National Defence / Défense nationale

Maritime Engineering Journal

80
Since 1982

Canada's Naval Technical Forum

Summer 2016

In-theatre Hull Repairs – The Value of On-board Technical Expertise

Also in this Issue:

Canada

End of an Era

Photo by Cpl Blaine Sewell

The retired destroyer *Algonquin* leaves Esquimalt on her last voyage.

see News Brief page 21

Maritime Engineering Journal

(*Established 1982*)
Summer 2016

**Director General
Maritime Equipment Program
Management**

Commodore Simon Page,
OMM, CD

Senior Editor
Capt(N) David Benoit
Chief of Staff MEPM

NCM Editorial Advisor
CPO1 Colin Brown
DGMEPM Unit Chief

Project Manager
Lt(N) Brian Smith

Production Editor/Enquiries
Brian McCullough
brightstar.communications@sympatico.ca
Tel. (613) 831-4932

Associate Editor
Tom Douglas

**Graphic Design
and Production Services**
d2k Graphic Design & Web
www.d2k.ca
Tel. (819) 771-5710

Commodore's Corner

Feature Articles

Book Review

News Briefs

CNTHA News

Hull technicians on board HMCS *Fredericton* pulled out the stops to repair damage to their ship's hull in a foreign port.
Photo by Cpl Anthony Chand

Current and past issues of the *Journal* are available online at the website of the Canadian Naval Technical History Association – www.cntha.ca

The *Maritime Engineering Journal* (ISSN 0713-0058) is an unofficial publication of the Canadian Armed Forces published 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 and requests for free subscriptions may be sent to: **The Editor, Maritime Engineering Journal, DGMEPM, NDHQ, 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* assumes 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.**

Commodore's Corner

By Commodore Simon Page, OMM, CD

Taking a look forward

Photo courtesy J.E. Scott Howells

Award Winners at the Fourth Year Naval Cadet Mess Dinner, Royal Military College of Canada (Kingston)

(Left to right): Cmdre Mark Watson, **NCdt Jordon Bornholdt** (winner of the Sea Logistics Sword), Cmdre (ret.) Bob Hamilton, Capt(N) (ret.) Jim Carruthers, **NCdt Sophie Cormier** (winner of the Carruthers Naval Operations Sword), Cmdre Luc Cassivi, **NCdt Jean-Francois Levesque** (winner of the Carruthers Naval Technical Officers Sword), and Cmdre Simon Page.

The fast and furious pace of work within the naval materiel management enterprise has continued over the last few months. Often, however, when talking with personnel within this enterprise, I am reminded that initiatives and projects for the most part seem to move very slowly. Either because of rich layers of process, bureaucracy in general or slow decision-making, there is a feeling for many that our materiel management achievements do not materialize (no pun intended) quickly. To this end, I always encourage people to take a step back and think of the delta between where we were one, two, or five years ago, and where we are now. In most cases the change and progress are stunning. One has only to think of the *Halifax*-class modernization project and our work to bring the *Victoria*-class submarines to steady-state to realize to what extent our achievements are not only tangible, but also executed at a sound and enviable pace. During a discussion with the MEPM Board of Directors, a few days ago, I found myself taking a look forward. Doing so made me quickly appreciate the magnitude of the work ahead of us, and also how fast the files and projects will need to move to meet all milestones and declare success.

Two years from now my reference point for this article, the HCM-FELEX Project, will have declared full operational capability, and be on its way to closure. All newly installed systems will have transitioned to steady-state, in-service support, and we will be focusing on optimizing the overall performance of the platform while continuing the integration of the Cyclone helicopters and the implementation of additional capability insertion such as the Underwater Warfare Suite Upgrade (UWSU).

Moreover, the Diesel Generator Replacement project will be at the top of a list of key sustainment projects that will ensure the effectiveness of our frigates until end of life. In the same vein, HMCS *Corner Brook* will be completing an extended docking work period, and be on her way to sailing as a sophisticated fighting platform with an enhanced weapon system, an upgraded sonar system, and satellite communications technology. At approximately that same time, one submarine will most likely be participating in RIMPAC 2018.

On top of all of this we will be welcoming and commissioning HMCS *Harry DeWolf*, the first Arctic and Offshore Patrol Ship (AOPS), and HMCS *Margaret Brooke* will be in the latest stages of her build. These ships will bring new technology into our fleets such as high-voltage electrical main propulsion and an integrated bridge navigational system. HMCS *Queenston*, our first future Joint Support Ship (JSS), will be in construction. While creating significant excitement all across Canada and the Royal Canadian Navy, this will concretize the extensive work the naval materiel management enterprise is currently doing to implement a comprehensive naval ship safety management system, and evolve our robust naval materiel assurance program.

As we accept HMCS *Harry DeWolf* into our fleet, we will be using a classification society to maintain these vessels in class throughout their service lives. Finally, an innovative, performance-based and long-term in-service contract for AOPS and JSS (AJISS) will have been signed and be in use to offer the full range of in-service support to these platforms. This contract will trigger an advanced naval in-service support system in which numerous entities will work collectively to meet the intent, availability, and performance at sea.

This may look overwhelming to many of you, but ultimately it conveys a very powerful message. Indeed, two years from now when we take a step back to look, no matter what the speed of the machine really is, we will be able to acknowledge that not only do we work effectively together, but that fantastic results are being continuously achieved within our organizations. We have a significant and wonderful challenge ahead of us, and we will need all hands on deck to get there, one step at a time, ensuring each step is forward.

A key investment as we move forward into this exciting future will be our people. Smart and proactive investments will be required to ensure all personnel joining our organizations remain excited about the business of building, managing, maintaining, and operating ships and submarines. In this context, I had the privilege of attending the Royal Military College of Canada Fourth Year Naval Cadet Mess Dinner earlier this year, and was quickly reminded that these young, intelligent, and excited individuals will be right in the middle of things when we take our *Next Look Forward*.

Furthermore, I recently attended the first graduation ceremony for Ottawa University's Telfer School of Management Certificate in Complex Project & Procurement Leadership, yet another superb investment in our people with innovative, relevant, and essential training that will be critical for the materiel management enterprise.

In closing, I encourage you all, within your respective spheres of work and responsibilities, to not only take a step back and acknowledge the progress, but also to take a look forward and assess how your contributions will help shape the overall landscape. I believe you will find this to be a rewarding and exciting exercise.

Happy birthday, Commodore Page!

The East Coast naval technical community at large made sure Commodore Simon Page (DGMEPM) did not forget his own birthday during the MARLANT Naval Technical Seminar in Halifax in May. The exact number of candles on his cake remains a mystery, but there was sufficient open flame to trigger a response from the nearest Section Base Team at the Stadacona wardroom. Happily, the evolution was completed without incident, and the cake was enjoyed by all – especially the man of the hour!

– Capt(N) David Benoit, COS MEPM

FEATURE ARTICLE

In-theatre Hull Repairs – The Value of On-board Technical Expertise

By Petty Officer First Class Brian Walsh

Photos by Cpl Anthony Chand, HMCS Fredericton*, except where noted.*

This 200-cubic metre blackwater barge broke loose in Souda Bay, Crete, damaging the hull of HMCS *Fredericton*. Wind and seas came up rapidly, causing three bollards to break free from the barge, resulting in extensive damage to the ship's hull a metre above the waterline.

HMCS *Fredericton* set sail on Op Reassurance on January 5, 2016. Less than two months into the deployment the unexpected struck (literally) shortly after coming alongside Souda Bay on the northwest coast of Crete on February 18. A blackwater barge that had been secured to the outboard (port) side of the ship broke loose when the wind and sea state rapidly, and unexpectedly deteriorated with gusts of 40-45 knots and two-metre high waves. These conditions caused the 200-m^3 blackwater collection barge to break loose after ripping off not one, not two, but three bollards. With only one line holding the barge to the ship, the yokohama fenders keeping the barge away from the ship floated away and the barge smashed into the hull several times as it was blown forward from the top part of ship to the foc's'le. Further complicating the situation, while the barge bollards were self-destructing, the special operations rigid inflatable boat (SO RIB) also broke its lines and drifted forward into a force protection boom.

This was not turning out to be a typical duty watch for the officer of the day and the duty tech, who happened to be the marine systems engineering officer (MSEO) and senior hull technician (HT), respectively.

All of this happened in a matter of minutes, as does any emergency. The ship's company was quick to respond, using fenders to minimize damage and cutting the last remaining line once the SO RIB was recovered and out of danger from being struck by the barge. Once the barge was away from the ship and there was no longer any risk to the ship, it was time to assess the extent of the damage. Reports of water in the mechanical workshop and a quick visual inspection kicked off the checks and guided us where to look first.

The first hole was located at deck level in the mechanical workshop and was a dead giveaway as sea water was coming into the space from the waves. Water running down the hull in the forward engine room (FER) indicated another point of ingress, and the senior HT played a game of peek-a-boo with the lagging to try to pinpoint the precise location. The second hole was found up at the deck head, which was actually an extension of the first hole through the deck and into the space below. Another hole was identified in the mechanical workshop, and the final puncture was located at the forward end of the forward A/C plant. In order to fully inspect, everything had to come out of the mechanical workshop, turning the flats outside into a temporary tool crib while repairs were conducted. A final, more detailed exterior inspection was completed from the SO RIB the next morning after the seas had died down. This allowed the captain, MSEO, chief engineer, and senior HT to get a better view of the damage to confirm that all the holes had been located and to identify where all the dents were.

