpreted the 00 as the year 1900.

At the beginning of DND's Y2K effort, there was a sense that time was tight and that organizations would not have enough time to review and remediate every system that could be affected by the millennium bug. An operational readiness program was therefore launched to identify and rank those missions that were critical to meeting Canadian Forces national and international objectives. The result of this high-level review was a much clearer definition of computer systems with respect to their criticality to the overall nature of operations. This in turn allowed the three environmental elements to to prioritize and manage their own Y2K efforts, such as the navy is now doing with its joint CMS/DGMEPM Year 2000 Ship Systems Project [*see "Navy's Y2K Ship Systems Project in full swing," Maritime Eng. Journal, Feb. 1999*].

The Y2K Ship Systems Project (SSP) is tasked with ensuring that Canadian naval ship systems and related shore installations are able to function normally in the face of the millennium bug. The project is being supported by a full program of documentation, certification and auditing for Y2K compliance, including system functionality validation trials being conducted by the Naval Engineering Test Establishment (NETE).

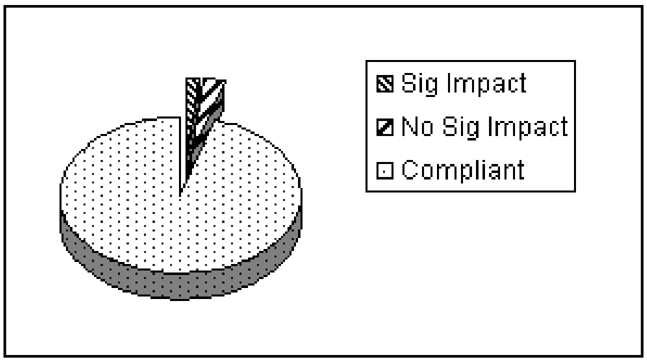


Fig. 1. Status of Mission Critical Systems

Compliance and Certification

The decision to fund Y2K assessment and remediation activities has been addressed in many ways within the CF and throughout the private sector. In the navy, senior management was determined not to mortgage future capital plans against Y2K remediation. Consequently, an elegant measure was taken when all Y2K assessment activities and corrective steps were directed to come from the existing maintenance budget. Life-cycle material managers (LCMMs) would simply prioritize Y2K as the first issue to address within the scope of all other materiel concerns.

To enable review of year 2000 plans and actions by LCMMs as they related to their systems, a certification review board was established by the project. The board is chaired by DMSS 8, with membership including the project manager of the Ship Systems Project, as well as representatives from ship system engineering and CMS/DMPPD. Each LCMM was required to prepare a year 2000 certificate and supporting technical package for each system or project under his management. The package supported the case for the particular certification category being sought, and provided such details as a system and interface block diagram, a basic description of the system's functions, and an analysis summary. Eight possible certification categories were established:

- No date usage (the system computes, but no dates are processed);
- Fully compliant;
- Converted (the system has been converted, tested and implemented, and is fully compliant);
- Replaced (the system has been replaced by: ______);
- Abandoned (the system will be removed from service before Jan. 1, 2000);
- Non-compliant with significant impact;
- Non-compliant with no significant impact;
- No computing component.

The project adopted a "stem to stern" approach for shipboard systems in each class of ship. Many systems were found to have no computing components. Among the remaining systems a large number did not process dates in any manner, while still more were already year 2000 compliant (using and displaying the full four-digit year). Approximately a dozen systems needed remediation work. About half of these systems have been converted, while the remainder were well on their way to compliant status, or having a CRB-accepted workaround put in place.

Validation Trials

In order to develop the necessary confidence in ship systems' ability to deal with the millennium bug, NETE was tasked to conduct Y2K system functionality trials in HMC ships. These trials sought to demonstrate that no Y2K bugs would propagate across the interfaces of complex, integrated systems, and that these and stand-alone systems could be demonstrated as Y2K-ready in the operational environment. In addition to demonstrating Y2K system functionality of integrated systems, these trials served to educate our personnel, and to better prioritize our remediation efforts.