Final tally: Two holes in the mechanical workshop, toward the aft end of the shop near the tool crib at approximately frame 31.5. The first hole extended from 30 cm above deck level down through the deck into the FER by 10-15 cm. The second hole was just above the first one and the associated deflection caused a wrinkle in one longitudinal. All four longitudinals between 2 deck and 3 deck in this area were damaged and distorted to some extent with an average inward deflection of 8 mm over one metre.

Hole between the mechanical workshop and the forward engine room. Photo taken in the mechanical workshop. The corner of the barge cut through the hull like a can-opener.

Damage received from the barge outside of the mechanical workshop and forward engine room.

The third hole was located in the forward A/C plant in line with the after side of frame 21, about 30 cm below the deck head and approximately 15 cm long by 4-5 cm wide. One longitudinal was tripped and deflected 5 mm from its original line inboard with a localized wrinkle at the point of impact just abaft frame 21, with a deflection to the frame of about 1 mm from its original line.

By chance, Grant Heddon, a hull surveyor from Fleet Maintenance Facility Cape Scott (FMFCS), was already on location to assist with the replacement and certification of the ship's deck cranes, and was able to provide valuable assistance with damage assessment, technical requirements for repairs, and specifications for temporary repairs. Along with recommendations from Mr. Heddon, ship's staff presented a plan to shore technical authorities for the HTs to conduct temporary repairs using the material and personnel resources on board. Shore authorities were initially reluctant with allowing us to conduct the repairs, but after further analysis the specifications and plan were approved.

To facilitate repairs, the department was quick to remove all lagging, work benches, shelving, equipment, stores, and wiring to give access to the damaged areas. The first step was to crop out the most distorted sections of hull surrounding the holes using the oxyacetylene emergency cutting torches. The purpose of this was twofold: to provide a flatter surface on which to weld the doubler plates, and to make a rounder hole to minimize the stress concentrations where fractures could develop. The HTs worked late into the first night to get as much of the cutting complete as possible so that they would be able to commence work on welding the doubler plates once the ship was turned to allow access from the jetty side.

At the start of day two, technical staff from the Hellenic Navy dropped by to apologize for their errant barge, offer support, and have a look at the scope of damage. It was an interesting experience to get their opinion on the damage and assessment. They offered to do a full repair in three to four days, but as we seemed to have things in hand we graciously declined their offer. They were quite adamant that we accept at least some of their help, and we took them up on their offer of material and technical support. Before they left, they certified the spaces gas free to conduct the hot work and took measurements for the required 8-mm, 350-WT steel doubler plates, which were cut and delivered that same day. They also provided us with contact information in the event we required any other support, and we called a few times to ask for steel wedges, gas for welding, and assistance with non-destructive testing (NDT). In the end, they seemed impressed with our resourcefulness and the speed with which the temporary repairs were completed, but we couldn't have been as successful without their support.

Ship's staff started welding in the mechanical workshop, installing a doubler plate for the section of deck that was cut out where the hole extended from the workshop into the FER. For all welds, one root pass and six to eight cover passes with 7018, 1/8-inch welding rods were completed using shielded metal arc welding. The HTs then moved on to the doubler plate for the hole in the forward A/C plant, completing the external welds using dogs and wedges to press the doublers to the hull for a tight fit. At the same time, one cracked longitudinal in the mechanical workshop was reinforced using a stiffener/backing plate welded to the longitudinal on the opposite side of the fractured wrinkle. After the external welds were made to the forward A/C plant doubler plate, and the mechanical workshop longitudinal stiffener was welded in place, work commenced on the external welds for the last two doubler plates for the mechanical workshop. The HTs put in another long day, working in shifts and through intermittent rain, to complete the majority of the external welds, making the call to down tools at close to 0100.

Ship's hull technicians used plugs and wedges to stop the ingress of water while seas were two to three metres high outside the mechanical workshop.

Hull repairs to the outside of the mechanical workshop and the forward engine room. Two doubler plates were welded to the hull of *Fredericton* by the ship's hull technicians.

Photo by PO1 Brian Walsh

Fredericton hull technicians LS Matthew Boucher and LS Matthew Watson cropped out the damaged section of the hull using oxyacetylene emergency cutting tools.

Repair from inside the mechanical workshop, and the deck between the workshop and the forward engine room.

The doubler plate welded to the hull outside the forward AC plant.

Photo by PO1 Brian Walsh

MS Peters doing an overhead weld inside the mechanical workshop to stiffen a structural member of the hull.

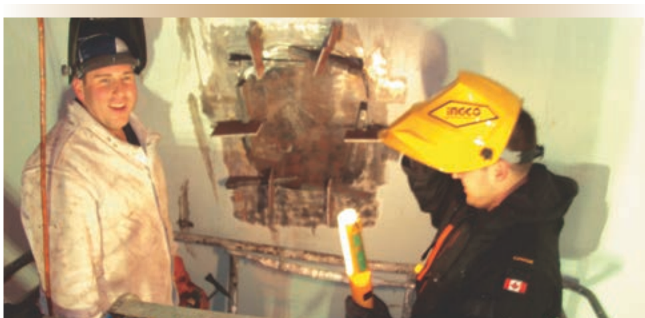


Photo by PO1 Brian Walsh

Hull technicians LS Matthew Boucher and AB Lariviere-Lacombe used dogs and wedges to press-fit a doubler plate to the hull prior to welding it in place.

The last day started early to ensure all the remaining work would be completed. Internally, the doubler plates were pressed, again using dogs and wedges, and welded to the back side of all three doubler plates. The internal welding presented a greater challenge as the location in the forward A/C plant was hidden behind a wire-way, and in the FER behind ventilation trunking, not to mention the awkward positioning required to work around longitudinals, bulkheads, and frames. The HTs persevered and completed their work that morning in time for the Hellenic Navy to conduct NDT. The specification called for magnetic particle inspection NDT to verify the integrity of the external welds. The inspection was completed and none of the welds showed signs of fractures that could lead to crack propagation. This gave ship's staff, Mr. Heddon, and shore authorities the confidence that the temporary repairs would hold for the remainder of the deployment when permanent repairs would be planned. All told, it took three 16-18 hour days for ship's staff to complete the necessary repairs.

It is not every day that hull techs get to weld doubler plates for damage to the hull. This is work that is generally reserved for the maintenance facilities on the coast. *Fredericton's* industrious, and skilled HTs managed to cut out the damage, weld in the patches, and stiffen a damaged longitudinal with the assistance and oversight of Grant Heddon. The assistance of the Hellenic Navy with provision of material and completion of non-destructive testing was invaluable. While many people thought the repairs would cause weeks of delay, this temporary repair was planned and completed without affecting the ship's mission in the Aegean Sea, or our scheduled sailing date. Situations like this demonstrate that having skilled technicians on board RCN warships is a must, and gives Command the tools required to make necessary repairs that will allow mission success. The Hull Section of HMCS *Fredericton* should be proud of their accomplishment in supporting Op Reassurance.

PO1 Brian Walsh is the Senior Hull Technician on board HMCS Fredericton.

Acknowledgment

The assistance of Lt(N) Mark Bartek, MSEO HMCS *Fredericton*, in reviewing this article and offering helpful guidance was most appreciated.

FEATURE ARTICLE

Railgun – Firepower for the Future

By Lt(N) Craig Newman, MSc

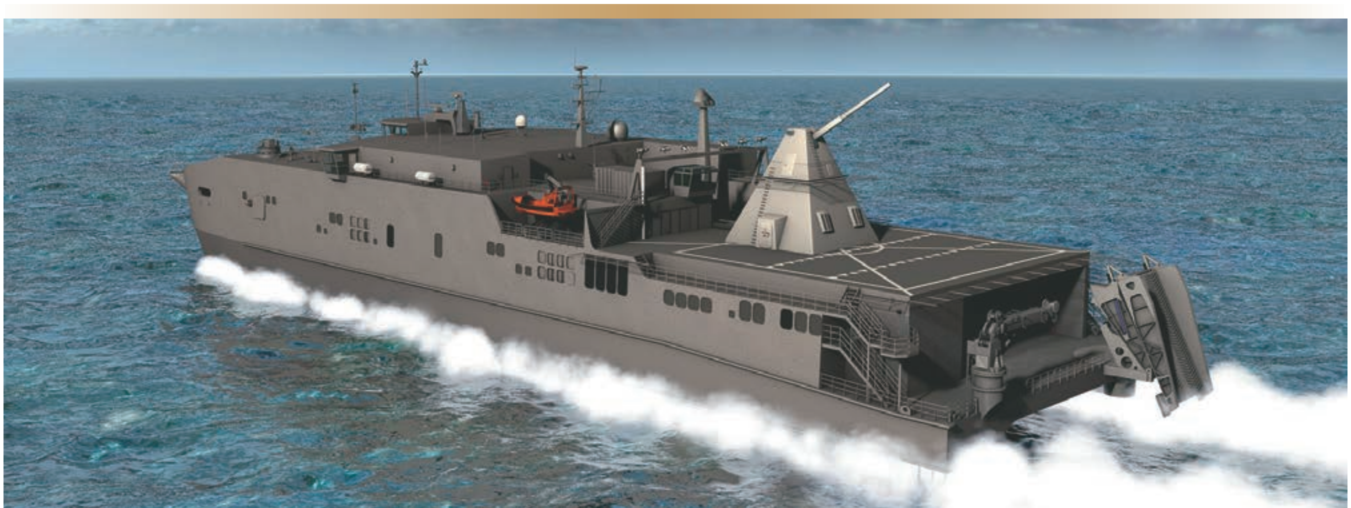


Image courtesy United States Navy

Artist's rendering of the Office of Naval Research (ONR) funded railgun on board USNS *Millinocket* (JHSV-3), the originally identified platform for installation and testing.

The U.S. Naval Sea Systems Command will commence at-sea testing this summer of a BAE Systems prototype railgun on board the joint high-speed vessel USNS *Trenton* (JHSV-5). After decades of development the testing will serve to evaluate the suitability of the railgun as an anti-surface warfare (ASuW) weapon.

The railgun is designed to launch a hypervelocity projectile with 32 MJ of kinetic energy at Mach 7.5, impacting its target at a range of 100 nautical miles and a speed of Mach 5.3. By comparison, the BAE Systems Bofors 57-mm gun currently in service on board the *Halifax*-class frigate fires a projectile with 1.3 MJ of kinetic energy at Mach 3 to a range of nine nautical miles.

Image courtesy United States Navy

Energy unleashed: A 2008 railgun shot.

Electromagnetic launchers (EMLs) such as railguns and coilguns exploit the EM forces resulting from the flow of electric current and the motion of electrical conductors to accelerate objects. EM theory was largely developed during the 19th century by individuals such as Gauss, Ørsted, Ampère, Faraday and Maxwell, but the application of the theory to projectile launch has been sporadic due to significant technical challenges encountered in the practical implementation of those systems. As a result, EMLs have largely remained scientific curiosities and the subject of science fiction.

However, with its origins in the Strategic Defense Initiative of the 1980s, research over the last 30 years has progressed to the point of enabling the introduction of these systems into both the military and civilian sectors. Potential applications include weapon systems, the Electromagnetic Aircraft Launcher System (EMALS), satellite launch and the investigation of atomic properties.

Anticipating increased interest within the RCN technical community brought about by the upcoming at-sea testing of the railgun, the intent of this article is to present the factors motivating the development of the railgun, expected applications of this technology, outstanding challenges to the railgun's introduction, the trend in marine power and propulsion system design that will enable the weapon's deployment at sea, and the fundamental EM theory necessary to understand the how the railgun functions.

Advantages, Applications and Challenges

Current and emerging threats to warships such as supersonic anti-ship cruise and ballistic missiles have greater speed, range and lethality compared to previous generations of naval weapons. These threats – for example the BrahMos missile or DF-21D "carrier killer" – have greatly increased the size of the battlespace within which a ship must operate, and at the same time have decreased the reaction time available to conduct the detect-to-engage sequence.

Additionally, the increasing requirement for warships to sail in the littorals threatens to, as author Wayne P. Hughes has written, "cramp movement and compress inshore operations into an explosive mixture of air, land, sea and undersea launched missiles." If ships are to successfully conduct the detect-to-engage sequence against these threats then the layers of defence must be expanded by integrating future sensors and weapons that are capable of effectively responding to those threats. The railgun promises to be one such weapon.

Compared to conventional guns that launch projectiles using chemical propellants such as gunpowder, the railgun exhibits a number of tactical and logistical advantages. Most benefits are derived from the increased muzzle velocity that the railgun can attain. Muzzle velocities achievable by conventional guns are less than 1,500 m/s (approximately Mach 4.4) due to the expansion speed limits of those propellants. Electrothermal chemical guns use electricity to modify propellant burn rate, but only provide marginally better performance over conventional guns.

The railgun, however, is not constrained by gas expansion limits and has demonstrated a muzzle velocity of approximately 2,380 m/s (Mach 6.9) for a 10.4-kg projectile. This higher velocity enables an increased weapon range, permitting wide-area coverage and exceptionally quick response to threats. Likewise, that range affords greater standoff distance between the launch platform and the target, thereby increasing the safety of the platform and its crew. Furthermore, the range or muzzle velocity of the projectile may be controlled by varying the electric current delivered to the weapon.

Image courtesy United States Navy

BAE Systems' railgun on display aboard USNS *Millinocket* in July 2014.

The higher velocity and kinetic energy imparted to the railgun projectile at launch of course results in a higher impact velocity with the target. A 5-kg railgun projectile impacting between 1,000 m/s and 1,500 m/s (or between Mach 2.9 and Mach 4.4) is capable of delivering approximately the same destructive energy that conventional ammunition delivers explosively. Provided that direct impact can be achieved, target destruction through kinetic energy coupling permits the projectile to be either inert, i.e. free of high explosive (HE), or to contain relatively small amounts of HE.

As such, a number of hazards associated with chemical propellants and HE may be minimized or eliminated, including:

- Collateral damage
- Unexploded ordnance
- Hazards of electromagnetic radiation to ordnance
- Accidental ignition by electrostatic discharge, and
- Projectile cook-off in the barrel.

Moreover, eliminating HE will result in lighter and smaller projectiles thereby enabling more projectiles to be stored in the same sized magazine. One projection predicts the magazine capacity on board a warship could increase by three to five times, giving rise to deeper magazines while permitting safer handling and storage of the projectiles. Of note, the long range of the weapon and the requirement for direct impact with the target necessitates that the projectile have a guidance system to correct for external ballistic effects and to engage moving targets.

Finally, at an estimated cost of roughly three gallons (11.4 L) of fuel per shot necessary to generate the EM energy to launch a projectile, it is estimated that railguns present a more cost-effective means of target engagement compared to weapons such as missiles. It can be expected that increased safety and decreased cost and collateral damage will greatly contribute to a positive public opinion of the weapon.

The railgun is envisaged to be a versatile weapon that will be employed in direct and indirect fire roles in both offensive and defensive ASuW and anti-air warfare (AAW). Recent research has suggested some innovative applications for the railgun such as a close-in weapon system (CIWS) or as a supersonic missile launcher. As a CIWS, the ability to vary projectile muzzle velocity would permit firing an "intelligent burst" such that the rounds are launched appropriately for simultaneous impact at the predicted intercept point with the target, substantially increasing the probability of a successful engagement against a supersonic anti-ship cruise missile.

However, realizing the full potential of the railgun is not without its technical challenges. Issues include:

- Transient voltages as a result of firing the weapon
- Thermal management of losses due to inefficiencies
- Effective electrical power system fault detection
- Fast-acting circuit breakers to handle the large electrical loads, and
- Sustained and rapid fire of the railgun.

Mega-ampere currents, kilo-gee accelerations, and mega-pascal pressures between the rails and the projectile could likely result in significant material wear of the barrel and an intolerable reduced operational availability of the weapon for maintenance. A robust projectile is also required to withstand those extreme launch conditions.

The ability for sustained and rapid fire is as much dependent upon the material degradation of the railgun as it is upon the system supplying electrical power to the weapon. There are a number of potential options being investigated to provide the megawatt to gigawatt power demands of the railgun, including capacitor pulse forming networks, homopolar generators, and pulsed alternators, among others. The pulsed power supply (PPS) system being developed by General Atomics that will be used with BAE Systems' railgun has not been disclosed, but the fact that the railgun will be undergoing sea trials suggests that some of the obstacles above may have been overcome.

Integrated Electric Propulsion

Certainly the maturation of railgun technology has enabled this next phase of testing of the weapon to be undertaken. However, it is largely accepted that it is integrated electric propulsion (IEP) that will permit the installation of high-energy weapons such as railguns and lasers on board future warships. As Andrew Tait stated in an article on IEP for Jane's *Navy International*, an IEP configuration seeks "to maximize the efficient use of primary power generation machinery by using the same source to deliver power for propulsion and for weapon systems, as well as the auxiliary electrical load." This design has been used on the Royal Navy's Type 45 destroyer as well as on the USN's DDG-1000 *Zumwalt*-class destroyer, providing the ships with approximately 54 MW and 80 MW of power respectively. These are relatively large amounts of power compared to the 3.4 MW supplied by the four diesel generator sets on the *Halifax*-class frigate.

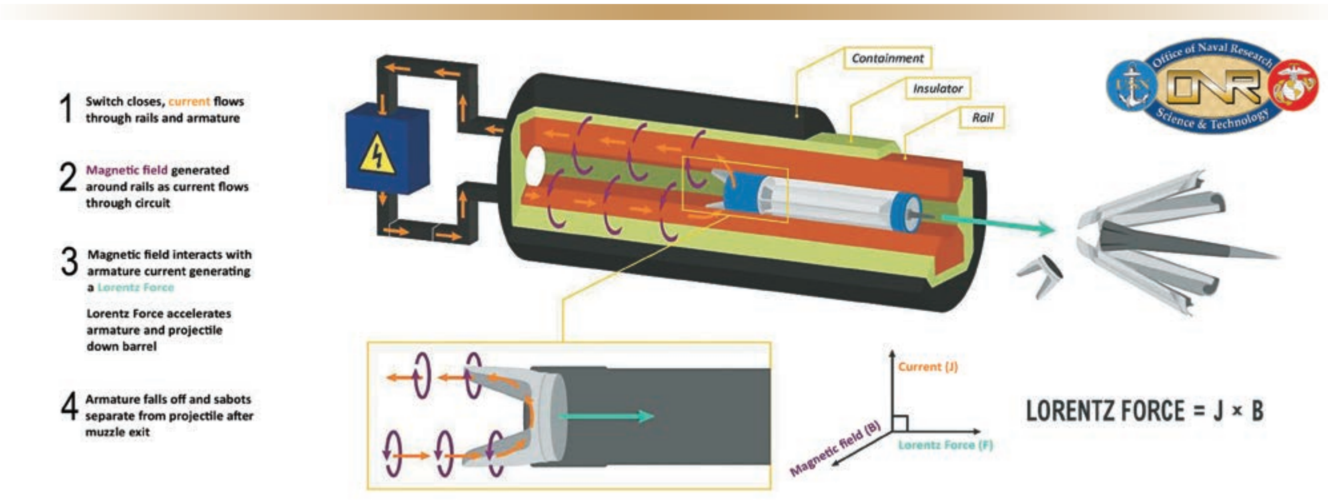
Besides increased amounts of electrical power, IEP is said to provide fuel savings and greater flexibility to choose the location of power generation and propulsion systems, as well as to eliminate the gearbox and thereby reduce acoustic signature. This technology is not without its own challenges, and despite the noted advantages some speculation exists as to whether IEP will become the new standard. With high-energy weapons still in the developmental phase there may be little more than IEP's own benefits to motivate adoption of this design approach in the near future. That said, the *Zumwalt* class was designed with high-energy weapons in mind, and the USN has stated that the first operational deployment of the railgun is anticipated to be on board the USS *Lyndon B. Johnson* (DDG-1002) in the mid-2020s.