Because the stakes of advancing clocks in seagoing ships were high, a progressive approach was taken to minimize the risk in these trials. Assiduous LCMM efforts to assess the compliance of specific equipment and individual systems provided early confidence that the shipboard trials would proceed safely. Where possible, trial programs for individual system groups (AWW, UWW, IMCS, Comms, NAV/INS and EW) were tested first in shore-based trainers before being moved on board the ships. Altogether, NETE has conducted Y2K testing in 10 different ships, including an AOR, two *Kingston*-class coastal defence vessels, four *Halifax*-class frigates and three *Iroquois*-class destroyers.

It is important to note that there are systems that will not be investigated by the navy's Y2K Ship Systems Project. For instance, the numerous personal computers used on board ship are being looked after by other agencies within DND/CF, while large commercial systems such as GPS, Inmarsat, and Satcom satellite networks are being addressed outside of DND (although the compliance of the ground-based receivers for these networks is being assessed).

The NETE system functionality trials have sought to establish Y2K compliance by verifying that there is no noticeable operator impact as a result of the Y2K environment. For example, during AAW serials, the emphasis was not on the ability to hit a towed target, but on the ability of the command control system to designate a target to a fire-control director, and successfully continue the process to the point of target prosecution.

In addition to validating the compliance of shipboard integrated systems for each ship class, ship-to-ship interoperability was tested between HMCS *Algonquin* (DDH-283) and her consort HMCS *Winnipeg* (FFH-338). The testing included such systems as Link-11, message handling, and the Joint Maritime Command Information System.

Finally, the Ship Systems Project seized an opportunity to demonstrate that Canadian warships could perform in a Y2K environment with an allied force. HMCS *Regina* (FFH-334) participated in a lengthy exercise with a USN carrier battle group. During this exercise, *Regina* demonstrated functional interoperability in all warfare environments (surface, air, subsurface), SAR events, helicopter air support, communications management, and maritime interdiction/naval boarding operations.

NETE produces reports of each system trial which are scrutinized by a formal trials acceptance review board. In this way, the SSP closes the loop that begins with LCMM equipment tests and predictions, and NETE field tests of shipsets. The result of the trials acceptance review determines whether a system's Y2K behaviour is satisfactory, and whether additional tests or remediation are warranted.

"Ship is...under sailing orders to proceed to sea to conduct Y2K testing. In preparation...the internal date is to be set at 1 Jan 2000 by 0730Q (Jan. 20, 1999)."

— Extract from HMCS *Montreal*'s Captain's Night Order Book, Jan. 19, 1999.

Known Y2K Anomalies in HMC Ships

LCMM efforts to investigate their systems have identified Y2K phenomena in a number of systems. In many cases, these were subsequently observed during validation trials. The phenomena include all of the expected behavioural quirks, but in most cases the Y2K problems in question can be worked around. These are being suitably documented and advertised. For example:

In both *Iroquois*- and *Halifax*-class ships, the command and control software exhibits Y2K symptoms when analyzing or playing back history recording files recorded across the millennium transition. This is a common Y2K symptom, and is easily overcome by dividing the task between the period prior to, and after, Jan. 1, 2000. Also, the software updater in the *Halifax*-class CCS-330 displays leap-year problems and would incorrectly link files that span the rollover. This particular problem will be eliminated by updating files so that they all reflect the same year.

The new message handling and distribution system in *Iroquois*-class ships is also non-compliant in terms of its ability to stamp the proper date-time group. This will cause some retrieval challenges, but the problem is being addressed through a new software release. Also being addressed is the inability of the communications control and monitoring system to accept date ranges spanning the millennium as valid intervals. This is reflected in empty system activity reports for message traffic, alarms, or other historical events.

The Y2K bug has also been observed to produce special symptoms in certain systems, such as in the SRD-502 direction finding system which loses exactly one second of clock time upon the rollover. While the SRD-502 only needs to be restarted to resynchronize its clock, more severe problems have come to light during recent tests of mission fits for the Canadian command ship for the Standing Naval Force Atlantic. The SRD-503, for example, exhibits significant degradation that is directly attributable to Y2K date environments (presently being addressed).

Auditing Activities

DND has established a review and audit process to span the entire CF year 2000 effort. The purpose of this Monitoring Review Program is to conduct independent reviews of both system certification and the process used to certify systems. The program has four streams of review, and the SSP is subjected to each.

The first review, sponsored by PMO Y2K, is a verification of system certification which examines the overall process, including the certification review boards and NETE integration testing. Specific systems were chosen, and the process and certification package for each was checked. The second audit program is conducted by the Chief of Review Services, and consists of a similar process and documentation review. The most extensive audit is the technical review program, which is mandated to conduct a technical review of certain high-priority, mission critical systems to ensure that assessment of Y2K activities has been duly diligent. The technical review program involved visits to field and support sites, a review of technical data packages, a review of manuals and specifications, and a detailed technical appreciation by a team of experienced technologists and engineers. The fourth audit is a risk reduction process put in place by the Y2K team for ADM(Mat).

In all cases, a minimum of 10 percent of an organization's systems was to be examined. All audits and reviews have revealed a solid process and a proper technical approach to the business of ensuring year 2000 readiness of shipboard systems. Few changes have been proposed, and no further review has been recommended. The final drafts of the audit reports are being submitted to the sponsoring organization for review.

Conclusion

The Year 2000 Ship Systems Project has endeavoured to take a practical approach toward Y2K certification of systems and testing in Canadian warships. The legal requirement to demonstrate "due diligence" and collect objective evidence has necessitated a management and operational level review of systems.

In 1998 the world's Y2K gurus were not only concerned that individual systems might fail, but that interfaces between integrated systems might also provoke Y2K failures. For this reason, the Naval Engineering Test Establishment was directed to conduct progressive integrated system testing. As an independent validator, NETE was the first agency (in place prior to all of the auditing organizations) to take a sober second look at the navy's Y2K activities. NETE reviewed the state of both stand-alone systems and the interfacial connections of integrated systems – delivering an effective check of LCMM efforts in the end-use, operational environment.

Certification efforts, laboratory testing and actual shipboard trials all suggest that HMC ships will experience little, if any, operational limitations as a result of the millennium rollover. The anomalies which have been identified are predominantly confined to archival and history recording functions. Extensive testing at the single-ship and battle-group level has continued to reinforce the robustness of our ships, and confidence in their ability to carry out almost any kind of mission with system clocks set to millennium dates.

Since its genesis in May 1998, the SSP has tackled an ambitious project with creditable results. The certification of some 1100 systems for all ship classes and the completion of at-sea trials for both major ship classes were completed in early February. The preliminary results of these efforts — system certification and validation trials together — give us excellent reason to be satisfied that ships will be available and fully capable after the upcoming New Year's Eve party.

LCdr Gravel is Project Manager of the navy's Year 2000 Ship Systems Project.

Lt(N) DeOliveira (DMSS 5-6) is Test and Trials Manager for the Year 2000 Ship Systems Project.

News Briefs

Towed Array: CANTASS Update

A **Senior Review Board** convened in March to review CANTASS project status and way ahead activities. The project received approval to address operational and training shortfalls (the main thrust of the way ahead) via the introduction of an adjunct signal processor for each CANTASS set, and the procurement of a CANTASS Mission Simulator for the West Coast. (The East Coast simulator, which was installed in the summer of 1998, is expected to be fully operational this fall.)

A **signal processing insertion** will be implemented to handle HF processing and transient signal detection, which are crucial in detecting high-frequency emissions and speed-related components of submarine and surface ship contacts. Transient signals can herald prelaunch and launch activity with torpedoes and missiles. The signal processing will occur on a COTS chassis adjunct to the existing CANTASS hardware that will host the CANTASS signal processing algorithms. The input to the adjunct processor will be a variety of pre- and post-processed signals and tracker data. The output will be integrated back into the CANTASS Data Management and Distribution Unit, which will allow new display formats to be integrated into the existing CANTASS displays. The upgrade promises shorter integration periods.