Theory

Given that EMLs convert electrical energy into mechanical energy, these machines are in many ways similar to electric motors. There are three variants of EMLs: the railgun, the coilgun, and the induction driver (or linear induction motor such as the maglev or EMALS). It is generally agreed that railguns are capable of achieving relatively larger muzzle velocities, while coilguns are capable of accelerating relatively larger masses. Much of the theory pertaining to how a railgun operates also applies to the other two EML variants. This section presents some of that theory without the use of calculus or references to concepts such as magnetic flux, self-inductance and mutual inductance, magnetic energy or current density.

A railgun is a direct current (DC) machine and may be modeled as a few simple circuit components connected in series. These elements are: a PPS providing the driving current; a switch that acts as the weapon's trigger; two parallel conducting rails that form the barrel; and, a sliding conductor between the rails – the projectile. The projectile is often referred to as the armature given its similar role to that component of an electric motor.

It is critical to understand that an electric current flowing through a conductor generates a magnetic field around the conductor. This concept is demonstrated by



The Lorentz Force: A simple diagram of the railgun demonstrating the interaction between the magnetic field and current to generate the Lorentz Force which launches the projectile.

the Right-hand Rule. Grasping the conductor in the right hand, with the thumb parallel to the conductor and indicating the direction of the electric current, the fingers perpendicularly encircling the conductor will indicate the direction of the resultant magnetic field.

The railgun launches the projectile by generating what is known as a Lorentz Force. When the railgun's trigger is pulled the PPS discharges its stored electrical energy into the circuit. The electric current travels through the first rail, across the projectile, and returns through the second rail. The resultant magnetic field between the rails interacts with the current in the projectile to create the Lorentz Force which causes the projectile to accelerate toward the barrel's muzzle. Suffice it to say that the magnitude of the Lorentz Force is directly proportional to the magnitude of the current, and that its direction of motion is determined by the direction of the current and magnetic field between the rails. The general railgun design method, therefore, is to maximize the Lorentz Force on the projectile and its resultant muzzle kinetic energy by maximizing the current from the PPS. Generating and storing that energy in the PPS requires considerable electrical power which explains why the railgun is referred to as a high-energy weapon.

Conclusion

The long range and quick response of the railgun suggest it will be an ideal solution to modern and future threats in the naval and littoral environments, and that it will also be a cost-effective and inherently safer option compared to guns and missiles that rely upon chemical propellants and HE. The RCN's growing interest in the railgun was recently signaled in *Leadmark 2050*'s strategic assessment of further naval requirements. However, as that document indicates, the installation of these weapons on board ships is dependent upon the availability of large amounts of electrical power, a problem to which the solution may be provided by IEP.

Testing of BAE Systems' railgun on board the USNS *Trenton* this summer will be a significant milestone in the history of EML development and may indeed serve to demonstrate, as the U.S. Office of Naval Research promises, that the "railgun is a true warfighter game changer." Despite this promise, it is prudent to consider that while the railgun may provide firepower for the future, success in warfare is dependent upon more than just weapons. As author Ian Speller suggests, the "performance of a platform reflects the technical specifications of the ship, but also the training, skill, experience and motivation of the crew, the quality of leadership and the adoption of appropriate fighting procedures. Technology is important in maritime warfare but it is not an independent variable. It cannot be understood in isolation to the way in which it is used."

Lt(N) Craig Newman is the Surface and Air Weapons Systems Officer at Fleet Maintenance Facility Cape Breton in Esquimalt, BC.

Reference:
Note: Much of this article's content is the product of research conducted in support of the author's thesis, "Electromagnetic Launcher Applications to Guided Weapon Systems," completed in July 2013, for the sponsored post-graduate MSc in Guided Weapon Systems degree program at Cranfield University, Shrivenham, UK. This source document contains full text references.

FEATURE ARTICLE

Equipment Health Monitoring with IPMS

By Lt(N) Eric Bertrand

The *Halifax*-class integrated platform management system (HCI) was delivered with on-board and shore-based computer servers dedicated to equipment health monitoring (EHM). While the requirements for these servers were only loosely defined in the contract with L3-MAPPS, a program has now been developed to acquire, store, and analyze *Halifax*-class EHM data. The program already saves time, effort, and money in multiple ways, and is transforming DND personnel into smarter equipment project managers and maintainers; however, we have only scratched the surface of the program's potential.

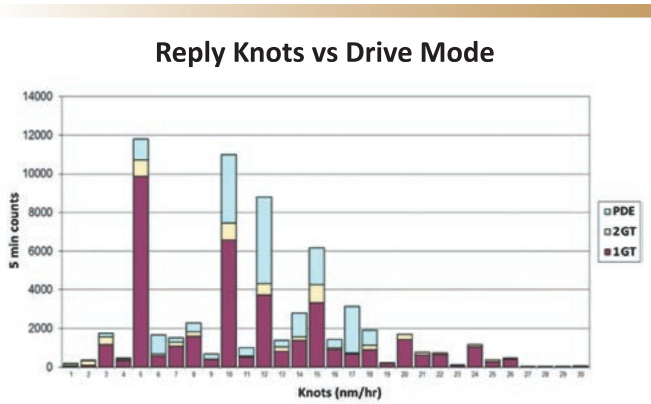
Business Case for Moving Forward

To get a better understanding of what is possible with HCI EHM, a modest effort was made to collect data and use it in obvious places. This would serve to work out the level of effort needed, and better determine how the data could be used to make the supportability of the *Halifax*-class more efficient.

EHM data is now used to populate key performance indicators (KPIs) within the Royal Canadian Navy's (RCN) Defence Resource Management Information System (DRMIS), thus generating maintenance based on operating hours for over a dozen major maintenance routines. This auto-generated maintenance assists fleet maintenance facilities (FMFs) and ship's staff in planning and calling up maintenance.

An effective use of EHM data was the removal of redundant mandatory reporting of equipment status. An analysis of the process for reporting diesel engine running hour messages, chiller running hour messages, and uploading switchboard logs showed that ship's staff were using a large amount of time reporting equipment status instead of spending that time on maintenance. Ship's staff spent on average 1.5 aggregate person hours a day uploading switchboard logs into DRMIS, and 2.0 aggregate person hours per month reporting messages. At first this may seem small, but, per year, approximately 2100 aggregate person hours were being spent on these activities across the 12-ship *Halifax*-class fleet. Ship's staff fleet-wide now spend less than 10 aggregate hours per year uploading information that is recorded into EHM.

Once it became known that EHM data was being stored in DGMEPM servers, the Canadian Surface Combatant Project Management Office (PMO CSC) analyzed this data to generate accurate, modern ship-speed profiles. PMO CSC determined that ships in theatre operate for very long periods at 5-10 knots while "patrolling a box," and then move at high speeds for only a small fraction of the time (Figure 1). This was actually much different than the previously accepted 1960s speed profile model. By optimally designing equipment for loitering at low speeds, the RCN will save tens of millions of dollars in fuel and maintenance costs throughout the life of the CSC.



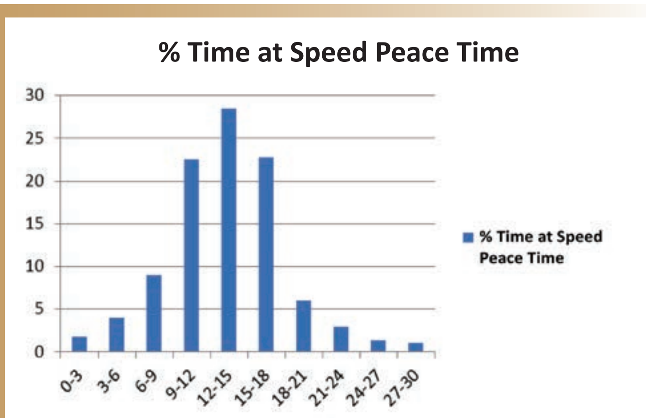


Figure 1: EHM drive mode current speed profile model vs 1960s speed-profile model

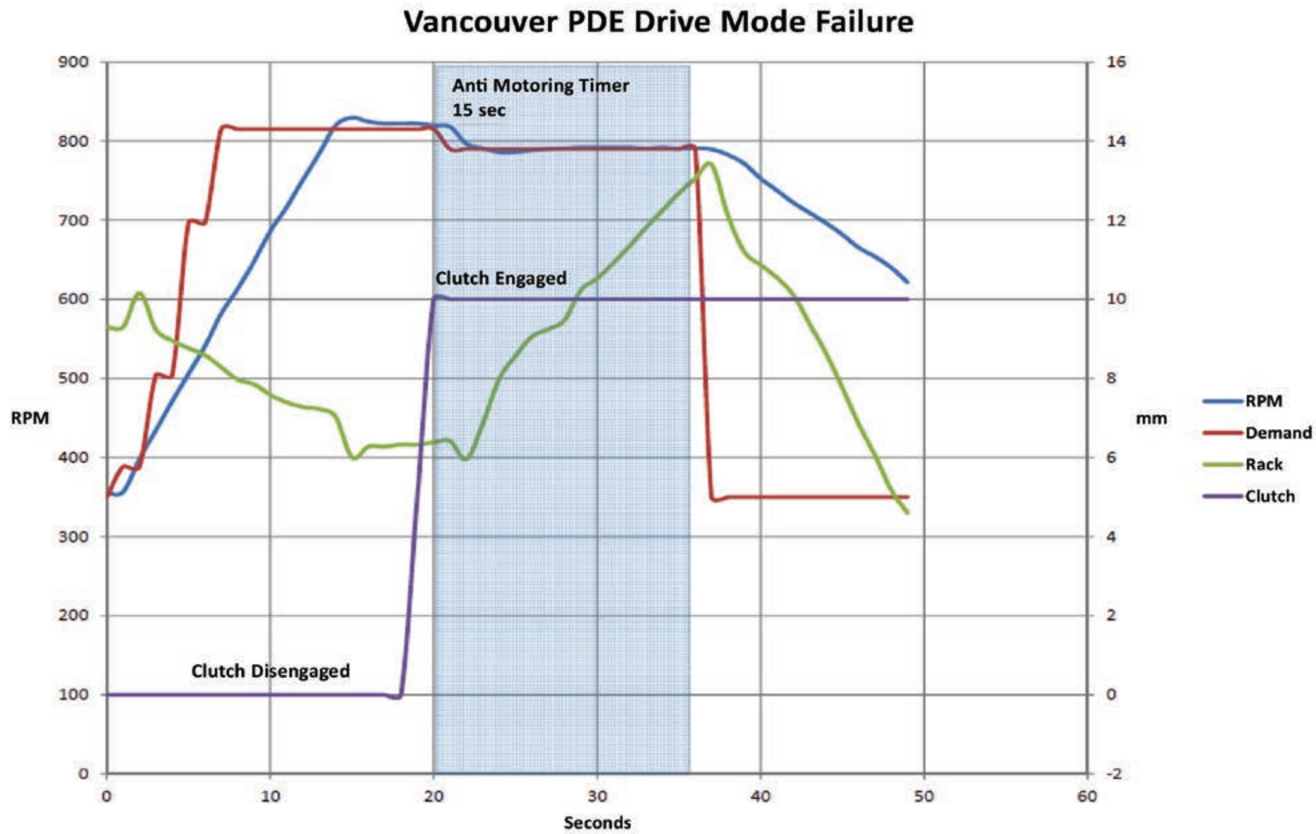


Figure 2: EHM can provide an exact record of events leading up to an equipment failure, which can allow subject matter experts to assist with troubleshooting remotely from ashore.

The *Halifax*-class navigation system (NavDDS) will be integrated with IPMS this year. This will allow ship's speed through water to be compared accurately with power-speed baselines to determine the optimum time to clean a ship's hull and propellers. Merchant vessels worldwide use this technique to save millions of dollars in fuel.

Less obvious, but no less important, is the ability to troubleshoot problems from ashore. Subject matter experts use EHM data, as well as event message logs, to determine the exact sequence of events leading to a failure so that they can provide better assistance to ship's staff on deployment. Figure 2 illustrates how a propulsion diesel engine drive mode changeover failure on board HMCS *Vancouver* (FFH-331) was clearly displayed.

Key performance indicators can be used to intelligently plan maintenance and prevent sending ships on operations with impending failures. For example, HMCS *Montreal*'s 2014 sea trials were cut short after two days due to a port plummer bearing failure. EHM analysis of the data showed that the port plummer bearing was reading approximately eight degrees Celsius higher than the starboard plummer bearing for several months prior to the sea trial, where they should have been very similar (Figure 3). A data analysis of this prior to the sea trial would have revealed this potential failure, and targeted maintenance would have saved tens of thousands of dollars' worth of operations that needed to be repeated.

Integrated Platform Management System EHM Overview

On board

The current HCI is comprised of a server in each ship that records all signals on IPMS for all equipment integrated to it continuously. It records signal values up to every 0.5 second on a change basis. The EHM server segments off the data monthly so that it can be uploaded to the shore servers via file transfer program (FTP) sites. The EHM viewer is commonly used by ship's staff to troubleshoot equipment problems by comparing different values over time.

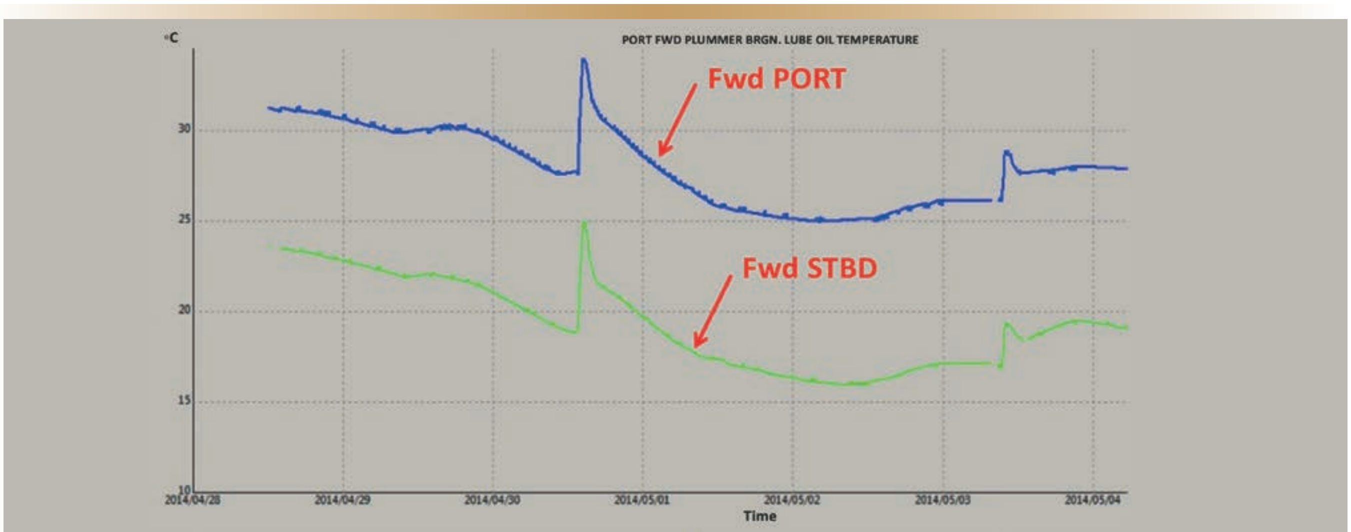


Figure 3: EHM data clearly showed that the port plummer bearing had been running hot on board HMCS *Montreal* (FFH-336) for some time. The eventual failure of the bearing in 2014 was predictable.

Ashore

There are currently many shore-based EHM servers: one EHM server per fleet maintenance facility (FMF) on the coasts, one at DGMEPM in Gatineau, one at the L3-MAPPS facility in Montreal, one at the Naval Engineering Test Establishment (NETE) facility in Montreal, and several at the coastal training establishments. These provide ample capacity to store and analyze ship data.

Data Management

There are currently two contracts for managing HCI EHM data. One is the in-service-support (ISS) sub-task for the L3-MAPPS field service representative (FSR) to collect the EHM data directly from ships when they come alongside home port and upload them to a shared server; the other is an EHM data management task with NETE to populate a central server, and provide DRMIS uploads and reporting services.

Recommended Improvements

In order for KPIs to be effectively used in condition-based maintenance (CBM), failure analysis and data mining are required. Baselines for normal operating parameters need to be established so that KPIs can be used to provide early indication of equipment problems. This takes time and effort, but it generally pays for itself as soon as it is used once to prevent a large equipment failure.

Ideally, downloading and uploading EHM databases from the ships, to FTP sites, back to DND servers, then to DRMIS and into equipment status reports would be an automated process. This would significantly speed up how quickly the maintenance system can detect potential equipment failures and assign intervening CBM. DGMEPM would have to work closely with the Assistant Deputy Minister of Information Management ADM (IM) to have this link established to take advantage of these benefits, while minimizing the information technology (IT) risks that could be introduced to naval platforms.

Conclusion

The EHM that came with HCI – the *Halifax*-class integrated platform management system – is already being used to effectively support the fleet of today and save time, effort, and money. There is much more potential for EHM data usage that is not being realized. This requires an upfront investment of personnel effort and capital that will yield major cost savings, and result in safer ship operations. Updating and streamlining the data management process will ensure a continuity of the EHM program and allow for modern condition-based maintenance in today's fleet, as well as in the future fleet.

DND is working to enhance the EHM program and increase the usages of data where there is a business case to do so. Any feedback through the Directorate of Naval Platform Systems would be most welcome.

LT(N) Eric Bertrand is the DNPS 3-7-2 Deputy Project Manager for the Halifax Class Integrated Platform Management System in the Directorate of Naval Platform Systems in Gatineau, Québec.

FEATURE ARTICLE

Untidys ho! The University Naval Training Division (UNTD) Story

By Bill Clearihue, UNTD Donnacona '64

Photos courtesy the UNTD Association of Canada

The UNTD was officially formed by Naval Order 2854 on June 19, 1943 as a wartime measure, but the inception actually dates back to 1938 and a chance meeting between Albert Wesley (Jack) Baker, and naval reserve Cdr Ernest Reginald (Reg) Brock.

Baker was a prominent entomology professor at the Ontario Agricultural College (now the University of Guelph), and a well-connected and prominent Navy Leaguer. While on vacation in Jamaica he was invited on board HMCS *Saguenay* (D-79) when the ship made a port visit at Montego Bay, and it was there he met Cdr Brock, the commanding officer of the Montreal RCNVR division, who was doing his summer reserve training on board the River-class destroyer. The two struck up a friendship that lasted for decades.