Target motion analysis requirements for *Halifax*-class frigates will be resolved by incorporating the **Passive Localization Assistant** (PLA) into the adjunct CANTASS processor. A trial of a stand-alone version of PLA in the frigates *Regina* and *Toronto* concluded that PLA is a valuable and necessary tool for undersea warfare, and fully addresses the *Halifax*-class target motion analysis requirement. It was also noted that PLA must be integrated into CANTASS due to the limited number of TASOP billets in *Halifax*-class ships.

A contract will soon be let to procure a CANTASS **Mission Simulator for the West Coast**. Following its analysis of CANTASS at-sea performance (using the Post Analysis System), the navy now has a much clearer understanding of its towed array training requirement. The signal processing, transient detection and PLA insertions will be incorporated into the new trainer, along with improved oceanographic and graphical user interfaces. All modifications to the new trainer will be retrofitted into the East Coast system.

The repair and overhaul contract for the CANTASS **Post Analysis System** (PAS) has been awarded to Array Systems Computing of Toronto. The company will initially produce a software support environment for PAS software development, then begin to address outstanding issues with the PAS (including Y2K concerns).

Other Activities...

• CANTASS Mission Simulator freeplay week (April 19-23, 1999): Fleet operators assessed the operational/training value performance of the East Coast CANTASS Mission Simulator prior to site acceptance testing (May 17-27).

• Fleet Operational Readiness Assessment Check (May 6-12, 1999): Proved the operational performance of CANTASS at sea, and benchmarked the system's performance against CANTASS Baseline 3 software.

• CANTASS Mission Simulator — Instructors Training Course (June 7-July 9, 1999): for CFNOS instructors.

• Program Generation Centre Upgrade: will bring the CANTASS software development tools to a more modern and supportable environment. This will ensure long-term support in an open architecture environment that will enable easier and less hardware-intrusive upgrades. — **Lt(N) Scott MacDonald, DMSS 7-8-2. [http://dgmepm.d-ndhq.dnd.ca/dmss.dmss7/pcantass/cantassf(3).htm]**

News Briefs

1998 MARE Training Awards

(Photos by CFB Halifax Photo, Pte. S. Kent, courtesy CFNES Halifax)

The following awards were presented at this year's East Coast MARE mess dinner on April 29th:

Mack Lynch Memorial Award

SLt Ryan New (presented by Capt(N) D. Hurl)

Northrop Grumman Canada Award

Lt(N) Joseph Pike (presented by Capt(N) G. Humby)

CAE Award

Lt(N) Edward Hooper
(presented by Wendy Allerton, CAE)

Lockheed Martin Award

Lt(N) Keith Coffen
(presented by Capt(N) (ret.) B. Baxter, Lockheed Martin Canada)

Runners-up:
Lt(N) Ducas
SLt Bouayed
SLt Mondoux

MacDonald Dettwiler Award

Lt(N) Greg Marquis
(presented by Lee Carson, MacDonald Dettwiler Canada)

Runners-up:
Lt(N) Deschenes
Lt(N) Porteous
Lt(N) Patterson
Lt(N) Gray

Share Your Snaps!

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

National Defence / Défense nationale

JUNE 1999

News

CANADIAN NAVAL TECHNICAL HISTORY ASSOCIATION

Inside this issue:

CNTHA News is the unofficial newsletter of the Canadian Naval Technical History Association, published by the Director of History and Heritage, NDHQ Ottawa, K1A 0K2, telephone (613) 998-7045, fax 990-8579. Views expressed are those of the writers and do not necessarily reflect official DND opinion or policy. The editor reserves the right to edit or reject any editorial material.

War Museum seeks CNTHA Assistance

Readers with a sharp eye will likely have noticed that Dr. Roger Sarty is no longer our point of contact with the Directorate of History and Heritage. Roger, who was recently recruited by historian Jack Granatstein to head up historical research and exhibit development at the Canadian War Museum (CWM), is ably replaced by Michael Whitby (who worked with Roger and Dr. Alec Douglas to establish the naval history program at DHH). Roger, meanwhile, continues to actively participate in the CNTHA, and is now asking our readers for assistance.

The war museum is seeking to strengthen its holdings of post-Second World War naval artifacts, especially those from the Cold War era. This is an important development as the foundation of the CWM's collection consists mainly of Canadian army artifacts from the two world wars. According to Roger, the retirement of the last of Canada's steam-driven destroyers presents an unparalleled opportunity to fill in some of the gaps in the naval collection, but the museum needs advice on what equipment to look for.

The *St. Laurent*- and follow-on classes were built at the height of the Cold War in the 1950s and 60s, and remained the backbone of our naval fleet right up until the early 1990s. As such, they embody some 30 to 40 years of Canadian naval history. They were the first major warships to be designed in Canada, and their repeated upgrades over the years often featured equipment and concepts that were in themselves Canadian innovations. Home to several generations of Canadian naval personnel, these ships harbour the essence of the Canadian naval experience from a long and important period.

Roger is asking for assistance in identifying specific pieces of equipment, perhaps even parts of structure, that should be acquired by the museum to meet its mandate of preserving key artifacts that will serve both as a memorial and as an educational resource. One suggestion already passed on to the museum is that they should especially try to gather equipment, consoles and displays from the operations room and bridge (which the museum says can be worked up into a nice display), but what they need to know is, Which specific items? Also, are there reasonably compact pieces of equipment and structure from other parts of the ship (say an engine-room display), that would meet the dual objectives of preserving what was familiar and important to service people, and providing a good resource for education and research?

Roger Sarty promises to keep us posted on developments. In the meanwhile, if you can help him out in any way with the new naval display for the Canadian War Museum, please contact him directly at: Director Historical Research and Exhibit Development, Canadian War Museum, General Motors Court, 330 Sussex Drive, Ottawa, K1A 0M8. (Roger.Sarty@warmuseum.ca); Tel. (819) 776-8664; Fax (819) 776-8657.

Mike Saker

Helping Official History: The Value of the CNTHA

Article by Michael Whitby

Given the fact that there has been a change in leadership of the naval history team at the Directorate of History and Heritage, it might be beneficial to re-emphasize the important contribution that the members of the CNTHA make to the writing of official history. In doing so, I will rely heavily upon Dr. Roger Sarty's discourse on the subject that appeared in the March 1997 edition of this newsletter, for he captured succinctly the reasons why official historians need your assistance.

First, let's clarify the term "official history." It can be misleading, but James Butler, editor of the massive British official history series on the Second World War, described official history as that commissioned and sponsored by a government which then opened its records for that purpose and took responsibility for the competence of the authors. That well sums up the position and role of Canada's official historians at the Directorate of History and Heritage. We are given a task, we receive unfettered access to departmental records and we complete a comprehensive historic volume to the best of our ability. Our job is to get it right, warts and all.

In January the Directorate of History and Heritage received the go-ahead to complete a three-volume official history of the RCN in time for the centennial of the Canadian navy (*see box at left*). This will be a huge undertaking, especially Volume III which will cover the years 1945 to 1968. Veteran sailors of that period know of the massive changes that took place, not just in the RCN, but in naval warfare in general, and understand the ever-increasing impact that technology had on naval warfare during that time frame.

Documents are useful only to a point to the historian who is seeking to understand and interpret the complexities of technological change. As Dr. Sarty explained so well, innumerable questions arise that must be addressed: How were ship and equipment requirements evolved? How did the teams responsible for equipment selection, design and procurement evolve? Who were the key players? How did the technical branches relate to the naval staff and to each other? How did the navy relate to the Defence Research Board, to the Department of Defence Production and to industry? How did the ships and equipment perform in the fleet? What problems arose and how were they tackled?