At the outbreak of war in 1939 all fit, male university students were required to join the Canadian Army's Canadian Officer Training Corps (COTC), which had formed in 1912. By 1941 the Royal Canadian Air Force had created its own campus University Air Squadron (UAS) recruiting program, but there was no such naval organization. With one of his own sons reaching university age, Jack Baker realized there was no way for young men to get involved in the wartime navy other than to quit school and join up. The navy was losing all potential officer candidates to the other two services.

Baker set about to correct this situation, and contacted his friend Reg Brock who was by now a captain in the RCNR, and Commanding Officer Reserve Divisions. When he pitched his plan for an equivalent navy program, Captain Brock not only bought into the idea but put Jack Baker in charge of making it happen, giving Baker a wartime commission as a lieutenant-commander. In conjunction with HMCS *Star* in Hamilton, a pilot training program was formed in 1942 consisting of eight senior COTC cadets. On the successful conclusion of that term in 1943, the UNTD was formally stood up, and Jack Baker set about visiting campuses and naval reserve divisions (NRDs) across the country to create the individual units and initiate recruiting. Winter and summer phase training began that year with 400 or so UNTDs being attested into the RCNVR as stokers second class (engineers), or as ordinary seamen (everybody else). A UNTD in his second year became an officer candidate, distinguished by an all-white cap tally.

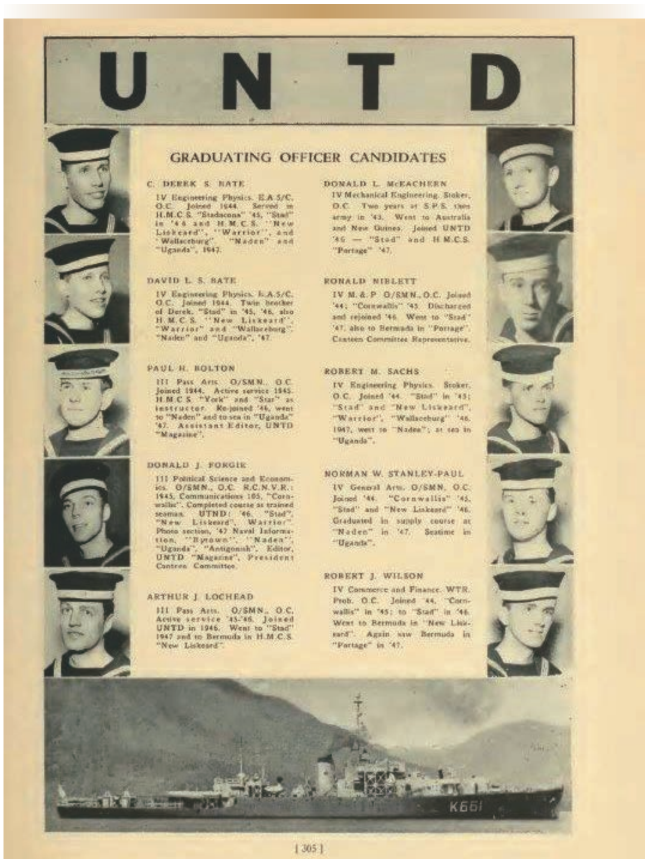
The UNTD Association's motto is Learn, Serve, Lead.

At the conclusion of hostilities the compulsory nature of the UNTD, COTC and UAS was removed, which not surprisingly resulted in a sharp drop in enrolment. The RCN was willing to consider a retooled peacetime UNTD program for the RCN(R), and so Jack Baker set out to find the person who could do that. He persuaded the former wartime RCN Director of Naval Intelligence, himself a Rhodes Scholar and academic, Cdr Charles Herbert (Herbie) Little, to put off his return to civilian life and take up the cause.

There were a number of education assistance programs offered to Second World War naval veterans, and on campus they found a welcoming environment in the UNTD. They brought a maturity and experience to the program which contributed to its success. By the summer of 1949 Cdr Little had developed a robust training program and succeeded in elevating the UNTD to officer cadet status, properly kitted out, trained and treated as such.

In the early 1950s, Canadian Service College naval cadets were incorporated into the UNTD system for purposes of pay, administration and training, and attached to naval reserve divisions. The RCN was replete with war assets: people, ships and establishments, and the UNTD recruiting level was determined by that capacity. At its high point there were more than 1,000 "Untidys" in training.

The formation of the UN (1945), NATO (1949) and NORAD (1957), as well as the Korean War (1950-53), Cuban Missile Crisis (1962) and Cold War kept interest in the military and the UNTD at a high level. In the mid-1950s the size of the RCN was four times what it is today on a per capita basis. The average naval reserve division had twice as many active serving members in the wardroom as there are members in the entire ship's company of an average NRD today.


UNTD

GRADUATING OFFICER CANDIDATES

C. DEREK S. BATE
IV Engineering Physics. E.A.5/C. O.C. Joined 1944. Served in H.M.C.S. "Stadacona" '45, "Stad" in '46 and H.M.C.S. "New Liskeard", "Warrior", and "Wallaceburg". "Naden" and "Uganda", 1947.

DAVID L. S. BATE
IV Engineering Physics. E.A.5/C. O.C. Joined 1944. Twin brother of Derek. "Stad" in '45, '46, also H.M.C.S. "New Liskeard", "Warrior" and "Wallaceburg", "Naden" and "Uganda", '47.

PAUL H. BOLTON
III Pass Arts. O/SMN., O.C. Joined 1944. Active service 1945. H.M.C.S. "York" and "Star" as instructor. Re-joined '46, went to "Naden" and to sea in "Uganda" '47. Assistant Editor, UNTD "Magazine".

DONALD J. FORGIE
III Political Science and Economics. O/SMN., O.C. R.C.N.V.R.: 1945, Communications 105, "Cornwallis". Completed course as trained seaman. UTND: '46. "Stad", "New Liskeard", Warrior". Photo section, '47 Naval Information, "Bytown", "Naden", "Uganda", "Antigonish". Editor, UNTD "Magazine", President Canteen Committee.

ARTHUR J. LOCHEAD
III Pass Arts. O/SMN., O.C. Active service '45-'46. Joined UNTD in 1946. Went to "Stad" 1947 and to Bermuda in H.M.C.S. "New Liskeard".

DONALD L. McEACHERN
IV Mechanical Engineering. Stoker, O.C. Two years at S.P.S. then army in '43. Went to Australia and New Guinea. Joined UNTD '46 — "Stad" and H.M.C.S. "Portage" '47.

RONALD NIBLETT
IV M. & P. O/SMN., O.C. Joined '44; "Cornwallis" '45. Discharged and rejoined '46. Went to "Stad" '47, also to Bermuda in "Portage". Canteen Committee Representative.

ROBERT M. SACHS
IV Engineering Physics. Stoker, O.C. Joined '44. "Stad" in '45; "Stad" and "New Liskeard", "Warrior", "Wallaceburg" '46. 1947, went to "Naden"; at sea in "Uganda".

NORMAN W. STANLEY-PAUL
IV General Arts. O/SMN. O.C. Joined '44. "Cornwallis" '45. "Stad" and "New Liskeard" '46. Graduated in supply course at "Naden" in '47. Seatime in "Uganda".

ROBERT J. WILSON
IV Commerce and Finance. WTR. Prob. O.C. Joined '44, "Cornwallis" in '45; to "Stad" in '46. Went to Bermuda in "New Liskeard". Again saw Bermuda in "Portage" in '47.

[305]

This page from the 1948 University of Toronto yearbook shows what UNTDs looked like then. All 10 of these graduates entered the UNTD in the wartime years, some going on active service before returning to school and the UNTD.

By the mid-1950s the importance of a university education was embraced by DND for officers of all services. Cdr Little formulated the Regular Officer Training Plan as a combination of the UNTD, academia and Canadian Service College regimens he had experienced, and that program exists essentially unaltered to this day. In 1991, Cdr Herbie Little received the Admiral's Medal for his work in transitioning the UNTD from wartime to peacetime operations.

By the late 1950s enrolment levels for the UNTD and sister programs were in steady decline. The Defence White Paper of 1964 spelled the beginning of the end for the UNTD, and in that year the intake numbered only 150 cadets. A number of NRDs were closed. The last formal UNTD intake was in 1966, with an "accidental" intake of eight cadets in the fall of 1967. With Forces Unification in 1968, the UNTD ceased to exist at the end of that year's summer training. Jack Baker attended the graduation of the last UNTD class, which included his grandson. Commodore Reg Brock, who crossed the bar in 1964, himself had two sons in the UNTD in the early 1950s.

During its 25-year run the UNTD enrolled 8,000 members whose impact on the navy and society in general is still being felt in substantial ways. The UNTD ceased to exist in 1968, but reserve officer training did not miss a heartbeat. By 1969 the tri-service Reserve Officer University Training Plan (ROUTP) had fielded its first members and has been running under various aliases ever since. By the mid-1980s the UNTD graduates were filling the command structure of the naval reserve. They in turn trained and mentored the ROUTPs, who now occupy these same positions. Although the University Naval Training Division Association of Canada (UNTDA) has always embraced the ROUTP cadre, this was formally acknowledged by the UNTD Association in 2014 to make it abundantly clear that ROUTPs are welcome on an equal footing.

The UNTD Association of Canada

In 1985 there were a number of major events celebrating the 75th Anniversary of the RCN. One of these was the renaming of the naval reserve ROUTP program back to the UNTD program, which prompted serving UNTDs to initiate a number of well-attended reunions across the country. From that connectivity the "White Twist Clubs" were formed as a national organization, but within two years both the White Twist Clubs and the UNTD as a renamed program were gone.