The recollections of those who witnessed or participated in those events are of immeasurable assistance to the historians who grapple with these critical questions. That was revealed to me in my work on "*Certified Serviceable, The Technical Story of Canadian Naval Aviation*." The vast expanse of anecdotes, reminiscences, copies of working papers, accounts of experience with certain types of kit, along with the photographs collected by a small group of dedicated naval air technicians, shed an enormous amount of light on what would otherwise have been a pretty dark hangar. It's not that the technical side of naval air would have been ignored in the official history, but it is doubtful that it would have been written with the clarity and insight of "those who made it so."

So we welcome, enthusiastically and gratefully, any material that members of the CNTHA can contribute to our growing naval technical collection at DHH. We also welcome your advice when we seek to understand the complexities of the post-war naval experience. You are valuable members of the naval team and you will help us to get it right.

Michael Whitby is the chief of the Naval History Team in the Directorate of History and Heritage.

Official History due in 2010

In January the Directorate of History and Heritage received renewed priority from the DND Heritage Board to complete a three-volume official history of the RCN in time for the centennial of the Canadian navy in 2010. This isgreat news. When completed, the project will enhance public understanding of the vital role the Canadian navy has played, and continues to play, in both peace and war.

The project will be a massive undertaking, but DHH is in good shape to see it through with our traditional high quality. We are in the final stages of completing Volume II, which covers the Second World War. A draft should be ready for the publisher at the end of this year, with publication about 18-24 months after that.

Some preliminary work has been done for Volume I (1867-1938), but we are much farther along with Volume III, which will cover the post-war years to 1968. The great progress with Volume III is thanks in no small part to the dedication of the naval technical community which has gathered a vast array of material on specific subjects such as naval aviation, sonar development and the hydrofoil project, as well as more general technical matters.

Over the past decade the naval history team at DHH has received tremendous support from the entire naval community. We are grateful for that and it gives us a great level of comfort to know that we will be able to continue to count upon that same enthusiasm as we see the naval history project through to completion.

M.W.

Book Review:

Desert Sailor: A War of Mine

By James T. Hewitt, Canadian Peacekeeping Press, Cornwallis Park, P.O. Box 100, Clementsport, NS, B0S 1E0, 1998. ISBN 1-896551-17-3. Soft cover, 192 pp, Illus., photos, appendices and index. $24.95 plus taxes and shipping.

Reviewed by Mike Young

To this reviewer's knowledge this is only the second book published by a Canadian naval officer on his Gulf War experience[1]. A specialist mine warfare officer, LCdr Jim Hewitt kept a journal during his time in the region. He has edited and smoothed the entries into a fascinating book.

As the title implies, this is both a personal account and an account of the sea mine warfare aspects of the 1991 Gulf War. Sent to the Gulf in late 1990, the author ultimately joined the staff of the multinational mine countermeasures (MCM) force, which was commanded by a USN officer. After the shooting stopped, LCdr Hewitt was one of the first ashore at the former Kuwait naval base. There he witnessed some of the effects of the Iraqi occupation — looting, vandalism and wanton destruction, coupled with some nasty booby traps — and collected some official "souvenirs" for use as training aids in the fleet school back in Halifax.

What makes this story fascinating is the insight the author brings as a specialist in the business of mine warfare. He was

(continued on page 4)

The amphibious assault ship USS Tripoli (LPH-10) lies in drydock in Bahrain after sustaining damage below the waterline from an Iraqi mine off Kuwait during the Gulf War in 1991. The ship was able to continue operations after damage control crews were able to stop the flooding. *(USN photo by JO1 Joe Gawlowicz. Used with permission.)*

The Collection
(354 Items!)

Among our latest acquisitions is a VHS tape entitled, "The Tracker Years." It is an amateur video produced and written by Alfred T. Bristow. In the credits he recognizes several retired naval officers, two of whom are known to me — Robbie Hughes and Benny Oxholm. The tape runs close to an hour in length and is most professional in presentation. Although primarily operational, it tells the story of the tracker aircraft in full and is a joy to watch. The production group is called Crystal Creations, and proceeds from the sale of tapes (at $34.50 each) are being used to support the Shearwater Aviation Museum Foundation.

Copies can be obtained from:

Alfred T. Bristow
#94-100 Burrows Hall,
Scarborough, Ontario M1B 1M7
phone (416) 299-8016

We are continually on the lookout for new material. If you have something and think we have it, send it anyway. We can sort it out. You can reach me by:

mail: 673 Farmington Ave.,
Ottawa, Ont., K1V 7H4
fax: (613) 738-3894
E-mail: phil@ncf.ca

Phil Munro

(continued from page 3)

aboard the MCM command shipUSS *Tripoli* when she hit a mine in the barrier off Kuwait and he describes the chilling scene as damage control parties fought to contain the flooding, shore up weakened bulkheads, restore electrical power and prevent explosions from a variety of flammable products released by the mine damage. The damage caused by a single mine to this 20,000-ton ship was major and a reminder of just how dangerous mines can be. The missile cruiser USS *Princeton* was also severely damaged as a result of actuating a mine in the same field.

It is clear from the observations of the author that, once again, when it came to mine warfare, some key naval planners, as well as some coalition senior officers, overlooked the lessons of history. Fortunately, this time the coalition forces were able to side-step. Next time we may not be so fortunate. This book should be mandatory reading for naval officers attending the Canadian Forces Command and Staff College.

Mike Young is an independent consultant based in Ottawa.

[[1]Cmdre Duncan "Dusty" Miller wrote about his experiences as a task group commander in the 1995 book, "*The Persian Excursion,*" written in collaboration with Sharon Hobson. RAdm Miller now commands the Canadian Maritime Forces Atlantic.]

RCN/RN Relations, 1955

In 1955 a number of Canadian officers and ratings were serving in Royal Navy submarines based in Portland, England as part of the deal that brought the (RN) Sixth Submarine Squadron to Halifax in that year. On June 16, 1955, one of the boats, HMS/M *Sidon* sank alongside the depot ship after a torpedo explosion, with fourteen lives lost. I happened to be Duty Staff Officer at NMCJS (London) that day. That evening I got a call from someone in the Admiralty asking whether the Canadian Government would have any objection to the Queen sending condolences to the relatives of the one Canadian petty officer killed in the blast. After a quick check to make sure that the next of kin had already been informed, I told the Admiralty to go ahead. On reporting this to Commodore Brock the next morning, he was appalled by the thought that anyone would even ask the question. We'd certainly succeeded (maybe too well) in sensitizing the RN to Canadian independence. — **Hal Smith**

Canadians at Harwell

Regarding an earlier query of, "Who were the Canadians, if any, who joined the team at Harwell?"

The following people undertook the 16-week course at Harwell, U.K., completing it in mid-January 1958:

- Cdr(E) (later Vadm) R. St.G. Stephens
- Constructor LCdr W.M. Ogle (left the RCN 1964)
- Lt(L) G.A. Kastner (retired as Lcdr)
- R.A. Mitchell, civilian engineer from NEDIT

They all then went to Y-ARD to work with the RN team studying nuclear propulsion.

Lt(E) (later Capt) S.E. Hopkins completed an M.Sc. degree in nuclear engineering at the University of Ottawa in September 1957. Cdr(E) (later Capt) M.W. Anketell-Jones was on the Harwell course immediately after the above four. [Source: *Crowsnest*, Feb. 1958, pp. 14-19, "Atomic power high in naval planning: RCN officers train in nuclear engineering," (which I happened to stumble across while looking for something else!). Most of the article is quoted from a survey by RAdm G.A.M. Wilson, RN, Deputy E-in-C in the Admiralty, December 1957.]

The article also says that LCdr(L) C.R. Nixon (left the RCN as Cdr 1963; later Deputy Minister of National Defence) and LCdr(L) J.A. Stachon (later Cdr) "are studying nuclear engineering as part of the course they are taking at MIT." This is something of an exaggeration as, at the time and for some time afterward, MIT offered only one course in nuclear reactor control — or about five percent of the total courses they took. [Source: Me! I took this MIT course in 1959.]

Hal Smith

We'd love to hear from you…

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