Regional and local groups continued to associate with varying degrees of formality and in 1987 the UNTD Association of Upper Canada was formed in Toronto. It was named to distinguish itself from the Ottawa group, and with a high concentration of ex-cadets was able to flourish. It was re-purposed and renamed in 2001 to the UNTD Association of Canada to reflect its increasingly national scope, although most of the members and executive were still from Southwestern Ontario. That demographic has been purposely shifted over the years and there are now regional directors for Newfoundland, the Maritimes, Quebec, Ottawa, Kingston, Manitoba, Saskatchewan/Alberta, BC Mainland and Vancouver Island. Of the 18 directors only seven are now from the Greater Toronto Area, and ironically none specifically represent Toronto.

The UNTDA has published a newsletter without interruption since 1987, as well as a book of anecdotes called UNTiDy Tales of Naval Officer Cadets (*see our review on page 18*). At least four books have been written by members that specifically chronicle how their UNTD experience shaped their lives. Well-known personalities such as author Peter C. Newman, crime writer Max Haines, politician and diplomat Roy MacLaren, and former Minister of National Defence Bill Graham have also mentioned their UNTD experiences within their own published autobiographies.

A publicly available UNTDA website was initiated in 1999 and serves as a repository for member information, archival files including yearbooks and newsletters, and links to related information.

The UNTDA continues to organize and host reunions of regional, national, and international scope as its primary mandate. The UNTD Association and individual members maintain strong leadership connections to virtually all other existing naval old-boy networks and heritage organizations. For example, about one-quarter of the membership of the Naval Association of Canada is comprised of UNTD alumni, and a number of UNTDs have served as president of the Canadian Naval Memorial Trust, and as commanding officer of HMCS *Sackville*.

The UNTD Association of Canada looks forward to welcoming new members. Membership in the UNTDA is $25 per year, and is open to all alumni of any regular or reserve naval officer training program from any era. The primary use of member dues is to support reunions, various heritage initiatives, and incidental costs of running the organization. Directors are volunteers and receive no compensation for their time or travel.

A membership application is available from the website at: http://www.angelfire.com/on2/UNTD/MApp.pdf

The last "accidental" group of UNTDs shown here in 1968 with their term lieutenant Roger Elmes (centre), current president of the UNTD Association since 2014.

We look forward to hearing from you.

Bill Clearihue is a director, as well as the archivist and newsletter editor for the UNTD Association of Canada [www.untd.org]. He lives in Oakville, Ontario.

A photo from the 2009 UNTD reunion held at the Canadian Forces College in Toronto. Dozens of reunions have been held across the country over the last 30 years, the most recent being in Victoria last April. Pictured here are Untidys from three decades (L to R): Bill Clearihue (Donnacona '64), Gil Hutton (Star '46), Bill Thomas (Prevost '59), and Bob Williamson (Star '57).

Gil Hutton crossed the bar in 2010, and his ashes were committed to the sea in October 2011 from the crew quarterdeck of *Queen Mary 2* in mid-Atlantic. The ceremony was officiated by Bill Thomas before a group of 70 UNTDs and spouses en route to the UK for yet another UNTD reunion.

Book Review

UNTiDy Tales of Naval Officer Cadets: The Story of Canada's University Naval Training Divisions

Reviewed by Tom Douglas – Associate Editor *Maritime Engineering Journal*

UNTiDy Tales
70th Anniversary Edition 1942 - 2012
Original Copyright 1993 by Cdr Robert J. Williamson CD RCNR (Ret.)
Expanded version privately published and available on-line at:
file:///C:/Users/Owner/Downloads/UNTiDy%20Tales%202012%20FINAL-%20NEWj.27%20(2).pdf
ISBN 978-0-9698768-3-0, 428 pages; illus; appendices; index

"I still remember standing at attention that first night, having arrived in Halifax from Vancouver, tired, not a little apprehensive and thinking, 'What have I got myself into this time?' – especially when the Chief Petty Officer addressing us said we were, in his opinion, spoiled college kids."

This reminiscence by former University of British Columbia Universal Naval Training Divisions (UNTD) cadet Jim Rogerson of his initial summer at HMCS *Stadacona* in 1952 is typical of a number of anecdotes in this book. Many of the participants in this naval officer training program were at first filled with trepidation, but that sentiment would evolve into feelings of pride and everlasting gratitude for being part of an initiative that turned green recruits into upstanding citizens of communities across the country. The Rogerson recollection continues:

(The CPO)… planned to make it his personal goal to send us packing. He fanned a bunch of train tickets and told us that when we had had enough, just come to him and we would be on our way home. Of course, along with the others, I immediately made the determined decision –"Not bloody likely!" As the summer wore on, I began to believe that if I survived, nothing would ever seem difficult again, and not much ever has!

While *UNTiDy Tales* is rife with engaging remembrances by graduates who went on to become either career military officers or to take up positions in the fields of medicine, business, law and politics, equally important from a historical standpoint are the reflections of those who were in at the beginning and have set down for posterity the rationale for launching the program.

The late Vice-Admiral John Allan, CMM, OStJ, CD, a UNTD cadet at Queen's University in the early 1950s, outlined the project's early history in the book's foreword. He mentioned that the project was officially launched across Canada in 1943. This followed a trial program in 1942 at Guelph's Ontario Agricultural College under the tutelage of Professor Jack Baker, in conjunction with HMCS *Star*, a unit of the Royal Canadian Naval Volunteer Reserve (RCNVR) located in Hamilton, Ontario.

It is timely, in the seventieth year of the founding of the UNTD (VAdm Allan wrote)*, that Commander Robert Williamson has revised and updated his original historical and anecdote-filled account of that successful endeavour. It is my belief that all of those who have been associated, in any way, with the UNTD know how important the organization has been to them and to the Navy. I also know they will cherish Bob's book.*

The author, a retired secondary school vice-principal from Hamilton, had joined the UNTD at McMaster University in 1957. He was commissioned in the Naval Reserve upon graduating with an Honours BA degree in Geography. In 1985 he took command of HMCS *Star*, serving in that capacity until 1988.

Williamson perhaps best sums up the UNTD's *raison d'être* and its value to both those who participated and the communities across Canada that benefited from this venture:

Students needed summer jobs and the navy needed a program to tap this student resource for both the Royal Canadian Navy and the Naval Reserve. But above all, the UNTD movement was popular. What young man could resist the appeal of travel and adventure or a visit to some exotic foreign port?

News Briefs

Shipboard Reverse Osmosis Desalination – SROD Mk IV

By Daniel Murphy

The recent repair and overhaul of the Mk III shipboard reverse osmosis desalination (SROD) system in HMCS *Halifax* (FFH-330) using new Mk IV technology is a prime example of efforts to keep the current Royal Canadian Navy (RCN) fleet up to date with state-of-the-art equipment. This newly overhauled SROD system will pave the way for new desalination technologies on board ship, and will put the RCN ahead of the currently fitted Mk III system in *Halifax*-class vessels. The Mk IV SROD promises to provide the navy with the means to meet future mission requirements, while enhancing efficiency and reducing maintenance.

Managing Ballast Water Requirements

Ballast water management is evolving to be at the forefront of environmental considerations, and harmful aquatic organisms in ballast water must be fully considered as we operate our current fleet and design new ships.

Ballast water brought on board to provide stability and manoeuvrability to a ship can contain thousands of aquatic species, including bacteria and other microbes. When ships discharge ballast water, this action introduces potentially alien species to the receiving water. In order to protect the water ecosystem from alien species, the International Maritime Organization (IMO) is establishing a Ballast Water Management Convention (BWMC). Regulation D2 of the BWMC will require ballast water be treated rather than exchanged. The BWMC is expected to be ratified this year (2016) and come into force one year later.

Technology combinations applied in the ballast water treatment system vary, but typically include two stages: physical solid-liquid separation (i.e. disc filter); and disinfection (i.e. chlorine, UV, and ozone). The BWMC will also allow alternative ballast such as fresh water provided the water meets BWMC ballast discharge standards. The ultrafiltration (UF) system used in the *Halifax*-class Mk IV SROD system provides a treatment solution that meets BWMC standards, while also providing a freshwater production capability that outperforms conventional solid-liquid separation technologies in many aspects, including reduced operating costs and footprint.

Photo by Brian McCullough

The Mk IV SROD from BluMetric Environmental Inc. offers significant improvements over the Mk III system currently installed in the RCN's *Halifax*-class frigates.

Increasing Scope of Water Production

In July 2008 the Directorate of Force Health Protection and the Naval Engineering Test Establishment performed a study of the Mk III SROD's ability to filter contaminated source water to provide safe drinking water. The source water was engineered to contain a five-times-higher level of contaminants than one would normally see in the most polluted harbours of the world. The results validated that the Mk III SROD could produce safe drinking water well within Canadian drinking water guidelines. The greatest obstacle was the increased consumption of filters and membranes.

By leveraging successful trials and research done by ADM(Mat)/DGLEPM through the same R&O contractor (**BluMetric Environmental Inc.** of Carp, Ontario), DGMEPM was able to automate the self-cleaning of the new SROD UF pre-filters to mitigate the burden on the maintainers. Automatic monitoring of equipment parameters allows for auto-cleaning sequences to eliminate

News Briefs

the need for filter change-outs. Automatic self-cleaning strainers were also introduced prior to the UF pre-filters to eliminate operator intervention during the strainer cleaning mode. According to BluMetric's Managing Director of Military Systems, **James Thomas**, the level of pre-filtration on the new Mk IV SROD thus allows for continuous operation in littoral waters without any decrease in system performance or increase in operating costs or maintenance.

Reduced Maintenance Time and Decreased Operational Costs

With the introduction of the self-cleaning strainers and automatic back-flushed UF filters, membrane source water going into the reverse osmosis membranes is filtered to a near-pure quality. The purified salt water extends the operational life of the high-pressure process pump and greatly reduces organic fouling of the membranes. This results in significantly reduced cleaning and maintenance cycles.

All of this equates to fewer spares required on board, and fewer maintenance hours. First- and second-pass process pumps have all been changed out in the fleet to a new Danfoss pump that has demonstrated high dependability and comparatively low rebuild complexity and costs. These same pumps are being re-used in the conversion from the Mk III to the Mk IV SROD. Such changes, in addition to proactive efforts to manage other obsolescence issues are enhancing SROD availability.

Greener Solution Initiative

The increase in self-cleaning pre-filtration and the change to more efficient process pumps have allowed the use of modern reverse osmosis membranes. These changes will increase potable water production to a projected 48 to 50 tonnes per unit per day that, combined with an energy savings of the new pumps, results in a 36-percent efficiency increase. This provides savings in the area of power, fuel consumption, maintenance hours, and spares costs. The "greener" unit encapsulates the innovative direction DGMEPM is taking to produce operationally effective, reliable engineering solutions for the fleet of today and tomorrow.

Daniel Murphy is the DNPS 6-5-4 LCMM/PM for Freshwater Systems in DGMEPM.

NCM Awards – Recognizing Excellence

T.M. Pallas Memorial Prize

This prize, sponsored by the Canadian Institute of Marine Engineering (CIMarE), recognizes top performance by students on the Marine Engineering Certificate 4 (Engineering Charge ticket) and Certificate 3 (Engineering Officer of the Watch) courses in Halifax.

The Cert 4 awardee, **Chief Petty Officer Second Class Jamie Stead**, was posted to HMCS *Athabaskan* as Chief Engineer of the Marine System Engineering department in March. Prior to this, he was the Care and Custody Chief of HMCS *Iroquois*, responsible to the officer-in-charge for the safety and security of the platform while the ship is alongside in Halifax awaiting disposal. This involved supervising equipment removals, and conducting preventive and corrective maintenance on systems needed to keep the ship habitable.

Bravo Zulu Chief Stead!

CPO2 Jamie Stead (left) receives his award from Cmdre Craig Baines, Commander Canadian Fleet Atlantic.

News Briefs

End of an Era – Farewell to *Protecteur* and *Algonquin*

By Lt(N) Doug Totten, CD, Executive Officer, Detachment *Algonquin*

The two oldest ships from the West Coast fleet are gone. On Sept. 19, 2014 the Government of Canada decided to retire HMCS *Protecteur* (AOR-509) and HMCS *Algonquin* (DDG-283), and put out a request for bids for their disposal. *Protecteur*, in service since 1969, had been scheduled for retirement in 2017, but suffered a career-ending engine-room fire in February 2014. *Algonquin* (in service since 1973) was due to pay off in 2019, but was too badly damaged in a collision with *Protecteur* in August 2013 to warrant the expense of repair. Both ships were paid off in 2015.

The two ships were to be broken up and sold for scrap in accordance with detailed procedures. The winning bidder was R.J. MacIssac Construction Ltd. of Antigonish Nova Scotia, who would tow the ships from Esquimalt, BC to Liverpool, NS via the Panama Canal. Ex-HMCS *Protecteur* left Esquimalt on her final voyage on Feb. 26, 2016 and arrived in Liverpool April 22. Ex-HMCS *Algonquin* followed on May 9, and is expected to arrive early to mid-July barring any transit delays.

The disposal planning requirements for both ships were unique due to the differences in size and the damage each had received. Preparations for towing would include full inspections by representatives of various agencies to ensure seaworthiness and damage control considerations, and to install necessary Panama Canal deck fittings. A multitude of equipment was removed from both ships that would be returned to the supply system or sold to other agencies. The removal of the Oto Melara 76-mm main gun from *Algonquin* was particularly interesting as it would be going back to the manufacturer for assessment due to its remarkable condition after so many years.

Walking through *Algonquin* just prior to her being towed out was surreal in that she still had hotel power and ventilation and looked ready to go to sea except for the lack of crew. Having been on her for the final days at sea it was a bittersweet moment to watch as *Algonquin* departed Esquimalt Harbour on her way to her final fate.

Photo by Brian McCullough

Algonquin and *Protecteur* alongside at Dockyard Esquimalt in October 2014. Between them, the two ships logged 88 years of service in the Royal Canadian Navy.

Photo by Cpl Blaine Sewell, MARPAC Imaging Services

Algonquin under tow leaves Esquimalt for the last time.

Photo by LS Ogle Henry, MARPAC Imaging Services

The Oto Melara 76-mm main gun is removed from *Algonquin* prior to the ship's disposal.

2015 NAVAL TECHNICAL OFFICER AWARDS

Halifax photography by Cpl Chris Ringius
Formation Imaging Services Halifax

Naval Association of Canada (NAC) Award

SLt Mattheus Fackelmann
Highest standing, professional achievement and officer-like qualities during Naval Engineering Indoctrination *(With Cmdre Mike Cooper, RCN (Ret.))*

Mexican Navy Award

SLt Ryerson Fitzpatrick
Top student, Naval Combat Systems Engineering Applications Course *(With Capitán de Navío Marco Antonio Bandala López)*

L-3 MAPPS – Saunders Memorial Award

SLt Ryan Luciano
Top student, Marine Systems Engineering Applications Course *(With Wendy Allerton)*

MacDonald Dettwiler Award

Lt(N) Steven Govenlock
Top NTO candidate to achieve Head of Department qualification *(With Richard Billard – Guest of Honor)*

2015 NAVAL TECHNICAL OFFICER AWARDS (continued)

Weir Canada Award

Photo by Lt(N) Peter O'Hagan

SLt Gregory Hutchings
Top Marine Systems Engineering Phase VI candidate
(With Serge Lamirande)

Lockheed Martin Canada Award

Lt(N) Shawn Stacey
Top Combat Systems Engineering Phase VI candidate
(With Stephen Rudnicki)

Royal Military College of Canada Carruthers Naval Technical Officers Sword

Courtesy J.E. Scott Howells

NCdt Jean-François Lévesque
For academic achievement and exemplary performance
(With Capt(N) Jim Carruthers, RCN (Ret.))

PRESERVING CANADA'S NAVAL TECHNICAL HERITAGE

CNTHA NEWS

Canadian Naval Technical History Association

CNTHA Website Overhaul

By Jeff Wilson and Don Wilson

CNTHA News *Est. 1997*

CNTHA Chairman
Pat Barnhouse
CNTHA Executive Director
Tony Thatcher
Directorate of History and Heritage Liaison
Michael Whitby
Maritime Engineering Journal Liaison
Brian McCullough
Newsletter Production Editing Services by
Brightstar Communications (Kanata, ON)
in association with
d2k Graphic Design & Web (Gatineau, QC)

CNTHA News is the unofficial newsletter of the Canadian Naval Technical History Association. Please address all correspondence to the publisher, attention Michael Whitby, Chief of the Naval Team, Directorate of History and Heritage, NDHQ
101 Colonel By Dr
Ottawa, ON K1A 0K2
Tel. (613) 998-7045
Fax (613) 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.

www.cntha.ca

When intruders hacked the CNTHA website over Christmas, they did us a favour. In the early hours of December 29th our server became an email spam bot, a holiday surprise our monitoring scripts announced at 8:00 a.m. We quickly stopped the spam, but the message was clear: our defences still needed work.

Every program is a potential source of intrusion, and so we decided to eliminate as much server software as we could. You could call this phase of the process: *Barring the Windows and Doors*. The biggest program on our server was our content management system (CMS), a popular mechanism used to generate web pages on demand. Our goal was to move web page generation offline, out of reach for potential intruders.

We evaluated several open source frameworks, and then once a viable set of tools was found and customized we wrote a program to extract the content from our CMS and convert it into the new format. We gave the website a fresh coat of paint as well as a new navigation structure, and we improved the site's search feature. The first version of the upgraded site was delivered in late April.

The search feature is a core capability of the site, and so it shows up on every page. Its default behaviour is to perform a so-called *fuzzy search* of input terms, allowing for a certain amount of misspelling. In some cases this casts too broad a net, for example it considers *processor* and *professor* to be equivalent terms because there is only one character distinguishing them (the search engine allows for roughly two edits per word). In response we have defined two more restrictive forms of input. If multiple terms are wrapped in double quotation marks (e.g. "signal processor") the system will ensure that these words are found near each other. If exact terms are required, the fuzzy spelling feature can be disabled by appending an exclamation mark (e.g. professor!).

Sue Easterman

Thank you

The CNTHA extends its deepest gratitude to **Sue Easterman** and **Joy Thatcher** for their dedicated work in transcribing the CNTHA's recorded Oral History interviews over the past number of years. This work requires careful attention to detail, and these two women always turned in amazing transcriptions from long hours of recordings. Sue turned five interview recordings into legible text for us from 2008 to 2010, and Joy produced 19 transcriptions for us.

In previous years our search index had contained only the content of our web pages, but our improved construction process has allowed us to expand the search index to include the text for the *Maritime Engineering Journal* and all PDF content. We went live with this in May.

The continuing phase of our upgrade is what we characterize as: *Increasing the Guard*. In practical terms this means automating the replacement of our servers so that we can roll out editorial changes and security updates quickly, but most importantly are able to respond to any suspicious behaviour by automatically replacing rogue servers without the need for administrator intervention.

We hope you will visit the upgraded CNTHA site and that its expanded search capability will help you appreciate the Royal Canadian Navy's outstanding technical heritage.